

BULLETIN No. 16.

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF FORESTRY.

FORESTRY CONDITIONS AND INTERESTS
OF WISCONSIN.

BY

FILIBERT ROTH,
Special Agent,

WITH A DISCUSSION

BY

B. E. FERNOW,
Chief, Division of Forestry.



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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF FORESTRY,

Washington, D. C., March 23, 1898.

SIR: I have the honor herewith to submit for publication a report on the forestry conditions and interests of Wisconsin, the result of a canvass made by Mr. Filibert Roth during the summer of 1897, in cooperation with the State Geological Survey of Wisconsin.

In an introductory chapter I have discussed the objects and methods of making such a canvass, and have formulated conclusions and recommendations, based upon the report, regarding the forest policy which the State should pursue.

The whole publication, it is hoped, may serve as an incentive and an example for other States to follow.

Respectfully,

B. E. FERNOW, *Chief.*

Hon. JAMES WILSON, *Secretary.*

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Map, showing character and condition of the forest resources of north Wisconsin opposite p. 28

INTRODUCTION.

OBJECTS AND METHODS OF ASCERTAINING FOREST CONDITIONS AND RECOMMENDATIONS REGARDING FORESTRY INTERESTS IN WIS- CONSIN.

In the early part of 1897 the legislature of Wisconsin passed an act for the appointment of a commission to formulate desirable forestry legislation for the State. The commission, appointed by the governor, called upon the writer for advice and assistance, and at a meeting held in Milwaukee early in July the writer contended that rational propositions could be framed only upon a thorough knowledge of the actual forest conditions and forestry interests of the State, which would require a more or less exhaustive reconnaissance in the field. Since the commission had no funds at its disposal, the writer offered the cooperation of the Department of Agriculture, as authorized by the Secretary, in detailing a competent expert for the work of making the survey and report. The State geological survey, having a clause in its appropriation which calls for reports on the economic resources of the State, was appealed to for cooperation, and kindly consented to place \$500 at the disposal of the expert to defray traveling expenses. At the same time the officers of the Chicago, Milwaukee and St. Paul, the Northwestern, and the Wisconsin Central Railroad companies kindly consented to supply the expert with passes, and also to furnish information regarding the lands belonging to their roads, and the secretary of state offered such assistance as the records of his office might afford.

It was under such conditions that Mr. Filibert Roth was detailed to undertake the work, which he has performed within the short space of three months in the most satisfactory manner. If the report should seem to be deficient in detail, an explanation may be found in the small allowance of time and funds, which should have been twice as large; for the purpose in hand, however, it is believed the information as presented is entirely sufficient.

The interest of the Department and the Division of Forestry in undertaking this work for the State forestry commission and the State geological survey was twofold: Not only was it desirable to have definite and authoritative knowledge regarding the forest conditions of at least one of the most important regions of lumber production, but a good opportunity presented itself thereby to show what kind of information should be had and how it should and could be most satisfactorily ascertained.

Ever since assuming charge of the Division the writer has contended that the primary requisite for Government activity on behalf of forestry was a tolerably accurate knowledge of the forest conditions and forestry interests of the country; but he was met with the objection that it would be improper policy to do for one State what every other State might with equal right demand to have done for it, and at the same time the means placed at his disposal were never sufficient to permit him to acquire this information with any satisfactory degree of accuracy for the whole country at once.

Later, when appropriations became more liberal, other lines of work had been developed to which the funds were to be applied, and this most necessary line of investigations had to be deferred, with the hope that the census authorities would see fit to supply the information. In this, however, we were again disappointed in the Eleventh Census. The Division hopes now, by similar cooperation with State authorities, to gradually acquire information, unless Congress should see fit to appropriate the \$250,000 which it would require in connection with the next census to ascertain at once in a conclusive manner the condition of our forest resources, and settle the much discussed question as to the need of attention to its more rational use and recuperation.

While it would be desirable to have even fuller information than is contained in the following report, we should possess at least as much knowledge of every State in order to render possible an intelligent consideration of the needs of Federal and State government forest policies and legislation.

OBJECTS OF FOREST SURVEYS.

In considering the information which such a report should contain it is well to be clear as to the objects for which such surveys are made and what relation the several parts of the information bear to these objects. Briefly, such a survey is to give by statistics and description a picture of the condition of the forest resources. Like all statistics and descriptive surveys of resources from the economic standpoint, forest surveys and statistics furnish the indispensable basis, not only for a rational consideration of present conditions, but of the prospective progress in the development of the resource and for the legislation concerning the same. The information, if correct and conclusive, will serve to guide, not only the policy of timber-land owners, lumbermen, woodwork manufacturers, etc., but also of the legislators, in deciding how far communal interests require legislative attention and what form such legislation should take.

The communal interest consists in seeing, in the first place, the entire land area devoted to productive use, and finally to the several uses to which each part is best adapted, for only in this way can the highest tax-paying power and the greatest material prosperity of the State be developed. Agricultural lands should be devoted to agricultural use,

while those lands which are too poor or are better employed in wood crops should be devoted to forestry use. Hence a segregation of the forest soils in quantity and general location at least is one of the first objects of such survey.

The fact brought out in the following report that 7,000,000 acres of Northern Wisconsin are poor farm land, i. e., forest soil proper, means that the State should as far as possible prevent the occupation of this area by farmers, since such occupation can only lead to pauperization of farmers and lands. It also means that this is the area from which the State can finally expect its forest supplies mainly to come, and also that this is the area of which probably the State must in the end become the owner.

The forest cover being a condition of the earth's surface which influences surrounding climatic conditions, especially the water drainage in certain situations, it becomes necessary to be informed on the topographical and geographical distribution of the forest areas with reference to water courses, so that the State may protect the communal interest by measures for the preservation of favorable water conditions. Baneful influence of denudation upon water conditions having been brought out in this report, a closer investigation of the changes and of the areas specially concerned is indicated, so as to insure special attention in the forest policy of the State to these areas.

FOREST SUPPLIES AS FACTORS IN WEALTH OF STATE.

The next object of the forest survey should be to determine the position of the existing forest supplies as factors of the wealth of the State. This entails on the one hand a statement of the capital and labor employed in woodworking establishments, the quantities of wood materials used for home consumption as well as export, and the economic conditions surrounding these industries and their relative importance, and on the other hand the amounts of standing timber available, the proportions of the more valuable kinds, the distribution of the forests whether in large or small bodies, a factor which influences their economic importance, and their location with reference to highways and markets. We are concerned to know not only how much wood of various kinds is used or needed, how much exported and thereby bringing money into the State, but also where do the raw supplies come from, and how long can these supplies be relied upon to continue as a factor of wealth.

It is, perhaps, proper to here point out especially that in our modern civilization the greatest prosperity of a State or community can only be secured by the greatest diversity of industries maintained within its borders. The State which relies upon agriculture alone, or upon mining, or upon any one or but a few industries, is bound sooner or later to retrograde. Hence, wherever, under naturally favorable conditions, a successful beginning in the development of an industry is

made, it is proper policy for the State to foster its permanence and further diversification.

Thus, if the report shows that the woodworking industries represent a capitalization of over \$100,000,000—one-sixth of the total wealth of the State—pay taxes amounting to as much as the entire State tax, and produce values in their output equal to more than one-third of those of agriculture, employing over 60,000 men, paying out in wages over \$20,000,000 per annum, it means that the continuation of these industries, which have been the main feature of the development of the country for the last forty years, are of paramount interest to the welfare of the community.

The value of these industries and their relation to other industries being fully exhibited and recognized, it becomes desirable to know what their future may be so far as continuance of raw supplies—reproduction of forest growth—is concerned. To form an answer to this question we must study the changes which go on in the forest cover through lumbering operations and clearing or which are due to fire and storm and the conditions of the young growth. This study involves an estimate of the cutover lands and of the prospective growth on such of them as are unsuited for agriculture, and therefore likely to remain in forest growth. What can be done to increase the supply, or to cheapen it? What can the community do to prevent the great losses to the State and county that would come from the discontinuance of these productive industries and by having large areas of land unproductive or turned into desert? These questions are to be answered on the basis of the aforesaid studies.

If we find that of about 130,000,000,000 feet of Pine all but about 17,000,000,000 have been removed in forty years; that the cut proceeds still at the rate of 2,000,000,000 feet per annum, while the regrowth amounts at present to not over 200,000,000, and is really without much future as long as no attention is paid to its protection and recuperation, it is evident that as far as the main portion of the lumber industry—the pine lumbering—is concerned, a contraction is rapidly approaching, and we are justified in demanding the consideration of measures which will prevent the destructive and encourage the reconstructive agencies.

POLICE FUNCTIONS—OWNERSHIP OF LANDS.

A special inquiry into the dangers and damage to forest property, which are avoidable through proper exercise of police functions, is also a part of such a forest survey; and finally, in order to enable intelligent action on the part of the State, a knowledge of the character of the ownership of lands is also desirable, whether held in small or large parcels, by settlers who are apt to improve or care for forest growth, by the exploiters and manufacturers themselves, by corporations which are continuous, or by speculators who have no permanent interest in the lands.

Since 50 per cent of the total area, and with it nearly all the true forest soils, are still in the possession of lumbermen, who would be more willing than speculators to dispose of this property to the State for future forestry purposes—men who undoubtedly have broad-minded views, and would gladly aid in any enterprise which not only advances the interests of their own business but of the community at large—it would appear most timely for the State to act at once and profit by this opportunity for possessing itself of these lands.

METHODS OF OBTAINING FORESTRY STATISTICS.

It will have become clear from these statements regarding the nature of the information needed that it can not be ascertained by the methods of a mere enumerator or census taker; nay, even a statistician without special technical training could neither ascertain nor compile the information satisfactorily. It requires the employment of an unusually well-fitted expert who is not only thoroughly familiar with forest botany and forest growth in all its stages of development, and its value, with timber estimating, and with the requirements and general features of the lumber and woodworking industries and of the market, but who has a capacity for quickly grasping facts in their relation to the problems of forest policy and forest technique, who possesses a broad view of all the problems and conditions entering into consideration, and can give them proper value and proportionate attention.

Forest statistics even more than other statistics must remain largely estimates, partly because, even if exact knowledge were attainable, practical considerations would not permit the expenditure for such an attempt, partly because many of the most important facts which serve to give a clear picture of the condition of this resource are not capable of numerical expression, or because such numerical data must at least be accompanied by a descriptive explanation of their meaning, such as only an expert can give.

Forest crops being most nearly comparable to agricultural crops, we may compare the gathering of forestry statistics to that of agricultural statistics, and in such comparison exhibit the difference of method.

The first question that arises is regarding the acreage. The farmer having expended work on the preparation of his soil can usually very accurately tell the acreage, and an enumerator may readily obtain the information. With forest lands the acreage is much more a matter of estimate. As a rule, situated as are the forest counties of Wisconsin, and in a country as little developed, the total land area of a county, minus the farm area and the water area may be set down as forest land; i. e., forest and waste land.

This information as to the area, however, remains meaningless until a further classification as to the character of the land is made, from which it would appear whether the soil is fit for agricultural use, and hence should not be permanently devoted to forest growth or whether it is

forest soil proper; i. e., ground which, on account of soil conditions or topographic features, should be permanently kept under forest cover, and must in the finally developed state become the basis of wood cropping.

It will be readily admitted that in this classification the climatic and economic conditions under which the lands are situated must also be taken into account, the character of the soil alone being insufficient for such classification; even otherwise fertile lands might under certain conditions be better kept in forest crop to insure diversified manufactures, which establish a home market for capital, labor, and produce.

Again, while by the mere statement of the farm area the immediate capacity of food production is at once more or less directly expressed, dependent only on the application of labor and skill, the statement of the woodlands area does not convey any idea of potential production, for forest crops are not and can not be raised in the manner of agricultural crops. They are and must be largely products of natural growth without any or much expenditure of labor. Hence, a description of the conditions of the natural growth upon them is essential to be able to estimate the economic value of the area in wood production.

Forest crops grow as a rule in mixture, and in these mixed growths tree weeds, i. e., species which either have no use or only inferior value occur. It becomes, therefore, necessary to know the composition of the forest growth in the proportion in which the different timber trees participate in it, if we wish to have any conception of its economic value and its promise for the future. The forest crop is one that does not ripen every year, nor is there even any particular time or age at which its natural development indicates that it is ready for harvest. Economic, not natural, conditions determine harvest time. It is therefore necessary to know something of the degree of development, the age of the crop, or the size to which it has attained, if we would fully estimate its economic significance for the present or future.

Finally, to have a knowledge of the immediately available supplies, estimates of the standing timber, of the crop which is immediately ready for the ax, are needed. Here again the expert knowledge, not only of the timber estimator, but also a knowledge of market conditions is required to do justice to the subject. Various woods are used for various purposes, and the sizes which are useful vary accordingly. The practice of the sawmills in different regions or under different economic conditions also vary, and thereby influence the amount of material that must be considered available. To get at a close estimate of standing timber would require much more elaborate painstaking and time robbing methods than the forest statistician could afford to employ for the purpose in view, which is to give an approximate picture of the condition of the resource.

He relies, therefore, as far as possible upon the detailed estimates made by competent men for other purposes, checking and counter-checking

the same. In order to do this intelligently he must have a judgment as to the competency of his informants, and finally he must be able to check the information in the field by estimating the probability of the correctness of his information. In this field work he will take care to observe, also, the distribution of the varying species composing the forest and the differences in types of forest growth, the damage which forest fires have wrought, the conditions which influence reproduction variously, and any other features which are not matters capable of being reduced to enumeration, but are capable only of descriptive expression.

In this manner the expert will gather in the field the information which enables him to produce a picture of the forest resources as it presents itself in the field, with due reference to its economic aspects to be expressed by numerical and descriptive text and possibly by maps and charts.

To complete this picture and furnish arguments for any measures that the State or private enterprise might take with reference to the use of these resources, some further information is necessary, which can usually be found collated for other purposes, or can be ascertained by the usual census methods.

Here belongs information regarding the proprietary conditions of the forest areas, whether State lands, belonging to public institutions, to private owners, and what classes of private owners, and the statistics which reveal the condition and relative position in the State's household of the industries exploiting and relying upon forest resources. This information, too, can not quite satisfactorily be brought together and compiled by a census taker unless he have some idea of the technicalities of lumber production and use of wood.

To be sure, as stated at the outset, all statistical information can only be an approximation of the truth, and the degree of approximation depends on expenditure of skill and money. In the canvass of the forest conditions of Wisconsin in this report much of the desirable information could not, at least conclusively or fully, be ascertained on account of the limitations of time and funds.

At the end of the report a suggestive schedule will be found, which exhibits the precise information desirable to ascertain, and which was used as a basis for this canvass.

RÉSUMÉ OF THE REPORT AND RECOMMENDATIONS.

From the results of this canvass for the State of Wisconsin we can make the following brief general statement:

The State of Wisconsin, with a population of about 2,000,000, a taxable property of about \$600,000,000, has a home consumption of over 600,000,000 feet B. M. of lumber, besides enormous quantities of other wood material, which, if imported, would cost the State over \$25,000,000. Of its northern half—a land surface of over 18,000,000 acres—only 7 per

cent is cultivated, the rest forming one continuous body of forest and waste land. From this area there have been cut during the last sixty years more than 85,000,000,000 feet B. M. of pine lumber alone, and the average annual cut during the past ten years has exceeded 3,000,000,000 feet.

The lumber industries alone exploiting these resources represented in 1890 one-sixth of the total taxable property in the State, paid to over 55,000 men more than \$15,000,000 in wages, and the value of their products was worth over \$35,000,000. To this amount \$25,000,000 per annum of wood manufactures must be added as relying on forest products produced in the State. Of an original stand of about 130,000,000,000 feet of pine about 17,000,000,000 feet are left, besides about 12,000,000,000 feet of hemlock and 16,000,000,000 feet of hard woods. The annual growth, which at present amounts to about 900,000,000 feet, and of which only 250,000,000 is marketable pine and 500,000,000 feet hard woods, is largely balanced by natural decay of the old overripe timber. In almost every town of this region logging has been carried on, and over 8,000,000 of the 17,000,000 acres of forest are "cut-over" lands, largely burned over and waste brush lands, and one-half of it as nearly desert as it can become in the climate of Wisconsin.

The wooded area proper is steadily being reduced by logging and to a smaller extent by clearing. At present nothing is done either to protect or restock the denuded cut-over lands, of which fully 80 per cent are now and will likely remain for a long time unproductive waste land. This policy causes a continuous and ever-growing loss to the Commonwealth, which at present amounts to about 800,000,000 feet per year of useful and much-needed material, besides gradually but surely driving from the State the industries which have been most conspicuous in its development, depriving a cold country of a valuable factor in its climatic conditions, and affecting detrimentally the character of the main drainage channels of the State.

PERMANENT FORESTRY COMMISSIONER OR COMMISSION.

It would clearly appear that it is the interest as well as the duty of the Commonwealth to adopt such measures as will tend to prevent further decrease and deterioration of its productive area and to engage in the work of recuperation. Such measures are adaptive; that is to say, they may be applied with a variable degree of thoroughness and consequent outlay. In the first place, it is shown that the interests involved are large enough to deserve a definite representation in the Government departments. Until a permanent forest commissioner or commission is created, who represents the interests of the Commonwealth in this matter, not much progress can be expected in having the interest of the community taken care of.

The first step to be taken by such an officer or commission would be to organize a service for the protection of forest property against fire.

Such protection is not afforded by paper legislation with threats of penalties, but only by the active exercise of the police functions of the State, by organizing the forces in the field for prompt action in preventing and stopping the spread of fires. Again, such organization can not be expected to be effective or to persist unless there is a head to it, whose duty it is to keep the organization in active order.

Legislation against willful, malicious, and careless firing of the woods exists in Wisconsin. There is even an organization of a fire police attempted by the appointment of unpaid fire wardens, and two officers of the government, the chief clerk of the State land office and his deputy, are made, respectively, State forest warden and deputy forest warden, to look after the execution of the law.

As stated in the report, these officers have done what, with their other duties, they could be expected to do, and the mere placarding of the law has served as a wholesome educational measure in awakening the people to the gravity of the losses by fire and in inculcating greater care. A special officer, however, would be able to do more, and by the continuous attention to this duty secure comparative immunity from the worst scourge of this country—the forest fire. It may as well be understood first as last that until safety of forest property is secured there will be little incentive to apply forestry principles to our woodlands. Such application means expenditure and tying up of capital, and nobody, not even the State, can be expected to employ such capital in any enterprise so hazardous as forest growth under our present unsatisfactory conditions regarding its safety. When this most pressing and palpable duty of the State is effectually provided for we may consider further measures. The first of these is again to be directed to the improvement in the fire laws. When the State has done its duty in organizing a fire police it can also control private action which creates unnecessary danger from fire. It can with propriety require of the lumbermen to dispose of their *débris* in such a manner as to avoid the excessive danger. This can be done. It is entirely practicable, and does not entail as much expense as has been claimed. It is already done by some in order to protect their own property. This practice should be made obligatory on all, and it will prove cheaper to all concerned than if the present law were conscientiously executed, which provides for the payment of damages and imprisonment of any person allowing a forest fire to run, by means whereof the property of another is injured or endangered.

CONTROL OF MANNER OF EXPLOITING FORESTS.

The next step that suggests itself to prevent the further deterioration of the forest resource is to control the manner of exploiting the same, to prevent wasteful cutting, to enforce replanting and attention to reproduction. Such measures have been repeatedly urged by persons who were misinformed as to similar control exercised in European

states. They appear to us entirely impractical under our conditions, and they have proved largely impractical and a failure in European states as far as they were attempted.

The restrictions which are imposed on private woodland owners in Europe take by no means the form of limiting the diameter of trees to be cut, as is often believed, but they are of a general character, and include injunctions against devastation and the demand that clearing of lands be not done without the permission of government; that where dangers from deforestation are anticipated, reforestation after cutting or during cutting should be provided for.

In France and Italy such restrictions refer only to woods within certain limits where damage is sure to follow indiscriminate cutting. In Germany direct restrictions of private control of forest property exist only with regard to 14.6 per cent of the total forest area, or 29.6 per cent of the private forest property, while the 70.3 per cent of private forest (34.5 per cent of all forests) are entirely without such restrictions except by civil process. This requires that a property owner should first prove by a jury, for the proceedings of which he has to pay, that damage to him must result from an inconsiderate treatment of his neighbor's forest, and then he must indemnify the neighbor fully for the curtailment of the exercise of his unlimited property rights. Under these circumstances the state is almost the only person to use this law.

The forest property of the cities, villages, and other communities or public institutions (about 15 per cent) are, to be sure, subject to more or less stringent control by the central government, so as to prevent misuse. It is rather more through example and educational means than otherwise that the state has influenced private owners to exercise good judgment in the use of their forest property. Lately, however, it would appear that the leading governments recognize that the duty of the state is to possess itself of all truly forest soils—i. e., such as are on account of their location or character unfit for agriculture or which should be maintained in forest growth to prevent erosion of slopes, blowing of sand dunes, and dangers to water courses, etc.

In France the government has increased its holdings since 1876 by 340,000 acres, and has in addition spent in the neighborhood of \$40,000,000 toward reforesting dunes and devastated mountain sides.

In Prussia, which represents two-thirds of Germany, for a number of years exchanges of the state forest property on agricultural lands and purchase of such waste lands have been the rule. Altogether between the years 1867 and 1895 over \$5,000,000 were spent in increasing the forest area of the government, each year's budget containing a considerable item for such purposes, that of 1895 and 1896 carried \$500,000 for such purchases of waste lands.

Bavaria increased its holdings in the last twenty-five years by 4 per cent. Wurtemberg, the state where all clearing is absolutely controlled by the government, increased its area by purchase by over 3 per cent, and Austria pursues the same policy.

In our country restriction of private control of forest property will, at present at least, not readily be permitted, and if enacted by law the execution of the law will certainly be circumvented in some way or other. The only proper method, therefore, is the acquisition of the lands which should be kept under forest cover in perpetuity by the State. Such ownership is logical, for the State, the community at large, is the only person interested in the future. Forest crops being a long time maturing, much longer than the average life of an individual, furnish little incentive to private capital, unless it be of persistent corporations or of the very wealthy who can afford to forego present revenues from their investments for the sake of their heirs.

