

FORESTRY IN MINNESOTA



Forestry in Minnesota

by

E. G. CHEYNEY

and

O. R. LEVIN



Published by

G. M. CONZET, Commissioner

of Forestry and Fire Prevention

Co-operating with

The Division of Forestry, University of Minnesota

HENRY SCHMITZ, Chief

March, 1929

INTRODUCTION

The Division of Forestry of the University of Minnesota and the office of the Commissioner of Forestry and Fire prevention receive letters almost daily asking for information on the forests and various phases of forestry development in the State. These are not technical questions. They come from school children who are writing themes for their school work, school teachers who are discussing the subject before their classes, history and economics instructors who want live material for their class work, women who have been assigned the task of reading a paper before their clubs, people who own a small patch of land and are thinking of planting some trees, and others.

The questions are so diverse that to answer them fully would require a large volume. To answer any one of them in detail requires a very long and usually unsatisfactory letter. Information so generally sought should be available in printed form. This little booklet attempts to answer correctly, but sketchily, most of the questions which are commonly asked in the hope that it will furnish much of the information wanted and enable the applicant to reduce his questions to a specific form which can be readily and satisfactorily answered. It is the intent to publish a series of bulletins describing fully the various phases of forestry. Therefore, this bulletin is confined to a brief outline, though in some cases an endeavor has been made to enlarge upon subjects on which information is more generally requested.

This publication is not an attempt to head off inquiries, which are, and always will be, welcome.

FORESTRY IN MINNESOTA

The original forests of Minnesota have been estimated at 38 million acres, or a little more than 70 per cent of the area of the State. They were made up of two divisions; the hardwood forests* and the coniferous forests.*

The hardwood forests, or the Big Woods as they were known to the pioneers, extended from the mouth of the Crow Wing River south to the boundary of the State and west to the prairies. They contained such trees as the white oak, red oak, black walnut, white ash, basswood, white elm, black cherry, cottonwood, sugar maple, hickory, and other hardwoods. They very closely resembled the hardwood forests found farther east.

It was into this section that the settlers first came. The forest was cut away, opening up land for cultivation, and most of the timber which could not be used locally was destroyed. There are no large tracts of unbroken forest left. This hardwood forest has come to rather an ignominious end without ever playing an important part in the lumber industry. The woodlots on the farms are the remnants of these forests. According to the figures given in the census these woodlots aggregate 723,795 acres.

The North Woods, or pine and spruce forest, was much larger and very different. It extended from the Big Woods north to Canada and west to the prairies. The southern half was a pine forest. Maple, birch and a few other northern hardwoods were scattered through the pines and occasionally formed more or less pure stands over comparatively small areas, but the pines made up the great bulk of it. A mixture of white and Norway pine composed most of the merchantable timber with jack pine mixing in on the poorer soils and forming pure stands on the very light sands.

In the northern half of the North Woods the spruce was the dominant tree. Balsam, poplar and birch were mixed in everywhere with some swamps covered with pure stands of tamarack and cedar, but the characteristic tree was the spruce.

The timber of the North Woods has been cut mostly by the lumbermen. A few settlers have gone into that country. A very few went in before the timber was cut that they might sell their stumpage to the lumbermen, but most of them drifted into the cut-over lands in the wake of the logging operations. Very little of the timber in this section was cut and destroyed in the process of land clearing; almost all of it went into lumber.

*See classification list of trees on page 44.

THE DEVELOPMENT OF THE LUMBER INDUSTRY

The First Sawmill

The first sawmill in the State was built in 1821 at St. Anthony Falls to saw the lumber for the building of Fort Snelling. The logs were cut in Dutchman's Grove on the lower Rum River. This was not a commercial mill.

It was not until 1839 that private capital put into operation the first mill at Marine-on-the-St. Croix. It was a small water power mill, but it ran for 50 years and sawed an aggregate of 197,000,000 board feet of lumber.

As the Federal Government completed treaties with the Indians, new territories were opened up to the logger. Five or six mills were built prior to 1844 in Stillwater which then promised to be the largest city in the State. Franklin Steele built a mill in Minneapolis in 1847 and bought his logs from Chief Hole-in-the-Day for fifty cents a tree. From this start Minneapolis gained the leadership in the lumber industry.

The accidental breaking of a log boom at Stillwater pointed the way to southern markets and log rafts began floating down the river to Dubuque, St. Louis and other river towns.

Mills sprung up wherever logs could be obtained. The cut jumped from one and one-half million board feet in 1843 to nine million feet in 1851 and forty-four million feet in 1857. By 1899 it had reached the enormous figure of 2,341,619,000 feet.

When the railroad first reached the Mississippi at Prairie du Chien in 1854, Minnesota had a population of about 8,000; by 1856 it had increased to 100,000 and with the coming of the railroad, logging expanded into new territory back from the rivers. Duluth was linked by rail to Minneapolis in 1870. Mills were immediately established there. In 1878 the first mill was built at Cloquet, which city was later to take the lead in the lumber industry away from Minneapolis and hold it to the present day. Other large mills were built at West Duluth, Carlton, Scanlon, Grand Rapids, Deer River, Cass Lake, Bemidji, Walker, Akeley, Cloquet, Virginia, International Falls and many other places. The last three named have the only large mills which are operating today and the Virginia mill is being dismantled now.

It was the revenues from these mills which made possible the rapid early development of Minnesota. The sawmills and the flour mills (the value of flour mill products surpassed that of the sawmills about 1875) were the backbone of Minnesota's initial wealth.

Paper Mills

The spruce forests soon attracted the attention of the paper industry and the first paper mill was built at Cloquet in 1898. Others followed at International Falls, Brainerd, Grand Rapids, Sartell, Little Falls and Cloquet and these towns became the center

of paper manufacture. For many years nothing but newsprint paper was manufactured from ground spruce and balsam. Later sulphite mills were built at International Falls and Cloquet and the use of other woods and the manufacture of other products became possible. The latest development is the new sulphite and soda mill at Cloquet that hopes to make possible the manufacture of paper from almost any kind of wood.

The Rise and Fall

Minnesota's timber cut grew by leaps and bounds until in 1899 it had reached an annual cut of 2,341,619,000 board feet and was surpassed only by Michigan and Wisconsin. But rapid as her rise had been, her fall was still more rapid. By 1920 the annual cut had fallen to 576 million board feet or two-thirds of the State's annual consumption, and Minnesota ranked 19th among the states of the Union. Between 1837 and 1927 over 75 billion board feet of pine was taken out of the North Woods.

At the same time that the forests were so rapidly disappearing the population was increasing and with the increased population came a greater demand for lumber. The very best grades of pine which had been available in unlimited quantities and had made such rapid development possible, had sold in the early days for \$6.00 to \$10.00 a thousand board feet. Now much poorer grades of pine lumber sell for \$40.00 to \$100.00 a thousand board feet and most of the production is shipped out of the State for special use.

Present Source of Lumber

A look into our lumber yards of today will disclose a surprising situation. Instead of the northern pines which at one time constituted the entire stock in trade we would see 85 per cent of the stock made up of Douglas fir from the Pacific Coast and yellow pine from the South for which the consumers are paying a freight charge of \$18.00 and \$11.00 a thousand board feet, respectively.

It is only now that we are beginning to realize what the destruction of our forests is costing us and will continue to cost us until we are growing our own timber supply once more. The people of Minnesota use about 350 board feet of lumber a year per capita. The State's population in 1920 was 2,387,125 which means a total lumber consumption of over 835,000,000 board feet.

Lumber Freight Charges

An excess freight charge of \$10.00 a thousand board feet on 85 per cent of 835,000,000 board feet means an annual transportation bill of over \$7,000,000. If the mill price is computed at \$40.00 a thousand, the value of the imported lumber is \$21,000,000. This makes a total of \$28,000,000 annually paid out of the State for lumber which we could just as well produce on our own land.

Forest Fire

It was almost inevitable that these extensive logging operations should have been followed by destructive forest fires. Two centuries of practice had pretty well established the custom of cutting the forest clean in one section and then progressing to another. The mere disappearance of the forest in any one state did not cause any apprehension, because people were accustomed to think of the rest of the country as possessing an inexhaustible and easily available supply. The fact that several "inexhaustible" supplies had already been used up did not seem to shake their belief in the least. But tremendous forest fires which covered thousands of acres and destroyed scores or even hundreds of lives began to cause some concern.

Step by step the forest conservation measures in Minnesota were forced by one fire after another. There were other contributing factors, but the fires always delivered the final punch which resulted in action.

STATE FORESTRY ASSOCIATION

As early as 1876 the Minnesota Forestry Association was formed. Their records seem to show that their early activities, stimulated by the stories of European travelers and the treeless character of the prairies to which they, as forest dwellers, were not accustomed, were devoted to the encouragement of tree planting, especially on the prairies. They obtained a subsidy of \$1,000.00 per year from the legislature as a semi-official organization, published considerable literature and accomplished some valuable educational work for many years. But the destruction of the forests by the logger and his camp follower, the forest fire, went on almost unheeded. Probably the association's greatest accomplishment was the securing of the passage of Amendment Number Nine in 1914, making possible the creation of State Forests in Minnesota.

It was not until 1894, when the great Hinckley fire rose out of the swamps on the wings of a hurricane, destroyed the flourishing town of Hinckley, swept over 160,000 acres and burned to death 418 people, that action came.

A STATE FIRE WARDEN

The legislature of 1895 appointed Gen. C. C. Andrews, Deputy Forest Commissioner and Chief Fire Warden. General Andrews had previously served as Ambassador to Sweden and had at that time submitted several reports on the management of the forests in that country. He urged similar action here. He was given authority to fight forest fires, but insufficient funds were appropriated to do effective work. He organized a system of township fire

wardens. It was not very effective because the wardens served without pay except when actually engaged in fighting fire, and because the people, especially the lumbermen who owned most of the timber lands, were not in sympathy with his work; but he made some progress.

THE STATE FORESTRY BOARD

The Legislature of 1899 created the State Forestry Board. This new administration fell heir to the lack of public sympathy and support experienced by former forestry departments and little progress in forestry developments was made, until the Baudette-Spooner fire in 1910 when forty-two people lost their lives. This fire furnished the spark to again focus public attention on forestry and resulted in renewed action.

The Lake States Forest Fire Conference was called in St. Paul on December 6-7, 1910. Delegates came from Michigan and Wisconsin and an attempt was made to formulate a practical forest policy for the Lake States.

