Report on the disastrous effects of the destruction of forest trees, now going on so rapidly in the state of Wisconsin. 1867

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REPORT.

INTRODUCTION.

The undersigned, having been appointed Commissioners, under the provisions of a law of the State of Wisconsin, entitled "an act relating to the growth of forest trees," approved March 23, 1867, to ascertain and report in detail to the legislature at its next session certain facts and opinions relating to the injurious effects of clearing the land of forests upon the climate; the the evil consequences to the present and future inhabitants; the duty of the state in regard to the matter; what experiments should be made to perfect our knowledge of the growth and proper management of forest trees; the best method of preventing the evil effects of their destruction; what substitutes for wood can be found in the state; and generally such facts as may be deemed most useful to persons desirous of preserving or increasing the growth of forest and other trees in this state—have complied with the duties thus imposed upon them, as well as the limited time and want of adequate means would allow, and now have the honor to submit the following report:

NECESSITY OF TREES.

Both past history and present experience show that a country destitute of forests as well as one entirely covered with them is only suited to the condition of a barbarous or semi-barbarous people. Deprive a people of the comforts and conveniences derived directly or indirectly from forest products, and they soon revert to barbarism. It is only where a due proportion between the cultivated land and the forests is maintained that man can attain and enjoy his highest civilization.

It would seem to be the part of wisdom in a state, as well as with individuals, to profit by the experience of others, in the present and in past time, to imitate their good works and to avoid their evil doings.

For it seems to be established as a fact that a country entirely covered with dense timber, as well as one destitute of trees, are each inhabited by savages. As heavy forests are removed and the country is brought under culture, civilization advances until a certain breadth of plowing and pasturage is reached; but if the removal of trees advances beyond that extent, so that the country is denuded of its trees, barbarism equally ferocious as in the timbered region again sets in. In the one case the savage men, desti-

tute of all domestic animals except the dog; are driven to the seacoast and water-courses, where by means of rudely constructed canoes they gratify the human passion for migration to and from their small corn patch, fishing places and hunting grounds; in the other, the horse, the camel or even the ox affords the means of wandering over extensive countries of thin grass, or desert sands, in quest of their prey.

Palestine, a land once "flowing with milk and honey," so full of native products as to attract the children of Israel from the highly favored plains of Egypt; a country which for many ages sustained a numerous, happy and prosperous people, is now comparatively a barren waste; its productions scarcely sufficient for a miserable population dwindled to only one-tenth of its former numbers. The most careful examination of the soil shows no want of the elements of vegetable growth—it remains as fertile to-day as in the most ancient times, thus showing that we must look to the changes in the local condition of the climate, rather than the exhaustion of the soil for the causes of the wonderful changes that have taken place; and these local climatic changes could only be produced by the indiscriminate destruction of the forests that originally covered the whole country.

Egypt and Palestine were once the granary of the world, but these countries have long since lost their proud position among the nations of the earth. We now claim to hold the keys to the food-production of the country, but we are also in danger of soon losing the position unless we profit by their example.

WARNINGS OF HISTORY.

Warnings from the experience of others may be found nearer home, and in more modern times. According to a recent report, it appears that in Switzerland the forests have been destroyed at such a rate that they do not now yield an adequate supply for the present inhabitants. The higher mountain regions have heretofore been considered the store houses of wood for the most populous parts of level Switzerland, and for foreign countries; but the depredations have been so extensive that many of the inhabitants are now suffering for the want of wood, and some of them are compelled to convey their fuel from six to twelve miles up the mountains. If the future forests, (says this report,) should not be better managed, and their too extensive removal stopped, they would soon be entirely ruined in some parts of these mountain regions, and then there would prevail such a state of things as already exists in Asia-Minor, Greece, a large portion of Italy, Spain, Southern France, &c., where forests abounded in former times. The decrease of fertility on the Alps, and especially on the upper boundary, the disappearance of the forests in the higher regions, the unfavorable changes of the weather during the time of vegetation, the frequent and extensive devastations of floods, avalanches, and precipitation of rocks, and large landslides on the sides of the mountains, filling up the valleys, are chiefly occa-

sioned by the extensive clearing of the forests, and the careless management, or rather, the mismanagement of those entrusted with its performance; and these persons now must ascribe the largest share of the misery which has and will befall them, to their selfishness, and their disregard of the laws of nature.

