

PRESIDENT'S ADDRESS.

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FORESTRY IN INDIANA.

It seems strange that while European countries, with their vast tracts of forests, were spending money, energy and time in an effort to secure a conservative and economical management of their timber lands and, in most cases, had brought the whole question to a very practical and wise solution resulting in the maintenance of the steady value of the forest crop and securing by careful and well managed cutting the largest possible yearly production and revenue, the United States did practically nothing to arouse her citizens to some such rational forestry management. It was not until 1873 that the American Association for the Advancement of Science, at its Portland meeting, appointed a committee to urge Congress to some action in connection with our forestry interests. The recommendations of this committee were favorably received, but not until 1876 was the Commissioner of Agriculture required to appoint a man to study our forestry resources, the consumption and exportation of our timber, the extent of our supply, the effects of forests on our climate and the best methods to employ in conserving them. Since that time the work of the Department at Washington has grown under the care of Messrs. F. B. Hough, N. H. Eggleston, B. E. Fernow, and the present Forester, Mr. G. Pinchot, who in the order named have been in charge of it. They have, with very meager appropriations—to 1899 but \$247,216.85—collected and published a large amount of valuable information relating to our forests, their use, care and abuse, and have secured the coöperation of many public-spirited men and not a few scientists, who have started, in many States, active campaigns educating the public in forestry matters and securing proper forestry legislation. Our federal government can not obtain the desired results without the active coöperation of the States and the support of its private citizens. Our own fair Indiana has been very remiss in the discharge of her duties in this matter, and the neglect has resulted in a great loss to our timber interests and the consequent injury to its numerous dependencies.

The State of Indiana is a part of the North Central Division of our country and includes 36,350 square miles, with an acreage of 23,264,000.

When the early explorers paddled their birch canoes from the Ohio up the Wabash and its tributaries they passed through a great wilderness of native forests of giant oaks, elms, maples and beeches. From the very banks of the streams where they landed to the tops of the highest hills was one unbroken covering of the forest primeval. The tall sycamores, lining the river banks like sentinels, crowded into the rushing waters the overhanging willows at their feet and guarded the giant elms, hardy soft maples and buckeyes of the rich river bottoms, while from the higher ground looked down the tall and rugged oaks, the mighty beeches and hard maples, walnuts, ashes and hickories, with here and there a towering tulip, all vying with each other for soil and sunshine. The lowlands of the north were clothed to the very water's edge with tamarack, ash and soft maples, and the sterile soil of the south supported a thick growth of cedars and scrub oaks. Everywhere trees and shrubs of lesser size struggled with each other and with multitudes of herbaceous plants for every inch of soil and ray of sunshine. The records of the dimensions of some of these giants of our virgin forest seem past belief. A few illustrations will suffice.

Red maple—Height, 108 feet; circumference, 13 feet.

Hickory—Height, 150 feet.

Tulip—Height, 190 feet; circumference, 25 feet.

Sycamore—Height, 120 feet; diameter, 13 feet.

Cottonwood—Height, 150 feet; diameter, 8 feet.

White Oak—Height, 150 feet; circumference, 20 feet.

Basswood—Height, 190 feet; circumference, 17½ feet.

The forest floor was a spongy mass of forest litter that held in its pores the products of many rains and freely gave of its wealth to thirsty soil of open areas and to the multitudes of springs that kept the rivers to a uniform volume. Birds and animals of many kinds and in great numbers found here a suitable home, while the streams were stocked with an abundance of fish whose nearly ideal environment gave no suggestion of future extermination. Such was the picture of the forest primeval.

This condition, contrasted with the one we now see about us, tells of striking changes during a short period. Everywhere level fields of beautiful corn, wheat, and other crops clothe the tracts that were once covered with forests.

In 1870 the State contained 7,189,334 acres of forest, which was one-third of its area. This acreage placed Indiana well up in the list of for-

est States. In 1880 this had been reduced to 4,335,161 acres, or one-fifth of the State's area. The records show that up to that time the forests had been removed mostly in the interests of agriculture and that no large bodies of the original tracts remained. At this period Indiana ranked fifth in her lumber manufacturing interests, but the statistician records the warning that, at the present rate of consumption, the forests of the State must soon cease to be commercially important.

In 1890 one-twelfth of our total area remained in forests, and the decade between 1880 and 1890 may be said to mark the greatest real loss to the State. The large decrease before this period was so closely connected with the clearing by settlers for cultivation that little of the timber in tracts not suitable for agriculture had been disturbed.

Between 1870 and 1880 2,854,143 acres of timber were removed and 3,829,459 added to cultivated lands, indicating a great demand for all tracts cleared in the past and also such open areas as might be tillable, while between 1880 and 1890 2,604,005 acres were cleared and but 1,173,744 acres added to cultivated fields. Over 260,000 acres were cleared annually during this period, or an excess of 60,000 acres yearly over what was removed in the most active immigration period just preceding. Timber was cut for revenue, and the demands of the manufacturing and shipping interests caused the owners to forget the relation of forests to our general prosperity. How the statistician's prediction has been fulfilled may be realized by reference to the statement of a well-known forester who, last year in reviewing the forestry interests of each State, says of Indiana that her forests have long since ceased to be of any value commercially. While this is not strictly true, it does illustrate the drift the State is making in this direction, since we now have but 1,227,141 acres, or one-twentieth of our whole area, in forests, and much of this has been cut over and the valuable part removed. The State no longer has any important supplies of valuable timbers, like oak, walnut, poplar, etc.