The immediate result of this Conference was the action of the 1911 Legislature in re-organizing the existing Forestry Board, passing a new set of forest laws and appropriating a much larger sum for the establishment of a forest protective force.

The re-organized Forestry Board was, at that time, considered to be one of the most ideally constructed forestry administrations in the United States. Forestry, dealing as it does, with long time technical operations, must be as free as possible from political interference and frequent upheaval. The method of selecting the Board was designed to remove it as far as possible from such influences.

It was made up of nine members, two of them—the Dean and Director of the Department of Agriculture of the University and the Chief of the Division of Forestry—ex-officio, and the seven others appointed by the Governor only on the recommendation of different organizations such as the Board of Regents, the State Horticultural Society, the State Agricultural Society, the Game and Fish Commission and the State Forestry Association.

It had as its duties the appointment of the State Forester, the policy of the State Forest Service, the administration of the State Forests and the promotion of forestry on both private and public land.

The State Forester

One of the immediate actions of the new Forestry Board was the appointment of a State Forester and his deputy, who organized the Minnesota Forest Service.

Opposition to the new organization was strong in certain quarters and interest in its work waned. The public did not yet fully realize the significance of its work. Again the great fire of 1918 supplied the necessary incentive. This fire wiped out Cloquet, Moose Lake and several small towns, burned into the suburbs of Duluth, took the lives of 438 people and destroyed millions of dollars worth of property.

Since 1918 the interest in the protection and development of our forests has been intense and sustained. Satisfactory co-operation is being obtained from nearly all parties concerned, and the public is strongly lending its support to all measures of conservation.

The State Forestry Board was discontinued by an act of the Legislature of 1923, when the State government was re-organized. At this time the Department of Conservation was created, with the chiefs of the Forestry and Game and Fish Department and the State Auditor in charge. The State Forester became the Commissioner of Forestry and Fire Prevention under this re-organization.

PRESENT ORGANIZATION

The Minnesota State Forest Service is now a unit of the Department of Conservation. This Service is administered by the Commissioner of Forestry and Fire Prevention with headquarters and office force located at St. Paul. The field work is carried on under the following divisions: General Fire Prevention, Railroad Fire Prevention, Public Relations, Research and Forest Management. The field force consists of assistants in each of the above divisions, district rangers, patrolmen, towermen and smoke chasers.

The work of this organization requires considerable detail and it is not possible to enlarge upon all of these phases in a publication of this kind.

Fire Districts

The Northern part of the State is divided into eighteen ranger districts, with a ranger in charge of each. The districts vary in size from one to two million acres, and the total area covered by fire protection in the State is a gross acreage of approximately 26,000,000 acres. Each ranger district has from two to seven forest patrolmen and lookout tower watchmen during the fire season of each year, which is from about the middle of April to the last of October. The permanent force in all the districts together is approximately eighty men, to which is added from one hundred to one hundred and fifty men during emergency periods. In addition there are co-operative patrolmen paid by the lumber and railroad companies who work under the supervision of the district rangers during the fire season.



The lookout tower and ranger station at Washish—one of the many which are used to protect your forests.

Ranger Duties

The ranger force is the backbone of the organization. This is especially true in the fire prevention and suppression work, which not only includes the actual fire fighting, but a large number of duties which are connected therewith. Some of these duties are: building and maintaining telephone lines, roads, trails, portages, cabins and lookout towers. Other work, not classified as fire prevention or suppression, is the management of State timber lands, supervising of the cutting of timber in co-operation with the timber department, tree planting and reforestation and educational work. This work occupies the time of the men during the safe, or "no fire" periods of the year. In the winter, or during safe periods, the rangers and permanent patrolmen are kept busy checking up logging operations, directing slash disposal to eliminate all possible fire hazards and on timber surveys and land classification.

In addition to this, considerable time must be spent at ranger headquarters compiling statistics, records of field activities, inventories of equipment, preparation of budgets and preparing for the spring fire season by arranging duties of the fire wardens and other co-operative agencies.

Towers and Tower Watchmen

When the present tower building program is completed there will be 130 steel observation towers in the State, each of which will overlook an average of 100,000 acres. At present there are about seventy manned towers. They are from forty to one hundred feet high and have glass enclosed cabins on top. They are located on the highest convenient points in each district. Each tower is equipped with a map of the area which can be seen from the tower, an alidade sight instrument and vernier scale to determine the direction of the fire, and a telephone connected to the ranger's headquarters.

Some of the towers have steel stairways and the public is welcome to visit them when open. Thousands of people touring the northern part of the State visit these towers during the summer. The tower watchmen are glad to answer questions about forestry and help people to know and make the best of the forests. Towermen are on duty all day during the fire season. Their duties are to locate the direction of the fire by means of the alidade, estimate the distance and size, send a man to the fire and report the fire to the Ranger. When the Ranger gets readings on the same fire from other towers, he projects the lines of direction on a large wall map. Where these lines cross is the approximate location of the fire.

Township Fire Wardens

The fire wardens are appointed by the Commissioner of Forestry and Fire Prevention. He may appoint members of town boards, mayors of cities and presidents or presiding officers of

village councils to act as fire wardens for their respective districts. They are authorized to do all things reasonably necessary to protect the property of municipalities from fire.

The issuance of burning permits to farmers, road contractors, and others clearing land, is one of the chief duties of the warden. Good judgment in issuing permits is a highly important matter in fire prevention. Permits are issued only to responsible persons who have taken the proper precautions to prevent their fire from spreading.

Railroad Fire Prevention

Of the accepted causes of forest fires, the railroads set about twenty per cent. The locomotive is the chief offender, being responsible for fifty-five to ninety per cent of the railroad fires, the others being caused by tie burning, clearing right-of-way, throwing lighted material from trains and such.

To combat the locomotive hazard, spark arresting appliances are installed. In the front end these consist of plates and wire netting through which all cinders must pass before reaching the stack. Under the fire box an ash pan is applied which catches all the cinders that fall through the grates. Laws have been passed outlining in some detail just how these spark arresting devices must be constructed and maintained.

As yet no device has been worked out that entirely prevents the throwing of sparks by locomotives. Consequently provision must be made for the extinguishment of these fires. This work takes the form of prevention and suppression.



The gas car used to patrol railroads after trains.

Of the preventive measures the most important is disposal of the combustible matter on and adjacent to the right-of-way. Where this is not entirely sufficient the construction of fire breaks is advisable. Of the suppressive measures, patrol after trains is the most effective. This is done either with a gas car or a hand car. Burning of right-of-way and ties is kept under supervision by requiring that the railroad companies procure a burning permit from a forest officer. The employee's attention is called to the necessity of exercising care in all fire preventive measures through bulletins issued by the management.

The cost to the companies is considerable, approximately \$100,000.00, which shows their interest in the work. This cost is justified by the progress made.

Public Relations

This is primarily an educational division, operated for the purpose of disseminating information and acquainting the public with the problems of forestry and its relationship to the individual. This is accomplished through publications, newspaper articles, lectures, exhibits and furnishing speakers for public or private gatherings.

This work is supplemented by the services of an Extension Forester, who is maintained by the College of Agriculture, Forestry and Home Economics of the University of Minnesota in co-operation with the United States Forest Service and the State Forest Service. His work is done in co-operation with county agricultural agents and consists chiefly of assisting the farmers with their forestry problems.

Timber Marking

The State Forest Service has, for several years, been attempting to maintain and improve the State's stand of timber, where the composition of the stand was such that it was reasonably possible.

Forests are peculiar in that they can be renewed, whereas so many of the natural resources when once used, are a thing of the past. Forests, on the other hand, can be utilized and under judicious management their yield may far exceed that of the natural stands.

If the stand is of the more desirable species or is a mixed stand, containing the more valuable species, the stand can be logged in such a way as to improve its composition. This is done by marking the timber before the operator starts his cutting operations.

There are, in reality, but two methods of cutting timber,—clean cutting and selective cutting. The other methods are but intermediate steps between the two named above. Some of the others that are used are the strip method, which is clear cutting in narrow strips leaving strips of standing timber between those cut;

and the seed tree method. The seed tree method is practically a clear cutting with scattered trees of the desired species left standing well spaced to reseed the cutover area.

As a tree cannot be depended upon to scatter its seeds for a distance greater than its height and then probably only in the direction of the wind at the time of the ripening of the seeds, it is readily seen that a great many trees are needed for prompt and effective results.

As costs of administration, fire protection and taxes must be paid each year, it is evident that if the new stand does not become established within a few years, it would be cheaper to replant the area as soon as it is cut. Five years is allowed for the establishment of the new stand in some of the northern European countries. If the new crop has not been established in that time, the owner is compelled to plant his land. It is therefore evident that the shorter the period in which the land lies idle, the greater will be the profit.

The most desirable method for the handling of stands of pine in Minnesota is by the selection method of cutting. This is an improvement on nature's own method of maintaining her forests. In nature, fires, diseases, insects and winds cause the death of trees, often making openings in the forest of several acres or even square miles. Under natural conditions the volume growth just balances decay, but man has improved upon nature. In the selection forest,



Selective logging takes out the timber that should be cut and leaves a good, clean, and better stand of trees

the timber is cut as it matures. The immature, fast-growing trees are left to reach their maximum growth before designated for cutting. In this way, the blank areas are kept at a minimum, and the many surrounding trees insure the early establishment of the forest of the future.

When the stand contains weed trees, that is, trees of low market value, they are taken out leaving the desirable species to regenerate the area.

Thus it will be seen that man's improvement upon nature's own method of reforestation is the most profitable.

Forest Officer Requirements

Permanent positions in the Minnesota State Forest Service are filled from the ranks of the temporary men. These are chosen from the men who pass the examination held in March each year at the office of the Commissioner of Forestry and Fire Prevention, St. Paul and at all of the ranger stations.

The following covers briefly some of the most important subjects which every successful forest officer must know:

1. General Forestry—This subject deals mainly with timber conservation, utilization and taxation, forest fire prevention, forest management and general forest policy.
2. Fire Fighting—This work is perhaps the more important of forest officers' duties and a good deal of experience is necessary to become successful. Besides the task of actually fighting the fire and of knowing the various methods employed in the handling of the different situations, it is necessary to be well acquainted with his territory, all of the co-operative fire protection organizations, be familiar with the manner of organizing fire crews, assembling the necessary equipment and supplies and means of quick and safe transportation.
3. Cruising is the term applied to timber estimating and inspection. In doing this work the tract which is to be cruised is systematically covered. The different ways in which this work is done varies considerably according to the type of country and the kind of timber.
4. Mapping can be classified under two headings, namely: field and office. The field mapping consists of getting data from which a map can be made. It may be the recording of topography or geographical information, the assembling of material from which to make a fire map or fire plan chart. It may be some special mapping such as the laying out and locating of a tower or cabin site. In order to effectively do this type of work, the officer must be qualified to locate the government corners established by surveyors. Ordinarily the hand or pocket cruisers' compass is used for this purpose and it is necessary to be

thoroughly acquainted with the use of this instrument. Office mapping consists of assembling the field material and placing it on paper.