As the report shows, about 37 per cent of the forest area of the State of Wisconsin is situated on land too poor for successful agriculture or on forest soil proper. These lands are the ones that the State or the counties should at least own and maintain for forest production, and the sooner they are taken by the State and placed under proper protection and management the better for the Commonwealth and the recuperation of lost ground. For the existence of this unproductive area in the hands of private owners is a danger to the State in more than one way.

The interest of the present owners, mostly lumbermen, who have taken the useful material from the land is small indeed, and especially in regard to its conditions and the growth on it. Even if they could they would hardly go to any trouble to protect this for the present unremunerative investment against fire, and hence it is a constant danger as a starting ground of forest fires to adjoining property. The burden of taxation either induces the owner to abandon the land, and it becomes ownerless for a time and nobody's charge or responsibility, or else he turns it over to some speculator who tries to sell it to some poor deluded settler, thus increasing the area of unprofitable farms without barns.

There is just now, we are informed, a syndicate at work selling such nonagricultural lands, and even counties are disposing of such property, which they have inherited through the nonpayment of taxes, for a mere song (\$12 per forty), for a use for which such lands are not fit, and to people who can only become impoverished by the attempt at farming the same. These lands should all remain or become communal property either of the State or of the county, and be devoted to wood cropping.

The State lands and those held for public institutions, some 340,000 acres, should of course at once be placed under the management of the forest commissioner. As to the manner in which the State should acquire the lands which it should possess—the 7,000,000 acres of forest soil—it is proper to consider that, since their acquisition is largely for the benefit of the future, the cost of acquiring them should also entirely

or largely be charged to the future. Since the lands to be so acquired are at present for the most part unsalable property, in fact often a burden to the owners, and actually unproductive, an arrangement should be made which, while insuring fair pecuniary consideration, obviates present payments.

While various plans may be proposed, the plan which appears to the writer the most just, both to State and owners, and also a practicable one, would be for the State to take the lands at their present market value and pay for them in scrip bearing 3 per cent interest, on which, however, neither interest or capital shall accrue until thirty years have elapsed, then yearly payments of 10 per cent of the accumulated capital and compounded interest may become obligatory on the part of the State until capital and interest is paid up, with the option on the part of the State to cancel the debt at any time before or after the thirty years. By this method the State avoids present expenditures and begins payments when presumably the lands under careful management may be in condition to furnish returns sufficient to meet the payments, while the owners receive a negotiable paper and avoid taxation, turning their unproductive property into immediately available cash or a safe investment for their heirs.

Such lands as we have in view might now be had at 25 to 50 cents per acre. We are informed that the county of Eau Claire lately sold such at \$12 per 40 acres. In thirty years the cost of an acre now worth 50 cents would have accumulated to \$2, on which then 20 cents would have to be paid for the first year and a decreasing amount every following year, while the property would be constantly appreciating. It would probably be fair to terminate the running of this scrip in fifty years, when the final payment would require 42 cents per acre, and the State would have paid altogether in original cost and interest about \$2.50 per acre. Or, if instead of a percentic payment equal yearly instalments of 20 cents per acre are paid after thirty years accumulation, the whole debt with interest would be cancelled in eight years. And should the management have been in any way successful the property would then pay a handsome income to the State, relieving its citizens to some extent of the necessity of raising taxes, and assuring favorable forest conditions in addition.

It appears that the constitution of the State prohibits the State from ever incurring an indebtedness for sums larger than \$100,000 and running for a longer period than five years. It would be wisdom to change such a constitution as soon as practicable, so that the State might own lands for internal improvement by means of forestry.

Meanwhile, the acquisition of the land by cession from individuals, and their reimbursements from eventual profits, whenever these may accrue, has been suggested. In such a plan, however, the private owner would be without any present quid pro quo, and would have to

take on trust the capability of the State management to produce tangible results; besides, the fair amount of participation in the profits of the management, if any, would not be easily agreed upon, and, moreover, a servitude on the land would be created, such as existed on the European State forest properties, and proved most baneful to a successful forest management until, with much expense, the States succeeded in ridding them of this incumbrance.

It must not be overlooked that the lands which it is proposed to make the property of the State are mostly deprived of their valuable material, and only time can restore salable products. Thirty years has been assumed as probably sufficient, when such products might begin to be found. This is a short enough time, and presupposes that many materials now unsalable will in that period be acceptable to the market. We have, therefore, to calculate with long-time periods, and it is preferable to delay a beginning until it can be made on correct principles.

In any plan which contemplates participation of the original owner in the results of the management, the fair apportionment would be to turn over to him the net proceeds in toto until a given amount has been paid, equivalent to a fair valuation at the present, with interest added. With such a plan it would be wisdom for the State not only to acquire lands which have been cut over, but to possess also virgin growth, or at least such lands as can furnish from the start salable material. It must also be considered that, to bring cut-over lands into proper conditions, expenditures for planting and other operations are necessary. The mere let-alone policy will in most cases not be sufficient to produce results. In proportion to the expenditures, to a certain degree, depends the success of a forest management.

Thus in Prussia, with an expenditure of \$1.20 per acre of its forest property of 6,000,000 acres or more, the net revenue amounts to only \$1 per acre, while Bavaria, with an expenditure of \$1.90 per acre, nets nearly \$2, and Saxony, with an expenditure of \$2.20, nets as much as \$4.20 per acre. Or, taking the changes in each of these States by themselves, when their expenditures were 89 cents, \$1, and \$1.25 per acre, respectively, their net incomes were 99 cents, \$1, and \$3.25 per acre.

NECESSITY OF TECHNICAL SKILL AND GOOD MANAGEMENT.

It will also be understood that, to assure a full measure of success in the recuperation of these lands and in the profitableness of the undertaking, technical skill and good managership must be commanded by the forestry department. There are no inherent difficulties to be expected in the management of the department provided it is properly manned. If they only knew and realized fully that forestry is best applied before the woods are mismanaged, the present owners of the uncut and uncultured forest properties would secure the technical advice which is necessary to properly manage these properties for continued wood crops. The forest department can be made useful in that direc-

tion, if equipped with such technical advisors, by showing to these forest owners the financial advantages of such management. In addition, the State should provide at the university or in connection with some other educational institution the means for the study of forestry.

In the United States the State of New York promises to be the first to enter upon a really rational forest policy. It spent \$1,000,000 last year for the purchase of forest land in addition to the 700,000 acres it owned before, and this year it voted another half million dollars for the same purpose. At the same time it provided a demonstration area of 30,000 acres, more or less, on which, under the direction of Cornell University, a demonstration of practical forestry methods is to be made which may serve as a model for the management finally of the entire State forest reserve; and a fully organized State college of forestry has just been established in connection with Cornell University, which will provide the managers of the State property and foster generally education in forestry—assuring a stable forest policy at least for that State.

B. E. FERNOW,
Chief Division of Forestry.

WASHINGTON, D. C., *March 20, 1898.*

FORESTRY CONDITIONS AND INTERESTS OF WISCONSIN.

By FILIBERT ROTH,
Special agent, Division of Forestry.

INTRODUCTORY.

A survey of the forest conditions, like the one herewith presented for the State of Wisconsin, must necessarily be made in the form of a census or canvass, the special object of which shall be to collect the knowledge of the woods, and the experience in actual logging operations of several hundred men, and to secure a better interpretation of this information as well as a proper insight into the forestal conditions not usually observed by woodsmen, through personal inspection of typical localities in every county.

From this it follows that all estimates of areas and yields represent the knowledge of the best-informed persons, and a fair degree of correctness may be claimed for the same for the reason that each district, at least every county, is represented by a number of competent men, the writer being enabled by personal inspection to weigh, verify, or harmonize conflicting statements. The greatest help came from the practical woodsmen, who, in all parts of the territory, kindly assisted both by verbal information and by the use of their exhaustive "minutes," many of which fill volumes and represent an amount of detail information such as exists for but few parts of our country.

In this connection it gives the writer pleasure to express his sincerest thanks to all these gentlemen, whose help alone insured reasonable success to so hasty a reconnoissance. The journey through the State occupied more than three months and involved one or more trips over nearly every mile of railway passing through the section, besides several hundred miles of travel by wagon. The county seat of every county was visited, and no county received less than two days' attention.

During the first part of the journey the writer was accompanied and greatly assisted by Prof. L. S. Cheney, of the State University of Wisconsin. Thanks are due to J. T. Cleveland, land commissioner of the Northwestern Railway Company, W. H. Killen, industrial commissioner of the Wisconsin Central Railway Company, and especially to L. Jackson, industrial commissioner of the Chicago, Milwaukee and St. Paul Railway Company, whose courteous assistance did much to facilitate the work.

PHYSIOGRAPHY OF THE AREA.

The territory covered is that part of the State lying north of a line from Green Bay to the mouth of the St. Croix River, with the counties of Portage, Wood, and Jackson as southern projections. It involves 27 counties, with a total land area of nearly 19,000,000 acres, or about 53 per cent of the entire State, and contains almost all of the present supplies of lumber-size timber of both pine and hardwoods remaining in Wisconsin.

Topography.—Over 90 per cent of this territory is a broad slope, which rises gently from the southeast, south, and southwest to a flat divide running near to and parallel with the south shore of Lake Superior. About 9 per cent is occupied by the more abrupt slope from this divide to the lake.

In going from east to west the divides between the several large rivers which drain the larger slope are very gradual, almost imperceptible, and in some cases are entirely lost in labyrinths of lakes and swamps. Hills over 300 feet high from their base are scarce; a few "mounds" or isolated steep hills with extremely narrow bases rise out of the sandy plains of Jackson and Clark counties, and a few larger, more massive hills occur in the valleys of the Wisconsin, Chippewa, and St. Croix rivers, and there is a range of low, broad hills which form the crests of the Iron and Copper ranges, but on the whole the hills and hilly tracts do not occupy over 5 per cent of the total area, while about 45 per cent is level upland and about 50 per cent is rolling country, of which a considerable portion is steep rolling "kettle" or "pot hole" land.

Soils.—The greater part of this area is covered by deep grayish clay and loam soils, bearing everywhere a forest of mixed hard woods or hard woods and conifers. A narrow belt of fertile "red clay" land skirts Lake Superior and is stocked with a unique mixture of conifers and hard woods, remarkable in the species which are associated, resembling more the regular pinery of the sandy lands than the mixed woods of the loamy soils. A very variable mixture of loam and sandy loam overlies the land about Green Bay; also parts of Chippewa, Dunn, Barron, and Polk counties. About Green Bay this land bore a very heavy forest of pine with a fair mixture of hard woods. In the western counties part of it was openings and part bore heavy pine forests. Throughout this area the presence of sand is indicated by the characteristic White Birch. Sandy lands, continuous with the sands of Waushara, Adams, and Juneau counties, form the southern edge of this district through Portage, Wood, Jackson, Clark, Chippewa, and Dunn counties. These sandy lands are either Oak and Jack Pine openings, i. e., brush prairies scatteringly covered by low, bushy Oaks and dense groves of small Jack Pine, or else they are regular pineries covered by dense stands of valuable pine, without hard woods.

Within the large loam-land area there occur three rather well-defined,

in most places sharply marked, islands of sandy soil. One of these, the "St. Croix Barrens," extends in a belt 10 to 20 miles wide from the northwest corner of Polk County to the peninsula of Bayfield; the other, a V-shaped tract with its southern apex near the junction of the Tomahawk and Wisconsin rivers, occupies the greater part of Oneida and Vilas counties; and the third, a broad belt like the first, extends from the Menominee to about Lake Shawano, and occupies the central part of Marinette and a broad strip through Oconto and part of Shawano counties.

In the aggregate the four several sandy districts occupy over one-fourth of the entire area under consideration; they are generally Pine lands proper, being covered with dense and almost pure forests of pine, both White and Red (Norway), and only in small part stocked with Jack Pine. The grayish to reddish-gray soil and subsoil of these sandy areas are not generally differentiated; they are usually of great depth, of medium to fine grain, and contain, over more than two-thirds of the area, sufficient clayey matter to deserve the name of loamy sand. These soils support a luxuriant growth of Pine, but are unsuited to Hemlock and hard woods, the latter being represented only by the White Birch, Poplar (Aspen), and some stunted Maple. The most characteristic plants of the cut-over lands of these sandy areas are the Jack Pine, Scarlet Oak, and Sweet Fern, while the White Birch is common to all loamy sands, but does not thrive on the poorest soils.

The districts of sandy loam before mentioned, which border for the most part on the sandy lands (fringing this territory on the south) and are mere modifications of the same, occupy about 15 per cent of the total area. The soil in these districts, though generally quite fertile, is extremely variable—quite heavy in places, often very sandy, and a considerable portion of the lands is covered in numerous small and large patches by layers of black muck, which greatly increase their fertility. The soil and subsoil of the large body of gray loam and gray clay lands are usually more or less well defined, and generally there is found a small amount of humus cover. In most localities the subsoil, especially of all knolls, etc., is mixed with gravel, which occurs either in layers of irregular thickness and distribution or is mixed promiscuously through the ground. Generally, too, stones or bowlders of large size (4 to 50 inches) occur both on top and in the ground, which, though quite abundant in places, do not on the whole interfere with agriculture, and are even regarded as an indication of good land. The mixture of gravel and loam or clay is extremely variable, and in places sufficient sand and fine gravel appear on the surface to make a soil classification quite difficult.

These general outlines will require much modification in a detailed description. Strips of sandy land follow up the rivers, especially the Wisconsin and its tributaries; small islands of loamy soils occur in all three of the large sand-land districts, while patches of heavy clays

and lighter gravelly soils occur in all portions covered by gray loams. The swamps, i. e., all poorly drained tracts stocked with Tamarack, Cedar, Spruce, or bare grass marshes and moss bogs and occupying nearly 12 per cent of the area, have for the most part a clay bottom and furnish a good soil, especially suited to hay crops. For a fairly accurate account and map of the soils of this State see the "Settler's Handbook of Northern Wisconsin," by Prof. W. A. Henry, University of Wisconsin, Madison, 1895.

Grouping the land from the farmer's standpoint, it would appear that about 20 per cent of the area is good farm land, about 40 per cent medium, while nearly 40 per cent is either not fit at all or only doubtfully suited to farming and should by all means be left to forest. In such a classification great divergence of opinion naturally prevails. Most estimates increase the good farm land proportion at the expense of the medium land, but we have preferred to adhere to the above conservative classification.

CLIMATE AND DRAINAGE.

The climate is cold, the winters are long, spring is almost wanting, summers are short but warm, and the fall is long, cool, and delightful. To illustrate the climate it may be said that the Black Walnut and Hickories are wanting, while the timber Oaks, both White and Red Oaks, are replaced by Birch in all but the southern and southwestern part of this territory. Corn is raised with difficulty except in the south and the drier western part, while fruit trees, even apples, do not prosper in the greater part of north Wisconsin.

The precipitation over the State is about 32 inches per year, of which 60 per cent falls in summer and autumn.

The territory under consideration is well supplied with streams and has a far better drainage than is generally supposed.

In this drainage the several rivers share as follows:

	Per cent.
Chippewa River (with Red Cedar at 6.2 per cent).....	28.4
Wisconsin River	21.0
St. Croix River	13.7
Wolf River.....	7.4
Black River.....	6.8
Menominee River (Wisconsin side)	5.7
Oconto River.....	3.4
Peshtigo River.....	3.2
Small rivers to Lake Superior	9.3
Small rivers direct to Green Bay.....	.9

Besides furnishing ample drainage, the basins of the Chippewa, Wisconsin, St. Croix, and Black rivers, which drain 70 per cent of the entire area, are covered with the most perfect network imaginable of small streams specially suited for purposes of driving timber. The rivers emptying into Green Bay also "drive" quite well, but have required more improvements, while those running into Lake Superior are largely unfit for driving.

OWNERSHIP.

Of the 18,500,000 acres of land contained in this north half of Wisconsin a little less than 7 per cent is improved; 24 per cent is held by actual settlers, the greater part of which falls to the counties along the southern and southwestern edge of this district; the United States holds about 5 per cent (2 per cent being Indian reservations); the State holds less than 2 per cent; the railways hold a little over 5 per cent, while the counties hold about 1.5 per cent in tax deeds, and about five times this amount conditionally on tax certificates. Of the 63 per cent owned by private nonresidents, fully 80 per cent, i. e., 50 per cent of total area, or 25 per cent of the land of the entire State, is held by lumbermen.

STATE LANDS IN WISCONSIN.

According to the report of 1896 the State owns 398,103 acres of land, of which about 90,000 acres are situated in Burnett and Forest counties, and over 100,000 acres in Vilas, Oneida, and Price counties; the bulk of these 190,000 acres is swamp and forest soils, the latter sandy pinery, mostly cut and burned over, since otherwise the low price at which they are held would make them cheap timber property. All these lands have come into the possession of the State by cession from the Federal Government.

The lands are divided as follows:

	Acres.
Drainage (swamp) lands	162,000
Indemnity lands *	31,000
Normal-school lands	162,000
Common-school lands	40,000
University	714
Agricultural college	317

Sales in 1895-96.

	Acres.	Amount paid.
School lands	13,581	\$15,583
Normal-school lands	18,693	27,104
Drainage lands	20,733	26,513
Indemnity lands	4,619	14,004
Agricultural college	120	133
University	161	599
Total	57,907	83,936

* Cession.

FOREST CONDITIONS OF THE PAST.

An uninterrupted forest, extending from Michigan through Wisconsin into Minnesota, originally covered almost the entire surface of these twenty-seven counties. Along the southern and southwestern border this forest faded into oak and Jack-Pine "openings," and, in places, gave way to regular prairies. Generally, it was a mixed forest of White Pine and hard woods on all loam and clay lands. It approached the

regular pinery form on the tracts of sandy loam and the red clays of Lake Superior, and it was invariably pinery proper, generally a mixture of White and Red (Norway) Pines, on all sandy and loamy sand districts.

Along a line extending approximately through range 7 W., from Lake Superior to township 31 N., thence to the southwest corner of Marathon County, and thence east to Green Bay¹ this great forest changed in character. To the east and north of this line the Hemlock joined the hard woods and pine on all gravelly clay and loam lands. The Birch (not White Birch) disputed precedence among hard woods, so that we may designate the forest as Birch forest with admixtures. The Red Oaks were thinly scattered and the White Oaks practically wanting. To the south and west of this line the Hemlock generally did not grow at all, the Birch became scattering, White Oaks were abundant, and the oaks gave character to the hard-wood mixture, making the bodies of pure hard woods, which were much more common on this side of the line, distinctly Oak forests.²

Along the southern and western boundaries of the forest (in Portage, Dunn, St. Croix, and Polk counties) the dense cover of a variety of tall hard woods and conifers gave way rather suddenly to monotonous brush-woods, composed of scattered bushy oaks, either alone or mixed with Jack Pine.

In almost all parts of the mixed forest of the loam lands the hard woods formed the body of the forest and the conifers the admixture. The hard woods were represented by trees of all sizes, from the seedling or sprout to the mature timber tree; they formed nearly all of the undergrowth, and this hard-wood forest showed every indication of thrift and permanence. The White Pine—Red (Norway) Pine did not grow on these loam lands—and Hemlock, on the other hand, were represented almost entirely by mature old timber standing isolated in groups or small bodies among the hard woods. Saplings, bushy young trees, and seedlings were comparatively scarce, an active reproduction was evidently not going on, and there is every reason to believe that both were losers in a long-fought struggle for possession of the ground in which a change in the general moisture conditions probably exerted considerable influence. For White Pine this was most conspicuous in the southern counties (Marathon, Langlade, and Dunn) and on the heaviest soils, where in many places the hard woods had entirely succeeded in crowding out the pine, but wherever sand or gravel discouraged the hard woods (in Wood, Barron, Price, and Sawyer counties), the pine held more nearly its own, and formed a fair proportion of the sapling timber.

¹ Leaving out of consideration the counties along Lake Michigan, which were not visited.

² The lines of distribution, as here laid down, refer only to the occurrence of trees as timber of economic importance, and not to their botanical distribution.

The thinly scattered Balsam and the less frequent Spruce appear to have occupied the same position as the pine and Hemlock, but it was naturally much less important and conspicuous.

In the regular pinery of the sandy soils the pines predominated, the Hemlock was entirely wanting, and the hard woods were scantily represented by small White Birch, Aspen, and Maple, which were mixed with the young pine; these deciduous trees were killed out in the dense stands of mature timber, but reappeared where the superannuated pines were dying off and the cover of their shading crowns was broken, as in some places in Oneida, Vilas, Marinette, and Bayfield counties.

On the better loamy sands the pine forest was a mixture of White and Red (Norway) Pine, with occasional patches (temporary?) of Jack Pine (Vilas and Oneida), but on the poorer sands the Red (Norway) and Jack Pine were often alone (pure growth), either one or both together forming forests of considerable extent, usually with hardly any undergrowth or admixture save some scattering scrub oak. This was the case in barrens of Bayfield, in Douglas, Marinette, and Portage counties.

The greater part of the swamps of north Wisconsin were well stocked with dense thickets of Tamarack, Cedar (*arborvitæ*), and some scattering Spruce. The Cedar (*arborvitæ*) prevailed in the swamps of the eastern part, especially those of the sandy loam lands along and near Green Bay, while the Tamarack had undisputed possession of the swamps of the southern and southwestern part, and also covered part of the swamps of the openings. The swamps of the central, northern, and northwestern part were stocked without regularity, some with Tamarack, others with Cedar, and in many of them both trees occurred together. The Spruce as a runty shrub or half tree covered many open bogs, and was scattered in the swamps, especially within the moister Hemlock area.

FOREST CONDITIONS OF THE PRESENT.

At present these forests are materially changed; more than one million acres have been cleared and put in cultivation. During forty years of lumbering nearly the entire territory has been logged over. The pine has disappeared from most of the mixed forests and the greater portion of pineries proper have been cut. There is to-day scarcely a township in this large area where no logging has been done. In addition to this, the fires following logging operations or starting in the new clearings of the settler have done much to change these woods. Nearly half this territory has been burned over at least once; about three million acres are without any forest cover whatever, and several million acres more are but partly covered by the dead and dying remnants of the former forest.