At present our largest tracts of timber are in the extreme southern part, in Franklin, Harrison, Brown, Jackson, Lawrence, Martin, Perry and Washington counties and a small tract in the north in Allen and Kosciusko counties. A few scattered tracts may be found elsewhere, but in the main these bodies are small and the timber of little consequence. The western border of the State contains but little timber and is the eastern edge of the great treeless region that extended over the north in Benton, Newton and Jasper counties and over much of Lake, Porter, La-

porte, Pulaski, White, Tippecanoe and Warren. Some of this is now covered with young forests that will eventually add much to the forest resources of the State.

An examination of the topography of the State shows that the cleared lands include the headwaters of our principal rivers and streams. The entire basin of the Wabash and its tributaries has been more or less denuded, or at least does not contain any considerable area of timber land. The basins of a few small streams, like the Blue and Pigeon Rivers and a part of White River, are still wooded and the influence of the remaining tracts here, as elsewhere, is manifest in the less conspicuous changes in the streams so protected. Truly the problem of securing the proper maintenance and control of the forests of the State is grave and important.

In order to appreciate fully the real value of our forests to our State let us consider their general influence upon some of our natural conditions and industries affecting the general prosperity of our commonwealth.

One of the most important assertions made by those who advocate rational forestry management is that the forests exercise a very large influence on our climate and rainfall. So great have been the claims of these zealous advocates that I sometimes feel that the whole cause of forest care is seriously injured by claims for which no convincing proof is forthcoming and which do not appeal to educated people accustomed to think for themselves. In fact, too often scientific men have indulged in pleasant contemplations on this subject and made statements that were not founded on sufficient data to satisfy a man who did not believe things because he wished them to be so. For the thorough examination of this problem we must have accurate data of climatic conditions for many years and in connection with these careful records of forestry changes for the same territory. In the study of these it should be kept in mind that general climatic variations occur in all countries even where no changes have been made in forestry matters and it accordingly becomes difficult to determine the exact relation of the forest changes to climatic variations in other countries where marked changes have taken place in the forests. Notwithstanding the fact that different climatologists maintain exactly opposite views regarding forest influences on the climate, there are certain facts that are hardly controvertible. It is doubtful if the forest tract influences very largely the climatic conditions or total rainfall of a country except in a very few favorably located regions, but the important thing for us to consider is the value of Indiana forests to our own com-

monwealth and if possible the extent to which we would be justified in devoting time and money to secure certain forestry regulations.

The soil of a forest is less susceptible to sudden variations in temperature than that of the fields outside, and consequently warms more slowly in summer and its cooling is delayed in the winter. The summer effect is much more marked than the winter effect. The mean annual temperature of the forest soil is about 21 degrees lower than that outside. In the summer this cool soil will temper the air above it, start currents in the direction of adjoining fields and lower their temperature.

The average annual evaporation within the forest is but fifty per cent. of that in the open, and the difference between the two is greatest in the summer when the saving for the forest is the largest and most needed. About twelve per cent. of the precipitated water is evaporated in the year from forest soil and forty per cent. from open fields, the presence of the forest litter effecting a saving in some cases of seven-eighths of what would otherwise evaporate directly. Much of this difference is due to the looseness of forest soil and its poor capillarity that fails to draw the water to the surface. That the forest serves as a windbreak, in preventing currents of air from rushing over adjoining fields and depriving them of their moisture, is obvious to all.

The extent to which the forest influences affect the adjoining fields, and the distance to which this may be felt, depends on the nature of the forest, its size, composition, age, exposure, underbrush, elevation, proximity of streams, etc.

A collection of all of the published records of temperature and rainfall taken in the State has been studied, but they do not furnish such data as would in any way bear on the problem in hand. The earliest records were made in 1867 at but two points in the State. The central office at Indianapolis was not organized until 1882 and its first publication was in 1884. In a half dozen places records were kept from 1872 to 1881 and then discontinued. All of these stations were cities or towns and do not afford data for the forests about. Certain it is that statistics to support our claims are not forthcoming in Indiana, but our conditions are not unlike those of other States from which these facts were gathered, and the results are applicable to our own territory.

The influence of the forests on the fertility or productiveness of our land has been discussed from many points of view and it is hardly safe to generalize in a matter so dependent on the controlling influences of local

conditions. The forests do affect climatic conditions in their immediate vicinity, and further, their influence is along the line of those changes that would act most beneficially to agricultural crops. The preservation of the rainfall by the forests is also of great advantage to our agricultural interests. These beneficial influences in Indiana are, in my judgment, evident only in the immediate vicinity of forests, and their removal has not, as far as statistics show, affected the production of certain crops in the whole State in any prejudicial way. The general disastrous effect will not be evident for some years. The great richness of our soil and its general suitability for agriculture delays the certain penalty, but it is sure to come, and then the restoration will be a long and difficult process.