5. Log Scaling—This applies to the measuring of cut timber in board feet, cords or whatever unit is desired. This is done with a standard scale rule.
6. Laws—It is necessary that all field men have a fair understanding of the forestry and game laws. They must also be familiar with the procedure in justice courts and of handling of complaints and warrants.
7. Public Relations—Relates to contact with the public through all available mediums, such as addressing meetings, publicity in the press, posting of signs and posters and many other methods which are used in reaching the public and advancing helpful information relating to the work.
8. Office Management—It is not necessary that a new officer be expert in handling the work required in a ranger's office but he should have a fair working knowledge of general office routine. It is important that he have the ability to write a good letter in a plain legible hand or on the typewriter, and be able to keep accurate and neat records.
9. Mechanical—The extensive use of fire equipment for fire fighting has made it necessary for all field men to know how to run a gasoline engine and make minor repairs. This also applies to motor trucks and gasoline speeders.
10. Physical and Educational Requirements—The nature of the general work required of a forest officer is such that he must have at least the equivalent of a high school education. The hardships which must be endured at times while at work in the field, necessitates a sturdy and well developed man. The age limit is between twenty-one and forty-five years.
11. Salary and Advancement—All persons entering the Forest Service start in as forest patrolmen at a salary not to exceed \$80.00 per month and necessary field expenses while away from headquarters on official duties. Advancement to the positions of forest ranger and other branches of field and office work is by the merit system based on a service rating.

A list of references for those who care to study for the examination may be found on page 50 in the appendix. Some of these publications can be had free of charge and others at a very nominal charge. A list of all United States Forestry bulletins and circulars can be obtained by writing the Superintendent of Documents, Washington, D. C.

FOREST PROTECTION

The problem of forest protection is of outstanding importance in Minnesota today and will continue to be so until the public realizes that the economic welfare of the State is being seriously hampered by continued forest fire losses.

The public, however, is rapidly becoming aware of the serious situation, due in a great measure to the fact that hundreds of thousands of people take a vacation trip into the North Woods. There they have seen the vast stretches of land denuded of forest growth by the recurrent fires.

The solution of the problem is a careful use of the forests by the people and greater protective measures by the State Government.

There are three kinds of fire, namely: ground fires, surface fires and crown fires.

Ground Fires

In places where a large accumulation of humus makes ground fires particularly hard to extinguish, the digging of trenches with a shovel or very heavy hoe has been found effective.

Peat fires come under the classification of ground fires and because of the high inflammability of dry peat, they are difficult to handle. A trench a foot or more wide must be dug down to mineral soil, or to wet peat, making sure that all roots, buried logs and other material which cross the trench and might carry fire, are completely cut through. Where a supply of water is available nearby, the entire edge of the fire is wet down by using pails and



Someone was careless. Everybody suffers.

small tank pumps. This will slow down its progress so that the work of putting the fire out completely can go on without the area of the fire increasing materially. Where a sufficient supply of water can be reached within two or three thousand feet, the use of portable power pumps and hose is the best means of fighting peat fires. The use of an iron nozzle about four or five feet long attached to the end of the hose, helps force the water into the burning peat underneath the surface.

Surface Fires

When a fire has started in a dense growth of dry grass, brush or debris, the best method of extinguishing is by direct attack: throwing sand on the fire with a shovel, spraying water with a hand pump, or beating with wet sacks, brooms or boughs. Plowing a furrow as closely as possible to the edge of the fire and allowing the fire to burn up to the fire line thus formed is sometimes advisable in event it is too hot to fight directly or has reached large proportions.

Crown Fires

A fire driven by a strong wind that jumps to the tops of the trees and advances rapidly through the crown is difficult to check. Such fires occur on steep slopes or where the branches come close to the ground. The best work can be done during the day time by



Fully equipped fire fighting trucks have added much to the speed and efficiency of fire suppression.

confining fire fighting activities along the flanks. During the night, when the fire decreases in intensity, the head end can be worked on. Back-firing should never be used by an inexperienced person and only as a last resort by an experienced fire fighter.

Fire Fighters

It is essential to secure men that are experienced in the woods and especially in fighting fires. When a fire occurs the first to be called are the men living in the vicinity. Hunters, fishermen and tourists in the vicinity may be summoned when additional help is needed, as forest officers have the authority to call for the help of any able bodied person. They may also commandeer automobiles, equipment and tools necessary but just compensation is made for their use.

CONSERVATION ORGANIZATIONS

There are several other official State organizations working for the conservation of the forests in the State.

The Division of Forestry

The State University—through its College of Agriculture, Forestry and Home Economics at University Farm—offers a complete four year undergraduate course for the training of technical foresters, lumbermen, wood chemists, grazing examiners and forest science specialists. It also offers graduate work in any of these lines through its graduate school.

Cloquet Forest Experiment Station

The Cloquet Forest Experiment Station comprises a tract of almost 3,000 acres located 4 miles southwest of Cloquet, Minnesota. The establishment of the Station was accomplished very largely through the efforts of Prof. Samuel B. Green. The bulk of the land, 2,215 acres, was contributed by the St. Louis River Mercantile Company of Cloquet. It has been enlarged by the purchase of 447 acres of Indian allotments and 240 acres of homestead lands. There is yet one more forty which should be purchased to round out the holdings.

This tract carries approximately three and a half million feet of saw timber, 383,000 cubic feet of pulp and bolt wood and much immature timber.

The station is maintained wholly by the University, through the Division of Forestry, but in order to avoid duplication of the work by the Lake States Forest Experiment Station, it is administered in co-operation with the United States Forest Service.

The University has built a group of buildings which, with the modern equipment, makes this one of the best forest experiment

stations in the country. Several hundred plots have been established in an endeavor to solve some of our forest problems and some very interesting experiments are in progress.

The station is used also as a forest laboratory for the junior class forestry school students.

Another field station is maintained by the University in Itasca Park. This station is primarily a field laboratory where the students of the freshman class in forestry may study the virgin forest. There is a class of from forty to fifty freshmen students there from June 15 to August 1 each year.

There is also some research work carried on there by the forestry, entomology and plant pathology departments of the University.

From August 1 to 15 the University conducts a short course for the training of Boy Scout leaders. Only scout masters, executives and other officials are eligible to attend. This work is done in co-operation with the national and district officers of the Boy Scouts of America. There is an average attendance of from forty to fifty students.

Lake States Forest Experiment Station

In 1923 the United States Forest Service located the Lake States Forest Experiment Station at University Farm in co-operation with the Division of Forestry. This is a purely research institution for the study of the forest problems of the three Lake States, Michigan, Wisconsin and Minnesota.

STATE AND NATIONAL FORESTS

The legislature passed a law in 1899 permitting the acquisition of State Forest Reserves by gift or purchase provided the cost did not exceed \$2.50 per acre. The name of these tracts was later changed to State Forests.

State Forests

Under this law the Pillsbury Forest, a thousand acres of cut-over land near Gull Lake, was received as a gift from former Governor Pillsbury, and a 27,000 acre tract near Burntside Lake was acquired from the government and became known as the Burntside Forest.

Itasca State Park was established by act of legislature in 1891. It included at that time a tract five by seven miles in extent surrounding Lake Itasca. This was enlarged in 1921 by the addition of a strip two miles wide along the whole west boundary, thus making the park seven miles square.

The object of establishing the park was to preserve a remnant of the primeval forest around the source of the Mississippi River, where both the forest and the game would be protected. At the

time that the park was created very little of the land belonged to the State. The alien lands were gradually acquired through purchase and gift, and the acquisition was completed only a few years ago. Unfortunately much of the virgin timber was cut while these negotiations were under way. There is, however, probably about 25,000,000 feet of virgin pine left standing.

The park was first administered by a board made up of the Governor, the Auditor and Attorney General. In 1907 this administration was transferred to the State Forestry Board.

A house was built for the Superintendent of the Park in 1900. This was a frame building located on the east shore of the lake a mile south of the outlet. In 1905 the State built Douglas Lodge and the Park superintendent established headquarters there. Since then many other buildings have been built around the Lodge and the whole establishment is leased by the State for use as a summer resort.

In 1907 the old Superintendent's house became the center of a summer station for the Forest School of the University. In 1925 new headquarters for the Superintendent were built half way between the school and the outlet.

The Park was made a State Forest when the control was transferred to the Forestry Board in 1907.

New State Forests

When the constitutional amendment was passed in 1914 authorizing the establishment of State Forests by the setting aside of non-agricultural lands already belonging to the State, some 409,000 acres of the rough rock outcrop lands in St. Louis, Lake and Cook Counties were so designated. Some of this land was eliminated by a later act and the present net area is about 350,000 acres. These lands were administered by the Forestry Board. The timber on them is cut according to forestry principles and camp sites on the lake shores are leased so that the forests may be used as a real playground for the people.

In addition to these State Forests the Federal Government has established two National Forests within the State under the administration of the U. S. Forest Service.

The Chippewa National Forest

This was formerly the Minnesota National Forest. It contains 190,682 acres of pine lands around Cass Lake, which is its headquarters. This forest differs from all the other National Forests in that it was created from Indian lands. Most of the mature timber has been cut and the proceeds turned over to the Indians but eleven sections of beautiful Norway pine were reserved on the shore of the lake in addition to some twelve million feet on Star Island.

The Superior National Forest

This forest contains 859,255 acres of the rock outcrop lands in St. Louis, Lake and Cook counties. The headquarters is at Ely. The Superior differs materially from the Chippewa. The timber is smaller and largely composed of spruce and jack pine. The topography is very rough and the lakes almost innumerable. It is probably the finest canoe country in the world.

PRESENT CONDITIONS OF MINNESOTA FORESTS

It is practically impossible to obtain a reliable estimate of the original stand of timber in Minnesota. The area has been placed with probable accuracy at around 38,000,000 acres but the changes in economic conditions which have taken place since 1850 have prevented any such accurate guess at the stand.