Timber protection is absolutely necessary for the successful cultivation of certain crops and fruit-trees. Dussard maintains, that the *mistral*, the dreaded northwest wind of France, whose chilling blasts are so fatal to tender vegetation in spring, "is the child of man, the result of his devastations. Under the reign of Augustus, the forests which protected the Cevennes, were felled or destroyed by fire, *en masse* A vast country, before covered with impenet able woods—powerful obstacles to the movement and even the formation of hurricanes—was suddenly denuded, swept bare, stripped, and soon after a scourge, hitherto unknown, struck terror over the land, from Avignon to the Buches du Rhone, and thence to Marseilles, and along the whole maritime frontier. The people thought this wind a curse sent of God They raised altars to it, and offered sacrifices to appease its rage."

Professor Rosa, in the Polytechnic Journal for December, 1861, gives the following: "To supply the extraordinary demand for Italian iron, occasioned by the exclusion of English iron, in the time of Napoleon I., the furnaces of the villages of Bergamo were stimulated to great activity. The ordinary productions of charcoal not being sufficient to feed the furnaces and the forges, the woods were felled, the copses cut before their time, and the whole economy of the forest was deranged. At Piazzatore there was such a devastation of the woods, and consequently such an increased severity of the climate, that maize no longer ripened. An association formed for the purpose, effected the restoration of the forest, and maize flourished again in the fields of Piazzatore"

Similar ameliorations have been produced by plantations in Belgium. Bande makes this statement: "a spectator placed on the famous bell tower of the cathederal at Antwerp, saw, not long since, on the opposite side of the Scheldt, only a vast desert plain; now he sees a forest, the limits of which are confounded with the horizon. Let him enter within its shade. The supposed forest is but a system of regular rows of trees, the oldest of which is not forty years of age. These plantations have ameliorated the climate which had doomed to sterility the soil where they are planted. While the tempest is violently agitating their tops, the air a little below is still, and sands far more barren than the plateau of La Hague, have been transformed, under their protection, into fertile fields." But to come still nearer home; many of those immigrants to Wisconsin, who came from New York and Pennsylvania, look back with pleasure to the days when they gathered peaches and plumbs, from the trees, growing wherever the seeds happened to take root; but if they return again to that old homestead they will find the primeval forests cut away and destroyed, and those trees dead.

and they will be told that new ones cannot be reared except in the most sheltered places. They will also find some of their favorite apple and pear trees falling before some unseen enemy.

The Hon. Horace Greeley, in his lecture delivered at the annual spring exhibition of the Brockport, N. Y., Union Agricultural Society, speaking on this subject says: "This matter of raising timber needs be better cared for. Taking the forest off has left our lands exposed to the bleak and driving winds, and has aggravated the disadvantages of our hot, dry summers, and bleak, cold winters. Lack of forests has narrowed the fruit region, and is constantly narrowing it. More forests must be raised, and those of the best kinds." So too, within the last ten years the peach and the pear grew in all the southern half of the State of Michigan; but now, when by the destruction of the forests, their ameliorating influence on the climate of the state is lost, the peach trees all over the state have failed, except upon a narrow strip under the east shore of lake Michigan.

T. T. Lyon, Esq., of Jackson, Michigan, a veteran pomologist of that state, places this matter in a clear light. In 1864, he said: "The natural result of this wholesale destruction is manifesting itself in the high winds, the more sudden changes, and the more extreme cold of our winters. Although in consequence of this state of affairs the peach, once almost as sure throughout our state as the apple, is now, in effect, driven under the lee of lake Michigan; and although our staple grain crop, wheat, was but two years since almost a total failure from want of shelter and protection, and though we have reason to fear that we have not yet seen the worst, the process of destruction yet goes on unchecked, and with a strange fatuity. Although the subject is one that deeply concerns us all, no measures are being taken or even seriously contemplated to stay the growing calamity.

"Two years since, at a similar meeting, I availed myself of the opportunity to urge upon the agriculturalists of the state the importance of action in this matter. During the next winter the wheat crops of the entire state, from the want of the usual covering of snow, and the general lack of shelter from wind and sun, was diminished in amount more than one half—a loss to the state in a single year of more than 5,000,000 bushels. The present winter threatens a repetition of the same calamity; and with the great breadth of wheat sown, we shall be fortunate if the amount of loss be not essentialy greater than before."