The annual yield of corn per acre has been gradually increasing in the whole State during the last thirty years, as the averages for these five-year periods will show:

1876—1880.....	23.55 bushels per acre
1881—1885.....	23.48 bushels per acre
1886—1890.....	29.77 bushels per acre
1891—1895.....	30.4 bushels per acre
1896—1900.....	37.2 bushels per acre

While it is doubtless true that some of this increase may be due to better methods of cultivation, yet it is hardly likely that this has produced any appreciable change during the last ten years, while during that period we have removed 509,045 acres of our forests, or more than one-third of the whole amount that remained. The average yield for each of the last three years is larger than for any previous year in the history of the State. Practically the same is true of our wheat, as these records will show:

1880—1884.....	12.3 bushels per acre
1885—1889.....	13.2 bushels per acre
1890—1894.....	15.8 bushels per acre
1895—1900.....	12.46 bushels per acre

This nearly steady increase is interrupted by the very low acreage of 1895 and 1896, when the yield per acre was below that of any previous year for which records exist, and certainly this falling off could not be due to deforestation since the three succeeding years returned to the normal yield per acre. The year 1891 produced the largest yield in the history

of the State, 20.9 bushels per acre. With oats the records show practically the same:

1878—1880.....	19.3 bushels per acre
1881—1885.....	30.56 bushels per acre
1886—1890.....	27.39 bushels per acre
1891—1895.....	26.26 bushels per acre
1896—1900.....	29.99 bushels per acre

These fluctuations do not indicate the constant deleterious influences of deforestation, and in 1899 and 1900 the yield per acre reached its maximum.

The same general conditions are found to exist in the case of other cereals.

While these things are true for the whole State, in those localities that have suffered most from deforestation the amount of wheat and other grains produced on an acre has fallen off with the steady decline of the forests. These local losses seem to be made good by the heavy yields of newly cleared ground which has not yet felt the full effect of cutting away its adjoining timber, but the time must certainly come when what has been true in so many countries will be found true here. The world is full of examples of barren and sterile areas that were once verdant and productive, and the change has been brought about as the result of deforestation.

The whole Mediterranean country was once the garden of the world, but with the ruthless destruction of the forests came the blight of drought, cruel winds, storms and snows, that ruined rich plantations, made vine-clad slopes unproductive and impoverished the entire basin. Parts of Germany, France and Spain have taken alarm at the approach of similar conditions and, at great expense, have restored to the lands their covering of trees and the return of prosperity has demonstrated the necessity of forests to the fertility of the soil.

One of the direct results of the destruction of our forests has been the disappearance of our springs, the consequent failure of our domestic water supply and the variation in volume and regularity of our streams. The annual rainfall has varied but little during the last fifty years, but the method of its disposal has materially changed. The great water capacity of forest soil and litter, the rapidity with which water percolates through it, the irregularity of the forest floor and the general absence of

ditches and gullies, decreases surface drainage during precipitation. The uniform covering of snow in winter prevents the soil from freezing and when the snow melts this body of water is retained. The great mass of water formerly held by the forest and gradually given out to the streams as they carried off the more immediate supply now flows from unprotected fields like rain from gravel streets, washing away the best of the upland, inundating the lowlands, and making agriculture along the banks of many streams most uncertain.

Then, too, the navigability of our streams has been seriously affected. The headwaters no longer contain sufficient water to float even the old-time flatboat, and farther down the stream the channel is simply a labyrinth of bars and shoals, products of denuded fields above, making navigation impracticable. The failure of our streams to compete as formerly in the commerce of our State increases the cost of living and destroys what otherwise might be a great industry.

The Wabash River, extending northward from the Ohio, receives tributaries from almost every section and drains four-fifths of our commonwealth. The central and southern parts are reached by the north and east branches of the White River and the north and north central parts by the Wabash and Tippecanoe. The records of the early navigation of these streams is full of interest. The head of navigation for boats of small draught was Monticello on the Tippecanoe, Logansport on the Wabash, Indianapolis on the White River, and on the east fork of the White and Muscatatuck rivers, as far east as Scott County. On the southeast the White River was navigable to Brookville.

Some of these early boats had really a large carrying capacity. One built at Terre Haute for the navigation of the Wabash was one hundred and thirty feet long and twenty-nine feet wide, with a carrying capacity of three hundred and fifty tons.

From the heads of navigation and below, and from the smaller tributaries of all of Indiana's streams from many miles in the interior, flat boats carried lumber, pork, poultry, corn, wheat, oats, fruits and hoop-poles down the Mississippi to New Orleans and the returning river steamers distributed great quantities of freight up many of these streams into the State. To some extent the smaller tributaries of the Ohio that reached into the State through one or two counties were factors in our transportation system. But all of this has passed away and from only a few places on the lower Wabash do we receive any practical advantage from our

waterways. It would be unreasonable to claim that deforestation has been the cause of all this, for cultivation of open fields and the extensive underdrainage of level areas has contributed very materially to these results.