In the better hard-wood areas (Taylor, Marathon, Langlade counties) the change is least conspicuous; the former existence of the pine is scarcely noticed, and the forest is damaged by fire only where it borders

on "pine slashings" or spots where quite a body of pine had occurred and had been removed. On the lighter, gravelly loam and sandy loam soils, where the pine formed a heavier admixture, the remaining Hemlock and hard-woods are badly damaged and often over extensive tracts (parts of Price, Chippewa, Sawyer, and Washburn counties) entirely killed. In most of the pinery areas proper (Oneida, Marinette, Washburn, near lake at Ashland and Bayfield, and in Douglas County) the repeated fires have largely cleared the lands of all the slashings. In these districts large tracts of bare wastes, "stump prairies," where the ground is sparsely covered with weeds and grass, sweet fern, and a few scattering runty bushes of scrub oak, Aspen, and White Birch, alternate with thickets of small pine (often Jack Pine) which in spite of repeated fires have escaped destruction or have reestablished themselves. Nor have these changes been restricted to the upland forests. The swamps, too, of every county have suffered from fires, and it is in the dense tamarack and cedar swamps of the sandy areas where some of the worst fires have had their start, and where the most complete destruction has taken place (as in Oneida, Price, Chippewa, and Marinette counties).

In the accompanying map an attempt is made to show the present forest conditions as well as to give some notion of the former extent and character of these woods. The areas of pinery proper, distinguished by red color, represent the pine forests of almost pure growth, without merchantable hard woods and Hemlock, covering the sandy districts of this region. The island tracts of mixed forest on heavier soil are not shown, and in the same way the numerous small tracts of regular pinery scattered through the great body of mixed forest, particularly along the rivers, were left out partly for sake of clearness and partly because their exact limits were not ascertained.

The hard wood mixed forest, distinguished by green color in three shades, to indicate differences of density or yield, is divided by a red line into two parts, the Hemlock and Birch area on the north and east of this line and the Oak woods west and south.

The existence of pine is indicated by red signs, the plus sign (+) being used where it still exists in considerable quantities, the minus sign (—) where it has been cut out.
















Where pine predominated, the signs of the red circle with and without a cross, denoting present and former conditions, are employed.

Where the hard woods are largely cut, culled, or destroyed by fire, the minus sign in black is used, while Jack Pine and Jack Oak are in all cases indicated, the one by red and the other by green (V sign).

CONIFEROUS SUPPLIES.

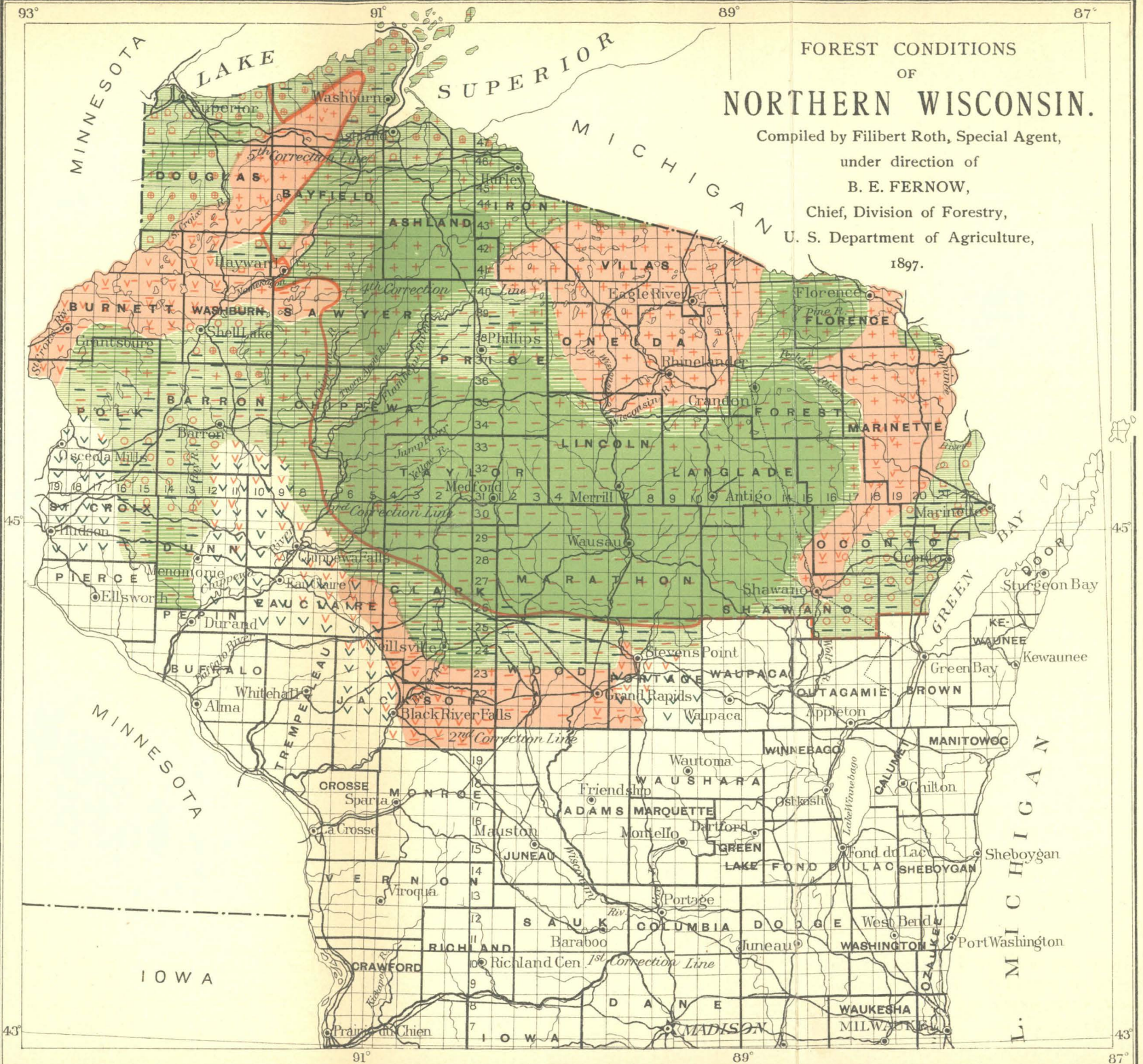
The conifers, particularly pine, formed solid, almost pure forests, over more than 30 per cent of the area under consideration, besides hundreds of groves of smaller extent scattered throughout the entire area of mixed

LEGEND.

-  PINERY, ON SANDY LAND, WITH-
OUT MERCHANTABLE HARD-
WOODS EXCEPT IN SMALL
SCATTERED AREAS.
-  PINERY WITH CONSIDERABLE
MERCHANTABLE TIMBER.
-  PINERY NEARLY OR ENTIRELY
CUT OVER.
-  PINERY LARGELY STOCKED WITH
CONSIDERABLE JACK PINE.
-  MIXED FOREST OF HARDWOODS,
PINE, AND, IN THE PART EAST
AND NORTH OF RED LINE, WITH
HEMLOCK.
WITH LESS THAN 3,000 FEET OF
HARDWOOD AND HEMLOCK PER
ACRE OF STOCKED AREA.
-  MIXED FOREST WITH 3,000 TO
5,000 FEET OF HARDWOOD AND
HEMLOCK PER ACRE OF
STOCKED AREA.
-  MIXED FOREST WITH OVER 5,000
FEET OF HARDWOOD AND HEM-
LOCK PER ACRE OF STOCKED
AREA.
-  MIXED FOREST WITH CONSIDER-
ABLE STANDING MERCHANT-
ABLE PINE.
-  MIXED FOREST FROM WHICH PINE
HAS LARGELY BEEN CUT.
-  MIXED FOREST FROM WHICH
HARDWOOD AND HEMLOCK
HAVE LARGELY BEEN CUT OR
DAMAGED BY FIRES.
-  MIXED FOREST, WHERE PINE IS
PREDOMINANT, THE FOREST
RESEMBLING PINERY
-  MIXED FOREST WHERE PINE
FORMERLY PREDOMINATED BUT
IS NOW CUT, AND THE APPEAR-
ANCE NOW IS THAT OF A PINE
SLASHING.
-  OPENINGS WITH JACK PINE
WOODS.
-  OPENINGS WITH SCRUB OAK
WOODS.
-  LIMIT OF HEMLOCK (AREA NOT
CARRIED OUT IN THE EASTERN
PART).
TO THE SOUTH AND WEST OF THIS
LINE, THE HEMLOCK IS NOT OF
COMMERCIAL IMPORTANCE, AND
THE BIRCH IS REPLACED BY
OAK.

FOREST CONDITIONS OF NORTHERN WISCONSIN.

Compiled by Filibert Roth, Special Agent,
under direction of
B. E. FERNOW,
Chief, Division of Forestry,
U. S. Department of Agriculture,
1897.



forest. In addition, they formed the most conspicuous part of these mixed forests themselves, so that the name of "pinery" was applied to the entire body once covering this area. The conifers covered especially the poorest land; they stocked the barrens, the light sands, the roughest gravel lands, and clothed the swamps wherever the latter permitted of any tree growth. Besides forming the bulk of the forest growth, the chief conifers, White and Red (Norway) Pine and Hemlock, grew to larger size and better shape, yielded more material, and were easier logged, transported, and sawed, and their products found a much more extensive market than those of the hard woods. In the total amount of saw timber the conifers originally excelled the hard woods about as five to one, but at present all the conifers combined furnish only about twice as much material as the hard woods.

WHITE PINE.

Past.—The White Pine occurred in nearly all parts of this area. In most counties it was found in every township on almost every section, and though checked, apparently by a lack of humidity, at the "openings," it followed all the streams—Wisconsin, Black, Chippewa, St. Croix, etc., a considerable distance beyond the limits of the forest. Generally, it seems quite independent of the quality of the soil. It grew as fast, as steadily, and to as large proportions on the sandy and gravelly lands along the Flambeau, Chippewa, and Wisconsin, as on the heavier soils of the divides and the famous Wolf River Basin.

The yields naturally varied with size and number of trees per acre. They were largest in mature stands of pure growth, such as may be seen in parts of Oneida and Vilas counties, where as much as 2,000,000 feet are cut from 40 acres, and where single acres might be selected that would cut 100,000 feet B. M. The yield is naturally smaller in very old timber, even in the pinery, where the stand is broken, and still more so in the old and scattered timber of the mixed forest, where often but one or two trees were found to the acre. A yield of 1,000,000 feet per 40 acres, or 25,000 feet per acre, was and is considered a very good yield, and, generally, the cut is less than half this amount. In all these wild woods the ground is irregularly covered, and almost every 40-acre tract has its bare places without merchantable timber; therefore all yield figures per unit are somewhat misleading. Entire townships (23,000 acres) are known to have cut over 400,000,000 feet per township, while 200,000,000 per township have been accounted for in the output of the several mills for the entire area of Wood County, and a cut of about 125,000,000 per township is recorded for the Wolf River above Shawano. For comparison with present supplies an attempt is made in the following table to estimate the original stand of pine for the several river basins. The figures are by no means high, and have been verified, at least, for portions of every basin, as explained further on.

Original stand of pine in north Wisconsin.

[Only the 27 counties visited are involved here.]

Name of river basin.	Number of townships stocked.	Yield per township (million feet).	Yield for river basin (million feet).	Yield of river as per cent of total per cent.	Present stand (million feet).	Remarks.
Black	40	225	9,000	7	250	Considerable jack-pine barrens.
St. Croix.....	100	125	12,500	9.7	3,500	
Red Cedar.....	40	200	8,000	6.2	475	Much hard-wood area. Do. Do.
Chippewa.....	175	200	35,000	27	3,500	
Wisconsin.....	172	175	30,100	23.1	2,800	
Wolf.....	60	125	7,500	5.8	475	
Oconto.....	28	125	3,500	2.7	150	Only Wisconsin side.
Peshigo.....	27	150	4,050	3.1	500	
Menominee.....	47	150	7,050	5.4	1,500	
Rivers to Lake Superior.....	76	150	11,400	8.8	4,200	
Rivers to Green Bay.....	7	200	1,400	1.1	.....
Total.....	772	129,400	17,400	

Of these 129.4 billion there is approximately—

	Billion feet.
Standing at present.....	17.4
Cut between 1873 to 1898.....	66
Probable cut 1840 to 1873.....	20
Accounted for.....	103.4

Leaving about 26 billion feet as probably wasted, chiefly destroyed by fire.

Present.—In considering the present supply of pine, both White and Red (Norway), of which fully 80 per cent is owned by lumbermen, it must be borne in mind that, in spite of many years of logging, but few townships of the better stocked regions, outside of settlements, have been logged clean, and counties like Chippewa, Clark, Marathon, and even Wood still continue to furnish large quantities of pine logs of all sizes. It is also interesting to note in this connection that it is not so much a lack of good logs, but the fact that of late everything is cut clean, which has reduced the average size of logs to half of what it was twenty years ago. In ascertaining the standing timber it is especially the fragmentary or culled condition of the forest which makes general or wholesale estimates difficult, and causes the opinions on pine supplies to vary within such wide limits. "Most men know little about what their neighbors have," and "the man whose pine supply is nearly at an end, and who finds it difficult to buy more stumpage, thinks that everybody shares his trouble." These two statements, variously expressed, may be heard in many places, are readily verified in every county, and fully indicate the difficulty.

The figures in the following table represent the results of a diligent and careful inquiry into the present condition of supplies. It is believed that, though somewhat higher than those of the majority of estimators, they are still quite conservative in the aggregate and justly apportioned among the several counties.

Standing pine in north Wisconsin.

[Expressed in million feet B. M.]

County.	Million feet B. M.	Remarks.	County.	Million feet B. M.	Remarks.
Ashland.....	300	Canvassed only for its pine.	Oconto.....	75	Probably too low, but left so in defer- ence to good authority.
Barron.....	150		Oneida.....	1,200	
Bayfield.....	3,000		Polk.....	240	
Burnett.....	200		Portage.....	20	
Chippewa.....	500		Price.....	200	
Clark.....	200		Sawyer.....	2,000	Believed to be 2,500 by good author- ity.
Douglas.....	3,500				
Dunn.....	20				
Eau Claire.....	50				
Florence.....	150		Shawano.....	300	
Forest.....	500		Taylor.....	200	
Iron.....	400		Vilas.....	1,500	
Jackson.....	100		Washburn.....	350	
Langlade.....	150		Wood.....	100	
Lincoln.....	250				
Marathon.....	200		Total.....	17,355	
Marinette.....	1,500				

The estimates here given are not calculated, but are simply information based upon estimates of different men well informed with regard to certain parts. They were critically examined by comparing them with those of other men, and also by comparison with results of calculations based on probable cut per forty or per town and the area supposed to be still covered with timber. Moreover, the probability of the correctness of the various estimates was subjected to scrutiny in various ways and tested by personal inspection of the field.

Upon such basis, utilizing partial and imperfect estimates, which were checked and counterchecked, the attempt was made to approach as near the truth as was possible. After the writer had made up his own estimates, he once more submitted the same to his informants, and their divergence of opinion, wherever essential, will be found noted in the part of this report which refers to conditions in each county.

The White Pine appears to seed heavily and quite regularly. The trees in all parts of north Wisconsin were laden with cones last fall (1897). The seedlings thrive best on sandy soils, but grow on loamy soils almost as well. The young growth forms dense thickets, grows very fast in height (1 to 2 feet per year) as well as in thickness (often one-fourth to three-eighths inch and more), and the sapling timber cleans itself quite well of its dead branches, but not as well as Red (Norway) Pine. In Wisconsin the normal tree is over 50 feet high at the age of 50, attains a height of over 120 feet and a diameter of over 30 inches, and continues its growth in thickness with a most remarkable uniformity to a great age (200 years and more). White Pine, as a mature timber, has more faults than Red (Norway) Pine, bears more large dead stubs, disfiguring its trunk, is prone to fork, often three and even four large forks springing from the same stem, and is much more unsound, old timber being frequently defective by decay.

Both White and Red (Norway) Pine find a ready market in every locality, being sold as stumpage, logs, and lumber. Fully 90 per cent

of the present cut of over 2,000,000,000 feet (the cut was about 3,500,000,000 in 1893) is logged on a large scale with heavy equipment and is sawn in large mills. All cutting is extremely close; in most camps everything is taken "that will make a 2 by 4 inch," so that even sapling thickets are no longer spared, and the milling, driving, grading, etc., is done with remarkable care and economy. Ordinary mature timber yields about 4 to 4½ logs per tree, where 5 to 7 logs cut 1,000 feet B. M. The general average size (diameter) of the pine logs is at present only about 14 inches, and it takes 10 logs to make 1,000 feet B. M. Where much Red (Norway) Pine is cut, the size is even smaller; large quantities are logged to-day where 15 to 20 logs are required to make 1,000 feet B. M.

Future.—The future of Pine supplies necessarily depends on the amount of growing timber and on its chance of growth. Throughout the hardwood districts there is no young growth of Pine of any consequence. Some groves of young Pine occur on many old and burned-over slashings on the sandy loam and loamy sand districts, where settlement has put a stop to the fires. In all pineries proper, many thickets of young Pine occur which have sprung up during the last twenty-five years, but most of these are on land either never logged before or else but lightly culled. If protected, these groves could soon furnish a considerable quantity of merchantable timber, but under present conditions they will be largely crippled or entirely killed by fires, or else cut into cordwood for shook purposes. By far the best example of thrifty young White Pine on old burned-over slashings may be seen at Shawano; other fine groves occur abundantly near Grand Rapids and at other places on the Wisconsin River, and also on the Chippewa River and its tributaries. These groves of Pine have sprung up so gradually that in many cases those familiar with the place are astonished when their attention is directed to them. After the first fires the land is covered by Fireweed and Aspen; it is usually burned over a few times more, until the bulk of the débris is consumed; then the Aspen is given a chance to form thickets of greater denseness, and the impression and the common notion is that this is the end, that the land is now to continue in Aspen, and that Aspen is the alternate in a "natural rotation" of Pine and hard woods. If, however, there are any survivors of Pine near by—a common occurrence, especially on slashings of former years—young Pine seedlings will soon make their appearance among the Aspen. These Pines, however, require about five years to attain a foot in height, and so for years, even though numerous (often 500 to 600 per acre), they escape the notice of most people. Before long the gray of the Aspen thicket changes to a mixture of gray and green, and in a few more years the Aspen grove is transformed into a Pine thicket, with the feebly struggling Aspen dying out. In the aggregate these groves of young Pine, of which there are many in every county visited, are safely estimated

at about 200,000 acres, sufficient to furnish within fifty years' time, if protected, a yield of more than a billion feet of marketable material. But while the ability of White Pine to reproduce itself is amply demonstrated in every county in North Wisconsin, the fact still remains that the great bodies of cut-over Pine lands have not and do not at present re-cover themselves with young Pine; it is also true that more than 80 per cent of the bare-burned cut-over lands are practically devoid of any valuable forest growth whatever.

RED (NORWAY) PINE.

The Red or Norway Pine occurs in every one of the twenty-seven counties here under consideration, but is abundant only in those which contain sandy districts of considerable extent. This Pine does not occur on the loam and clay soils, except on the slopes along Lake Superior; it generally grows mixed with White Pine on the loamy sands (in Oneida, Vilas, etc., counties), and occupies alone or mixed with Jack Pine the poorer sands (barrens of Bayfield, Marinette, etc., counties). The Red Pine grows quite rapidly when young (as fast or faster than White Pine on the same poor soils), and up to the age of about 100 years, but it grows very slowly when old, generally forms a more slender stem than White Pine, and does not attain the same dimensions, especially in diameter. It seeds heavily and reproduces well, shares in covering pine slashings, forms dense stands, cleans itself well of limbs, makes a straight, clean stem, is more sound than White Pine, and yields very heavily. Originally it formed but a very small part of the entire stand of Pine, but to-day about 13 per cent of the remaining supply is Red Pine. It is treated like White Pine in all branches of exploitation, but it brings a smaller price and is more extensively cut into dimension stuff. Its frugality, rapid growth, fine dimensions, and heavy yield highly recommend this tree in considerations of reforestation.

JACK PINE.

In Wisconsin *Jack Pine* generally takes possession of all the poorer sands, where hardwoods and even White Pine no longer thrive. Nevertheless, it is also found on sandy-loam areas (Shawano County and parts of Marinette County) where better trees have grown, and it appears that its presence in these localities is due to large fires which many years ago completely consumed the former forest and so reduced the fertility of the soil that none but this most frugal of conifers could reclothe the land. Jack Pine forms characteristic dense thickets and even forests of many miles in extent, and it mixes frequently with Red Pine, less with White Pine, and still less with hardwoods except the Scarlet and other Scrub Oaks, and to a lesser extent the White Birch, its normal companions.

In Wisconsin it is always a small tree, generally less than 10 inches

diameter and below 60 feet in height. Frequently groves of several hundred acres consist apparently of trees of nearly one age and size. The tree reproduces well, grows quite rapidly, but only while young, and is generally short lived, reaching its best growth before the eightieth year. At present it is not used to any extent, neither stumpage nor logs having real commercial value, except in parts of the Jack Pine and Oak openings, where it is used as fuel and for farm purposes. The total stand of this Pine, if taken down to 4 inches, is about 3,500,000,000 feet, of which about 1,700,000,000 might be utilized for dimension stuff while the rest could be employed as pulp wood. Its great frugality, ease of propagation, rapid growth, and large yields will recommend the Jack Pine for the purpose of restocking all poorer sands.

HEMLOCK.

Hemlock is confined to the gravelly loam and clay lands of the more humid half of north Wisconsin and shares some of the peculiarities of the White Pine growing within these limits. It is generally old timber, with little indication of active reproduction. Over wide areas only large, old trees occur, and in many localities even these are gradually dying out. Wherever the forest is partly cleared, where considerable pine is removed, the hard woods cut out, clearings and roads opened, and also where fire has run, the Hemlock, with its shallow system of roots, at once shows its great sensitiveness to any interference in soil moisture, and generally all, or at least most, of the trees succumb. In this way a large proportion of the Hemlock on the lighter gravelly loams of Price, Sawyer, Chippewa, and other counties, and also much of the timber on heavier lands in the vicinity of pine slashings, etc., has died and now furnishes great quantities of dead and down material for future fires, which in turn will decrease the supply of this material, the value of which is greatly underestimated.

There is apparently no lack of seed, for the Hemlock, like Pine, this season (1897) was full of cones, and yet there is but very little reproduction of this timber. For miles no young growth of any size is seen, and the small trees, often mistaken for saplings, generally prove to be runts, suppressed individuals, often 150 and more years old. The only places where this tree still seems to hold its own are in some of the wet "half swamps" of the eastern part of this area. The young Hemlock stands a great deal of shading and close crowding, but grows slowly both in height and thickness. The tree does not clean itself well of its branches, rarely forks, forms a more tapering trunk than the pines, and does not attain their dimensions. In the southern part of its area and on the heavier soils it grows to a height of 85 to 100 feet, with a diameter of 24 to 30 inches. In the northern counties and on the lighter gravels it is usually both shorter and smaller, frequently not over 60 feet high and under 20 inches in diameter. Hemlock is generally quite sound, but much of it is claimed to be shaky at the butt.