A committee of the House of Representatives of that state at its last session reported to that body on the subject of the forest trees, and stated that, last year the loss on all that part of the state lying south of the Michigan Central railroad,—a region deprived of the ameliorating influences of Lake Michigan upon the southwest side—and comprising the richest agricultural portion of the state, was estimated at no less than three-fourths of the entire wheat crop! From what inquiries they had been able to make, the loss on the wheat crops alone, of that state, for the last four years, is not

less than $20,000,000. They say that they would be most happy to believe that this enormous loss springs from causes evanescent in their nature, and destined speedily to pass away, to return nevermore. But they feared that these vast losses are but "the beginning of sorrow," and, that the improvidence which laid open their fields to that scourge of God, the southwest wind, by the wholesale destruction of their forests, is now only beginning to reap the fruit of that want of forethought; and that these losses can be avoided only by restoring in part at least, the natural barriers against the wind.

If we enquire for the cause and origin of this wind which has made such havock, in New York and Michigan, since the cutting away of the forests of those states, we shall find it nearer our own door than theirs. Nor is it alone a cold southwest wind, which chills, freezes, congeals and dries the sap of life out of vegitation, that is to be dreaded, but equally to be shunned is the same southwest wind, when in another portion of the year, it becomes as fearfully dry and hot as the sirocco from the burning sands of Africa.

Geographers have fixed the center of the United States near the city of Lawrence, in Kansas. The thermometrical observations taken at Leavenworth, 26 miles from this center, for many years have shown "that Fort Leavenworth was subjected, beyond any other part of the United States where similar observations had then been made, to sudden and extreme changes both of heat and cold, of moisture and drought." Since the settlement of Kansas, the terrible droughts experienced, and the many men who have perished with the cold on the plains between the Missouri river and New Mexico and Salt Lake, bear evidence to the truth of the observations at Leavenworth; being more than confirmed by those of Fort Larned and other posts on the Arkansas and its branches.

And this is to be expected in the nature of things. There is no large body of water in the central part of the North American continent, west of the Missouri river, which is able to exert any controling influence upon the temperature of all that region. When we go north from Leavenworth five degrees, we are in a cold and frozen climate, closed early in the fall, and locked in frost until late in the spring. Pass five degrees southward, and we have almost forsaken the region where ice may be said to form: hence this middle ground is wholly controlled by the prevailing type of the season, interspersed with the sudden and ofttimes violent injection of short periods of temperature from the opposite points of the compass. Thus the general winter may be mild, without snow, with scarcely frost enough to prevent ploughing a single week through the entire winter, and still there may come days when the thermometer will sink to 30 or 40 degrees below zero. On the other hand, in a long, cold, snowy winter, a period of very spring or early summer, as regards its balminess and comfort, may break in with equal suddenness.

The same latitude upon either the Atlantic or Pacific coast is no criterion

by which to judge of the temperature of the plains. The presence of a great ocean, with its broad, open bosom continually exposing to the biting air its fresh warm currents, and evaporating its waters to moisten the dry atmosphere, gives a stability and controls the temperature, unknown when we reach a point almost 2,000 miles from each ocean, and 1,000 from the Gulf of Mexico.

The wind set in motion on this treeless plain, charged with heat or cold, as the case may be, meets no resistance as it sweeps 500 or 600 miles, and like some falling body acquires velocity as it makes distance from the mountains to the settlements east of the river.

On the tropics the trade winds blow continually from the east. As these strike the Mexican coast in the Gulf of Mexico, they are deflected to the north along and among the ranges of the mountains east of the Rio Grande. There all humidity is lost, and they are dried to excess as they reach and pass the 40th parallel, where the prevailing winds of the globe are from the west. From the snow-capped mountains they roll in torrents across the broad plains of New Mexico, the Indian and Colorado Territories, over Kansas and Nebraska, easily surmounting the narrow belts of timber, which are at first hid in the deep channels of the water courses, then spreading out but slightly at the Missouri and the rivers of Iowa; thus almost unobstructed they fall upon the prairies and thin oak openings of Illinois and Wisconsin, without local impediment.

Having discovered whence our dreaded enemy comes, and how he comes; the remedy is plain; and it become the duty of every land owner to build up proper obstructions to his march. It is also the duty of the state to lend protection and assistance to the land owner, by the enactment of such laws as shall make it an inducement to the owners to undertake the task. As the wind comes from south of west, it indicates that the timber to break its force should be planted on the west and south sides of the land to be protected. The north side will not so much require protection until such destruction has taken place in our northern forests as shall let in the winds from the north; but even then those winds would come to us like the southwest wind which reaches Michigan, more or less tempered by passing over Lake Superior. But the beltings of any number of tracts of land of ten acres each will all be protected on every side by merely closing up their ultimate north and east sides, which may be done by a half belt, or such rows of trees as ought to be planted along every road side.