Our lumber interests are of sufficient importance to demand our very careful protection. They represent the second largest industry in the State and with the disappearance of the supply of raw material our very large income from them will be seriously curtailed. For many years our timber industries have drawn raw material from the best of our timber resources at a comparatively low price, but now the quality of this material is decreasing and the price increasing. Both of these factors make it difficult for our manufactures to compete with corresponding establishments located in timbered districts. To be sure, much of the raw material could be shipped in, and indeed about eighty per cent. of it is now imported, but this additional cost makes it impossible for our manufacturers to compete successfully and they are compelled to move to other States. We have already lost some of our important plants to Kentucky, Missouri and Arkansas.

In 1840 our lumber production (raw material for our factories) amounted to \$420,791, in 1877 to \$10,791,428, and in 1893 to \$18,403,267.

The last ten years has seen an almost phenomenal increase both in number and variety of wood industries. More than fifty different kinds of establishments are using wood as their raw material, and to supply this demand timber has been cut without reference to its effect on the land or the State.

Some interesting and striking facts are discovered from an examination of our fruit crops in connection with the deforestation of our lands. The discoveries are certainly suggestive of a very close relation between the two.

In 1880 the eleven counties producing the largest yield of apples were as follows:

Counties.	Bushels of Apples.	Acres of Forest.
Allen	1,007,576	108,132
Crawford	608,043	50,005
Harrison	610,500	81,807
Kosciusko	602,462	52,275
Laporte	617,353	33,457

Counties.	Bushels of Apples.	Acres of Forest.
Ripley	650,735	69,183
St. Joseph	780,243	43,958
Steuben	655,843	47,973
Sullivan	1,059,149	46,867
Washington	888,421	80,852
Wayne	607,377	47,265

Several of these counties are among the most heavily wooded of any in the State and, with the possible exception of Laporte, they all contain a very large acreage of forest. The history of the apple crops in connection with the history of the removal of the timber in these counties helps to substantiate our claim for their importance. In 1897 these counties made the following showing:

Counties.	Bushels of Apples.	Acres of Forest.
Allen	6,170	29,876
Crawford	9,894	22,374
Harrison	57,241	40,125
Kosciusko	721	24,052
Laporte	1,304	17,490
Ripley	7,630	27,079
St. Joseph.....	980	9,463
Steuben	432	1,746
Sullivan	13,123	9,718
Washington	8,202	42,381
Wayne	3,863	7,718

From these figures it appears that the counties now exhibiting the largest falling off in their apple crops show nearly corresponding reduction in their forest areas (Allen, Sullivan, Steuben, Kosciusko, St. Joseph). Similar conditions are not found all over the State, but it is certainly suggestive that those counties that formerly produced the largest apple crops and have suffered most from deforestation have fallen to the end of the list in their yield of apples (Steuben, Sullivan, St. Joseph, Allen), and the importance of the forest becomes the more significant when we discover that of the counties formerly producing the largest crops those have fallen off the least that have removed the smallest amount of timber (Crawford, Harrison, Laporte, Ripley, Washington).

These relations are too significant and constant to be simply coincident, and in my judgment do demonstrate a very close relation between the forests and the fruit crops.

It is true that many counties like Tipton, Vigo, Putnam and Hendricks, that are not now largely covered with timber, are among our best producers of apples, but in these places investigation shows that the raising of apples is attended with great difficulty and spraying and other precautions are required that twenty years ago were not necessary. I do not insist that the presence of large tracts of forests in Indiana are absolutely necessary for the production of a successful fruit crop, but the facts seem to show that such tracts are conducive to its best development. It is more than a coincidence that Harrison County, with the largest acreage of forest of any county in the State, stands second in the size of its apple crop and first in its peach crop.

The influence of the forest is manifested in their moderating effects that prevent sudden changes and extremes of temperature that would be injurious to fruit trees; also the retention of the snow in winter prevents the ground from freezing and imperiling their roots. The removal of the forests in the vicinity of orchards has caused the disappearance of the large number of birds that formerly made their homes near but are now driven to distant forests for nesting and seldom appear in the orchard. These birds formerly destroyed large numbers of insect pests that now so seriously affect both trees and fruit. The general absence of these insects in heavily timbered counties is doubtless due to the birds. It is not likely that the presence of new insect pests, introduced into the State in nursery stock and in other ways, would account for the decline in many counties since any such pest would soon be generally distributed over the State and affect all regions alike. The raising of perfect apples is attended with difficulty and yields such poor financial returns that the number of trees in the State has decreased twenty-five per cent, during the last twenty years, but the decline in the yield has been fifty-five per cent, for the same period.

There can be no question as to the influence of the forests on the abundance and condition of the fish in our streams. The presence of fish depends largely on the constancy and character of the water in the stream and this is so directly connected with the size and location of our forests that the relation is easily recognized.