When logging operations began in the State only sound, high quality logs of white pine were taken. Consequently the early estimates took no account of jack pine, spruce, tamarack or any of the other so-called inferior woods which have since come into commercial use. Some of them even ignored Norway pine. That is one reason why one early estimate gave only one third as much as has been cut since.

The partial records which we have indicate that the total cut of lumber in the State has so far aggregated somewhere around 75,000,000,000 board feet.

Products from the Forests

This does not by any means represent the total products from the forest. There are many products of the forests which are never put in the form of lumber. For example, statistics for Minnesota in 1912, indicate that the total value of the lumber manufactured in the State that year approximated \$25,000,000, pulpwood \$1,500,000, mining timbers \$1,000,000, posts and poles \$5,000,000, railroad ties \$2,500,000 and firewood \$9,500,000. That is, the total value of lumber was \$25,000,000 while all the other products were valued at \$19,500,000.

Many estimates have been made of the present stand of timber and they differ widely. W. T. Cox, former State Forester, estimated the total stand of all timber in the State, including cordwood, at 75,000,000,000 board feet in 1912. The United States Forest Service estimated the stand of saw timber alone in the three states, Michigan, Wisconsin and Minnesota, as 110,000,000,000 board feet in 1918, and the total stand of all classes of timber at over 50,000,000,000 cubic feet. An estimate made by the Forest School in 1924 placed the total stand in Minnesota, including all products at about 32,000,000,000 board feet in the northern two-thirds of the State.

These figures seem high but it must be remembered that a very large part of the remaining timber will produce only a very low grade product much of which is only fuel wood.

The primary object of much of the logging in the Eastern States was the clearing of the land, and the settlers followed on the heels of the logger.

In Minnesota the logging was a commercial proposition. It proceeded much faster than the land could be absorbed by the settler and the result has been the tremendous accumulations of cut over stump lands. Had these been allowed to produce another crop of timber there would be little loss; but fire was allowed (in many cases encouraged) to burn over them and they are now a barren waste, producing nothing and hanging like a drag on the productive land. The U. S. Forest Service estimated that there were over 20 million such idle acres in the Lake States in 1920, and Minnesota has her share.

The original forest area of the State was about 38,000,000 acres; the present forest area is approximately 21,000,000 acres. However, much of the area now classified as forest land is producing brush or small inferior types of forest trees and on about 2,000,000 acres the virgin stand is untouched.

Economic Survey Needed

There has been no complete and satisfactory soil or economic survey of the State on which to base an accurate figure but rough estimates indicate that there are between ten and fifteen million acres of land in the State which will produce a higher net revenue from a forest crop than they will from agriculture or any other use.

Growth Per Year

An acre of this land, if properly taken care of and stocked with a good stand of timber, will grow at the rate of about 300 board feet per year. At this rate our ten million acres of forest land should produce, under efficient management, 3,000,000,000 board feet per year, three and a half times our present consumption.

But there is no danger of our producing too much wood. It will be many decades before our forest land can be put in such productive condition. Even were the whole amount available today there could not be enough because the prairie states of Iowa, North and South Dakota will never produce enough wood for their own use and the forest regions of Minnesota are their natural source of supply.

Much of this cutover land, where fire has not burned too severely or too often, will produce a second crop of timber without planting. It will not be of the best quality or the greatest quantity which could be raised on those lands under better conditions, but all wood crops will be valuable twenty-five years hence. The advance growth already on them will help to bridge the gap until more timber of a better quality can be produced. Even though of

low quality these forests will form a local timber supply free from heavy freight charges, and that is the most important result to be attained.

Non-Productive Lands

There are, however, certain of these cut-over lands, a very considerable area in the aggregate (probably four per cent of the total) which cannot produce a crop unaided for many decades and should be planted as soon as possible.

In addition to these forest lands there are several million acres of potential agricultural land which will not be brought under cultivation for a long time to come. At the rate that land has been cleared during the past ten years, it will be over a century before this type of agricultural land will be needed. Why let these acres lie idle in the meantime?

Even though they are not planted they certainly should be protected from fire and encouraged to produce a crop of timber wherever possible. All young growth of timber wherever found will be necessary to supply our needs for the next fifty years. Whenever the land is needed for agriculture, it can be cleared then as easily as now.

FOREST INFLUENCES

The forest performs many functions in addition to supplying us with timber, pulpwood, posts, poles, piling, ties, fuelwood, and the raw material for our many wood using industries.

Floods and Erosion

It is a well known fact that forests reduce the rapid run off of surface water after heavy rains and thus help to prevent floods. The force of the rain is broken by the leaves and branches and the water reaches the ground in the form of a fine spray, dripping lightly from the leaves or running down the stem. On the ground it is absorbed by the thick layer of leaf mold and humus and carried away underground to feed the springs. This process requires some time and the result is a steady and permanent flow of water in the streams. Not until the whole surface layer of the ground has been completely saturated can there be any surface movement of the water on the forest floor.

When the timber has been removed a great change takes place. The rain now beats directly onto the ground with great force. The leaf mold has rotted and there is nothing to absorb the water. It soon begins to trickle down the hill. Each drop leaves a trail behind it that is more easily followed by the next drop. Drop joins drop and there is soon a torrent rushing down the hill, washing out a channel and flooding the stream below.

A few minutes after a storm the water is gone, a tremendous amount of damage has been done by the violence of the flood, sand and gravel are carried down burying the fertile lands below; the springs go dry.

Millions of acres have been laid to waste in China in just this way; thousands of acres of the most fertile vineyard lands in France have been depopulated by the floods which followed the cutting of the timber on the Alps; scores of denuded hillsides in Southern Minnesota are gullied out until they themselves are spoiled for cultivation and the valleys below them are threatened.

The local damage done by such erosion is only a small part of it. The effects are far reaching.

Navigation

River navigation, which should play such an important part in our national transportation system, is greatly impeded on streams which are subject to flood. In the spring the water is so high that navigation is dangerous; during the dry season the shallowness of the water makes the crossing of the sand bars doubtful and often impossible.

Water Power

The water power is affected in much the same way. During the flood season much of the water overflows the dam and runs idly by, often causing great property damage; in the dry season there is not enough water left to turn the wheels of the mill.



Barren hillsides erode with every rain

A steady, uniform stream flow, such as comes from a well-forested water shed, is far better for both navigation and water power. The average flow of a stream means nothing; it is the steady, uniform flow that determines its usefulness.

Sanitation and Irrigation

The large amount of silt dumped into a stream from an eroded watershed often destroys the fish in a stream and makes the water unfit to drink.

Erosion is also a very serious nuisance in the operation of irrigation projects. The silt fills up the reservoir and destroys the value of the dam—often the only suitable dam site available. It silts up the ditches and sometimes spreads a layer of sterile sand over the fertile fields.

The Remedy

Once started erosion is a difficult and expensive thing to stop. France has spent millions of dollars and half a century trying to overcome the results of a few years of foolish cutting in the Alps. They have done little more than half the necessary work.

Dams must be built at short intervals, in the upper reaches of the streams to prevent the rush of the waters long enough for bushes and trees to gain a foothold. Only the roots of such plants can bind the soil and hold it against the grasping water. Only when the vegetative cover has been restored over all the steep portion of the watershed will erosion and floods be stopped.

Even on comparatively gentle slopes, where the effects are not spectacular, a quiet and insidious erosion is often carrying away the organic matter from the soil and will eventually leave a sterile



Forests on the hillsides prevent erosion

field. This erosion has already started on the hillsides along many of the streams in the southeast portion of the State. Many hillside fields have been destroyed and many acres of fertile valley lands buried in gravel.

Recreation

The American people are turning to the forest more and more for recreation to relieve the tense strain of city life. Hundreds of thousands of people visit the National Forests every year. Even more visit other forests where their presence is not recorded. Every other car on the highway in the summer time carries a camping outfit.

Without the forest the country would be an unattractive place for the summer tourist. What would become of the beauty of our lakes if the forests were wiped off the shores? Who would want to camp in a country of blackened stubs and barren rocks? Moreover the forest is the home of the game. Destroy the forest and you destroy many of our most valuable game animals and most of our fur bearers. The fish would soon leave the streams if all their shady haunts were destroyed. Take away the forest, the game and the fish and what attraction is left for the tourist?

Only during the past five years, with the development of the automobile, the building of roads and the urge to the out-of-doors have people begun to appreciate the beauty of Minnesota's lakes and forests.

Northern Minnesota is a Mecca for tourists. It is one of the best summer playgrounds and vacation places that is available to the people of the United States. The forests and lakes give to the State a characteristic and peculiar charm of landscape that is hard to equal anywhere. It is for this reason that people from all over the United States are seeking their recreation here. Some seek their pleasure in canoe trips, others build summer homes on the shores of the numerous lakes, thus spending practically the whole season in this State. There are still large areas of undeveloped wilderness, some of which in time will be dotted with numerous summer homes and hotels. However, a large part of this area will always remain a wilderness and furnish an unexcelled region for the man who loves to travel by canoe.

Public Camp Grounds

In the New State Forests, comprised of some 350,000 acres located in the northern part of St. Louis, Lake and Cook counties, the State has considerable areas of land upon many lakes. These forests are under the supervision and management of the State Forest Service and are managed according to forestry principles. Lands on the lakes and rivers are being developed into public camp grounds and summer homesites as rapidly as the demand for them arises. The timber is preserved for beauty. The public camp grounds are located wherever there is an opportunity for the public

to get to them. The building of a road opening up a new country is an important factor in determining where the camp grounds are to be located. At the present time there are four large ones and a number of small ones established in the New State Forests. The Kabetogama Public Camp Ground, located at Gappa's Landing on Lake Kabetogama, has a capacity of from one hundred to one hundred and fifty people. This area has been under-brushed and cleaned up, tables, benches and fire places have been built and proper sanitation furnished. At Burntside lake in Burntside State Forest a campground has been started. At the present time this will take care of seventy-five to one hundred people, but can be increased to at least five hundred. In Cook county there is a public camp ground on the South Brule river and one on West Bearskin lake in the Brule State Forest. At any of these camp grounds the public is welcome to come, pitch their tents and stay as long as they want to. There is no such thing as a "No Trespass" sign. There are, however, notices posted to forbid the cutting or mutilation of live trees. When new roads are extended and more of the lakes become accessible, the number of camp grounds will be increased.

Along the canoe routes, camp grounds for the canoe tourists are also being established. The portages or carrying places between the lakes are being put on State land wherever this is possible. These are constructed for use in fire protection work, but they will also aid in the recreational development of the State Forests. This will assure the public of always being able to travel over these routes without having to cross private lands.