In all favorable localities it cuts about three and farther northward about two logs per tree. Being generally mixed with hard woods in very variable proportions, the yield of Hemlock varies within wide limits. Mature stands of pure growth yield 500,000 feet and over per 40 acres. To cut 200,000 feet requires good Hemlock land, and generally, where large areas are considered and the Hemlock forms 40 to 60 per cent of the total cut (Pine being removed), yields of 100,000 to 150,000 feet per 40 acres may be expected. The present supply of Hemlock is generally much underestimated. This is partly due to the fact that large quantities have been killed by fire and exposure to wind and sun and partly to market conditions which have prevented a proper appreciation of this product. Generally Hemlock was not estimated at all, or only the larger and best trees considered. According to the best information, there are standing at present nearly 12,000,000,000 feet of Hemlock saw timber, and this estimate is, in the opinion of the writer, still 25 per cent below the real truth. The distribution of this supply over the several counties is given in Table on page 73, and whatever may be said of the total, the figures are believed to fairly represent the relative proportions. In places Hemlock is extensively peeled for its bark, considerable quantities are cut into lumber, chiefly dimension stuff, some of it is used as pulp, but in general it is not yet appreciated, so that neither stumpage nor logs can readily be sold, and millions of feet are wasting in the woods. The ability of the Hemlock to endure crowding and shading is more than offset by its slow growth and its demands on soil, so that this tree deserves but a secondary place in the forest of the future.

ARBORVITÆ (CEDAR).

Arborvitæ or Cedar in Wisconsin is practically limited to the moister hemlock area, but, unlike the Hemlock, it continues through Douglas County into Minnesota, where it is a common tree throughout the humid forest region. Generally the Cedar (*Arborvitæ*) is limited to the swamps, but, as in parts of Minnesota and Michigan, it also invades the ordinary forests. In many swamps it is wanting, frequently it is the sole occupant. More commonly, however, it is mixed with Tamarack, some Spruce, and often a few scattered hard woods. It forms dense thickets, reproduces well, grows rather slowly, is generally under 18 inches breast high and less than 60 feet in height. The older trees are normally defective at the butt. The yield of Cedar is extremely variable and difficult to estimate. As the tree is salable down to 4 and even 3 inches, the yield is generally great wherever the swamps have not been burned. A total of 1,300,000,000 feet B. M., the equivalent of 2,600,000 cords, may be regarded as a very conservative estimate. Cedar (*Arborvitæ*) is cut for posts, poles (both telegraph and telephone), ties, and shingle timber. Wherever near highways Cedar finds good market. The logging is generally done on small scale, and exact figures for total cut are therefore not accessible.

Tamarack, like Cedar (*Arborvitæ*), grows chiefly in the swamps, and invades to a small extent the upland woods only in some of the moist and cold localities, especially along Lake Superior. Unlike the *Arborvitæ*, the Tamarack inhabits the swamps clear to the western and southern limits of the district under consideration, and even stocks part of the swamps of the adjoining Oak and Jack Pine openings or brush prairies. In these drier localities it remains small, but within the more humid parts it attains ordinarily 12 to 16 inches diameter, a height of 70 to 80 feet, with a most remarkably small taper. It reproduces well, grows quite fast, forms very dense thickets, often entirely covering the swamp with poles of nearly one age and size, often also occupying merely its edges or the center. Frequently, nearly always in the drier western and southern parts, it is practically alone, i. e., forms groves of pure growth, but quite often it is mixed more or less with Cedar, Spruce, and some hard woods. Being salable only as tie and pile timber, Tamarack under 10 inches is not merchantable, and many swamps, though densely stocked, do not contain a cord of marketable material. The older stands are generally more open, many of the trees having fallen prey to age and weather. These broken stands, with their tall marsh grass and large masses of dead and down timber, form, during dry seasons, most favorable starting points for fire. For this reason many of the swamps—in some counties the majority—contain no green timber and continue to be for years a serious menace to the surrounding country. The standing merchantable Tamarack is estimated at about 1,620,000,000 feet, or 3,200,000 cords, to which would have to be added at least an additional 3,000,000 cords if pulp wood down to 4 inches is included.

In estimating the amounts of swamp timber, namely, Cedar (*Arborvitæ*) Tamarack, and Spruce, the area of the swamps was estimated in lump for some counties, but more commonly it was ascertained by going over the minutes and maps for each township with some well-informed person. The area of burned-over and open swamps was then deducted, and finally a yield per acre for the wooded swamp area settled upon. This latter is generally about 3,000 feet or 6 cords per acre, and, though apparently low, is not far from the truth when compared with estimates of large areas which have been examined in this connection. In estimating the proportion of Cedar (*Arborvitæ*) Tamarack, and Spruce, locality and market conditions are considered. For some localities upland Cedar and Spruce are also estimated.

Though many of the Tamarack and Cedar swamps will in time be converted into hay marshes and even fields, both Cedar and Tamarack will undoubtedly continue to produce large quantities of useful material. At present but little Tamarack is cut; some is sawn into dimensions stuff, a little of it is used for piling and poles, but, strange to say, the poor sappy poles of Red (Norway) Pine are preferred in the

market, and even ties have such a poor rating that most of the ties of these sections are either shipped in or made of Hemlock.

SPRUCE.

Spruce occurs scattered throughout the moister loam land districts, especially of the northern and eastern parts of this territory, but it is more commonly restricted to the swamp and semiswamp areas. On many of the poor moss bogs it forms the only tree growth. It is nowhere abundant, forms no solid bodies, is a mere runty shrub or half tree on the moss bog, and even on the better soils attains a diameter of only about 12 inches and a height of 50 feet. Trees over 12 inches in diameter are the exception; trees 18 inches in diameter and over are rare. It seems to reproduce fairly well, endures shade, but appears sensitive to changes in soil moisture, thriving only in very moist localities. Being scattered, Spruce is logged only in a small way, though, on the whole, considerable quantities are being cut for pulp, and an increase of this cut may be expected.

The total stand of Spruce in north Wisconsin may be placed at about 1,200,000 cords, including all wood down to 4 inches.

BALSAM FIR.

Balsam Fir is thinly scattered in most forests of the more humid loam and clay lands. Like Spruce, it is often wanting over considerable tracts, but few large districts are entirely without it. It reproduces well, stands crowding, and endures shade; it grows fairly well when young and favorably situated, remains small, but is not as short-lived as is often supposed. It is generally less than 12 inches in diameter and below 60 feet in height. It never forms large bodies, is little used as yet, and is rarely cut for saw logs; it is occasionally used for temporary buildings, and of late to some extent for pulp wood. Being usually left out of timber estimates, the amount of standing Balsam is not easily ascertained. In all forests where Balsam Fir occurs in commercial quantities the yield per acre was placed at from 50 to 100 feet B. M. per acre, or 4 to 8 cords per 40 acres, an estimate which agrees with some estimates made by the Chicago Northwestern Railroad Company in Forest and adjoining counties. This figure will generally prove considerably below the truth, but it seemed desirable to have at least some estimate, however crude, of this material—doubly so, as it is already beginning to have a market value as pulp wood. Including everything from 4 inches up, there are probably about 800,000 cords. The Balsam Fir has no future, the ground it occupies is largely farm land, its growth is too slow, and its size is too small to commend it to future operations.

HARD-WOOD SUPPLIES.

Aside from the general outlines of the Hemlock and Birch bearing portion of the great forest, as differentiated from the Oak forest, no

sharp limits of distribution or composition of the hard-wood forest are possible. Basswood, Maple, Elm, and Ash, the principal hard woods aside from Oak and Birch, all enter into the composition of the hard-woods forest in nearly all parts of this area, though in widely varying proportions. Thus, in one locality Elm formed 30 per cent and more of the woods, while in another, but few miles distant and with soil, drainage, etc., alike, the Elm is nearly replaced by Basswood or Birch. Nor is it easy to draw lines with reference to size and quality development. Good timber on good soils passes by easy stages into inferior timber on poorer soils, and it is but fair to say that some good timber grows in every county. In general, it is an unquestionable and well-recognized fact that the hard-wood timber grows smaller and scrubrier northward, and when the extremes, as, for instance, the hard woods of Dunn or of Shawano, are compared with those of Iron and Douglas counties this truth is quite apparent; but the transition is gradual, and any apparent lines of demarcation generally are explained by differences in soil rather than effects of climate. In the southern portion of the area under consideration the hard woods attained considerable dimensions. Oak, Basswood, and Elm 90 to 100 feet high and over 30 inches thick are not unusual. In general, however, the mature timber is under 30 inches in diameter and under 75 feet in height, and on many large tracts shorter than 60 feet and under 20 inches diameter.

Generally the hard woods are "short bodied" as compared to conifers; they furnish per tree about $2\frac{1}{2}$ logs, and in the northern counties scant $1\frac{1}{2}$ logs, of which it takes 7 to 10 to the thousand. Of the different kinds, Basswood and Elm are tallest and longest in body, the former quite commonly cutting 3 and even $3\frac{1}{2}$ logs per tree, and the latter often furnishing ship timbers 60 to 70 feet in length. Birch is generally the shortest, and large trees often furnish but a single log. As might be expected, much of the older hard-wood timber is in all stages of degeneration and decay, so that a considerable portion of it is defective and the cut consequently wasteful. The Oak, being naturally the longest lived and having the most durable wood, is least affected; "it cuts sound;" Basswood, Birch, and Ash are about alike and quite defective when old; while of all hard woods the Maple is the most affected. With this tree especially the fault seems not entirely a matter of age, but is apparently largely due to injury in consequence of frost—"frost cracks," with their peculiar rampartlike thickenings or ridges along their edge, being very common. These cracks naturally admit fungi and insects, and thus introduce decay. This defect in Maple is most strongly complained of in the central and northern parts and least in the southeast and southwest, where a great deal of fine Maple occurs.

Concerning the yields in hard woods, opinions differ widely, but it is believed that the estimates are generally too low and are commonly deficient. There are several reasons for this, the chief of which are lack of experience both in estimating and milling of hard woods, the

men being used only to pine but not to hard woods. To this must be added lack of time, the work usually being too hurried, and also the fact that most of the work is done for certain kinds (Oak, Basswood, Elm, etc.) and usually includes only choice material, the peculiarities of the hard-wood market naturally reacting even on the matter of estimates. Generally the yields are estimated at from 80,000 to 150,000 feet per 40 acres, or 2,000 to 4,000 per acre for fair to good lands, and from 25,000 to 50,000 feet per 40 acres for the poorer lands and the northern lake districts. Some townships in Wood and Marathon counties are known to have cut over 100,000,000 feet B. M. per town, or nearly 5,000 feet B. M. per acre for the total area, swamp and all. Smaller districts, as some forests in Shawano and Langlade counties, cut from 10,000 to 15,000 feet B. M. per acre, but these must be regarded as exceptions.

The amount of standing hard wood and Hemlock is determined by ascertaining the area of fairly stocked woodland, excluding swamp lands, then settling on the yield per acre or forty, and finally estimating their relative proportions. The determination of the area is the weakest point. The yields for all principal localities are based on wholesale estimates and results of actual operations. Thus the cut per township or for a number of sections, also the estimates of lumbering and railway companies, besides the detailed experience of several hundred men, are considered, and the results weighed by comparing the growth in different localities.

The proportions of Hemlock and hard wood and the different kinds of hard woods among themselves are ascertained in the same manner. There exist for all principal localities extensive detailed estimates (those of the Chicago Northwestern Railway and those made for several years by Mr. Ben. Hall, of Marinette, are models of this kind), of which a number were examined, and in addition the views of different operators were compared. To most persons the figures of yield will probably seem high and, in truth, 6,000 feet per acre, or 240,000 feet per forty, does appear like a large amount, even for the best counties, but it must not be forgotten that here all kinds of timber, Birch, Maple, Elm, etc., and also all sizes above 12 inches, and for Oak and Hemlock, even tie sizes, are considered merchantable, and also that waste and swamp areas are excluded, and thus only the acres of well stocked land enter into consideration. Those who consider the yield as taken too low (and there will be many of these) will bear in mind that merchantable saw timber in hard woods and Hemlock at present is quite a different thing from Pine, and also that both hard woods and Hemlock are short-bodied, have been injured by fire, and involve in all old stands a heavy per cent of defective material.

Present stand of hard-wood saw timber.

Kind of wood.	Million feet B. M.	Per cent of all hard woods.	Remarks.
Oak.....	1,400	8.6	75 per cent Red Oak.
Basswood.....	4,600	29.0	
Birch.....	4,150	26.0	Yellow or Red Birch.
Elm.....	2,650	16.5	30 per cent Rock Elm.
Ash.....	900	5.6	Mostly Black Ash.
Maple.....	2,300	14.3	Mostly hard Maple.
Total.....	16,000	.....

The hard woods are cut in all parts of this territory. They are generally logged in a small way and most of the lumber is cut in small mills, with a yearly output of from 500,000 to 5,000,000 feet. According to a careful canvass conducted by the Northwestern Lumberman, of Chicago, the results of which are published in its issue of January 22, 1898, the total output of hard-wood lumber amounts to about 275,000,000 feet B. M. To this must be added large quantities of mining timber used in the Florence, Iron, and Ashland mines, together with railway ties, piling, construction, and ship timbers, and also considerable quantities of cooperage material and wagon stock, which in the aggregate probably brings up the total cut of hard woods to about 500,000,000 feet.

The most valued and therefore also the most culled of the hard woods is the Oak, particularly White Oak, the exploitation of which was begun in Wood and Clark counties more than twenty-five years ago. Of the other hard woods, the Basswood is most extensively cut and finds the most ready market, followed in this respect by Elm, particularly the fine Rock Elm. Birch, though the prettiest wood of the region, is much underrated, owing to fashions which prejudice the market. Nevertheless large quantities are cut every year, and the same is true of Maple, which is generally the least estimated of the hard woods. Owing to its irregular distribution Ash is of local importance only, though in some places it is claimed that ash logs are as easily procured as almost any other (Oconto County).

Among trees of secondary importance Aspen (Poplar), White Birch, Butternut, and Beech may be mentioned in order of their economic value. The Aspen (Poplar), both the common Aspen and Large-toothed Aspen, is found in all parts of the area, but is conspicuous as a timber tree only in the northern forests, especially of Douglas, Bayfield, and Ashland counties. These Aspens (Poplars) take possession of all burned slashings; but aside from their use as nurse trees to pine and better woods the Aspens (Poplars) on the slashings of North Wisconsin so far have generally been of no value, and it appears doubtful if they ever shall be except in a few localities, especially in the better sandy loam districts.

The White Birch is best developed near Lake Superior. It never grows large, generally remaining a mere sapling, commonly less than 12 inches in diameter and 50 feet in height. In this territory it is

almost always a member of mixed woods, often joining the White Pine, rarely forming thickets by itself (on some burned areas in Forest County). It is cut for chair stock, etc., but 90 per cent of all White Birch is too small for present markets.

The Butternut is sparingly scattered over the better loam lands (as far north as the Iron Range), occurs isolated, rarely in small groups, and, though it grows to good size, its distribution here seems uncertain and accidental.

The Beech is restricted to the sandy loam lands of the Green Bay region and invades but the edges of the real loam or clay lands of northern Oconto and Shawano counties. Wherever seen it appears to thrive, is abundant in all sizes, and evidently reproduces well.

Throughout the hard-wood forests all stages from the seedling to the old and decaying timber trees, are represented. In some cases the stand of old mature timber is quite heavy and undergrowth and sapling timber restricted, generally the mature trees are in the minority, standing scattered 10 to 20 per acre, and the greater part of the ground is occupied by young trees, small saplings, and bushy or withy beginners. The undergrowth is generally composed of young trees, and distinct kinds or species performing this function are few, often wanting. All kinds of hard woods reproduce actively, as is well illustrated in numerous windfalls and abandoned clearings, where dense thickets of mixed hard woods occupy every foot of ground. Abundance of seed and ability to stand shade enable the Maple to predominate among the young growth, even where it holds but third rank and less as a timber tree. Conspicuous among the young growth, without ever attaining the size of log timber, are the Blue Beech, Striped Maple, and, somewhat less abundant, the Hop Hornbeam. As a common underbrush proper on both loam and sandy soils may be mentioned only the Hazel, and, to a much smaller degree, the Dogwood (Cornel) and Wild Red (Pin) Cherry, the latter becoming really conspicuous only on the burned lands. The willows are quite abundant as scattering brushwood on open places, and occur on the dry sandy as well as clay lands. Alder replaces the large willows along many of the streams and in some swamps, it is never more than a bush, but as such forms characteristic alder brakes.

The scrubby hard woods of the openings consist almost exclusively of oaks. Varieties of both White and Red Oaks (particularly Bur, White, and Red Oak) grow here into bushy dwarfs 15 to 25 feet high, 4 to 12 inches in diameter, branching out almost from their very base. These scrub oaks occasionally form thickets, but generally stand too far apart to prevent a ground cover of grass and weeds.

Since it occupies the better soils, the area of the hard wood forest will naturally continue to be diminished as the country settles, and the present supply will be reduced at a rate quite independent of hard wood lumbering. Nevertheless, the difficulty of clearing, comparative safety

from fires, abundance of young well-growing stock, all combine to prolong the supplies, and the outlook for the hard woods is far brighter than for the much more valuable pine.

SUMMARY OF SUPPLIES.

In the following tabulation the entire supply of wood materials standing is summarized and classified according to the uses that might be made of the same:

Summary of wood supplies standing in Wisconsin, classified.

Saw timber.	Million feet B. M.	As per cent of—	
		Conifers and hard-wood, resp.	Total saw timber.
Conifers:			
White Pine	15, 000	52	33.3
Norway Pine	2, 300	8	5
Hemlock	11, 700	40	26
Total	29, 000	100	64.3
Hardwoods:			
Oak	1, 400	8.6	3.1
Basswood	4, 600	29	10.2
Birch	4, 150	26	9.3
Elm	2, 650	16.5	6
Ash	900	5.6	2
Maple	2, 300	14.3	5.1
Total	16, 000	100	35.7
Other supplies.			Million feet B. M.
Poles, piling, ties, posts, etc.:			
Cedar			1, 300
Tamarack (8 inches and over)			1, 600
Jack Pine (over 8 inches)			1, 700
Total			4, 600
			Thousand cords.
Cord wood for pulp, fuel, charcoal, etc.:			
Hemlock			5, 500
Jack Pine (under 8 inches)			3, 600
Tamarack (under 8 inches)			3, 000
Spruce			1, 100
Balsam			800
Total for conifers			14, 000
All kinds of hard woods			60, 000
Sapling pine under 8 inches, about 5,000,000 cords.			

It will be observed that an enormous amount of coniferous material exists which under present conditions possesses hardly a market value. Most of this material will grow into lumber and pulpwood, and it is to be hoped that its loss by fire may be averted.

PRESENT ACCRETION OR INCREMENT.

In North Wisconsin a grove of well-grown sapling pine timber, 60 years old, may be assumed to cut at least as much as 15 cords of bolt

size material, or about 6,000 feet B. M. In the old woods as they stand, the trees above sapling size represent the great mass of the wood material, and therefore the growth of wood is largely on trees nearing or already of log size, so that the same amount of growth per acre here adds more saw timber than in the young grove above considered. For this reason a good thicket of pine 60 years old may not cut much more than 6,000 feet per acre, since much timber is under size, but the same stand at 120 years would easily cut 15,000 to 20,000, in spite of the fact that over half the trees that were found in the 60-year grove have died before this age is reached. From this it would appear that 100 feet B. M. per acre and per year on sapling timber is probably a safe estimate for the growth in this region. About the same conclusion will be reached if a grove of old hard woods is considered. Such a grove, which may cut 6,000 feet per acre, will be found to consist largely of young trees, among which there may be 20 to 30 good size older trees, and if examined, it will be found that the age of the oldest is not over 150 years, so that here about one-third or less of all the trees standing on the acre have produced the 6,000 feet B. M., which we are taking for lumber, in 150 years; the whole acre, therefore, may be assumed to be able to produce this amount in one-third this time, or, in other words, the same acre might be logged over for 6,000 feet about every fifty years. Such an assumption is fully supported also by comparing the cross sections of the Pine and hard wood, which shows that though growing rather slowly (for hard woods), nevertheless, Oak, Basswood, etc., in Wisconsin, equal and excel Pine in rate of growth.

If, then, 100 feet B. M. per acre and year be assumed as an average estimate of growth for this region, the total annual growth over the whole may be set at about 900,000,000 feet B. M., which is distributed among the different kinds according to their ascertained acreage, as follows:

	Million feet.
White and Red (Norway) Pine	250
Jack Pine	30
Hemlock	75
Tamarack	30
Cedar	20
Spruce and Balsam	10
Hardwoods	500
Total	915

From this growth must be deducted the loss by decay or natural waste, which in all wild woods necessarily equals growth when large areas and long periods are considered. For White Pine, Red (Norway) and Jack Pine, also Tamarack and Cedar (*Arborvitæ*) in Wisconsin, nearly half the present growth takes place in young, immature timber, since this largely prevails. With Pine in the hard-wood forest, and still more with Hemlock, decay proceeds faster than growth; for Spruce and Balsam an increase is doubtful, and with the hard-wood forests in

general the matter seems in a condition of equilibrium. This growth naturally is reduced by all operations, reducing either the forest area or the growing timber by clearing, by logging sapling or growing timber, and most of all by fires.

COMMUNAL INTERESTS IN FOREST CONDITIONS.

The importance of the forest to the State of Wisconsin as a factor of wealth is very great. The statement that "the wood industries have built every mile of railway and wagon road, every church and school-house, and nearly every town, and that in addition they have enabled the clearing of half the improved land of north Wisconsin," is by no means an extravagant exaggeration. Between 1873 and 1898 more than 66,000,000,000 feet B. M. of pine alone were cut from this forest, and even then the lumber industry was in a flourishing condition on all the streams, and had built up La Crosse, Eau Claire, Chippewa Falls, Grand Rapids, Wausau, Fond du Lac, Oshkosh, Green Bay, and many other places. The output of the lumber industry alone for the year 1897 is illustrated in the following table, taken from the Northwestern Lumberman, whose excellent canvass has before been referred to:

Total cut of lumber in Wisconsin for the year 1897, in million feet B. M.