Early records show that our fishing industry was very important and the source of no little revenue that provided the sole support of many of our citizens. Nearly all of this has passed away, fishing is not now an established business and the food fishes are gradually disappearing from our streams. It is true that seining, dynamiting, and other methods of illegal fishing and stream pollution are responsible for much of this, but the complete disappearance of many streams and the steady reduction of others, with the uncertainty of their volume, has been by far the largest factor in the decline. This uncertain flow and decrease in volume prevents the stream from clearing itself particularly in the summer when the danger from its pollution is greatest. Such waters are not suitable either for the homes of fish or their spawning and we must change the character of our streams if we expect to return to our former conditions.

The present condition of the forests in the State as they appear from a general examination makes us realize the magnitude of the problem we are facing. Nothing succeeds like success, and to this might be added nothing fails like failure. This is exemplified in studying the large tracts of partially cleared and neglected timber land all over our State. A great portion of this area is covered with old and ill-shapen trees of valuable woods not removed in lumbering and many thrifty trees of wood that is not now considered valuable and, in addition to this, many thrifty trees of good timber not yet large enough to be marketable, growing without any care or attention, too isolated to secure for the valuable trees the benefits of natural pruning that would result in clear stems, or to secure for the vicinity the natural advantages of a forest in retaining the forest litter or influencing the soil, water supply, and to some extent the climatic conditions. At the same time the trees are too close and afford too much shade to permit the growth of good grass. The problem is too complex for the average owner, the whole area grows steadily worse and soon ceases to excite a desire for improvement in the mind of the holder.

The causes of this decline in our forests, beyond the legitimate clearing for cultivation, have been many, but the most important of all has been man's greed and the desire for immediate realization of his heritage. This desire has not been curbed by an appreciation of the importance of our forests to our prosperity. For this educated people, who are conscious of the many important consequences resulting from the decline of our forests, are more or less responsible.

Some of the other causes of the forest's decline may be properly considered in turn.

The greatest foe that attacks our forests is fire. No other destructive agent leaves us with so little in our hands to mourn over or to form the incentive for future care and protection. The great destroyer engulfs everything it reaches and we are left with ruined and blackened fields that indicate the cost of its visit. The loss and danger is two fold: First, the destruction of old and marketable standing timber that could soon be converted into cash, and the stunting and scarring of many young trees that never recover or make at most an insufficient growth, in the end to be discarded as poor or unsound timber; second, the loss of forest humus and of young sprouts and seedlings that represent the working capital of the farmer or forester. Upon this the hopes of his future profits depend, and while the loss seems difficult to estimate at the occurrence, it becomes more manifest as time passes and the fields become simply waste land covered with herbaceous and shrubby vegetation, scattering noxious weeds over all the region and bringing no returns to the owner.

The extent to which Indiana has suffered from forest fires can hardly be discovered. We have had no historic fires, such as those of Michigan or Wisconsin, to use as a suitable text for vigorous protestations against carelessness on the part of farmers, hunters and railroads, but careful estimates show that we are annually losing large sums in this way, and a little care and foresight would relieve us of this useless waste. In 1880 90,427 acres of timber were burned over, resulting in an estimated loss of \$130,335, and during that year no unusual fires occurred. This indicates approximately our annual loss. We should take immediate steps to check this waste.

Something must be done to secure immunity from the great loss we suffer from browsing animals, which now prevent the reforestation of many tracts that would otherwise soon naturally grow up to young trees. The pasturing of our wood lots prevents the possibility of natural increase in the forest acreage and deprives the forest soil of much of its value from the destruction of its litter by the stamping of cattle. This can be more efficiently remedied by securing the coöperation of the owner than by legislation.

The State also loses much from destructive lumbering. A visit to any of our large timber tracts shows the reckless waste from this cause. Without any thought of the future a tract is cleared of its timber and only

the best of the logs are drawn out. Frequently large tops with their limbs that might be utilized in many ways are left. Small trees or saplings are removed for wood or are cut down in making roads and in clearing and the possibility of early reforestation is destroyed. The debris of such reckless logging operations remains on the ground to invite destructive fungi and insects and furnish fuel for fires that otherwise might run out if the ground was clear or covered with a thrifty growth of young trees.

The marked increase in the number of concerns using small and second growth timber makes it important that we watch the development of our young forests lest they, too, fall a victim to man's greed before they are of sufficient size to be profitably marketed or before plans for systematic cutting are inaugurated.

Insect ravages are a source of very serious loss to our forests in many parts of the State. Our records show occasional outbreaks in various localities and whole forests are frequently denuded. While in the majority of cases this does not at once result in the death of the tree, it does produce serious loss in its effect on the reduced growth and diminution in thickness of the annual ring, that valuable increment that represents practically the only return to the owner. Frequently deformations and abortions of various parts result from the attack of borers and other insects. In most cases it is hardly practicable to inaugurate exterminative measures when any considerable area is affected because of the great cost and difficulties in treatment, but where local outbreaks occur, due to particularly dangerous pests like the San José scale, and the whole region is threatened, the State can well afford to coöperate and promptly back such measures as will result in wiping out the cause of the danger.