As it now is, we look over the state and see in the southern, most populous and least wooded portion of the state of Wisconsin, the forests have been destroyed at such a rate that they do not yield a supply adequate for the wants of the present inhabitants; and the forests of the northern regions, heretofore considered the inexhaustable store house of wood for the adjoining treeless districts will soon be so reduced that the people must look else-

where for their supplies, unless a better policy in regard to them be speedily adopted.

The state of Illinois is familiarly known as the "Prairie State," on account of the scarcity of timber. Large quantities of wood and lumber are annually exported from Wisconsin to supply this scarcity of timber. So apparent are the evils resulting from a want of forests in that state that there is a very general disposition among the inhabitants to plant trees, and we may in a few years find Illinois amply supplied and her fields protected with forest trees. On the other hand Wisconsin, except in a few southern and southwestern counties, is abundantly supplied with forests—so abundant that the chief efforts of the inhabitants are directed to their removal and destruction. It will not be long if this course is continued before Wisconsin will be groaning under the evils of a country exposed to the full blasts of every wind that blows. Illinois will be the well-wooded, and Wisconsin the prairie state.

In Europe where these matters are rapidly becoming better understood, it has been found necessary for the governments to manage and preserve the forests. Forestry in all its details is a very important feature of the productive economy of many of the states, and consequently much attention has been paid to it; the forests being kept with the cleanliness and good order of a park.

THE EFFECT OF CLEARING THE LAND OF FOREST TREES UPON THE CLIMATE OF THE STATE.

Temperature.—To become convinced that the destruction of the forests would increase the temperature of the ground in summer one has only to ride in an open conveyance, on a hot day, across a prairie or cleared country, and then enter the depths of a dense forest. The change is at once apparent—from the burning heat of the sun we pass to the cool shade of the trees, and find a contrast so great that it must have been observed by every one; it is the difference between sunshine and shade; and is so obvious that it seems scarcely necessary to adduce arguments or illustratrions in further proof of the fact that *clearing the land of trees increases the temperature of the ground in the summer.*

It is not to be supposed that the sun supplies a less amount of heat upon a given surface of forest than upon the same area of cleared ground; but in the former case the heat is intercepted by the leaves of the trees, and therefore does not reach the ground. Hence, although the mean temperature of the summer as measured by the thermometer in the shade in the usual way, may not be effected by the clearing away of forests, yet the quantity of heat that actually reaches the ground is vastly increased; and it is this temperature of the ground, perhaps as much as that of the air above it, that effects the growth of farm crops.

Again, if one should pass in an open conveyance from an exposed or prairie

country into one covered with trees, at a time when the winter cold is the most severe, he would immediately find a degree of comfort and relief, that renders all arguments needless, to show that *clearing away the trees from the land diminishes the temperature of the gronnd in winter.* It is familiarly known that frost does not penetrate the ground to the same depth in the woods as in the fields.

Although the thermometer will always exhibit several degrees, often as high as twenty, between the temperature of the thick woods and the open prairies; yet men do not require the delicate sense of the thermometer to teach them this truth; their own sensation advises them of the change from open grounds to the surroundings of overhanging trees, before they have time to consult the instrument. Cut away these trees and a change must follow the destruction.

In the state of Michigan it has been found that the winters have greatly increased in severity within the last forty years, and that this increased severity seems to move along even-paced with the destruction of the forests. Thirty years ago the peach was one of the most abundant fruits of that state; at that time frost, injurious to corn at any time from May to October, was a thing unknown. Now the peach is an uncertain crop, and frost often injures the corn.

Trees have a power to conduct heat, by which they facilitate its passage from the air to the ground in summer, and from the ground to the air in winter.

Trees also, like animals, have a specific heat of their own, which aids in equalizing the temperature of the surrounding air.

For some unexplained reason, connected with vegetable life, trees when in full foliage become cold at night, often colder than the air, which therefore is also cooled by this cause.

Forests, by their shade, prevent the radiation of heat from the ground.

The evaporation of a large amount of water from the surface of the leaves of trees produces coldness in the air in contact with them.

It is quite evident, therefore, that a forest is a great equalizer of temperature, modifying both the extreme heat of summer and the extreme cold in the winter; its removal makes the climate more *excessive;* the range of the thermometer being increased; and many crops, fruits, &c., that could be raised under the protection of the forests, are killed, either by this excessive heat or extreme cold.