In Itasca State Park and Forest there is a large public camp ground, easily reached by auto which is located on the north end



Itasca Park Camp Grounds—one of the tourist camps maintained on state land



of Lake Itasca. At the camp grounds the Forestry Department has a caretaker in charge who devotes his entire time to the work of maintaining the grounds, regulating their use and giving information. The camp grounds are capable of accommodating about 600 people, and it has been necessary to enlarge them from year to year.

Summer Home Sites

Lake shores in the New State Forests that are not used for public camp grounds are sub-divided into building lots. These lots are leased to people who desire a small summer home on a lake. The lots have a lake frontage varying from seventy-five feet to one hundred twenty-five feet, depending upon the topography of the land, and are selected with a view to furnishing one good building spot for a cabin. The depth of the lot is from 150 to 200 feet. The rental for these sites is from ten to fifteen dollars per year, depending upon the location.

Applications for leases for summer homesites are increasing and people are seeking summer homes further and further away from civilization. The good roads that are being built over the northern part of the State will make many more of the lakes accessible. With this road work continued it will be possible for people living in the cities to spend their week ends on their favorite lake in the North.



A snug little log cabin 'midst the whispering pines on the shores of one of our 10,000 sky blue lakes

TREE AND FOREST GROWTH

The human body is made up of minute living cells which are grouped into tissues and various organs. A tree's construction is very similar; in fact, it is impossible to differentiate between the cells of certain lower animals and plants.

A tree breathes, eats and sleeps. Let us see how a tree lives. Tiny root hairs at the tip of the roots reach into the soil and take in the soil moisture containing food elements in solution. This water is transported up through the roots and the sap wood by a process known as "osmosis." It is carried to the branches, twigs, and out into the leaves and there it is used to manufacture starch, which is the food supply of the plant. Carbon dioxide gas, which is an impurity in the air, is absorbed by the leaves and combined with the water, which with the aid of sunlight and chlorophyll (the green coloring matter in the leaves), is changed to starch. This phenomenon is called "photosynthesis."

The starch is stored in the leaves temporarily and in the food cells of the sap wood permanently. When the tree needs food, the starch is changed to various plant foods and sent to the growing tissues. The growth takes place in a microscopic layer of cells known as the "cambium." The cells in this layer divide many times and form a new layer of wood every year. A tree has the form of a slender cone and the growth in height is put on only at the tip. This explains why a mark on the trunk of a tree does not move upwards as is the popular conception. In the early spring the cells formed are thin-walled and when seen by the naked eye they appear porous and light-colored, while the cells formed in the summer are thick-walled and appear as a dark compact line. This one season's growth is called the "annual ring" and by counting these rings we may determine the age of the tree.

The diagram shown here represents a section of a trunk of a tree. Such a section could be made by cutting a slice off the top of a tree stump or by cutting a similar slice out of one of the branches. Cut one and see if you can find these parts of the tree. These elements appear differently in the various kinds of wood and this is the basis for identifying the wood after it has been manufactured into products. The elements in some trees are similar and this causes them to be placed in the same group or family.

The natural growth of the forest is a continuous and relentless warfare carried through without mercy to the bitter end. All the trees are not armed in the same way, but whatever the weapons, the struggle goes on remorselessly.

Some grow faster than others and over-top their enemies. Some, though slower growing, can stand the shade and eventually win out over the opponent who temporarily outstripped them. Some are fast growing but short-lived. They triumph for a while but finally succumb to the slower but more persistent plodders. Some are badly worsted on the better soils but vanquish all comers

on poorer land. In the same way some others such as tamarack, black spruce and white cedar can hold their own only in the swamps where the other trees cannot follow them.

In the dense forest the competition between the species, and between individuals of the same species, is very keen. Shrubs, herbs and grass may enter into it in the more scattered stands. The trees which are best adapted to their environment survive, the others which try to compete with them are suppressed, usually stunted and often killed.

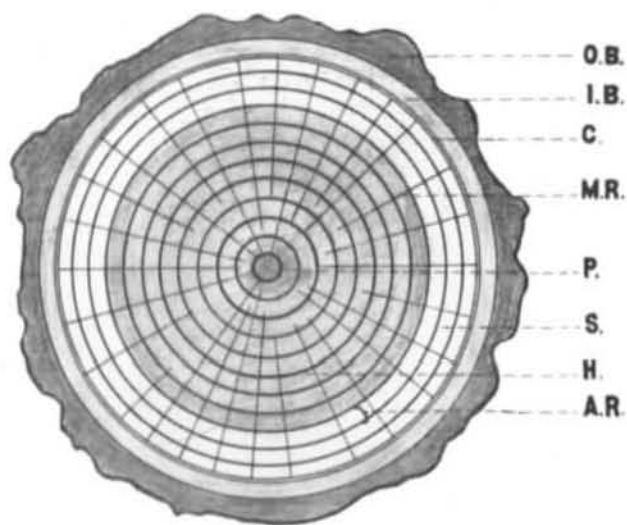


DIAGRAM OF CROSS-SECTION OF A TREE

O. B.—Outer bark, a protective covering.

I. B.—Inner bark, which is soft and spongy.

C.—Cambium, which is a microscopic layer of living cells where the growth takes place. These cells divide and some go to make up the sapwood and others the inner bark.

M. R.—Medullary rays which transfer food and water horizontally in the tree.

P.—Pith, a spongy tissue found in the center of the trunk and all branches.

S.—Sapwood, the active portion which conducts water and food from roots to leaves.

H.—Heartwood, which is inactive but gives strength.

A. R.—Annual Ring, a layer of light and dark wood forming one season's growth. The lighter and more porous portion is formed in the spring and the darker, more compact portion is formed in the summer.

With certain of the conifers—such as the pines and spruces—and sometimes with certain of the hardwoods—such as popple or oak, this struggle results in a pure stand of a single species over a considerable area. In other cases where the contestants are more evenly matched many species survive and, still struggling, form a mixed forest. This is more often the case with the broadleaved trees than with the conifers.

Where groups of seedlings have grown up in the openings formed by the death or overthrow of an old tree, or where the seeds of tolerant trees have taken advantage of a thin spot to sneak in under the larger trees, the forest is many-aged. There may be trees from one year old to 500 years old on a comparatively small area. But where the old forest has been cut down or destroyed by fire the catastrophe is usually followed by a growth of almost the same age over the whole area, and very often all of one species.

Silviculture

Such struggles as this dissipate the strength of the trees and slow up their growth. Therefore it is the forester's duty to so control this struggle that the results will be only beneficial, for a certain amount of struggle is necessary to the best development of the forest.

For example—When a forest plantation is made, from 1,000 to 2,000 seedlings may be planted per acre. It is probable that not more than 200 or 300 of these can ever mature on an acre, but it is necessary to plant them thick that they may be able to shade out the grass and other competitors and the more quickly shade the limbs off each other so that long, clean stems, free from knots, will be produced.

Once this cleaning process has been accomplished the forester must come to the rescue and cut out the less promising specimens. This saves the better trees the trouble of killing off the others and enables them to devote all their energy to faster growth. Possibly such thinning will be necessary several times before the selected trees have attained the desired size.

With such help as this the trees are left more evenly distributed. Only the better species and the better individuals are allowed to grow. They are relieved from much wasteful effort and can therefore make more rapid growth. The result is a greater volume of timber produced in a shorter period of time. Forestry is an art involving almost as many refinements and ramifications as agriculture, but the above is a very brief statement of one of the underlying principles.

Forest Management and Regulation

Another fundamental forestry principle is the establishment of what is known as a sustained yield. This is accomplished by so managing the forest that a complete series of age classes is present. Each year, or periodically, according to the plan adopted, the oldest

of these age classes is cut. As the size of each age class is so regulated that it is equivalent, when cut, to the total growth in the forest for that particular year, that same amount may be cut every year forever without reducing the amount of wood capital present.

The trees in the forest may be likened to an invested capital. The annual growth on the trees represents the interest. As long as only the growth is cut the forest may continue to yield interest indefinitely without decreasing the capital stock. Proper handling will at the same time increase the growth and improve the quality of the forest.

The following would be an ideal example. Take for example 10,000 acres of forest in which there is a series of age classes from one to one hundred years old, each covering an area of one hundred acres. Each year the oldest age class is cut and the area immediately replanted. Under this plan one hundred acres of one hundred year old trees could be cut every year forever.

That is the plan that forestry attempts to put in practice. Many factors such as fires, insect attacks, disease and emergency demands for timber are continually interfering with this plan. It can never be carried out exactly, but the forester is continually striving to bring his forest as near to this ideal as possible.

Methods of Reproduction

The reproduction of the forest may be accomplished in one of two ways.

Seed may be collected in the forest; seedlings grown in a nursery and planted in the forest as wanted. This is known as artificial regeneration.

The mature timber may be so cut that the old trees will seed up the ground and establish a new crop to take their places.

The former is more certain in its results and more easily controlled, but the latter is considerably cheaper.

FOREST PLANTING

A few trees, such as poplars and willows are usually reproduced from cuttings but most of the others are more easily grown from seed.

Seed Collection

All trees do not mature their seed at the same time. For example, white elm seed ripens in May before the leaves come out; soft maple ripens in the early spring and sugar and red maples in the fall. As most of the hardwood seeds can be picked up from the ground it is time enough to collect them when they begin to fall.

With evergreens the case is different. When the seeds have once fallen to the ground, it is practically impossible to pick them

up again. Therefore, it is necessary to pick the cones from the trees.

The seeds are found in the cones, two at the base of each fertile scale. They mature, for the most part, in the latter half of August and the first half of September. When the squirrels begin to eat them it is time to examine them. When immature, the seed coat will be white or light brown and the inside of the seed milky. When the seed coat is a rich brown and the inside firm, the seed is ripe. They should be collected as soon as ripe and stored where they will not mold. Soon after the seed ripens the cones open and the seeds drop out.

Seed Extraction

The extraction of the seed from the cones is a rather technical process and can only be briefly indicated here in a very general way. The cones are heated enough to open them, care being taken not to use enough heat to hurt the seed. The seed is shaken from them, rubbed in a sack to break off the wings, and separated from the scales and chaff with a clover cleaner.

It may be sown in the ground at once or stored in a stone crock or tight jar and put in a place free from artificial heat and well ventilated to prevent molding. The seed must be in a tight container for it is the preferred food of chipmunks, squirrels, mice and all such.

Sowing the Seed

Hardwood seeds may be sown and cared for in exactly the same way as garden seed.