A most important and practical precaution to prevent the increase in insects and fungi is to remove, as far as possible, old stumps and logs, cut down and convert into wood or lumber dead trees, or remove their bark, and thus decrease the possibility of the multiplication of the pests by destroying their usual and most frequent breeding places.

As far as I have been able to observe, our State has suffered little in the way of extensive outbreaks in any particular locality from parasitic fungi, and while a goodly number of species of these destroying agents may be found in the State, yet they are of the kind that attack very old or dead timber and could be readily controlled by proper attention to the destruction of their usual breeding places, as was suggested in the case

of the insect pests. The marketing of timber deteriorating from the presence of fungi would preclude serious loss.

Of other forest enemies, storms, lightning, snow, gnawing animals, etc., we have our occasional outbreaks, but none of sufficient magnitude in recent years to cause serious loss. The destruction frequently resulting from the first agent could usually be very much reduced if prompt measures were taken to market, as soon as possible, all timber that had in any way been irreparably injured.

We should carefully guard every avenue of waste. Our inexhaustible fuel beds should be made, as far as possible, to take the place of the more valuable timber that is now being used for wood. Many so-called worthless and cheap woods could doubtless be substituted for valuable kinds now generally used and a more accurate knowledge of the properties of our various woods by our wood workers would effect a great saving. More up-to-date methods of sawing, happily now being largely used, would also increase our resources.

The importance of our forests to our State should now be apparent. Their influence on the rainfall secures in time and place results of greatest benefit to all. They likewise influence in a beneficial way the immediate climatic conditions, the value of our soil for agricultural purposes and the production of a satisfactory fruit crop. They determine very largely the number and character of our streams, their importance as water-ways, and the abundance of food fishes. They are indispensable to flourishing manufacturing and commercial industries, thus affecting the distribution of population. I may also add, we owe something to them for the maintenance of good sanitation and low mortality.

The very much depleted condition of our forests and the danger of their complete destruction from the forces just enumerated calls for immediate and vigorous action. This should be along two well defined lines: education and legislation. The land owners of the State can be forced to do but little, but by judicious and united efforts a public sentiment can be created in favor of the movement and the majority of the forest owners will join in the efforts to secure practical results.

The State, county and township agricultural associations at all public gatherings should present forestry topics for discussion, and here, as elsewhere, competent persons should present the facts applicable to local conditions, giving to the farmers simple and practical directions for the care of their forests and the most economical methods for increasing their

acreage. At fairs and meetings of associations opportunity is nearly always afforded for such work. Our teachers should be urged to give at their gatherings frequent opportunity for the presentation of such forestry matters as would be appropriate to the occasion. At our agricultural college and in connection with several of our public educational institutions courses in forestry should be given so that our coming generation of agriculturists, teachers and professional men may deal with our problems in an intelligent way. We need in every community men trained in forestry matters who, even though they may not be actively engaged in forestry work, will be the leaders of public sentiment and the organizers of movements in the direction of forest care. Some of these men may in time be encouraged to supplement the work of the State by securing control, at tax sales or in other ways, of suitable forest lands and managing them in a manner to obtain a permanent investment, that could be made to yield a reasonable return to their posterity. In some countries large estates have been left in this way, protected by proper conditions that would prevent subsequent holders from depreciating the value of the investment, that, well managed, would yield a very liberal return.

Although the State does not own forest lands, she should educate her citizens in this subject for the same reason that she now does in agricultural matters, even though she is not engaged in agriculture.

It is also important that the public schools lend their influence to this cause in devoting some part of their time to the general study of our trees and the value of our forests. This need not be introduced into the curriculum as a regular subject, but in connection with the nature work in the grades some few matters might be presented and in the high school a few talks to the whole student body each term would accomplish very much, indeed a simple recognition of the importance of the subject would greatly assist in securing a hearing with the young. A German proverb says, "Whatever you would have appear in the nation's life you must introduce into the public school, and in not doing this we are missing one of the most important means of bettering our forestry conditions."

Fortunately one day has been set apart for the consideration of our forest interests, and the proper observance of arbor day in our State affords one of the very best methods of presenting this subject to the people. This day should be carefully observed in every school district in the State as a holiday and appropriate exercises should be prepared for the occa-

sion. In these exercises the pupils of our public schools should take as prominent a part as possible by reading suitable poems or presenting essays on various subjects connected with our trees and forests.

In addition to this there should be presented to the people at these gatherings a thoroughly practical talk by some one trained in forestry matters on subjects that will reach the farmers, who own ninety-seven per cent. of the forests, and direct them in improvements and work that will result in a betterment of our forestry conditions. An effort should be made to correct the prevailing impression that forestry means the hoarding of trees. It should be clearly explained that the application of proper methods would result in inaugurating a system of intelligent cutting that would bring to the owner the largest yearly returns without impairing his investment. It should be further explained that there is no desire to re-forest land well adapted for cultivation, but rather to cover with forests the vast areas of brush and waste land, that in 1893 represented thirty-five per cent. of our total acreage, and that only in this way can these tracts be made profitable.