[Taken from the Northwestern Lumberman, January 22, 1898.]

Name of district.	White and Norway Pine (alone).	Hemlock.	Hard woods.
Below Minneapolis, i. e., on Mississippi River (a)	284.3	3.8	7.1
St. Croix Valley (b)	105		
Chippewa Valley	274.8	18.8	26.7
Omaha Road (Ch. St. P. M. and O. R. R.)	185.2		
Wisconsin Valley	398.7	23.6	60.6
Wisconsin Central Road	134.1	24.3	84.5
Lake Shore (Ashland Branch)	126.5	18.9	61.1
Ashland District	265.3	2.6	
Soo Line (M. St. P. and S. St. M. R. R.)	50.2	2.6	7.1
East Central Wisconsin	36.6	9.9	6.9
Southern Wisconsin			10.3
Miscellaneous			2.7
Duluth district	34		
Green Bay shore, below Menominee (c)	129	11.9	6.0
Green Bay shore, on Menominee	167		
Total	2,190.7	116.4	273

(a) Only one-third of the original item is supposed to be cut on Wisconsin soil.

(b) Only one-half of the original item is supposed to be cut on Wisconsin soil.

(c) Only one-half of the original item "on Menominee" is supposed to come from Wisconsin, but the part "below Menominee" is all credited as cut in Wisconsin.

The following table, the data for which have been taken from the annual statements of the lumber cut, as given by the Northwestern Lumberman, represents chiefly the output of pine. Since, in the original statements, Wisconsin was not clearly separated from Minnesota on the one hand and Michigan on the other, it was necessary to modify some of the original figures. The "Duluth district" was entirely left out, as

being supplied from Minnesota, although West Superior is included in this item. This latter item could be segregated and added to the data given below only for the cut of 1897. Of the "St. Croix River" and "Green Bay shore" only one-half is credited to Wisconsin, and of the "Mississippi River" only one-third.

Cut of lumber (chiefly pine) in Wisconsin during the twenty-five years ending 1897.

[Expressed in million feet B. M.]

Year.	Lumber cut.	Year.	Lumber cut.	Year.	Lumber cut.
1873	1,240	1882	2,580	1891	3,010
1874	1,200	1883	2,750	1892	4,010
1875	1,250	1884	2,950	1893	3,490
1876	1,340	1885	2,710	1894	3,100
1877	1,000	1886	2,680	1895	2,800
1878	980	1887	2,890	1896	2,080
1879	1,470	1888	3,210	1897	2,430
1880	1,920	1889	3,270		
1881	2,190	1890	3,660	Total	60,210

To this must be added about 10 per cent for shingles, lath, etc., so that the total sawmill output for the period was about 66,000,000,000 feet B. M. In this amount insignificant quantities of hard woods and hemlock are included, while in earlier times, probably, a considerable amount even of pine cut is not represented, the earlier figures being less accurately ascertained.

To this enormous amount of marketable material must be added large quantities of Cedar timber, ties, poles, posts, piling, etc., also ties, piling, and construction timber of hard woods and Hemlock; ship timbers, the exploitation of which has brought special crews from Quebec and other points to these woods; large quantities of cooperage and wagon stock; many million feet of mining timbers, besides many more millions of feet of material for home use, as well as fuel and charcoal. The value of these materials, according to the State census of 1895, exceeded in that year the enormous sum of \$53,000,000 for "lumber and articles of wood" alone, and this, aside from the large quantities never recorded, and the still larger amounts used in home consumption, such as fuel, fencing, construction material, etc., which may safely be placed at \$10,000,000, amounting in the aggregate to more than one third the entire value of the products of agriculture.

In 1890, according to the very incomplete Federal census of that year, the value of the rough lumber, cooperage, and wagon stock, ties, poles, posts, piling, and all products of the wood industries as they leave the first hand, amounted to over \$40,000,000. If to this be added the value of pulp and tanning material, of mining timber, and that of the large home consumption, it brings up the total to fully \$50,000,000 for these products at first hand and shows them, like the census figures of 1895, to exceed one-third of the value of all farm products of the State. And to these farm products alone are the simple forest products comparable, for in most other industries the same often highly finished and costly article appears with little or no modification as products of several branches of the same industry. Thus, for instance, the same piece of costly wrought metal is first credited to the rolling mill, then it appears

with little change as a product of the boiler maker, and it reappears without change as part of a distilling outfit, or steam engine, thus occurring three times as a product of the iron industry, besides, perhaps, swelling the output credited to a shipbuilding establishment.

Besides possessing a value of their own, the products of the woods add to the wealth of the State by stimulating secondary manufacturing industries, supply planing and pulp mills, furniture, cooperage, and wooden ware establishments, and wagon and car shops, whose aggregate output in wooden articles amounts to over \$20,000,000.

Products of lumber and sawmills of Wisconsin (842 establishments reported.)

[From Federal census of 1890.]

Class of products.	Establishments reporting respective items.	Quantity.	Value.
Aggregate value of all products (a)	842	.....	\$51,908,767
Forest products:			
Saw logs for domestic consumption (feet, scaled measure)	137	289,226,998	2,153,154
Telegraph poles (number)	123	5,189	3,706
Fence posts (number)	155	509,453	29,454
Railway ties (number)	174	353,139	52,272
Piling (pieces)	70	13,938	20,128
Hewed timber (feet, board measure)	1	40,000	600
Round timber, for export (feet, scaled measure)	2	390,000	2,691
All other products which have not become the material of the mill	74	.....	99,352
Total			2,361,357
Lumber-mill and saw-mill products:			
Sawed lumber (feet, board measure)	657	2,812,564,872	31,873,910
Bobbin and spool stock (feet, board measure)			
Furniture stock (feet, board measure)	152	11,039,772	129,976
Carriage and wagon stock (feet, board measure)	152	4,171,461	52,436
Agricultural implement stock (feet, board measure)	127	855,632	10,936
Pickets or palings (feet, board measure)	116	32,885,699	150,818
Shingles (number)	371	1,366,022,000	2,186,643
Staves (pieces)	38	58,187,022	363,714
Headings (sets)	41	7,818,755	312,135
All other products (including receipts from custom sawing)	550	.....	3,029,103
Total			38,109,671
Planing-mill products and remanufactures	193	.....	11,437,739

^a The value of products is the net value at the mill, exclusive of expenses of selling. The cost of this item is stated under the head of "Annual expense charges," and should not be considered as a charge on the cost of manufacture.

CUSTOM SAWING, DETAILED.

	Number of establishments.	Receipts from custom work.
Establishments engaged exclusively in custom sawing	94	\$430,847
Establishments engaged partially in custom sawing	431	392,232
Total	525	823,079

SPECIAL INDUSTRIES AND BY-PRODUCTS.

	Number of estab- lish- ments.	Value of product.
Handles, chair stock, and similar turned and shaped goods	13	\$41,884
Tubs, pails, churns, packages, miscellaneous wooden ware, and veneers	9	999,738
Hoops	3	28,655
Paving blocks		
Hubs, spokes, and similar wagon stock, in shape	11	380,240
Agricultural implement stock, in shape	1	5,700
Miscellaneous	8	74,244
Estimated value of laths		550,000
Estimated value of other by-products		125,563
Total	45	2,206,024

Value of products of wood industries in the several counties of Wisconsin.

[From the State census of 1895.]

Name of county.	Lumber, shingles, and laths, manufac- tured.	Articles of wood, manufac- tured.	Wagons, carriages, and sleighs, manufac- tured.	Name of county.	Lumber, shingles, and laths, manufac- tured.	Articles of wood, manufac- tured.	Wagons, carriages, and sleighs, manufac- tured.
Total for State	34,437,000	19,234,000	5,300,000	Washburn	358,000		
Ashland	1,389,000		3,000	Wood	941,000	272,000	7,000
Barron	575,000	50,000	32,000	Total for timbered counties	24,568,000	3,612,000	386,000
Bayfield	1,714,000	8,000	1,000	Brown	1,227,000	277,000	24,000
Burnett	13,000	8,000		Eau Claire	2,170,000	230,000	12,000
Chippewa	317,000	239,000	5,000	Juneau	137,000	2,000	7,000
Clark	325,000	371,000	10,000	La Crosse	2,113,000	54,000	109,000
Douglas	744,000	1,179,000	242,000	Monroe	237,000	2,000	4,000
Dunn	1,025,000		4,000	Outagamie	83,000	260,000	14,000
Florence	10,000			Waupaca	998,000	56,000	9,000
Forest	1,018,000			Winnebago	1,082,000	3,920,000	349,000
Iron	25,000	21,000		Total for counties directly depend- ent on the Wis- consin forests	8,047,000	4,801,000	528,000
Jackson	24,000	6,000	5,000	Other parts of the State	1,822,000	10,821,000	4,386,000
Langlade	453,000	112,000	5,000				
Lincoln	2,353,000	11,000					
Marathon	2,000,000	711,000	13,000				
Marinette	3,749,000	136,000	3,000				
Oconto	746,000						
Oneida	1,481,000	302,000					
Polk	115,000	2,000	1,000				
Portage	518,000	105,000	21,000				
Price	492,000						
Pierce	135,000	32,000	22,000				
Sawyer	304,000						
Shawano	351,000	5,000	5,000				
St. Croix	702,000	41,000	1,000				
Taylor	656,000	1,000	6,000				
Vilas	2,035,000						

From this enumeration it would appear that the value of lumber and articles of wood alone produced in the timbered counties, and those directly dependent for their supplies on the forests of Wisconsin, amounts in one year (1894) to not less than \$41,000,000. To this must be added \$3,200,000 for the wood products of Sheboygan and \$4,700,000 for those of Milwaukee which are at least partially dependent on Wisconsin supplies, being in part supplied from Michigan sources, making the total value of product for the State a round \$50,000,000.

In 1890 there was invested in the saw-milling industry alone, according to the census of that year, nearly \$85,000,000, or a sum equal to

one-third of the assessed value of all land in the State, or about one-sixth of the value of all real estate, and over one-eighth of the assessed value of the entire wealth of Wisconsin. Of this \$85,000,000, over \$13,000,000 is in the milling plants and machinery, \$11,000,000 in logging equipments, logging railways, etc., including also logs on hand at the time, and over \$31,000,000 in timber land, tributary and belonging to the sawmills. These industries paid during that year nearly \$700,000 taxes, a sum equal to the total State taxes of Wisconsin; they paid over \$3,000,000 for running expenses aside from wages; about \$15,000,000 for wages and logging contracts, and over \$700,000 for the keep of animals alone.

The lumbering industry gave employment in a regular way to over 55,000 men (not women and children), besides purchasing several million dollars worth of logs. Of those employed in these operations a large per cent are settlers who through this industry alone are enabled to support themselves until their slowly growing clearings furnish sufficient harvest. It is the taxes on timber land (not waste land, however), and its industries which furnish the "road money," and it is this same fund which builds, equips, and largely maintains in the thinly settled backwoods of Wisconsin schools equal if not better than those of the country districts of any other State. It is this same industry which for years has made farming in the backwoods more profitable and the farmers more prosperous than those of some other States with milder climates and equally fertile soil. Nor is it the Pine alone which has done and is doing so much for this country; for, owing to an unnecessary and injurious competition in the exploitation of the pineries, a concentration of milling and logging operations has resulted, which in many cases has deprived the particular counties in which the pine supplies were located of much of the benefit which otherwise would have accrued to them from this resource, and it is to be expected that to counties like Langlade, Shawano, Forest, Lincoln, Taylor, and others, the standing Hemlock and hard woods will prove to be of greater value than was their former stand of pine.

FOREST, CLIMATE, AND WATER FLOW.

The beneficial influence of the woods in tempering the rigors of a cold continental climate, with its sudden changes and severe storms, is probably conceded by all. What share the forest has in the general changes of humidity is not so apparent. That a general and very gradual change from a moister to a drier condition has been going on for a long time over the entire Lake region seems quite certain. The behavior of Hemlock and even of White Pine in the matter of distribution is probably in part due to this change. How much the forests have done to retard the progress of this desiccation can only be inferred. On the other hand, the striking changes in the drainage conditions which have required but a short time, have taken place within the memory of many

of the residents, which have fairly forced themselves on the attention of all experienced and observing people, are all too intimately connected with the changes in the surface cover to leave in doubt the influence of this latter on the former.

The flow of all the larger rivers has changed during the last forty years; navigation has been abandoned on the Wisconsin, logging and rafting has become more difficult on all rivers, and, what is even a far better measure of these important changes, the Fox River is failing to furnish the power which it formerly supplied in abundance. Similar observations have been made on all smaller streams. The "June freshet," which in former years could be relied upon in driving operations, has ceased on most streams and is uncertain on the rest of them. Of the hundreds of miles of corduroy road a goodly per cent has fallen into disuse, the ground on the sides has become dry enough for teams, many swamps of former years are dry, and hundreds of others have been converted into hay meadows and fields without a foot of ditching. Tamarack stood on parts of the present site of Superior, and both Cedar and Tamarack were mixed through the forests in many places where the mere clearing has sufficed to dry the land for the plow. Many of the smaller swamps are changed before actual clearing takes place. Where the fires, following the logging operations, have cleaned out the swamp thicket, Aspen has followed the fire exactly as in the upland, and although in some cases many years have elapsed, the places have not reverted to swamp timber—the ground is too dry; the hardwood thickets have come to stay. These things are well known, especially to the woodsmen of the region; they are in all cases ascribed to the removal of timber, and there is probably no locality in the world where this subject could better be studied than in north Wisconsin. A drive with some old resident through the settled parts of Shawano, Marathon, Taylor, and other counties, and the rehearsal of his memories, present matters of the utmost interest in this connection, which will hardly fail to convince even the most skeptical of the decided changes in drainage and soil moisture which have occurred here and are still in progress.

THE OUTLOOK FOR THE FUTURE.

It is impossible to foretell how long the Pine is likely to last. As stumpage increases in price and the opportunity to buy it decreases, one mill after another drops out. Half the mills of twenty years ago are no longer in existence, not because they failed to pay, but because their Pine supplies gave out, and this same condition will continue. The output, already on the decline, will grow smaller, and the exploitation of the 17,000,000,000 feet of standing timber is likely to be drawn out over a period far greater than would seem possible with the present rate of cutting. Nevertheless, the experience in parts of Michigan, and also of Wood, Portage, and other counties in Wisconsin, indicates that

cutting will go on without regard to the end, its rate depending merely on considerations of market conditions and facilities for handling timber, so that the end of the greater part of Pine lumbering is likely to be quite sudden and its effect correspondingly severe.

The cut of Hemlock, though still small, may at any time take on considerable dimensions. There are several good reasons which make this desirable. The wood is much better than is commonly assumed, and it is mere prejudice—and more prejudice of the carpenter than the consumer—which prefers poor Pine to good Hemlock. For some time the old Hemlock has been dying out quite rapidly in most parts of this area; this process will certainly continue, and unless the old stands are cut much valuable material will be lost.

Hard-wood lumbering will continue for a long time, though probably at a very variable pace. As things are now, the present cut of 400 to 500 million feet per year can be continued for more than fifty years, unless settlement and consequent clearing should progress at a very unusual pace.

The outlook for the forest itself has been indicated in the preceding. The hard-wood forest is being reduced by logging and clearing, the pineries are disappearing, and fires assist in both, besides burning out the swamps.

As pointed out, both White and Red (Norway) Pine are perfectly capable not only of continuing as forests, but of reclothing the old slashings, but are generally prevented from doing so by fire.

The Hemlock is in a process of natural degeneration, and even the hard woods, though thrifty while intact as forests, seem to fail on most cut-over lands wherever fire has run. Thus about 60 per cent of the cut-over and burned-over lands are to-day devoid of any valuable growing timber, producing only firewood at best, and the other 40 per cent of the 8,000,000 acres of cut-over lands are entirely bare. And this unproductive area is rapidly increasing in extent under present methods.

Assuming that 100 feet B. M. could be grown as the possible annual increment per acre on lands entirely without care, save the protection against fire, the State of Wisconsin loses by this condition of affairs annually 800,000,000 feet B. M. of a marketable and much needed material. This loss is primarily a communal loss, a damage to county and State, for the individual owner does not suffer; the land is bought for the timber, and when this is cut the land is only held if it appears that a low tax assessment and opportunities to sell, etc., will promise more profit in holding than in abandoning it.

FORESTRY OR AGRICULTURE.

The argument is advanced that this land is needed for agricultural purposes; that all of it will soon be settled, since even on the poor sand lands improved methods and potato crops have proved a success. While this statement is certainly true of all good clay or loam lands, it

applies but doubtfully to over half and certainly not at all to nearly 40 per cent of this area. How long it takes to improve a territory, how much unproductive waste remains even in the older so-called "well-settled" counties, appears from the following concrete cases:

Of old Sauk County not one-half is improved land; the five counties of Adams, Waushara, Juneau, Marquette, and Monroe, with an aggregate area of over 2,000,000 acres of uncommonly level land, have 30 per cent improved land, or over 1,500,000 acres of waste and brush land, most of which is not even serving the purpose of pasture. Adams, Marquette, and Waushara counties, with their 800,000 acres of waste land, instead of having for sale 80,000,000 feet of pine which might be growing every year on its nonproductive area, supported in 1895 a wood industry whose product amounted to the pitiful sum of \$13,000, and probably the material for this was imported.

Even where the land is good and might all be farmed, it is doubtful whether the forest can entirely be dispensed with. Experience in older countries and in the Eastern States is against it; the farmers of the fertile prairies are planting trees, for the sake of the wood, on land of unexcelled fertility. Some of the farmers of Trempealeau and other counties, who have to go 20 and more miles into the Jack-Pine groves for their fuel, find that wood is both indispensable and too bulky to haul far; and, valuable as pasture land is to the thrifty farmer of southern Wisconsin, the great importance of a convenient wood supply has led to an actual increase in wooded area in most of the southern counties of the State.

How soon the 17,000,000 acres of wild land of north Wisconsin will be settled no one can tell; the likelihood is that over 10,000,000 acres, comprising much of the best land, will still remain either woods or unproductive brush land for fifty years to come. The advantage to a county and to the State of having poor, unproductive sand lands settled by poor and ignorant people who support farms "without barns" can not here be discussed. Neither is it here contemplated to enter into the question of communal property, i. e., whether it might not be well for a county, which can get land for the mere taking, to hold a few townships in county forest and have these county forests at least defray the county expenses and give work to many people. Even if the counties can not, certainly the State can afford to acquire and hold for the future all cut-over lands. Such communal properties have been the mainstays of European States in all financial crises, and have been eagerly sought and guarded by all European governments as well as by towns, counties, and cities. With a county holding 100,000 acres of good forest land every citizen becomes part owner; his farm, his store, or shop is valued in proportion as it shares these advantages, and, instead of hindering the development of a county, as is so often claimed, such a forest property would stimulate immigration and help to develop, both directly and indirectly, all the resources of the county.

RECOVERY AND PREVENTION OF WASTE.

What can be done to save the enormous loss to the State is clear. The land must be restocked and the young timber must be given a chance to grow on all lands which are essentially forest soil and not desirable for agriculture.

FOREST FIRES.

What the fire has done to the Pine supply is apparent from the conservative figures of the original stand of Pine. Besides this injury to Pine, the fire has killed more than 5,000,000,000 feet of Hemlock, at least 1,000,000,000 feet of Cedar, and several billions of hardwoods, besides large quantities of Tamarack, and, in addition, stands of young and sapling Pine (under 8-inch diameter) covering many thousand acres, which to-day would furnish 5,000,000,000 or more feet of merchantable material. The same work of destruction continues; this very fall (1897) many hundreds of acres of young sapling Pine were ruined by fire, and it will be many years before the opening of settlements and roads suffices to permanently suppress the fire fiend. From this it is clear, and the fact is fully conceded by all persons conversant with the conditions of these woods, that the first and most important step in the prevention of further destruction of the forests consists in the organization of an efficient fire police.

That a diversity of opinion should exist on this subject is but natural. To most people the entire subject is foreign, the problem too large. To many even well-informed and experienced men the forest fire is an enormous affair, a calamity which man is entirely unable successfully to combat. Nevertheless, the best-informed men, nearly all woodsmen ("cruisers" and loggers), whose opinion was sought in this connection, expressed themselves in favor of such a police and felt certain of good results. In considering this important subject it may be of interest to point out a few fundamental facts which may help to shape a policy:

(1) All fires have a small beginning. The Peshtigo fire, by far the most terrific ever experienced in Wisconsin, was known to be burning and gaining headway for fully two weeks before it broke out in the final and then perfectly unmanageable form. The Phillips fire was heard and the smoke seen and felt in town for days before it reached the village and converted it into ruins.

(2) All fires stop of their own accord after they have run for a moderate distance, evidently finding obstacles which gradually reduce their power. The Peshtigo fire did not involve the fourth part of Marinette; the Phillips fire not a fourth of Price, and a most intense fire in northern Chippewa, which, when at its best, sent firebrands across a lake over half a mile wide, did not keep on running, but stopped without going much, if any, beyond the county line.

(3) The majority of fires are small fires. When the "whole country is on fire," it is not one fire but hundreds of separate fires, all or nearly all of which have had their origin in carelessness.

(4) It is carelessness and not malice, and it is more carelessness of letting fires go than of starting them which has resulted in the enormous losses.

(5) Forest fires are diminishing in number as settlement progresses; every road, every clearing helps to supply barriers, increases the number watching and fighting fires, and assists in the doing of it.

(6) Forest fires are both prevented and fought in the wild forests of India and in all parts of Europe; in localities where hundreds of acres of the young sapling Pine, with their fine largely dead and dried up branches (along the lower part of the stem), stand so thick that it is difficult to pass, and where, in addition, poverty and chagrin among a dense population living close to the confines of the woods furnishes willful and malicious incendiaries.

To the opponents of police organization it may also be pointed out that for this country experience is as yet almost entirely wanting. In New York and in Maine and in Canada the fire police have rendered valuable service, but it is impossible for anyone to say at present just how successful will be the fire police of north Wisconsin. Even the meager efforts which have of late been attempted to educate, remind, and warn people in matters of forest fires have already produced good results. The State sends out through its land office, practically without expense, placards, which have been extensively and judiciously placed and the people read them and mind them. In this connection it is to be regretted that the attempts which have been made, especially by the Menominee River lumbermen, to introduce the burning over of the "works" or choppings throughout the woods, have not found favor and have been abandoned. This practice, experience shows, costs only 3 to 5 cents per 1,000 feet of logs and would practically put an end to the regular slashing fires. In the light of past experience it is clear to all that not only 5 cents but even 50 cents per 1,000 feet could profitably have been devoted to the suppression of fire.