Evergreens need special treatment. The ground should be finely pulverized as for small garden seed. Beds not over four feet wide are the most convenient for weeding. The ground should be leveled and the seed sown either in drills about two inches apart or broadcast. The seed may be placed very close together in the drills or about one seed to the square inch if broadcast. None of the coniferous seeds should be covered to a depth of more than a quarter inch, and less than that would be better for smaller seeds. The seeds should be watered well after sowing and kept fairly moist until they germinate. A burlap mulch will help to conserve the moisture but must be removed as soon as growth starts.

For the first year the little trees must be provided with partial shade. A lath screen is the most convenient. Pine is usually left in these beds two years and spruce three years before transplanting into nursery rows where the plants are placed two inches or three inches apart in rows six inches apart. They may be left in those rows for two or three years if desired before they are planted out in their final location.

In both transplanting and field planting there are two points which must be observed strictly: *the roots must not be allowed to dry*

for an instant; and the dirt must be firmly packed around the roots when they are placed in the ground.

A four by twelve foot bed will produce about 5,000 seedlings and 5,000 trees will plant about five acres with six by seven foot spacing. The conifers grow very slowly for the first six or seven years; after that about one foot per year is a reasonable growth to expect.

The safest practice is not to manure trees, especially evergreens. Very well rotted manure may sometimes be used profitably as a top dressing, but it is safer to never bring it in contact with the roots.



A forest tree nursery at Itasca Park, used as a laboratory and for experimental purposes by the Forestry College

Pruning

Hardwood trees may be trimmed any time during their dormant period. If the roots are pruned in transplanting, the top should be pruned correspondingly to maintain the balance. They are often pruned to improve their shape. They will stand very heavy pruning and still live, but it should be kept constantly in mind that it is very seldom possible to greatly improve the natural form of a tree. All wounds should be painted with white lead immediately to prevent rot.

An arbor-vitae hedge may be pruned to advantage. Where the lower limbs of other evergreens have died they may be trimmed off close to the trunk to improve the appearance of the tree. The

pruning of evergreen trees under any other condition is a very questionable practice and should be avoided altogether when the trees are used as a windbreak.

Sprouting

The evergreens in this section of the country do not sprout from the stump or roots, but most of the hardwoods do. Willow, cottonwood and box-elder, especially, sprout luxuriantly from the stump. These sprouts grow very rapidly because they are supplied with food by a large and well established root system.

If it is desired to reproduce the tree in this way two or three of the most vigorous sprouts should be selected and all the others cut off. If the sprouts are not wanted the stump may be killed and all sprout growth stopped by mopping the top of the stump during the dormant period, with the following preparation. It must be remembered that this solution is deadly poison to people and animals as well as trees. Formula: One pound arsenic, one pound washing soda, four gallons water and one half pound whiting.

Natural Reproduction

Nearly all trees will reproduce themselves by means of seed when the conditions are right.

Seed

The trees must be old enough to produce seed. This age varies from a very few years old in the case of the jack pine to several decades for oak, white spruce, etc.

Some trees—most of the evergreens—seed abundantly only once in from three to five years. Most of the hardwoods seed annually.

Seed Bed

The ground must not be too hard or too thickly covered with dead leaves or grass. The former will prevent the penetration of the tender root; the latter will prevent the root from reaching the mineral soil before it dries out. The ground is usually in good condition in the forest if the growth is not too dense.

Light

But very often there is practically no reproduction in the forest. There is not enough light for growth. The seed falls but it either does not germinate or fails to penetrate the undecayed leaf mold.

The forest should be cleared out a little so that the sunshine can get in and the leaf mold can decay and little seedlings will spring up everywhere. This is the reason for the dense reproduction often appearing in openings where old trees have fallen down or in places where the timber has been cut. It is partially due to root competition but is best expressed in crown density.

OBSTACLES TO DEVELOPMENT

There have been three great obstacles in the way of the development of practical forestry.

(1) The abundance of virgin timber and the competition in the marketing of it have reduced the margin of profit to the point where it has not been possible to grow timber and sell it in competition with the timber from the virgin forest.

(2) Forest fires have been so prevalent that it has not been possible to make an investment in young timber with any degree of certainty that it could be grown to merchantable size.

(3) Our annual taxation of growing timber has required too heavy an outlay of capital, and the uncertainty of what the assessed valuation would be in the future has made the risk of confiscation too great.

The first two points have been covered in general on the foregoing pages. The following is a somewhat brief explanation of the forest taxation problems.

Taxation

The present system of taxation of real property was developed and put into operation before forestry was dreamed of in this country. Farming, mining and manufacturing were the common occupations. The conditions affecting them were well known and the taxes were adjusted to fit those conditions. All of them produced an annual revenue. The crop planted in the spring was harvested in the fall; the capital invested in a factory produced an annual income. There was at that time no conception of a use for land in which a certain tract could mature a crop only at long intervals.

In what sort of a predicament would a storekeeper find himself if he were obliged to pay his bills every month, but could collect what was due him only once in every five years? How could a farmer succeed if he had to pay a tax on his standing crop sixty or eighty times before he could harvest it?

Such conditions seem ridiculous enough when applied to these industries and yet we are applying them with a perfectly sober face to the taxation of our forests. We are taxing every year timber which cannot reach merchantable size for many years to come. Where can the revenue be obtained with which to pay these taxes? The land itself cannot produce it. The assessed value may be there, but it cannot be liquidated.

The present system of taxation may be fair enough, though far from wise, when applied to mature timber. The timber is marketable. A certain amount of it may be sold to pay the taxes on the rest. In other words, it is capable of producing an annual revenue, probably at the cost of flooding the market, but neverthe-

less possible. That has been the practice in the past and no great hardship has resulted from it in this State.

But how about the progressive timberland owner who wishes to grow a second crop of timber on his cut-over lands? If the land has been cut clean he cannot possibly expect a merchantable crop of any kind of timber in less than twenty-five years, in many cases it will be nearer fifty years, and in some cases a hundred years. He has a considerable investment there in his land, a much heavier one if he has planted it; he must expend a certain amount of money each year for care and protection; but he cannot draw out any income.

The assessor decides that his ten year old timber is worth \$20.00 per acre and he pays taxes on that basis for maybe ten years. Then the assessor notices that the timber is growing and raises the valuation to \$30.00. That same growing timber is taxed again and again at a constantly increasing valuation. It is not only taxed at a higher valuation but at an uncertain valuation which no man can predict.

Not many men can be expected to invest money under such conditions and no countries in which the cultivation of forests has been highly developed did expect it. They recognize the intermittent character of the returns and content themselves with an intermittent tax.

Auxiliary Forest Law

To remedy this condition the Legislative Session of 1927 enacted the Auxiliary Forest Law. This permits owners of forest land to make a contract with the State for a period of fifty years which may be renewed for another period of fifty years. The land must be suitable for growing timber and is taxed at the rate of eight cents on every dollar of assessed value (the assessed value being one-third of the full and true value of the land). In addition to this, an annual tax of three cents per acre for fire protection is charged and a yield tax of ten per cent of the value of the timber is payable when the timber is cut. The tax on farmers' woodlots is the same except that no tax for fire protection is levied.

The Legislature of 1927 provided for the organization of the Minnesota Reforestation Commission (an Interim Committee) consisting of five members of the House appointed by the Speaker, five members of the Senate appointed by the President of the Senate, and one person appointed by the Governor, the President of the Senate and Speaker of the House. The Commission was required to make a thorough study and investigation regarding the afforestation and reforestation of land, delinquent real estate taxes, the finances of counties, and taxing districts in the forested areas of this State.

Changes Recommended

After careful study this Commission recommends that a tax of not to exceed five cents per acre be placed on auxiliary forest land. Under the 1927 law the rate was eight cents on each dollar of assessed value. The annual tax of three cents per acre for fire protection and the yield tax of ten per cent on timber when cut is to remain the same as under the 1927 law.

A summary of the Auxiliary Forest Law may be found on page 47 in the Appendix.

THE FUTURE OF FORESTRY

The forests of the Eastern States have been so depleted that considerably more than half the timber in the country is now located west of the Rocky Mountains. At the present rate of consumption there is probably enough of it there to supply the whole country for thirty to forty years. But when the Pacific Coast has a monopoly on the supply the rest of the country will have to pay a tremendous price for its lumber.

The supply now on hand in the west will last just about long enough to permit the maturing of a timber crop in other parts of the country if it is started at once. Meanwhile, Minnesota must pay heavily for her shortsightedness in not acting sooner. She must pay; but she can avoid an absolute timber famine and provide for the future by prompt action now.

What Minnesota Must Do

Experience of other countries has shown that forestry, involving as it does such long time investments, cannot be left wholly to private capital. The maintenance of a certain part of the forests—usually from twenty-five to fifty per cent—has been proven to be a necessary function of the State. The production of pulpwood and small sized timbers requiring a comparatively short time will be readily undertaken by private capital, but larger timbers, requiring from sixty to one hundred and twenty years to reach maturity must, for the most part, be grown by the State.

Some of the best managed forests of Europe, located on soils of very poor quality, produce a net annual revenue of \$6.00 to \$8.00 per acre. A return of \$2.00 to \$3.00 per acre over very large areas is quite common. Forests will in the course of time become very large sources of revenue in this State, far more than the virgin forest produced in the past, but before they can do it large sums must be expended in their development. No business can be developed without capital.

Before either the State or private capital can afford to put money into forest development, the risk from loss by forest fires must be greatly reduced. It is useless to invest money in planta-

tions or other forest operations if there is a good chance of the forest being destroyed by fire. The great forest fires which have destroyed thousands of acres of timber and hundreds of lives in this State can and must be prevented.

Adequate appropriations for fire protection and an increase in the number of our forest rangers and patrolmen can do much toward keeping out fire. However, no patrol system that can be devised will prevent costly forest fires until all the people are educated to help. When every citizen is trained to exercise care with the use of fire himself and feels under obligation to put out a fire whenever and wherever he sees it, there will be no more big forest fires. Until such time comes, fires will continue to burn our timber. It is not some one else's business; it is squarely up to every one of us.

But fire prevention alone is not enough. If a project requiring many years and large amounts of money for its fulfillment is to be undertaken, whether by State or private capital, people must believe in its necessity and its feasibility. The truth is not hard to find. Even a casual glance at the history of the development of forestry in any of the other civilized countries and at the present condition of our own forests should convince the most conservative.

Again it is squarely up to every individual citizen to either educate himself or listen to those who do know.