The thoroughness with which the State is settled makes it likely that this land is unfit for cultivation, and if this could be added to our permanent forests, and these properly managed, our condition would be almost satisfactory. This waste land is well scattered throughout the State, but several large tracts are located in Harrison, Parke, Perry, Jackson and Crawford counties, and these should, if possible, be secured by the State. No other line of activity offers as large returns with so little labor as the reclaiming of these waste tracts. A little tree planting, pruning, and clearing of worthless stock for wood to pay the cost of the work, and the protection of these trees from forest enemies would soon secure a forest that would become, if properly managed, a permanent and paying investment. An especial effort should be made to reclaim all of this land that is located in any way to influence our streams and if possible restore to the State these important factors in our prosperity.

In some States the results from the work of arbor day have been very important. In New York, last year, the day was observed in 10,251 school districts, and in twelve years 229,616 trees have been planted. Our State should not be behind in this matter.

The next important means by which we hope to secure a betterment of our forestry conditions is through legislation. The history of forestry legislation in Indiana at the opening of the last legislature was summed up

by an eminent botanist who, in discussing the forestry laws of several States, said of Indiana that she had nothing to offer in this direction. While this does represent the main facts in the case it does by no means tell the whole story. A law passed in 1899 exempted from taxation permanent forest land containing not less than 170 trees per acre and also any areas that might be planted to the same number or more, cultivated a few years and protected from cattle for a stated time. A like exemption could be secured by bringing land containing 100 or more trees to the same standard and maintaining it as a forest.

This law has in it much that is good, but the results of its operation demonstrate the difficulty of accomplishing much by legislation without provision for education. This law was intended to induce owners to secure a compactness that would make their timber lands forests in all that this term means to the forester and thus prevent the clearing of land below the point where it ceased to be a forest and became a woods pasture. The financial consideration was not enough to attract any very large number of people and the farmer was not made to see the beneficial effects of the forest so preserved or the possibility of their management to secure profitable returns. Further no attempt was made to direct the owner in his efforts to bring his depleted forests to the standard where exemption could be secured and consequently the total acreage was not increased. But 284 exemptions, including 5,312 acres, have been secured in the whole State.

The law passed by the last legislature seems to be a wise one in that it places the forestry matters of the State in charge of a properly organized board with authority to make all desirable recommendations for the regulation of our forests. The last legislature deserves our special commendation in its taking the first official step and establishing a board of forestry. I am certain that this board will receive the hearty support and cooperation of the Academy of Science and of the public spirited citizens who have for many years persistently urged attention to our forestry interests and thus have opened the way for forestry legislation. To secure any permanent benefits additional laws must be enacted, whenever such as are suitable to our local conditions are suggested, and the campaign of education inaugurated must be pushed by all friends of forestry. Had the State adopted any radical legislation without the thorough study of the situation within our borders it might have resulted in a misfit, since only those forestry laws are really effective that are based on the exact needs

of a locality. Additional legislation must follow investigation and not precede it.

What it is possible to accomplish by forestry legislation may be discovered by an examination of the legislation in those States that have done most in forestry matters. A few of these States have worked out problems very similar to those that now confront us and from them we may learn much. In New York, as the pioneer in this country, the legislation has developed as the result of experiment and investigation with the single purpose of preserving to the State its valuable forests. The State first, in 1885, secured control of certain large tracts of virgin forest and placed the management of these in the hands of a forestry commission. This commission was given charge of all forestry matters, including the collection and dissemination of information, the care of forest fires, the reforestation of new lands, and, in fact, was the custodian of the State's forests. This board has been several times reorganized, until the men who compose it are each charged with the responsibility of a certain part of the State's work. The remuneration is sufficient to obtain thoroughly competent persons for each department and thus secure a businesslike service. This board has expended more than \$3,000,000 in the purchase of forest lands of the Adirondacks. With it all they have wisely guided public sentiment until the people are wholly in sympathy with the work and are proud of their foresight in saving to the State so much that is vitally connected with its prosperity. In addition to this New York has established a school of forestry that has already accomplished much toward solving many problems peculiar to American forests. It is fortunate that New York has been so generous in conducting her experiments on such a large scale, for the outcome of this will be of incalculable aid to other States which have the same problems to face. We can not copy European forest methods and hope to secure the greatest efficiency in our forest work. Principles are valuable but the methods of their application must vary.

In Pennsylvania the history of forest legislation shows the usual results. Failure to fix responsibility and to arouse public sentiment made the law inoperative, but in 1897 the people were stirred to action, forest fires were promptly put out and the State has established forest reserves by retaining the land that came to it from the nonpayment of taxes and in condemning for that purpose suitable tracts at the headwaters of her principal streams. Laws relieving forest land owned by farmers from

taxation has done much to encourage tree planting, and what was missed in our own law has been secured here by educating the people to a realization of the importance of immediate action.