CHANGES ON CUT-OVER LANDS.

The condition and character of the aftergrowth on cut-over lands is quite variable, since, according to original condition and subsequent treatment, changes occur in the plant cover as well as in soil conditions. These conditions and changes have a bearing on the question of the future of these lands, whether they be left alone or be restocked with timber, so that it appears desirable to give a description at least of the more frequent types.

SANDY PINERY LANDS.

(1) When a clean, dense stand of mature pine timber is cut, and the fire gets into the slashing late the following summer, after all the limbs and tops on the ground have had a chance to dry, the ground is fairly cleared by the fire, the bulk of the tops are burned, and a "stump

prairie" remains. On the poor sandy soil, with the small humus cover destroyed, there comes first a crop of fire weeds, then Aspen and Sweet Fern with other weeds, and then some grass and isolated bushy Scrub Oaks (often some Willows) cover the ground sparsely. As soon as enough dry leaves and other material have accumulated the fire recurs and the small Aspen and other growth is killed. By this time the ground is much reduced in fertility, Aspen is slower to return, and the ground is largely taken by weeds and grass. A few repetitions of fire change the ground sufficiently to prevent the further growth of Aspen for years, and there are many areas where this tree has given up all effort to restock the land.

This type seems to be the common form of slashing in heavy pine. Such areas furnish little forage for live stock; they are naturally poor, and this condition is much aggravated by repeated fires and exposure to wind and sun. To an attempt at restocking with timber they offer no obstacle save their poverty, which would soon be changed by growing timber.

If the fire is not repeated in such a slashing the Aspen forms dense thickets, in which Pine, Birch, and Maple gradually find suitable conditions for their growth. For years the detrimental effect of the fire is visible in the stunted growth of the young trees. Aspen, which in the original forest grow often several feet a year in height, remain short runs, and it is not until ten and more years of rest from fire have permitted the accumulated litter to improve the soil that a more vigorous growth becomes apparent. Tracts of this kind occur in every county, but they form only a small per cent of the total area of cut-over lands. They are troublesome to clear after the thickets once have attained considerable height, and they do not furnish good pasture. To continue them as woodlands they require merely protection from fire, and for their improvement Pine should be supplied either as seed or plants wherever it is wanting.

(2) Where the old stand of Pine was broken and a considerable mixture of small Pine and hard woods existed there remains after the first fire a large amount of scorched and charred standing dead and dying material. In this, as in the following form of cut-over pinery lands, young growth readily succeeds, provided fires are not repeated. But this happy accident does not generally occur; the great quantity of dead material, most of which does not fall during any one year, keeps the ground furnished for several years with débris, and thus invites the the return of fires, which continue to come until the ground is largely cleared. The area now resembles the case first considered; it is a stump prairie, usually not as clean, and here, too, the return of tree growth is very slow and often for years discouraged altogether.

(3) Where groves of sapling Pine have been culled of their larger timber and are then fired, the greater part of the remaining growth is injured and much of it is killed. These injured groves are generally

of little promise in themselves; their growth is hampered and their scorched butts doomed to decay; but they are valuable in so far as they readily restock the ground with young timber, providing it is not killed by fire. If fires occur, which is generally the case, the entire grove is gradually burned and killed, or if the fire gets in during a very dry season and attains considerable proportions the entire grove is changed at once into a tangle of scorched and charred poles, which require for their improvement either a great amount of labor and expense or else the starting of more fires to first get rid of the débris. Where fire runs through slashings (in large timber) too early in the season, and when the ground is still wet, and also where no fire occurs for several years after logging, so that the leaves have become litter and the small twigs are decayed, then the slashings, even of wasteful operations where large amounts of heavy tops and much dead and down material exists, are often not burned clean, the ground being strewn with scorched logs and tops, and many cases exist where settlers are logging to-day on old slashings of this kind, although not a living Pine occurs.

It is but natural that these several forms grade into each other, and that nearly every slashing, especially during the first few years, markedly changes its complexion. In general the bare land form predominates in all pinery areas and occupies to-day probably about 40 per cent of the cut-over lands.

LOAM AND CLAY LANDS.

(4) A greater admixture of hard woods, due to the presence of more clay in the soil, materially affects the condition and appearance of the cut-over land. Where Pine was predominant and the hard woods scant, as on the red clays about Lake Superior and on the poorer gravelly loam, the removal of the heavy stand of Pine commonly involves almost a total destruction of the hard woods, just as in the case of the regular pinery; the ground is soon cleared by a repetition of fires, the aspen ceases to return, but, unlike the sands, these loam lands soon produce a fair amount of grass and the land is converted into pasture.

(5) Where the hard wood is heavier, and especially where Hemlock enters into the composition of the forest, the dead timber remains standing for years, a forest of dead trees, and often 400 to 800 cords of timber per acre may be seen after repeated, and often severe, fires have swept over the ground. Such areas are not rare; the fires of 1894 created quite a number. They are undesirable pasture lands, difficult to clear, and still largely too good to be restocked with timber, which in such places would require considerable labor and expense.

(6) Where the heavy hard woods and Hemlock predominate and the Pine is a mere scattered admixture, the ground and litter is usually damp. Fires run only during exceptionally dry seasons (as in 1894). The removal of the Pine is not followed by fire. It leaves the lands densely

timbered, so that they hardly seem to deserve the appellation of cut-over lands. Nevertheless, even in these forests fires have run, never far, to be sure, but still strips 5 miles and more in length are seen, where the fire has left a dense, heavy cover of dead and dying, scorched and charred trees of all kinds. Fortunately these tracts are not very numerous. Their only hope lies in clearing them for farm purposes, for which nearly all of this heavier land is eminently well suited.

RESTOCKING.

What may be done to restock the land will vary from place to place, according as the land is well under way to reclothe itself, or is a bare waste, or is a tangle of *débris*, or covered with worthless thickets of fire-damaged woods. The restocking may be done at once or by piecemeal. It may be done thoroughly or roughly. It may assist nature to a small or large degree. Where scattered saplings and defective trees have been left in logging and have survived the fires, they continue to seed the ground. About each of them a little crop of seedlings springs up after good seed years (every three to five years), and if protected these grow; and in about twenty years, by the time the mother trees are gone, they bear seed themselves, and then the process of restocking really begins. Thus, much valuable time is lost, and the ground remains exposed too long to wind and sun, and is thereby reduced in its fertility.

In many districts seed trees are wanting; repeated fires have killed both mother tree and seedlings, and nature must be assisted if anything is to be accomplished in reasonable time. In most sandy pinery lands where the fires have made a clean sweep the work does not require much preparation, and a very cheap beginning can be made by planting a much smaller number (say 500 per acre) than is really needed to make a satisfactory stand. These plants, together with the Poplar, Birch, and other brush, soon make a cover for the ground, the young Pine rapidly grows into marketable wood, and at the age of twenty and less it begins to shed an abundance of seed, so that before the first trees are ready to cut every foot of ground would be covered by a promising pine thicket.

Where the ground is covered with large quantities of dead and down timber, and especially where dense thickets of fire-killed brushwood offer serious obstacles to any silvicultural processes, fire may have to be resorted to as a cheap and rapid means of clearing. The outlay for all work of this kind need be made but once; the forest once established will be permanent, and by judicious logging and adequate protection against fire it will renew itself indefinitely.

Of equal and perhaps greater importance than the choice of proper methods will be the selection of the proper trees to plant. Among the native growth the pines are preferable to the hard woods, and the White Pine is foremost in this as in every other respect. Nevertheless, Red (Norway) Pine and even Jack Pine will prove of great value and

may often have to be resorted to. The value of these pines lies not only in their frugality, their adaptability to poor soils—soils that are really unfit for farming—but also in their gregarious habit, since they thrive in great numbers together and thus facilitate exploitation, and also in their capacity of developing a large number on a small area, which, together with the great length of their trunk, produces large yields; and, finally, in the character of their wood, which will at all times insure for their product an almost unlimited market.

The White Pine will thrive on 90 per cent of all sandy areas of north Wisconsin and on all loam and clay lands; it grows fast and in very dense stands; is useful for pulp at 30 years of age, for box boards at 50, and makes lumber at 80 to 100 years. According to the experience in Massachusetts and New Hampshire, groves 60 years old cut over 30,000 feet shook boards per acre, and furnish trees 12 to 20 inches in diameter and over 70 feet in height. These New England groves, which have largely sprung up on old abandoned farm lands and are generally without any particular management, are reported to furnish in the aggregate from 30,000,000 to 50,000,000 feet per year.

Red (Norway) Pine is even more frugal than White Pine, and there is no sandy area in northern Wisconsin which this tree can not be made to cover with an abundant growth of fine timber. The Jack Pine is the most frugal tree of all, and, though of small stature and short-lived in Wisconsin, will prove a valuable aid in connection with the other pines and especially as nurse tree on the poorest sands.

To encourage the hard woods will not be necessary, except in some localities. Wherever abundant now they are growing well, and are likely to be continued in the wood lot of the farmer on all clay and loam soils. It may safely be predicted that the hard woods in the better hard-wood counties will be abundant for many years. The hard woods do not thrive on most of the land here considered "forest land." They refuse to grow on the sands, yield light, cut wastefully, and furnish a product which, however valuable intrinsically, will for a long time have to contend with a limited and exacting market.

To those who are astonished at the mere idea of planting forests and who scorn European methods as impracticable in this country it may be of interest to know that in Saxony, where the most intensive kind of forestry is carried on, an area of 400,000 acres, or about two-thirds as large as Lincoln County, brings the State a net income of nearly \$2,000,000, furnishes regularly every year to consumers about 20,000,000 cubic feet of wood, so that pulp mills and sawmills have long become permanent institutions, and that in this State, where forests are largely planted with nursery stock, the silvicultural work of planting, sowing, etc., all told, amounts, on an average for the entire woods, to 10 cents per acre per year, and involves only 6 per cent of the total expenses, which in this case include all logging operations.

Whether all these efforts will pay as long as the land is held by

private owners, whose fortunes are only of to-day and whose heirs will prefer to parcel the land out to inexperienced settlers, can not here be considered. The experience abroad and also in this country indicates that the State must at least undertake the care of the most difficult and unprofitable parts, and that the greatest good to the greatest number lies in State ownership of forests. New York waited a long time to see private owners manage rationally in its woods, but has been compelled at last to buy the land and to establish a forest organization to keep its mountains from being converted into desert brush lands and its streams from being alternately dry branches and mud torrents. A similar movement in Wisconsin would at present be greatly facilitated by the present conditions of ownership. The land is still held in large bodies and by men actively engaged in a business quite distinct from speculation and dealing in real estate, and therefore a transfer could be effected in most cases very easily and at prices (25 to 50 cents per acre) which would seem to guarantee financial success to forestry even in the backwoods of Wisconsin.

FOREST CONDITIONS IN THE SEVERAL COUNTIES.

Ashland County.—The northern one-fifth of the county was formerly a pinery on red clay soil with a thin sprinkling of inferior hard woods, some Hemlock, and occasionally Cedar and even Tamarack on the more level areas. To the south a mixed forest of hard woods, Hemlock, and Pine on gray loam and clay lands stocked both slopes of the range as well as nearly all parts south of the range. In places, especially along streams, Pine was predominant, which was also the case on the small sandy tract along the Flambeau in the southeast corner of the county. The Pine timber along the lake, except that of the Indian reservation, is cut and the Pine has been culled from most of the mixed forest and is estimated, all told, at only 300,000,000 feet. Small patches about the mines have been cut clean of all timber. Generally the hard woods and Hemlock are uncultured, and, with a yield of 4,000 feet per acre, amount to about 700,000,000 feet of Hemlock and 900,000,000 feet of hard woods, of which Birch and Basswood form fully 60 per cent, while Oak is hardly of economic importance. Fires have injured Ashland only in the pinery along the lake, and thus even the swamps are fairly well stocked with Cedar, Tamarack, and some Spruce.

Barron County.—The northern one-third, a gray loam and gravel land, was originally stocked with a mixed forest of Pine and hard woods, the Pine prevailing, except on the ridges of the northwestern part of the county. In the central part, on a variable sandy loam, there was a pinery with a thin mixture of hard woods and occasional better hardwood bodies (see "Soo" Line from Cameron west). The southeastern one-fifth of the county, widest along the east line, was sandy, Jack Pine and Oak openings. The Pine is cut, except in the northern and northeastern towns; the hard woods are culled and in nearly all parts

of the county damaged by fire. The standing Pine is in isolated bodies and is estimated at 150,000,000 feet. The scattering bodies of better hard woods are believed to represent a stand of about 250,000,000 feet, in which Oak, Basswood, Birch, and Maple enter in nearly equal proportions. The few swamps of this county are reported bare of merchantable timber in larger quantities. Large tracts of cut-over and burned land occur in nearly all parts.

Bayfield County.—A belt of red clay, 6 to 10 miles wide, skirting the lake, is pinery with a light mixture of scrubby hard woods and some Hemlock. The southeastern one-third, occupied by the basins of the Nemakagon and White rivers, is a mixed forest of Pine, hard woods, and Hemlock on a gravelly gray loam; and the central and western part, a broad belt extending from T. 50, R. 5 W., southwest into Douglas County is a sandy Jack Pine and Norway pinery, with considerable White Pine in places. The timber along the lake, except that of the Red Cliff Reserve, is generally cut; it is also heavily cut into on White and Nemakagon rivers and along the Northern Pacific Railway. The present stand of pine is about 3,000,000,000 feet, of which a large part falls to the regular pinery lands. In addition there are about 400,000,000 feet of Hemlock and an equal amount of hard woods, most of which is Birch, Basswood, and Maple; the Oak, though abundant as scrub wood, being scarcely represented as real timber tree.

On some of the "barrens" or Jack Pine and bare sandy lands no timber existed when logging began, but there is evidence that in former times they, too, were covered by a forest of larger timber.

The numerous swamps of the southeastern part of this county are fairly well stocked with both Cedar and Tamarack, and also some Spruce. The swamps of the estuaries along the lake are generally covered by heavy growth of Cedar. Bare wastes of great extent occur in all localities, where Pine logging has been going on.

Burnett County.—Nearly the entire county is a sandy Jack Pine and Norway pinery, dotted with regular "barrens" and island patches of better loam lands. In the northwest corner, north of the St. Croix River, is a tract of gray loam lands, which was stocked originally with Pine lightly mixed with hard woods. Along the south line of the county extends a body of loam lands, covered in part by heavy and almost pure stands of hard woods, only the sandy depressions bearing Pine. The Pine in this county is largely cut; the little hard wood has been damaged by fire, and Jack Pine only occurs in extensive woods. The scattering Pine is estimated at about 200,000,000 feet, and about 200,000,000 feet of hard woods are believed to occur in this county, besides some 300,000,000 feet of Jack Pine, which sooner or later must become valuable. The swamps are largely bare or else covered by a light growth of Tamarack. A large part of this county is positively bare land, being devoid of any forest cover.

Chippewa County.—The southwestern and south central one-fifth of

the county is Oak openings and prairie (extensively settled) in its western, and Jack Pine woods in its eastern part; the remaining four-fifths of the county are forest. Of this, the part east of the Chippewa River and small tracts along the river on the west side are covered by a mixed forest, in which Hemlock and Birch are abundant, except on the southeastern part of the county, where the Birch and Hemlock forest merges into an Oak forest. In the timbered part of the county west of the river the Hemlock is missing and Birch is much less common. Though the Pine has been cut in all parts of this large county, there is still a considerable amount scattered and in isolated bodies, which is estimated at about 500,000,000 feet. The hard woods have been cut into in the southeastern and also in the northwestern part, and large tracts have suffered heavily from the fires of the large Pine slashings following all the streams; the Hemlock has been cut but little, but, like the hard woods, has been damaged by fire. The standing hard wood and Hemlock yield about 5,000 feet per acre, the yield in the pure hard woods of the western part being lighter. About 800,000,000 feet of Hemlock and about 1,100,000,000 feet of hard woods are believed to exist in this county. In the hard woods in the western and also the southeastern woods the Oak is predominant, but on the whole forms little over 10 per cent, while Basswood and Birch constitute over half the total supply.

The swamps, extensive only in the northeastern part of the county, have been much run over by fires and are, therefore, very poorly stocked. Large areas of burned-over wastes occur along all the streams.

Clark County.—The greater part is a level loam land area, which was formerly covered by a forest of hard woods mixed with a remarkably heavy stand of large White Pine. Hemlock occurs only in the northeastern portion. The western and southern part is invaded by the sandy area covering Jackson and Eau Claire counties, and was formerly covered by a pine forest without hard woods. The pine has nearly all been cut and was sawed at La Crosse and Eau Claire, and only about 200,000,000 feet are believed to be still standing. The hard woods are culled especially for Oak, and have suffered from fires. The remaining supply is estimated at only about 650,000,000 feet, of which Oak is still nearly 30 per cent, the remainder being chiefly Basswood and Elm. Clark has few swamps, and these are poorly stocked.

The greater part of the country to-day is still covered by culled hard woods; much of it is settled and only the sandy pinery presents tracts of bare waste many miles in extent.

Douglas County.—The northern one-third of this county is red clay land with pinery, in which is found an unusual mixture, for this State, of Pine (chiefly White Pine), White and Yellow Birch, and other hard woods, generally with more or less Cedar and Tamarack. South of this and extending south to the St. Croix and east to the Brule is a similar forest of pines with a somewhat heavier mixture of hard woods, heaviest

on the range, growing on gray loam land. The southeastern part, south and east of the St. Croix, is a sandy Jack Pine and Norway pinery with large Jack Pine woods following the river into Burnett. The pine has been cut along the lake and also along the St. Croix and the railways, but there is still a great deal of standing timber in large and small bodies, estimated to cut about 3,500,000,000 feet. The hard woods have been little invaded, but, forming here only a secondary mixture, are largely killed by fire when the pine slashings are burned, as is well illustrated by the country about and south of Superior. On Maple Ridge considerable hard wood is cut, and, strange enough, Oak forms often as much as 25 per cent of the yield. Scattering as they are, the hard woods are still believed to cut about 700,000,000 feet.

Dunn County.—Of the sandy east half the northern portion is Jack Pine woods and openings, the rest Oak openings with real prairies. On the western half the clay and loam land ridges were once covered with almost pure hard woods, and the more sandy valleys were stocked with a mixed growth of large pine and hard woods, the former often prevailing. The woods on Hay River partook of the regular pinery form and merged into the Jack Pine woods of the northeastern towns. The Pine is practically all cut, though the scattering patches still amount to several million feet. The hard woods are much interrupted by clearings, many tracts have been culled and even cut clean. The isolated tracts of hard wood, with a yield of about 4,000 feet per acre, are estimated to cut 400,000,000 feet, of which Oak is 25 per cent and Basswood and Maple form 50 per cent. The few swamps are generally bare of merchantable material. Large areas of bare waste land occur in the Jack Pine district and may be seen along the railway between Wheeler and Summit. Many groves of fine young White Pine are fast growing into timber about Menominee.

Florence County.—The greater part of this county was a mixed forest of Pine, hard woods, and Hemlock on a gray loam, with smaller tracts of regular pine land, especially along the streams, and a larger tract in the northeastern part, where even Jack Pine woods covered considerable ground. At present the Pine is largely cut, and only about 150,000,000 feet are believed to now exist in this county. The hard woods and Hemlock have not been cut, except small patches about the towns, but they have been injured in places by fire. With 4,000 feet per acre of both hard woods and Hemlock, the cut of the latter is about 300,000,000 feet and that of the former about 400,000,000 feet, of which Basswood, Birch, and Maple form 75 per cent, while Oak scarcely occurs. The swamps are generally covered and swell the entire cut of timber by over 100,000,000 feet. Burned areas occur in every town of the county and, as in others, form a far greater proportion (here 20 per cent) of the entire land surface than is usually supposed.

Forest County.—The northwest quarter of the county is largely a flat, swampy pinery; the rest is a hard wood, Pine, and Hemlock mixed

forest, generally on gravelly, gray loam. This mixed forest is interrupted and dotted with numerous bodies of pine lands, where the Hemlock and hard wood almost disappear. The pine is mostly cut; about 500,000,000 feet B. M. are still claimed as standing. The hard woods and Hemlock are unculled and but little hurt by fires, except about the pine slashings. With 4,000 feet per acre of well-stocked woods, there are about 500,000,000 feet B. M. of Hemlock and 1,000,000,000 feet of hard woods, of which Birch and Basswood form about 60 per cent. As in the neighboring counties, a little Red Oak occurs in Forest County, but it is thinly scattered over the entire county and would hardly form more than 2 per cent of the cut. Many of the swamps are open bogs, the rest are generally stocked, and the swamp timbers, Cedar, Tamarack, and Spruce amount to fully 300,000,000 feet. Nearly all pine slashings are burned bare, so that a considerable amount of waste land occurs.

Iron County.—The southern one-fourth is a flat loamy-sand pinery of the same nature and continuous with that of Vilas and the northeast corner of Price County. The rest is a loam and clay land area with a mixed forest of hard woods, Pine, and Hemlock. On the range the hard woods and Hemlock predominated and Pine was scattering; otherwise the Pine formed a heavy mixture everywhere. The numerous swamps, especially abundant in the southern half of the county, are generally stocked with Cedar, Tamarack, and some Spruce, and these woods also invade more or less the low, flat portions of the ordinary woods, which are not really swamp. At present the Pine is cut from parts of all townships, some of them being pretty well cleaned out, and the standing pine timber is estimated at only about 400,000,000 feet. The hard woods and Hemlock have been cut clean on a small area about the mines, but otherwise remain unculled and not badly hurt by fire. The standing Hemlock is estimated at about 350,000,000 feet, and the hard woods at about the same. Of these, Birch, Basswood, and Maple predominate.