Faith and fire protection will be enough to stimulate the development of State forests, but private capital must have something more. Put forest taxation on a definite, rational basis so that there is a possibility of predicting future costs with some degree of accuracy, and a possibility of paying them without killing the goose which lays the golden eggs, and private capital will seek investment in this attractive field.

Not much is needed to bring about the development of this great natural resource, but that little is indispensable.

APPENDIX

HISTORIC FIRES

The following historic forest fires are still remembered in the United States and it may be seen that Minnesota has had her share of them.

Date	Name of Fire	Location	Acres Area Burned	Lives Lost
1825—Oct.*	Miramichi	Maine & New Brunswick	3,000,000	160
1837	Seboois	Maine	130,000	
1846	Yaquina	Oregon	450,000	
1853—May	Pontiac	Quebec	1,600,000	
1860	Nestucca	Oregon	320,000	
1868—Sept.	Coas	Oregon	300,000	
1868—Sept.	St. Helen	Washington & Oregon	300,000	
1871—Oct.	Peshtigo	Wisconsin	1,280,000	1,500
1871—Oct.		Michigan	2,000,000	
1876	Big Horn	Wyoming	500,000	
1880—Sept.	Bagot	Quebec	288,000	
1881—Sept.	Michigan	Michigan	1,000,000	138
1891—May	Comstock	Wisconsin	64,000	
1894—July	Phillips	Wisconsin	100,000	13
1894—Sept.	Hinckley	Minnesota	160,000	418
1902—Sept.	Columbia	Oregon & Washington	604,000	18
1903—Apr. June	Fernie	British Columbia	64,000	9
1908—Sept.	Chisholm	Minnesota	20,000	
1910—Aug.	Great Idaho	Idaho & Montana	2,000,000	85
1910—Oct.	Baudette	Minnesota & Montana	300,000	42
1918—Oct.	Cloquet-Moose Lake	Minnesota & Ontario	250,000	438

* From the U. S. F. S. Bulletin, 117.

FOREST TREES IN MINNESOTA

Conifers

Northern white pine	(<i>Pinus strobus</i>)
Norway pine (red pine)	(<i>Pinus resinosa</i>)
Jack pine	(<i>Pinus banksiana</i>)
Tamarack (American larch)	(<i>Larix laricina</i>)
White spruce	(<i>Picea glauca</i>)
Black spruce	(<i>Picea mariana</i>)
Balsam fir	(<i>Abies balsamea</i>)
Northern white cedar (arborvitae)	(<i>Thuja occidentalis</i>)
Red cedar (juniper)	(<i>Juniperus virginiana</i>)
Dwarf juniper (a shrub form)	(<i>Juniperus communis</i>)
Yew (a shrub form)	(<i>Taxus canadensis</i>)

Deciduous Trees

Black walnut	(<i>Juglans nigra</i>)
Butternut	(<i>Juglans cinerea</i>)
Shagbark hickory	(<i>Hicoria ovata</i>)
Bitternut hickory	(<i>Hicoria cordiformis</i>)
Black willow	(<i>Salix nigra</i>)
Pussy willow	(<i>Salix discolor</i>)
Bebbs willow	(<i>Salix bebbiana</i>)
Babylon weeping willow	(<i>Salix babylonica</i>)
Aspen (popple)	(<i>Populus tremuloides</i>)
Large tooth aspen	(<i>Populus grandidentata</i>)
Balsam poplar (balm of Gilead)	(<i>Populus balsamifera</i>)
Eastern cottonwood	(<i>Populus deltoides</i>)
Paper birch	(<i>Betula papyrifera</i>)
Yellow birch	(<i>Betula lutea</i>)
River birch (red birch)	(<i>Betula nigra</i>)
Hop hornbeam (ironwood)	(<i>Ostrya virginiana</i>)
Blue beech (hornbeam)	(<i>Carpinus caroliniana</i>)
White oak	(<i>Quercus alba</i>)
Swamp white oak	(<i>Quercus bicolor</i>)
Bur oak	(<i>Quercus macrocarpa</i>)
Red oak	(<i>Quercus borealis</i>)
Scarlet oak	(<i>Quercus coccinea</i>)
American elm	(<i>Ulmus americana</i>)
Rock elm (cork elm)	(<i>Ulmus racemosa</i>)
Slippery elm	(<i>Ulmus fulva</i>)
Hackberry	(<i>Celtis occidentalis</i>)
Red mulberry	(<i>Morus rubra</i>)
Wild crab	(<i>Pyrus ioensis</i>)
Elder leafed mountain ash	(<i>Pyrus sambucifolia</i>)
Mountain ash	(<i>Pyrus americana</i>)
Serviceberry (juneberry)	(<i>Amelanchier canadensis</i>)
Dotted thorn	(<i>Crataegus punctata</i>)
Red haw	(<i>Crataegus mollis</i>)
Long-spined thorn	(<i>Crataegus marshalliana</i>)
Canada plum	(<i>Prunus americana</i>)
Pin cherry	(<i>Prunus pennsylvanica</i>)
Black cherry	(<i>Prunus serotina</i>)
Choke cherry	(<i>Prunus virginiana</i>)
Coffee tree	(<i>Gymnocladus dioica</i>)
Honey locust	(<i>Gleditsia triacanthos</i>)
Black locust	(<i>Robinia pseudacacia</i>)
Prickly ash	(<i>Xanthoxylum clava-Herculis</i>)
Sugar maple (hard maple)	(<i>Acer saccharum</i>)
Silver maple (soft maple)	(<i>Acer saccharinum</i>)
Red maple	(<i>Acer rubrum</i>)
Mountain maple	(<i>Acer spicatum</i>)
Box elder	(<i>Acer negundo</i>)

Bladder nut	(<i>Staphylea trifolia</i>)
Basswood	(<i>Tilia glabra</i>)
White ash	(<i>Fraxinus americana</i>)
Red ash	(<i>Fraxinus pennsylvanica</i>)
Green ash	(<i>Fraxinus pennsylvanica lanceolata</i>)
Black ash	(<i>Fraxinus nigra</i>)
Nannyberry (sheepberry)	(<i>Viburnum lentago</i>)

Note: Named according to the U. S. Forest Service check list.

KEY FOR THE IDENTIFICATION OF NATIVE MINNESOTA CONIFERS

A. Trees with needle-like leaves: Pine, Spruce, Balsam Fir and Tamarack:

I. Needles in groups of two to five.—Pine.

a. Needles in groups of **five**. Bark of young tree smooth; of older tree deeply furrowed and dark brown in color.
WHITE PINE (*Pinus strobus*).

b. Needles in groups of **two**.
Norway Pine and Jack Pine.

1. Needles five to six inches long, semi circular in cross section and close together. Bark of young trees scaly and dark brown in color; of older tree reddish in color.
NORWAY OR RED PINE (*Pinus resinosa*)

2. Needles three-fourths to one and one-fourth inches long, flat in cross section and spread apart. Bark scaly and dark brown in color.
JACK PINE (*Pinus bankiana*).

II. Needles in rosettes around a swelling on the branch. Leaves are dropped in Autumn. TAMARACK (*Larix laricina*).

III. Needles borne singly on branch. Spruce, Balsam, Fir.

a. Needles four-sided; stiff pointed or sharp at the tip.
SPRUCE (*Picea* sp.).

b. Needles flat; flexible, round or blunt at the tip.
BALSAM FIR (*Abies balsamea*).

B. Trees with scale-like or awl-like leaves: Cedar, Juniper:

I. Trees with all scale-like leaves, branchlets flat and exhibit a strong odor when fresh, fruit is small cone.
NORTHERN WHITE CEDAR OR ARBORVITAE (*Thuja occidentalis*).

II. Trees with some scale-like and some awl-like leaves. Fruit a blue-black berry.
RED JUNIPER OR RED CEDAR (*Juniperus virginiana*).

MINNESOTA FOREST LAWS

It is unlawful:—

To refuse to fight fire when summoned by a Forest Officer.

To cut timber without posting notices and notifying the Forester, except for fuel wood or when clearing land tenanted by owner.

To cut, remove or transport living evergreens (Christmas trees and decorations) without a written permit signed by the owner of the land.

To clear public road bed or highway without first notifying forester.

To dispose of slashing and debris except by direction of forest officer unless snow is on the ground.

To leave fire unattended.

To leave fires unextinguished.

To build camp fires without clearing debris for radius of five feet.

To have fire (except for domestic purposes) without permit issued by forest officer unless firebreak sufficient to prevent spread of fire be freshly plowed around area or the ground is snow covered.

To carry naked torch, firebrand or exposed light in or near forest land or along any highway or trail thereover.

To drop or throw into combustible material in or near forests or woodlands any burning match, ashes or pipe, burning cigar or cigarette or any other burning substance.

To drive upon or over forest lands any motor vehicle with open cut-out or without muffler on exhaust pipe.

To operate a donkey, traction or portable engine or gas tractor or internal combustion engine in the vicinity of peat roads or dry loose peat lands until same be provided with a spark arrestor.

To destroy, deface or remove notices posted for forest protection.

SUMMARY OF AUXILIARY FOREST LAW

1. Auxiliary Forest may be any area not less than 160 acres valued at not over Ten Dollars nor less than Three Dollars actual value per acre. Assessed at one-third of its true value.

2. Taxed annually at the rate of eight cents on each dollar or fraction thereof. Failure to pay tax shall be cause for cancellation.

3. Woodlot Auxiliary Forest can be made on areas of not less than twenty acres nor more than forty acres, regardless of the value of the land.

4. Merchantable timber being upon the land at the time it is made into an auxiliary forest, shall be taxed separately; mineral the same.

5. In addition to the foregoing taxes, each auxiliary forest, except those in woodlots, guarded or protected by resident owners or tenants actually living on the land or immediately adjacent thereto, shall pay a special state tax of three cents per acre per annum for forest fire protection. This goes into a special fund known as the "Auxiliary Forest Fire Fund."

TO ESTABLISH AN AUXILIARY FOREST

1. Auditor shall before presenting application to county board, publish once in the official county paper, notice of such presentation, at the expense of the applicant and mail a copy of the notice to the clerk of the township in which the land is situate.

2. The county board shall consider such applications and shall hear any matter that may be offered in support or opposition to the application.

3. The county board shall make record of its action on the application.

4. If rejected the county auditor shall indorse such rejection on the application and return it to the applicant by registered mail within thirty days.

5. If rejected in part only, the applicant may change the application and return it within thirty days.

6. If the application is approved, the applicant is notified and application sent to the Commissioner of Forestry.

7. The Commissioner must act on the application within ninety days and give notice to applicant and county board of action taken.