The States of New York, Pennsylvania, Wisconsin, Minnesota and Michigan, representing the most advanced position in forestry matters and in accord with the best judgment of the foremost forestry experts in the United States, have recognized the importance of the State in the control of her forests and the dangers of leaving an industry so vitally connected with the prosperity of her people wholly in the hands of private parties. The aim of the most rational forestry legislation should be to permit the State to obtain control of large tracts, located suitably to influence the head waters of our streams and our agricultural interests and secure permanency to our lumber industries, and then place the management of these in the hands of trained foresters who would secure from them a financial profit to the State in addition to maintaining their highest efficiency as forests. Then the maintenance of smaller tracts that may be acquired from the nonpayment of taxes and adding to these, as occasion presents, lands not especially suited for agricultural purposes. This policy, in those States where its effects have been observed, has received the universal support of the people. Depredations interfering with the best development of the State reserves can be controlled by positive legislation that will fix responsibility and punish the guilty. Forest thieves, fires, browsing on public lands, etc., could all be controlled with ease. In whatever is done the State must take its citizens into its confidence and be prepared to defend each policy or line of action by careful figures based on facts secured from the local conditions. The State should likewise avoid anything that savors of a monopoly in this enterprise and should in every way encourage private capital to coöperate in the work.

It would doubtless be out of place at this time to make suggestions for radical legislation since the present forestry board will no doubt soon have plans along this line based on the very careful study of the local conditions. I wish, however, to commend to the consideration of our legislators the very comprehensive and rational law before the Michigan legislature last winter. This in my judgment is the most perfect plan of forestry legislation that has been presented in this country. This bill was prepared by a forestry commission appointed in 1899, and was based on the needs as discovered from a study of the conditions.

The organization of the fire warden force is most complete: it places responsibility carefully and makes the expense of fighting fires fall largely upon the counties in which it exists, and if any negligence on the part of the warden is discovered the whole burden falls on the county in which he is shown to be remiss. A series of State reserves are to be established in suitable localities where land can be secured from that which has come to the State because of the nonpayment of taxes. The entire management of these forests is placed in the hands of the commission, and they are empowered to appoint a trained forest warden, with assistants, who will have the immediate management of these lands and be responsible to the commission. Appropriations are made for the work, and every phase of it seems to be covered by carefully drawn and very comprehensive legislation. While the laws are based largely on those of New York, they contain a few improvements, and in some respects they might be safely adopted by our own State as more applicable to our conditions. Certain details of the laws in many States are very valuable, but the aim of our State should be toward practical results and not to experiment with any plan unless it has proven to be applicable to many cases and might be effective in our own. The people must be shown the wisdom of each step and this will make our forestry work easy.

A word of caution in connection with the subject of legislation may not be out of place. Great care should be exercised against the possibility of excessive exemption from taxation or the raising by tax of money to pay premiums on forest plantations, else the burden will fall too heavily on our agricultural regions that are not fortunately located for forests, and result in a prejudice against any forestry legislation. While such legislation is a great incentive to forest attention and does stimulate a healthy interest in forest matters, it must not be too liberal or continued beyond a period when its educational effect is desirable, since practical forestry is a profitable occupation and should stand on its own merits. True some farmers have tried it and failed, so have they tried farming and not met with success, but long experience with forests under many and varied conditions has demonstrated the success of the plans, and there can be no question as to its outcome in our State. The problems that confront us in Indiana may be briefly stated as follows:

1. Preservation of our forests now located on lands that are not suitable for agriculture and the management of these tracts so that their productiveness will be permanent.

2. The reforestation in the most economical way of similar lands, now denuded, and securing for them the very best management possible.

3. The maintenance of such other tracts as may be necessary to secure the proper protection to our agricultural, commercial, and sanitary interests.

4. The securing of all needed legislation that will place our forestry interests in the hands of competent persons and supporting them by all authority necessary to secure wise management and permanency to the proper conditions.

As bearing upon the direct solution of these problems I may be permitted to make some specific recommendations. The State should establish forest reserves in different sections where at the public expense peculiar problems connected with each locality could be worked out by experts in charge and plans presented that would be sufficiently profitable to induce private capital to engage in the undertaking. It is further desirable that the State follow the plan already inaugurated in this country and establish in connection with one of our State institutions a school of forestry where our people could be trained in this branch of industrial activity and where the forestry interests of the State could be centered.

But in all of these matters the intelligent support of Indiana's best citizens is solicited and it is only with the hearty coöperation of every one that anything worthy of our great State can be accomplished.

Many fascinating fields for work and investigation along these lines are opening in Indiana, and it is hoped that our scientific friends may be induced to coöperate with our State board in these matters.

CORRELATION OF FORESTRY AND THE SCIENCES.

W. H. FREEMAN.

Forestry as the science of promoting and fostering the forest area by preservation and cultivation has a significant correlation with the more prominent sciences of geography, zoölogy, engineering, manufacture and government.

This as a fact is beyond questioning, but the ways, manner and extent of the correlation are not generally known, nor have educators, especially in the United States, given it merited consideration. There are excuses for this. Educators and the people generally are not to be censured for this