Jackson County.—The western half is a sandy loam district almost entirely occupied by oak openings mixed on some tracts of heavier soil with bodies of better hard-wood timber. The eastern half is a level, sandy pinery, with many swamps and no hard-wood timber. This area furnished considerable Pine, but is now largely cut and burned over, and only about 100,000,000 feet of Pine is claimed to be standing. Numerous small and large bodies of young sapling Pine and also of Jack Pine interrupt the extensive bare wastes. The swamps, which are generally bare of merchantable material, were formerly stocked chiefly with Tamarack, but have been cleaned out by repeated fires.

Langlade County.—This county is covered by a continuous mixed forest of hard woods and Hemlock, in which Pine occurred both scattered and in denser bodies in patches and belts, which, unlike those of Marathon, do not always follow drainage courses. The Pine is prac-

tically cut, though the scattered material is still estimated at about 150,000,000 feet. The hard woods are dense and heavy; their cutting has hardly begun, and fire has injured but little, nor is it likely to do so in the future. The standing Hemlock amounts to about 1,000,000,000 feet, the hard woods to 1,100,000,000 feet, of which Birch, Basswood, and Elm in nearly equal proportions form about 80 per cent, followed by Maple and Ash and a very small quantity of Oak. The swamps are generally stocked with Cedar, Tamarack, and some Spruce. Larger bare areas occur along the Wolf and involve in all parts only the pine slashings.

Lincoln County.—A mixed forest of hard woods, Hemlock, and Pine covers the clay and loam lands, or about 80 per cent of this county. A small strip along the Wisconsin River, and a broad V-shaped tract spreading northward from below the junction of Tomahawk and Wisconsin, are sandy pinery. The pine is generally cut, only about 100,000,000 feet being in larger bodies, but there is a great deal of scattered pine which will bring up the total cut to at least 250,000,000 feet. The hard woods are as yet unculled, have suffered little injury from fire, and with the Hemlock will cut 6,000 feet per acre of all well-stocked land. This means a total cut of about 1,000,000,000 feet of Hemlock and an equal amount of hard woods, in which Birch, Basswood, and Elm represent about 70 per cent and Oak only about 3 to 5 per cent. The swamps are largely stocked with both Cedar and Tamarack and a little Spruce, but many of them have been burned into or were entirely cleaned out. Cut-over, burned, or bare lands exist wherever Pine was dense, and in the aggregate amount to many thousand acres of the very kind of land least desirable for farming.

Marathon County.—Except the narrow border along the larger streams where Pine prevailed, this county was a continuous mixed forest of Pine, hard woods, and Hemlock. The Pine is nearly all cut; the present stand is estimated at about 200,000,000 feet, of which considerable is thinly scattered through parts of the mixed forest. The forest of hard woods and Hemlock has been heavily cut into for more than ten years. It is interrupted by large clearings, but has not been injured much by fire. The standing Hemlock is estimated at about 1,500,000,000 feet, the hard woods cutting about the same. Of the latter, Birch and Basswood in nearly equal amounts form 60 per cent, Elm 20 per cent, and Oak only about 5 per cent.

Marathon has little swamp; most Pine slashings have been burned over and, since so much good land exists all around, they are generally wastes. Many groves of young White and Norway Pine may be seen along the Wisconsin River. Though well settled and stocked with hard woods which do not encourage fires, even this county in the dry season of 1894 suffered considerably from fires, which emphasizes the need of organization for their prevention.

Marinette County.—The greater part of this county is a pinery. Its

territory is slightly invaded by the mixed forest of Florence and Forest counties along the county line. Isolated bodies of Pine, lightly mixed with hard wood and Hemlock, are scattered in parts of the pinery, particularly the towns along the Menominee River. Formerly a heavy stand of Pine mixed with hard woods occupied the part next to Green Bay. The latter area was burned over during the Peshtigo fire of 1871, and is now bare or brush land with some settlement. Pine has been cut in every town in the county; the present stand is estimated at about 1,500,000,000 feet. The light mixture of hard wood and Hemlock is largely fire-killed wherever the Pine has been cut; the green timber remaining is estimated at nearly 500,000,000 feet, half of which is Hemlock. Of the hard woods, Maple, Birch, and Basswood predominate; Oak, as timber, being very scarce. In the brush land along the bay the young growth of White Cedar is disputing the ground with Poplar and White Birch. Extensive tracts of Jack Pine occur in the central and southwestern parts. Large burned over wastes exist in all parts of the county.

Oconto County.—Over half of this county next to the bay, which is a tract of variable sandy loam land, was covered by a heavy forest of Pine, mixed with Hemlock and hard woods. The central part of the county is a sandy belt of pinery land, continuous with the sandy pinery of Marinette and Shawano counties. The loam and clay lands of the northern one fourth was originally stocked with a heavy mixed forest of hard woods and Hemlock, with Pine either scattering or in small bodies. At present the lower part of the county is cut over, much of it bare, and a large part settled. The Pine is cut in nearly all parts of the county, and only 65,000,000 to 75,000,000 feet are claimed to be standing. The hard-wood forest, in which the Beech is conspicuous only on the lower sandy loam lands, still covers a quarter of the county, and is estimated to cut about 500,000,000 feet of Hemlock and 400,000,000 feet of hard woods, principally Birch, Basswood, Elm, and Maple, considerable Ash and little Oak. The swamps of the lower part are burned over and extensively drained and utilized. Those of the north half are generally stocked, the Cedar prevailing. Fine groves of young White Pine are abundant in the southern towns.

Oneida County.—Almost the entire county is a loamy sand pinery in which good hard woods and Hemlock are practically wanting. A few isolated island-like bodies of mixed forest on heavier soil, a small tract in the southwestern, and larger ones in the southeastern part of the county, disturb the general uniformity. The Pine has been cut along nearly all streams and railways, while the remaining timber occurs in interrupted stands, and is estimated at 1,200,000,000 feet, of which a considerable part is Red (Norway) Pine. Of about 60,000,000 feet of hard-woods, 40,000,000 feet are Birch and Basswood, the rest being Elm and Maple, and very little Oak. The Hemlock is believed to cut about 20,000,000 feet and is too scattering to be considered at present. The

numerous swamps, formerly stocked with Tamarack, Cedar, and some Spruce, have suffered much from fires. Large tracts of burned-over and bare land occur in all parts of the county, and of the numerous Pine thickets, which occupy thousands of acres, a great many have been injured and killed by fire.

Polk County.—The northwestern corner from Wolf Creek to the St. Croix River is a sandy Jack Pine woods, which continues into Burnett County. The remainder of the northern half is generally a hard wood forest, quite pure on many of the ridges, mixed and often entirely displaced by Pine in the sandier depressions and valleys. The southeastern portion, about two tiers of towns along the east line from southern boundary northward, was originally pinery with a light mixture of hard woods and better bodies of hard woods in places, and the southwestern portion was Jack Oak openings. The Pine is mostly cut; the standing timber is in isolated bodies, and is estimated at about 240,000,000 feet. The hard woods have been extensively culled, except in the northern townships, where a stand of about 600,000,000 feet is believed to exist. Of this, Oak and Basswood form over half, while Birch is comparatively scarce. Polk County has few swamps and no large quantities of merchantable timber is claimed, for the Cedar is practically wanting. The Jack Pine woods are quite extensive and will yield a heavy cut. Bare areas are common here as in other counties. A few of these tracts are stocked with fair-sized Poplar, which on this sandy loam seems to thrive better than elsewhere.

Portage County.—The southeast quarter is Oak openings with groves of Jack Pine, especially in the western part. The southwest quarter is Jack Pine woods, and in the southern portion there is a marshy pinery, forming part of what is known as "Little Pinery." The northern half, broader on the western side, was once a mixed forest of Pine and hard woods with some Hemlock, and was divided by strips of sandy pinery following up the Wisconsin and Plover rivers. Both Pine and hard woods have been cut in nearly all parts of the county, but there are still smaller bodies and scattering timber to warrant an estimate of about 20,000,000 feet of Pine. The hard woods and Hemlock, of which some fair bodies exist in the northeastern part of the county, represent a probable cut of about 150,000,000 feet, 50,000,000 being Hemlock. The extensive and dense Jack Pine woods will furnish 150,000,000 feet of material for special mills or pulp purposes, and will in time prove of considerable value. The swamps, of which a large part are open marshes, have suffered much from fires. Large tracts of burned-over Pine slashings exist throughout the lumbered part of the county.

Price County.—The entire county is a level loam and gravelly loam area, formerly stocked with a most luxuriant mixed forest, in which Pine prevailed in most of the northern two thirds, and the Hemlock and hard woods in the rest. On a few small tracts in the central part and also along the Oneida County line in the northeastern part of the

county a sandier soil gave rise to almost a pure pinery form of forest. The Pine is generally cut; about 200,000,000 feet are still believed standing, but most of this is scattered, and not over half in large bodies. The Hemlock and hard woods in over half the county have suffered seriously from fires, and over large areas have been killed entirely. Nevertheless, there are nearly 400,000 acres of wooded area, which it is believed will cut about 1,000,000,000 feet Hemlock and 900,000,000 feet of hard woods, in which latter Birch and Basswood predominate, with Elm and Maple following, both Ash and Oak being rather scarce. Price is one of the counties in which fire has done unusual damage, and large areas are entirely bare of growing material.

Sawyer County.—A mixed forest of Pine and hard woods originally covered the entire county, except a narrow strip along the Nemakagon, which is a sandy Jack Pine and Norway pinery, and a sandy pinery area south of Round Lake from the Chippewa west to the county line. Over considerable areas, as, for instance, along the Chippewa and Flambeau, the Pine prevailed. Hemlock occurs only in the eastern two-thirds, being rarely found west of range 7 west. The Pine has been cut along all the rivers, but there are still large quantities, which in the aggregate are estimated at 2,000,000,000 feet, and by some even at 2,500,000,000. The Hemlock amounts to about 900,000,000 feet, the hard woods 1,000,000,000, of which fully half is Birch and Basswood and about 10 per cent is Oak, the latter occurring chiefly in the western part of the county. The 12 per cent of swamp lands are generally stocked, though extensive damage has been done to those in the vicinity of Pine slashings. Even in this county, with little settlement, large tracts of burned-over lands are abundant.

Shawano County.—The southeastern one-third of this county, with its variable sandy loam and loamy soil, was formerly covered by a heavy forest of Pine, mixed with hard woods. The country about Lake Shawano and north to the county line is part of the sandy pinery district extending from this lake to the Menominee River. The northwestern two-thirds was a very heavy mixed forest of Hemlock, hard woods, and Pine, growing on a good, though in places very strong, loam and clay soil. The Pine is cut, except in the Indian Reservation, where about 300,000,000 feet are still claimed standing. The hard woods and Hemlock of the southeastern two-thirds are culled and damaged by fire, while those of the northwestern half are largely intact and have been injured only about Pine slashings. The standing Hemlock is estimated at 650,000,000 feet, the hard woods at 700,000,000 feet, of which Basswood, Elm, and Maple form over 70 per cent and Oak only about 5 per cent. Beech occurs only in the sandy loam area. About 30,000 acres around Shawano are covered by young White Pine, which has sprung up on old slashings. The extensive swamps of the southeastern part have all been burned over, and many of them are being drained and cultivated. Those of the western half are largely stocked with

Cedar and Tamarack, some of them yielding 15,000 feet and more per acre. Bare "stump prairies" occur in all parts of the county.

Taylor County.—A continuous mixed forest of Pine, hard woods, and Hemlock on a loam and clay soil once covered the entire county. The Pine has been cut, except small bodies in the southwestern part, estimated at about 200,000,000 feet. The remaining forest still covers more than 60 per cent of all wild lands and cuts about 6,000 feet per acre. In this forest Hemlock is predominant, and is estimated at about 1,500,000,000 (some good authorities place it at 2,000,000,000) feet, and the hard woods at about 1,000,000,000 feet, of which 70 per cent is Basswood and Birch, and only about 5 per cent Oak. The few swamps are generally stocked with Tamarack, some Cedar, and Spruce. Owing to the dense damp cover of the mixed forest, Taylor County has suffered little from fires, and large bare lands are comparatively scarce.

Vilas County.—Except the northern one-fourth and some scattering island tracts where a mixed forest stocks the better soils, this county is an uninterrupted pinery, principally White Pine, with little Norway and hardly any Jack Pine, covering a rather level, loamy sand area dotted with several hundred lakes and numerous swamps. Pine lumbering began here along the Wisconsin River over twenty-five years ago, and the Pine forest is cut into in almost every township. The present stand of Pine is estimated at about 1,500,000,000 feet, besides many thousand acres of sapling and young Pine thickets which might soon grow into valuable timber. Both hard woods and Hemlock are rather scattered, except in some of the northern townships; the Hemlock is estimated at about 120,000,000 feet; the hard woods, of which Birch, Basswood, and Maple are most important, at about 150,000,000 feet. Of the numerous swamps, which form over 20 per cent of the area, many are open bogs, but the majority are stocked with Tamarack and Cedar and some Spruce. Both in the swamps and the Pine slashings fire has made much havoc, and large areas of bare stump wastes occur in abundance.

Washburn County.—An area involving the northwestern one-third of the county, with broad arms extending up the Totogatic and Nema-gon rivers into Bayfield and Sawyer, was formerly sandy pinery, with large bodies of Jack Pine and Norway, mixed with White Pine. The rest of the county, generally a gravelly gray loam, was covered by a heavy stand of White Pine with a light mixture of hard woods. The Pine is generally cut. The present stand is estimated at 350,000,000 feet. The hard woods have suffered much from fires, and over large areas not a foot of merchantable timber exists. The standing hard woods are estimated at about 220,000,000 feet, of which Basswood, Maple, Oak, and Birch, in nearly equal proportions, form about 80 per cent. No swamp woods of commercial importance are reported. Some of the largest areas of perfectly bare-cut and burned-over lands in Wisconsin occur in this county.

Wood County.—The north half of this county was formerly covered by a heavy stand of White Pine, with a mixture of hard woods, to which was added, along the north line, a sprinkling of Hemlock. South of this the sandy loam and loamy sand area was covered by regular pinery, which gave way on the west side of the river to an extensive open marsh and cranberry bog dotted by sandy, pine-covered islands. Extensive bodies of Jack Pine follow up the river into Portage County.

The Pine has nearly all been cut, and the 100,000,000 feet of standing Pine assumed for this county is mostly scattering and sapling material. The hard woods have long been culled in all parts of the county, and not over 12 per cent of the area, with a probable stand of about 300,000,000 feet, is believed to remain. Of this hard wood over half is Oak and Basswood. The Hemlock is confined to the northern townships and will cut about 50,000,000 feet. Aside from the large open swamp in the southwestern part, there are comparatively few swamps in this county. Large cut-over and burned-over areas are numerous, and much land is stocked with culled woods, furnishing ample fuel, etc. Some fine groves of young White Pine may be seen along the Green Bay line near Grand Rapids.

LIST OF PRINCIPAL FOREST TREES OF NORTH WISCONSIN.

[Arranged according to economic importance in the region.]

I. CONIFERS.

1. PINES:

- (a) White Pine (*Pinus strobus*) occurs in all parts of the territory as scattering mixture in the better hard-wood mixed forest of the heavy soils, predominant on lighter sandy and gravelly loams, and as pinery proper on the extensive loamy sand areas. It is the largest and most valuable tree of the region.
- (b) Red Pine (Norway Pine) (*Pinus resinosa*) grows on all sandy pinery areas, scattering in the southern, abundant in the northern counties. It does not mix with the hard-woods on clay land except near Lake Superior, is generally mixed with White or Jack Pine, but in places forms pure stands of considerable extent. In value it ranks second among the forest trees of north Wisconsin.
- (c) Jack Pine (*Pinus divaricata*) is a small tree, grows generally in thickets, either pure or mixed, stocks all poor sandy lands, and, unlike the other pines, it also occupies part of the openings. It is of limited economic value.

2. HEMLOCK:

Hemlock (*Tsuga canadensis*) grows on all clay and loam lands of the eastern half of north Wisconsin; is either mixed scatteringly or evenly with the hard woods or else predominates in bodies of variable extent. The Hemlock is a large tree, grows slowly, is easily killed, even by mere exposure, and is not reproducing itself well in most parts of this region. It is of greater economic value than is generally credited.

3. CEDAR:

Cedar.—This tree, commonly called White Cedar, or simply Cedar, should, to distinguish it from other Cedars, receive the name *Arborvitæ* (*Thuja occidentalis*). It is a medium-sized tree of the swamp and moist portions of the upland mixed forests. It occurs in most counties and prevails in the swamps of the Green Bay region; a tree of considerable value.

4. TAMARACK:

Tamarack (*Larix laricina*) is the common swamp tree of north Wisconsin. It forms dense groves of pure growth, mixes with Cedar (*Arborvitæ*) and Spruce, remains small in the swamps of the "openings," but reaches a fair size (80 to 90 feet in height) in the swamps of the forest region proper; of secondary value.

5. SPRUCE:

Spruce, White Spruce, Cat Spruce (*Picea canadensis*), and Black Spruce (*Picea mariana*) are small, shrubby half trees on the moss-covered bogs, and small to medium-sized trees on the better-timbered swamps and the more humid portions of the loam and gravel land mixed forests. No distinction of species is made in using the wood, the logger's distinction of White and Black Spruce referring to quality of wood merely. The Spruce occur in all parts, but are most abundant in the northern and eastern counties.

6. BALSAM:

Balsam Fir, in this region, commonly called Balsam (*Abies balsamea*), is a small tree growing scattered in nearly all parts of the mixed forest.

II. BROAD-LEAVED TREES (HARD WOODS).

1. BASSWOOD:

Basswood (*Tilia americana*) is a rather tall, long-shafted tree, common in all hard-wood forests; one of the most useful and best developed.

2. BIRCH:

(a) Yellow Birch (*Betula lutea*) (also called erroneously "Red Birch," "Black Birch," and "White Birch," when in the log to distinguish character of wood) is predominant in the hard-wood forest within the Hemlock area, grows on all loam and clay lands, but rarely enters the regular pinery. Though it is here assumed that the Birch generally pronounced Yellow Birch is truly the *Betula lutea*, this can not be considered as settled since the imperfect botanical distinctions between *Betula lenta* and *Betula lutea* render it difficult, if not impossible, to distinguish these two species.

How far the true Sweet (or Red) Birch (*Betula lenta*) replaces the Yellow Birch is as yet not certain. The woodsmen do not distinguish except by the wood, and thus their classification is mainly one of quality of timber and not of species.

(b) Paper Birch (*Betula papyrifera*), commonly called White Birch, but not to be confounded with the true White Birch (*Betula populifolia*). The Paper Birch is the characteristic hard-wood tree of the fresher sandy soils, is always small, grows best in the northern counties, does not thrive on the poorer sandy "barrens," occasionally forms small thickets, is generally mixed with Pine and along Green Bay with *Arborvitæ*. Like Aspen, it enters extensively in the brush cover of many cut-over bare lands, but thrives only where considerable sand is present in the soil.

3. ELM:

(a) White Elm (*Ulmus americana*) is a tall, long-shafted tree common in all hard-wood forests.

(b) Cork Elm (*Ulmus racemosa*), commonly called Rock Elm, replaces to quite an extent the preceding species in many localities, and probably forms near 30 per cent of all Elm of the region.

A "Bastard" Elm, with the foliage of White Elm and the bark of Cork Elm, is often noted by the woodsmen.

(c) Slippery Elm (*Ulmus pubescens*) occurs sparingly in parts of this region; is unimportant.

4. MAPLE:

(a) Sugar Maple (*Acer saccharum*) is a common tree of all hard-wood forests, and, to a very considerable extent, invades with Aspen and Paper Birch the regular pinery. Among the small young growth of most hard-wood forests it predominates in number.

(b) Silver Maple (*Acer saccharinum*), often called Soft Maple, is quite generally distributed throughout the mixed forest, as is also the

(c) Red Maple (*Acer rubrum*).

The bush maples, Spiked and Striped Maple (*Acer spicatum* and *Acer pennsylvanicum*) form a considerable part of the undergrowth in the clay land mixed woods.

5. OAK:

(a) Red Oak (*Quercus rubra*) is the common timber oak of the region, and occurs in all counties and on both sandy and clay soils, but is abundant only in the western and southern counties, and makes a good tree only on the heavier soils.

(b) White Oak (*Quercus alba*) occurs quite abundantly in the southern and southwestern counties, but is very scarce in any form in the greater part of the region. This is also true of the

(c) Bur Oak (*Quercus macrocarpa*).

In the north central and eastern parts, in the upper Wisconsin, Menominee, and Peshtigo basins the Scarlet Oak (*Quercus coccinea*) is generally the only "Scrub Oak." It is scattered here over extensive tracts of sandy cut-over lands as a bushy tree or shrub. The "Scrub Oak" of the openings, along the southern and western edge of the region, is formed of a variable mixture of all species of oak of the territory.

6. ASH:

(a) Black Ash (*Fraxinus nigra*) and

(b) White Ash (*Fraxinus americana*), the former by far the most common, are found in every county, are generally restricted to the swamps, and, on the whole, form a very small portion of these woods either in number of specimens or as saw timber.

7. ASPEN:

(a) Aspen (*Populus tremuloides*) very commonly called Poplar.

(b) Large-toothed Aspen (*Populus grandidentata*) are very common in all parts of north Wisconsin; they are much more conspicuous on the cut-over lands as brushy cover, in the sandy pineries as scattered mixture, and also in the mixed forests of the Lake Superior region than in the better hard-wood forests, where they form but an insignificant proportion of the merchantable material.

Of the less conspicuous or less important forest trees must be mentioned:

BEECH (*Fagus latifolia*) is a common tree on the sandy loam and loam lands near Green Bay.

BUTTERNUT (*Juglans cinerea*) scattered throughout the better hard-wood forests.

BLUE BEECH (*Carpinus caroliniana*) and Hop Hornbeam (*Ostrya virginiana*), both of which occur quite abundantly in all hard-wood forests without ever forming merchantable timber.

HICKORY, chiefly Pignut, Bitternut, and Mockernut (*Hicoria minima*, *glabra*, and *alba*) occur in the southern districts and occasionally reach timber size.

BLACK CHERRY (*Prunus serotina*) rarely occurs on the better lands and can not be considered as an important tree.

Relations of area and ownership.