8. The applicant shall furnish to the county attorney an abstract of title or a certificate of title if the land is registered, including certificate by the county auditor and the county treasurer that there are no unpaid taxes thereon, and a certificate of judgment search by the clerk of the district court. The county attorney shall examine such abstract and certify to the Commissioner, the name of the owner of the fee title thereto and the names of all other persons having any interest therein or lien thereon.

9. The Commissioner shall execute the contract.

10. The Commissioner shall prescribe such terms and conditions as will reasonably tend to produce merchantable timber on the lands described in the contract and shall specify the kind and amount of seeds or seedlings of trees to be set out.

11. The period of time that the land shall be in an auxiliary forest, not to exceed fifty years and renewable for another fifty or part thereof.

12. The present contract form calls for not less than 400 well established trees per acre at the end of ten years.

13. The owner must execute his part of the contract within 60 days or the proceedings to establish the auxiliary forest cease.

14. When the contract is executed it must be recorded in the office of the Register of Deeds at the expense of the owner.

15. The county attorney is to again furnish certificate of title, upon presentation by the owner of proof that no changes have been made since the application was filed.

16. The contract is subject to supplementary legislation, which does not impair the contract rights of the parties.

17. Failure of the owner to fulfill the contract gives the Commissioner the right to cancel the contract. The owner is entitled to a notice, and a hearing within 60 days after the notice.

18. The contract may be cancelled upon written application of the owner.

19. When contracts are cancelled, the Commissioner shall send notice to the county auditor, and the land shall cease to be an auxiliary forest, and shall, together with the timber thereon become liable to all taxes and assessments that would have been levied against it, from the time of making such contract, with interest at 6 per cent per annum on the unpaid taxes but without penalties.

20. No timber shall be cut or removed from the land until all taxes have been paid or suitable bond given.

21. If the terms of the contract, other than delinquent taxes, are unfulfilled, the Commissioner may fulfill same; the cost to be assessed against the land.

22. The merchantable timber on any auxiliary forest, other than merchantable timber growing thereon at the time of filing the contract, may be cut at any time during the life of the contract. In any event, such merchantable timber shall either be cut or the yield tax paid upon its value at the expiration of the contract or the expiration of the renewal of any such contract.

23. Whenever the merchantable timber shall be cut, the owner thereof shall pay a special tax thereon, called a yield tax. The tax is equal to 10 per cent of the full and true value of such merchantable timber on the stump.

24. At the written request of the owner, the Commissioner shall make an examination of said timber and designate for the owner the kind and number of trees most suited for removal.

25. The owner shall, before any such timber is cut or removed, give bond equal to the amount of the yield tax as determined by the county board, plus 25 per cent thereof.

26. The owner may at any time, having given thirty days notice in writing to the county auditor, cut and remove from an auxiliary forest, timber standing thereon which was merchantable at the time the forest was created.

27. No report shall be required of timber cut and used by the owner for domestic uses, such as fuel, fence posts or building purposes when the same is so used on land owned by him and contiguous to or within the limits of the auxiliary forest from which the timber is cut.

LIST OF REFERENCES FOR STUDY

"Woodmen's Handbook," Henry S. Graves, Bulletin No. 436, Government Printing Office, Washington, D. C.

"Cary's Handbook," obtainable at most book stores.

"A Policy of Forestry for the Nation," Circular No. 148, U. S. Agriculture Dept., Office of the Secretary, Washington, D. C.

"Care and Improvement of Farm Woods," Farmers Bulletin No. 1177, Supt. of Documents, Washington, D. C.

"Forest Planting Experiments in Minnesota," by T. S. Hansen, University Farm, St. Paul, Minnesota.

"Forests Yield Taxes," National Resource Production Dept., Chamber of Commerce, Washington, D. C.

"The Forestry Primer," Minnesota Forestry Dept., St. Paul, Minnesota.

"Handbook for Rangers and Woodsmen," by J. L. B. Taylor, John Wiley & Sons, Inc., New York City.

"A National Program of Forest Research," American Tree Assn., Washington, D. C.

"Organized Community and Forest Fire Control," National Resource Production Dept., Chamber of Commerce, Washington, D. C.

"Technical Bulletin," No. 39, Lake States Experiment Station, University Farm, St. Paul, Minn.

"Chapters 1 to 8 Incl., Western Fire Fighters' Manual," Western Fire and Conservation Assn., Portland, Oregon.

"Game and Fish Laws for Minnesota," Game and Fish Department, St. Paul, Minnesota.

"Forestry Laws of Minnesota," Forestry Department, St. Paul, Minnesota.

"Commercial Forests and the Community," National Resource Production Dept., Washington, D. C.

SLASH DISPOSAL

Slash (or slashings) is a term applied to the leaves and branches of trees left in the woods after a logging operation. This slash or debris, if allowed to remain on an area increases the fire hazard many-fold, due to the fact that fire burns more intensely and is more difficult to control in areas of dense slashings. One of the most perplexing problems the forest ranger has to contend with is to determine the best method of slash disposal to employ.

There is one law which relates to the disposition of slashings where no definite notice need be given by the forest ranger. This requires that "where timber is cut in, upon or adjoining any forest land and no specific directions are given by the Forester for the disposal—all such slashings and debris within two hundred feet of any adjoining timber land or any public highway, railroad, portage or lake shore shall be piled in separate and compact piles ready for burning immediately after said cutting is done and while the slashings are still green."

In all other cases the method of disposal is left to the discretion of the forest ranger and he must give due notice of such method to the timber operator. These methods have been studied for many years and they are still being improved. At the present time the following rules give the essential features of the slash policy for Minnesota:

A. Privately owned Lands:

1. Do not burn logging slash by any method when there is any possibility of fires running, except to clear rights-of-way or building sites, and then only when sufficient men are present to handle fire; the burning to be done under permit.

2. Slash from heavy stands of pine, spruce or balsam on highland should be burned as cut, if in the winter, or well piled for later burning. Slash made between April 25th and October 15th should be piled and burned later. (These directions apply whether all the slash is to be burned, or only part of it.)

3. In swamps very light slash may be lopped or left as cut. Heavy slash may be winter burned (on snow), either as cutting progresses or in piles. In wet swamps no burning is necessary except around edges and fire lanes.

4. On land likely to be soon cleared for agriculture, but not being cleared immediately, burn all slash for 200 feet around the sides, as made, and the remainder in piles or windrows when conditions are safe for burning.

5. Make all piles that are to be burned later, at least fifty feet from living trees.

B. State Owned Lands:

1. All pine, highland spruce and balsam shall be burned when cut except on summer operations and on scattered and light mixed

stand or in extremely isolated places. Disposal shall be under the directions of the district ranger.

2. Swamp types—All heavy stands to be winter burned along main roads, logging roads, etc. Remainder all left, but piled or lopped as directed by the rangers.

3. Swamp types—Light mixed stands and more or less isolated; pile heaviest areas for burning and leave remainder and lop if necessary. Pile everything 200 feet back along roads, trails, streams or other areas traveled by the public.

4. Where burning is ordered it must be up-to-date with the cutting and the rangers are instructed to take legal action to compel strict observance to the requirement.

INDEX

	Page
Introduction	
Forestry in Minnesota	5
The Development of the Lumber Industry	6
The First Sawmill	6
Paper Mills	6
The Rise and Fall	7
Present Source of Lumber	7
Lumber Freight Charges	7
Forest Fire	8
State Forestry Association	8
A State Fire Warden	8
The State Forestry Board	9
The State Forester	9
Present Organization	10
Fire Districts	10
Ranger Duties	11
Towers and Tower Watchmen	12
Township Fire Wardens	12
Railroad Fire Prevention	13
Public Relations	14
Timber Marking	14
Forest Officer Requirements	16
Forest Protection	18
Ground Fires	18
Surface Fires	19
Crown Fires	19
Fire Fighters	20
Conservation Organizations	20
The Division of Forestry	20
Cloquet Forest Experiment Station	20
Lake States Forest Experiment Station	21
State and National Forests	21
State Forests	21
New State Forests	22
The Chippewa National Forest	22
The Superior National Forest	23
Present Conditions of Minnesota Forests	23
Products from the Forests	23
Economic Survey Needed	24
Growth per Year	24
Non-productive Lands	25

INDEX—Cont.

Forest Influences	25
Floods and Erosion	25
Navigation	26
Water Power	26
Sanitation and Irrigation	27
The Remedy	27
Recreation	28
Public Camp Grounds	28
Summer Home Sites	32
Tree and Forest Growth	33
Silviculture	35
Forest Management and Regulation	35
Methods of Reproduction	36
Forest Planting	36
Seed Collection	36
Seed Extraction	37
Sowing the Seed	37
Pruning	38
Sprouting	39
Natural Reproduction	39
Seed	39
Seed Bed	39
Light	39
Obstacles to Development	40
Taxation	40
Auxiliary Forest Law	41
Changes Recommended	42
The Future of Forestry	42
What Minnesota Must Do	42
Appendix	
Historic Fires	44
Forest Trees in Minnesota	44
Conifers	44
Deciduous Trees	45
Key for the Identification of Native Minnesota Conifers	46
Minnesota Forest Laws	47
Summary of Auxiliary Forest Law	47
To Establish an Auxiliary Forest	48
List of References for Study	50
Slash Disposal	51

FIRE PREVENTION RULES

1. **MATCHES**—Be sure your match is out. Break it in two before you throw it away.

2. **TOBACCO**—Be sure that cigarettes, cigars and pipe ashes are dead before throwing them away. Never throw them into grass, brush, leaves or needles.

3. **MAKING CAMP**—Before building a fire scrape away all inflammable material from a spot five feet in diameter. Dig a hole in the center and in it build your camp fire. Keep your fire small. Never build it against trees or logs or near brush.

4. **BREAKING CAMP**—Never break camp until your fire is out—dead out.

5. **EXTINGUISH CAMP FIRE**—Stir the coals while soaking them with water. Turn small sticks and drench both sides. Wet the ground around the fire. If you cannot get water, stir in earth and tread it down until packed tight over and around the fire. Be sure the last spark is dead.

6. **BRUSH BURNING**—First get a burning permit from your local Fire Warden. Never burn brush piles or slash when there is the slightest danger that the fire will get away. Evening and night burning is the safest.

7. **REPORT FIRES**—Put out all small fires you find in or near the woods. If it is too large for you to handle, call the nearest telephone operator and she will notify a forest ranger, patrolman or fire warden.