	Population.	Taxable wealth.	Total area. [Division of For- estry.] <i>a</i>	Land surface given by—			Area in farms.		Lands held by—		
				Division of For- estry. <i>b</i>	Land Of- fice Re- port, 1896.	Chief Ge- ographer Census 1890.	Total.	Improved.	United States Govern- ment.	State. <i>c</i>	Railways. <i>d</i>
			<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>
Ashland.....	17,200	\$5,900,000	679,000	676,000	678,000	<i>e</i> 1,054,000	59,000	8,000	<i>f</i> 122,000	6,700	122,000
Barron.....	20,100	1,900,000	576,000	561,000	560,000	576,000	264,000	79,000	1,000	300	.....
Bayfield.....	12,500	5,600,000	977,000	959,000	955,000	899,000	51,000	2,000	<i>f</i> 74,000	6,000	33,000
Burnett.....	5,800	600,000	571,000	537,000	560,000	570,000	235,000	20,000	116,000	30,400	.....
Chippewa.....	28,700	7,800,000	1,267,000	1,253,000	1,254,000	1,267,000	281,000	131,000	6,000	8,100	2,000
Clark.....	21,300	4,300,000	783,000	778,000	778,000	783,000	228,000	82,000	1,000	1,300	.....
Douglas.....	29,900	16,500,000	858,000	848,000	844,000	855,000	25,000	3,000	63,000	8,200	.....
Dunn.....	25,000	4,000,000	552,000	550,000	542,000	550,000	378,000	175,000	2,000	.....	.....
Florence.....	2,800	1,000,000	319,000	312,000	304,000	318,000	18,000	2,000	4,000	4,700	40,000
Forest.....	1,200	1,600,000	706,000	681,000	<i>g</i> 893,000	<i>g</i> 816,000	44,000	1,000	15,000	39,000	225,000
Iron.....	5,300	2,300,000	519,000	504,000	506,000	(<i>h</i>)	2,000	2,000	<i>f</i> 18,000	9,200	122,000
Jackson.....	16,700	2,200,000	634,000	636,000	633,000	634,000	289,000	124,000	9,000	5,800	.....
Langlade.....	11,000	1,200,000	560,000	555,000	571,000	560,000	82,000	20,000	2,000	11,000	60,000
Lincoln.....	14,700	3,200,000	576,000	572,000	581,000	448,000	49,000	9,000	11,000	19,400	37,000
Marathon.....	36,500	5,300,000	1,012,000	1,007,000	1,005,000	1,013,000	380,000	103,000	1,000	4,200	5,000
Marinette.....	27,200	5,600,000	909,000	898,000	883,000	715,000	222,000	29,000	24,000	14,700	4,000
Oconto.....	18,300	2,700,000	723,000	713,000	702,000	721,000	187,000	58,000	<i>f</i> 72,000	8,000	37,000
Oneida.....	7,000	2,900,000	744,000	694,000	570,000	<i>j</i> 1,303,000	23,000	1,000	36,000	37,600	24,000
Polk.....	16,100	2,500,000	615,000	595,000	597,000	611,000	282,000	83,000	7,000	3,000	.....
Portage.....	28,500	3,300,000	529,000	523,000	514,000	506,000	330,000	142,000	500	5,300	.....
Price.....	7,200	1,100,000	827,000	815,000	820,000	742,000	97,000	7,000	12,000	29,400	159,000
Sawyer.....	3,700	1,500,000	876,000	836,000	870,000	875,000	72,000	3,000	16,000	11,800	.....
Shawano.....	22,500	3,300,000	740,000	737,000	733,000	737,000	283,000	94,000	<i>f</i> 103,000	2,300	15,000
Taylor.....	3,400	1,000,000	632,000	632,000	621,000	633,000	72,000	15,000	3,000	200	78,000
Vilas.....	3,800	1,400,000	677,000	566,000	561,000	(<i>k</i>)	2,000	.....	<i>f</i> 70,000	4,900	4,000
Washburn.....	4,200	700,000	552,000	529,000	545,000	552,000	37,000	5,000	62,000	9,100	.....
Wood.....	21,600	2,700,000	529,000	515,000	514,000	529,000	184,000	53,000	800	600	.....
Total.....	434,400	92,100,000	18,956,000	18,482,000	18,594,000	18,267,000	4,400,000	1,260,000	<i>f</i> 861,000	<i>c</i> 282,000	<i>d</i> 957,000
Total for entire State.....	1,937,900	603,400,000	.....	.....	35,275,000	34,848,000	18,400,000	9,500,000	909,000	293,000	.....

a Figures of total areas, including water surfaces, seem never to have been published. The figures here presented were obtained by the use of the town plats, allowing each township 23,040 acres, excepting those with irregular outlines and those bordering correction lines, for which the geometrical area of the land survey was used. *b* It being apparent that the two sets of figures given by the General Land Office and the Census did not only not agree, but have signs of clerical or other errors (especially in the Census figures), a careful revision was made by use of the town plats, resulting in the figures given in column 4. *c* Besides this, there are 47,000 acres of park land in Iron and Vilas, but this is now being sold. *d* These are chiefly Wisconsin Central and Chicago Northwestern Railway lands. Considerable land is owned also by the "Omaha" and others, but details could not be obtained. *e* Includes what is now Iron County. *f* Largely Indian reservation, which makes over 40 per cent of the total. *g* Includes the part of R. 11 E., now given to Oneida and Vilas, so that these two should be larger by that amount. *h* Included in Ashland. *i* The State census gives 239,000 acres; the United States Census of 1890 gives for Ashland and Iron together only 23,000, so that there seems an error. *j* Includes Vilas County. *k* Included in Oneida.

Surface features.

IN THOUSAND ACRES. *a*

	Total land surface.	Lakes and larger streams.	Cultivated land. <i>b</i>	Forest and waste land.	Well-stocked forest. <i>c</i>	Swamp, i. e., land with cedar, tamarack, etc.	Cut-over land, waste, and also "openings."	Land with a soil chiefly of— <i>d</i>				Farm land— <i>e</i>		
								Clay.	Loam.	Sandy loam.	Loamy sand and (poor) sand.	Good.	Medium.	Poor, i. e., forest soils proper.
Ashland.....	676	5	8	668	400	70	200	170	440	70	.....	135	340	200
Barron.....	561	17	79	482	70	25	385	.....	225	250	85	180	240	140
Bayfield.....	959	22	2	957	475	100	380	190	390	.....	380	100	360	500
Burnett.....	537	34	20	517	100	80	330	.....	110	110	320	55	135	345
Chippewa.....	1,253	13	131	1,122	500	60	560	125	865	.....	250	310	560	380
Clark.....	778	5	82	696	200	40	455	.....	620	.....	160	310	270	200
Douglas.....	848	15	4	844	450	130	265	220	430	.....	190	175	370	300
Dunn.....	550	4	176	374	75	10	290	110	165	100	175	160	250	140
Florence.....	312	10	2	310	160	50	100	.....	110	110	90	50	160	100
Forest.....	681	25	1	680	400	140	140	.....	370	210	100	140	270	270
Iron.....	504	15	2	502	250	100	150	100	275	.....	130	100	200	200
Jackson.....	636	.....	124	512	25	65	420	.....	65	250	320	120	260	255
Langlade.....	555	5	20	535	350	70	115	165	270	80	40	165	230	160
Lincoln.....	572	10	9	563	345	50	175	120	350	.....	100	170	255	145
Marathon.....	1,007	6	104	903	500	30	370	200	700	.....	105	300	600	100
Marinette.....	898	10	29	869	300	110	460	.....	225	200	470	135	315	450
Oconto.....	713	10	58	655	180	85	390	.....	360	210	140	140	360	215
Oneida.....	694	60	2	692	150	150	390	.....	75	.....	520	70	200	420
Polk.....	595	20	83	512	150	20	340	.....	180	360	55	150	300	145
Portage.....	523	6	142	381	20	100	255	.....	160	160	200	100	220	215
Price.....	815	12	8	807	380	125	300	.....	365	250	200	160	330	325
Sawyer.....	836	40	3	832	525	130	175	.....	415	340	80	165	320	350
Shawano.....	737	8	94	643	225	100	320	75	440	110	110	220	300	215
Taylor.....	632	6	15	617	400	20	215	125	445	60	.....	250	260	120
Vilas.....	566	110	1	565	200	135	230	.....	110	.....	455	55	110	400
Washburn.....	529	23	5	524	100	50	360	.....	200	130	200	80	185	265
Wood.....	515	15	53	462	65	110	285	.....	260	100	155	160	200	155
Total.....	18,482	506	1,257	17,225	6,600	2,100	8,500	1,800	8,600	2,900	5,150	4,100	7,400	6,800
As a per cent of the total....	100	2.7	6.8	93.2	35.8	11.7	45.6	9.8	46.6	15.8	27.8	22.5	40.3	37.2

a In the estimates all figures are rounded off for convenience' sake.

b State Census Report, 1895.

c This but partly truly virgin forest, since pine has been culled out in all parts of the territory.

d Swamps are not considered; for instance, those of the sandy areas are simply included in this, and they appear as having a sandy soil, which is but partly true.

e This classification, when submitted to revision by the best informants, was generally accepted, and their corrections usually affect only the "good" farm land, while the third class, most important in this connection, was generally considered a fair estimate.

Standing timber, in million feet, B. M.

	Total of mer- chantable Pine, both White and Nor- way.	White Pine, only saw timber.	Norway Pine, only saw timber.	Hemlock, tie size and bet- ter.	Cedar down to 3 inches diameter. <i>a</i>	Tama- rack, tie size and better.	Spruce, including pulp wood. <i>b</i>	Balsam, including pulp wood. <i>b</i>	Jack Pine to 4 inches diameter.	Total for hard woods. <i>c</i>	Oak. <i>c</i>	Bass- wood. <i>c</i>	Birch. <i>c</i>	Elm. <i>c</i>	Ash. <i>c</i>	Maple. <i>c</i>	Hard wood and Hemlock cord wood, in million cords. <i>d</i>
Ashland.....	300	255	45	700	80	80	50	20		900	20	300	300	130	30	120	3
Barron.....	150	145	5						50	250	50	60	50	40	10	40	1.5
Bayfield.....	3,000	2,500	500	400	70	150	75	25	400	450	20	100	175	45	20	90	3
Burnett.....	200	150	50			20			500	200	60	45	20	20	10	45	1
Chippewa.....	500	500		800	10	30	20	20	150	1,100	120	340	280	180	60	120	4.5
Clark.....	200	200		30		25		5		650	150	180	30	160	30	100	3
Douglas.....	3,500	3,000	500		20	150	50	30	300	700	100	200	250	50	30	70	3
Dunn.....	20	20							100	400	100	120	15	60	30	75	1
Florence.....	150	135	15	300	65	45	25	15	25	400	5	125	100	50	20	100	1.5
Forest.....	500	450	50	600	155	100	65	40	100	1,000	20	280	300	175	75	150	3
Iron.....	400	350	50	350	110	75	35	15	25	350	5	100	125	35	15	70	2
Jackson.....	100	100				10			100	50	10	15		5	2	18	0.5
Langlade.....	150	145	5	1,000	160	130	35	30	20	1,100	40	300	300	250	80	130	3.5
Lincoln.....	250	230	20	1,000	100	125	25	25	50	1,000	30	300	350	170	50	100	3.5
Marathon.....	200	195	5	1,500	10	15	5	25	10	1,500	75	450	450	300	75	150	5
Marinette.....	1,500	1,200	300	240	150	100	50	10	400	250	10	50	65	40	15	70	1
Oconto.....	75	65	10	500	75	35	15	15	50	400	10	100	120	50	40	80	2
Oneida.....	1,200	1,000	200	20	30	100	20	10	300	60	2	25	15	5	3	10	0.5
Polk.....	240	230	10						100	600	150	160	40	120	30	100	2
Portage.....	20	20		50	10	35	5	5	150	100	10	35	20	15	5	15	1
Price.....	200	200		1,000	25	75	20	15	25	900	30	300	270	150	50	100	4
Sawyer.....	2,000	1,700	300	900	45	125	25	25	100	1,000	100	300	300	150	50	100	5
Shawano.....	300	275	25	650	85	30	15	20	20	700	30	180	100	175	40	175	2.5
Taylor.....	200	200		1,500	10	25	5	30		1,000	50	300	340	150	40	120	4
Vilas.....	1,500	1,300	200	120	75	100	30	10	200	150	5	40	55	15	5	30	1
Washburn.....	350	325	25			40			250	220	40	60	40	30	10	40	0.5
Wood.....	100	98	2	40	10	30	5	5	50	300	75	75	30	30	30	60	2
Eau Claire.....	50	50															
Pierce and St. Croix.....										300	70	90	10	45	25	60	1
Total.....	17,355	15,038	2,317	11,700	1,295	1,650	575	395	3,475	16,030	1,387	4,630	4,150	2,645	880	2,338	65.5
In per cent of hard woods.....										100	8.7	29	25.6	16.7	5.5	14.5	

a Ties, posts, poles, and piling are here converted into B. M.

b Two cords=1,000 feet B. M.

c Given in million feet of saw timber.

d This is estimated on the assumption that when the saw logs are removed there is still 10 cords of firewood or material over 3 inches diameter per acre, and where large areas of culled woods exist these also enter into consideration of this item.

Schedule of inquiries on forest conditions of Wisconsin; Lincoln County.

[Filibert Roth, 1897.]

[References : H. W. Wright, John Woodlock, Herm. Rush, William Bradley, J. J. Hoffman, C. D. Clark, L. N. Anson, N. Emerson, and George Langley.]

I. OWNERSHIP.

	Acres.
Total area	576,000
Total area (Forestry Division)	576,000
Land surface (Forestry Division)	572,000
Land surface (U. S. Land Office Rept.)	581,000
Land surface (chief geographer, U. S. Geol. Survey in Census Bul., 1890) ..	448,000
1. Actual settlers, farmers, etc.	* 49,000
2. Private owners not occupying land	447,000
3. Of this lumbermen hold 60 per cent.	
4. Railway companies (Wisconsin Central Railway)	41,800
5. Township	
6. County	4,000
7. State	19,440
8. Of this in bodies over 160 acres: 66 per cent.	
9. United States lands	11,200

II. GENERAL SURFACE CONDITIONS.

	Acres.	Per cent. of total.
1. Cultivated land	† 9,000	2
2. Forest and waste lands	553,000	97
3. Virgin forests	345,000	60
4. Virgin forests in tracts of over 160 acres	345,000	60
5. Cut-over lands	158,000	28
6. Swamp	50,000	9
7. Lakes	10,000	2
8. Land best to be left as forest	145,000	25

III. CONFIGURATION AND WATER COURSES.

1. Of total area, 20 per cent long slopes; 10 per cent hilly land; 55 per cent rolling; 15 per cent low flats.

NOTE.—No hills over 300 feet high; most large hills have long slopes. Considerable “pot-hole” land exists both in loam and sand land area.

The entire county is drained by the Wisconsin and its tributaries, the Prairie, Pine, Spirit, Somo, Tomahawk, New Wood and Copper rivers, all of which furnish good driving facilities.

IV. SOIL AND DRAINAGE.

1. Strong clay, 20 per cent of area; depth, great; color, gray; grain, fine, mixed with gravel and large stones. Loam, 60 per cent of area; depth, great; color, gray; grain, fine, mixed with gravel and large stones. Loamy sand, 20 per cent of area; depth, great; color, reddish gray; grain, medium, with little fine gravel.

2. Good farm land, 30 per cent of area; drainage, good. Medium farm land, 45 per cent of area; drainage, good. Forest soils proper, 25 per cent of area; drainage, good.

NOTE.—Many of the marshes make fine farm land.

V. FACILITIES FOR TRANSPORTATION.

1. Railways (names), Chicago, Milwaukee and St. Paul; Chicago and Northwestern; “Soo;” Wisconsin and Chippewa. Miles, complete, 82.

* The U. S. Census, 1890, gives 63,481; the above is figure of State census, 1895.

† U. S. Census of 1890 gives this at 10,500; the above is State census, 1895.

2. Roads in good and bad condition, about 300 miles; roads not yet opened, about 1,500 miles.

3. Streams large enough to float timber, over 200 miles; useable, six months per year.

VI. WOOD INDUSTRIES.

1. Pine mills cut in 1897, 120,000,000 feet; saw little hemlock or hard woods.
2. Tan bark, 30,000 cords hemlock.
3. Other woodworking establishments: (To be amplified by census statistics.)

Merrill was the head of raft navigation, and lumbering began as early as the fifties.

In 1895 the product of the wood industries of Lincoln were valued at \$2,350,000.

VII. MARKET (g = unlimited; l = limited; n = none at all).

White Pine stumpage, g; logs, g; lumber, g; firewood, l-n; mill refuse is used.

Norway stumpage, g; logs, g; lumber, g; firewood, l-n; mill refuse is used.

Hemlock stumpage, l; logs, l; lumber, l.

White Cedar stumpage, l; logs, g.

Tamarack stumpage, n; logs, l-n.

Oak stumpage, l; logs, l; lumber, g; firewood, l.

Elm stumpage, l; logs, l; lumber, g; firewood, l.

Basswood stumpage, l; logs, l; lumber, g; firewood, l.

Birch stumpage, l; logs, l; lumber, g; firewood, l.

Ash stumpage, l; logs, l; lumber, g; firewood, l.

Maple stumpage, l; logs, l; lumber, g; firewood, l.

Poplar stumpage, l; logs, l; lumber, g; firewood, l.

Chiefly Birch and Maple is sold for fuel.

Hemlock bark, good; Oak bark, none to be had.

NOTE.—Stumpage of Hemlock and hard woods has no ready market. It is sold for the labor of clearing, etc. Hemlock stumpage is being sold for bark purposes to a limited degree.

Two principal areas must be distinguished:

(1) The level and rolling clay and loam lands occupying about 80 per cent of the county, and stocked with a mixed forest of hard woods, Hemlock, and Pine. The soil is generally a gray loam on a deep gray clay and loam subsoil, more or less mixed with gravel, and some stone of larger size. In places, as on nearing the rivers and also along the sandy area in the northern part, the soil becomes a sandy loam, usually with much gravel, and in other places, particularly the southwestern and western part, it is a heavy loam and clay. These differences in soil are reflected in the forest cover, almost pure hard woods occupying the heaviest clays and most fertile loams, a Hemlock forest stocking the lighter gravelly loams and the Pine predominating on the sandy stretches.

The Pine is cut from nearly all parts of this area, but its removal has left the woods generally an undisturbed, dense, unculled, mixed forest of hard wood and Hemlock, in which the former existence of Pine is hardly noticed, since the humidity maintained, prevented both the starting and running of fires.

Narrow belts of sandy gravel and sand, along the Wisconsin and some of its tributaries, formerly stocked with heavy Pine forests, now all cut and the slashings burned and largely waste. On some of these old slashings Pine groves of young White Pine may be seen.

(2) A level sandy pinery area, occupying the northern part of the county east of R. 5 E., forming a broad V-shaped body, rapidly widening from its apex, below junction of Wisconsin and Tomahawk rivers, and extending into Oneida.

The soil and subsoil here is a light loamy sand of great depth, medium grain, and generally a reddish gray color, more or less mixed, locally, with a fine gravel. This area was densely covered by a forest of White Pine, with about 20 per cent Norway,

and, locally, some Jack Pine. This is now practically all cut, and repeated fires have cleared the greater part of all forest cover, leaving the ground covered by Break, Sweet Fern, and bushy Scrub Oak and Poplar, neither of which seems capable to form a tree under these conditions. A number of fire-damaged groves of sapling and small Pine interrupt these tracts of barren lands.

VIII. FOREST GROWTH.

A. Timber lands, i. e., from which little or no timber has been taken.

(a) Originally: Mixed forest, 75 per cent of area; in which Pine, 40 per cent; hard woods, 30 per cent; Hemlock, 30 per cent. Pine woods, 14 per cent of area; swamps, 9 per cent of area; lakes and rivers, 2 per cent of area.

(b) At present:

1. Hardwoods:

Of these, proportion in mixed forest—

Oak, 3 per cent, nearly all Red Oak; Elm, 20 per cent, nearly half Rock Elm; Ash, 5 per cent, nearly all Black Ash; Maple, 15 per cent; Basswood, 25 per cent; Birch, 30 per cent; White Birch and Poplar, 2 per cent.

Size and quality vary with the soil. Maple is very abundant, but much is defective. Hickory, Blue Beech, Hop Hornbeam, and Butternut occur.

The standing Pine suitable for ordinary logging is placed at about 75,000,000 feet. To this must be added large quantities of scattered material which is being logged, chiefly by farmers, in a small way, and which will swell the total cut easily to 250,000,000 feet B. M.

2. Mixed conifers, with or without hard woods, 345,000 acres; yield, 6,000 feet per acre; Hemlock, 50 per cent; quality, good; diameter, 18 inches; height, 85 feet; hard woods, 50 per cent; quality, common; diameter, 18 inches; height, 70 feet; Hemlock is good, cuts $2\frac{1}{2}$ -3 logs per tree, 10 logs per 1,000 feet; hard woods, short-bodied, 2 logs per tree, 6-8 logs per 1,000 feet; White and Norway Pine mostly cut.

Undergrowth and soil cover: Humus, not deep; moss, bare. The undergrowth is formed of young trees, Bush Maple, Hazel, Dogwood, also small Blue Beech, Hornbeam, and Balsam.

3. Swamp forests, 30,000 acres; yield, 3 M feet, or 6 cords; Tamarack, 50 per cent; height, 80 feet; diameter, 12 inches; White Cedar, 40 per cent; height, 50 feet; diameter, 16 inches; Spruce, 10 per cent; height, 50 feet; diameter, 12 inches. The swamps are generally stocked, many have suffered from fire, and many have trees of "all one size," and all too small to use, so that the yield, when large areas are considered, is not very great.

B. Cut-over lands, i. e., where most or all valuable timber has been removed.

1. Total, 158,000 acres.

2. Tracts owned in quantities of over 160 acres,—

3. Land not burned over, but no merchantable timber left, 100,000 acres.

4. Land burned over recently and waste, 58,000 acres.

5. Land stocked with young growth of Pine, 10,000 acres.

Of this—

White Pine, 80 per cent, with Poplar; Norway, 20 per cent, with Poplar; Birch and Poplar found on all slashings, but of no promise.

White Pine is 1 to 20 feet high, grows thriftily; Norway Pine is 1 to 20 feet high, grows thriftily. Some very promising little groves occur about Merrill.

6. On these lands there is generally much fallen timber of all sizes; the humus is burned off. The soil is covered with debris, Poplar brush, and on sandy land by Sweet Fern and Cherry. The chance of seeding is poor, often wanting over large districts. Danger of fire very great during every dry season. Help to fight fires is inadequate where most needed.