Humidity.—No constituent of the atmospheric air is more important, or less understood, than aqueous vapor, the greater or less amount of which regulates not only the growth of plants, but also to a considerable degree the health and comfort of the inhabitants. It prevents the undue radiation of heat from the ground, and thus aids materially in maintaining that equitable degree of temperature so essential to many of the processes of nature. Here again, it will be found upon passing, on a very dry day, from an open

to a well-wooded country, that a very marked change occurs; in the woods the air is more nearly saturated with vapor, the ground is moist, and not hardened by the loss of water, and hence no further arguments need be adduced to show that *clearing away the forests from a country will increase the dryness of the ground.*

This effect of aqueous vapor in preventing the radiation and loss of heat from the ground is subject to direct measurement. During nine days in June, 1866, at Milwaukee, when the air was most nearly saturated with vapor (relative humidity 90 per cent.), it was found that the difference of temperature of the day, and of the night was 18°,—while in the same number of days when the air was most dry (relative humidity being only 56 per cent.), the difference of temperature between day and night was 29°, showing a difference of 11°, due to the existence of the vapor, which acts like a blanket in preventing the occurrence of frosts and the consequent destruction of tender plants. Forests, by increasing the moisture of the air adds to the security against frosty nights.

From observations made at the agricultural college at Lansing, Michigan, by Dr. R. C. Kedzie, as compared with those made at Milwaukee, it appears that the amount of evaporation from the surface is considerably greater in the latter place; and in the interior of Wisconsin, away from the influence of the lake, the difference must be still greater—thus showing a greater necessity for the protection by forest trees in this state than in Michigan. This necessity continues to increase as we go westward until we approach the arid and almost desert plains at the foot of the Rocky Mountains.

Trees have a very decided effect upon the temperature and humidity of the air by the evaporation constantly going on from the surface of the leaves. It is a principle in chemical science, that evaporation produces cold; and careful experiments show, that to convert water into steam or vapor 965° of heat must be supplied. In the steam engine this supply comes from the fuel consumed for the purpose, but in ordinary evaporation an equal quantity comes, (though a longer time is required,) from the surrounding air. To absorb heat from any medium is to make it cold; and the amount of heat absorbed from the atmosphere by the evaporation of water from leaves of trees must therefore be very considerable.

To estimate roughly, but with as much accuracy as possible, the vast quantity of water consumed by vegetation in one year we may assume the following data:

The average amount of earthy matter in plants, or the amount of ash left when consumed by fire is about five per cent, or one pound in every twenty. The average amount of earthy matter contained in natural waters is about eight grains* in a gallon (of 58,318 grains) or one pound in 7,290 pounds. From this it follows, that to obtain 20 pounds of wood, or other vegetable

* The water of Lake Michigan has recently been found to contain 8.30 grains in a gallon.

matter, 7,290 pounds of water must be absorbed by roots from the soil and evaporated from the leaves—for all mineral matter in plants comes from water containing it in solution—in other words, to produce one pound of vegetable matter, 365 pounds of water must be evaporated. Now, if we assume, about 6000 pounds as the annual product of an acre of land in wood, leaves, &c., a very simple calculation will show, that a rain fall of nine inches is required to supply the water which must necessarily be consumed to produce the mineral matter annually formed or deposited in the tissues of plants; a quantity exceeding one-fourth of the whole annual quantity of rain falling in this state.

The process of evaporation of water is very much accelerated by wind; for when the air is still it soon becomes so nearly saturated with moisture that no more can be absorbed from the soil, or from leaves: but when this moist air is removed by the wind the absorption of moisture continues.

The ground under the forests being shaded and kept cool, the evaporation from the surface is very much diminished, and the water of rains remains longer in the ground to supply the absorption of roots, within the forests, than upon open fields.

Another source of increased moisture under trees is the coolness of the leaves at night causing a deposition of dew, sometimes in such quantities as to cause drops of water to fall to the ground like rain.

HOW TREES AFFECT THE SPRINGS, STREAMS AND RAIN OF A COUNTRY.

From what has already been said it is evident that *clearing away the forests diminishes the flow of water from springs*. In the woods the water is retained in the soil, evaporation being prevented by the shade, while in the fields the water is rapidly evaporated, or, not being impeded by vegetation, runs off to the river and water-courses more rapidly, thus giving less time to penetrate the soil and supply subterranean passages to springs. There are well attested instances where springs have been dried up in consequence of the clearing of adjacent forests.

Forest growths are regarded by many of our ablest physicists as exerting a marked influence over the amount of rainfall in such a region. The fact that all countries abundantly clothed with forests are also well supplied with rain and the rain is equally distributed through the season of vegetable growth, would naturally lead to the conclusion that forest growths have some agency in determining this rainfall. Others have claimed that the equable rainfall was the effect of other causes, and that the abundant forest growth was the effect of the abundance and distribution of the rain, and not the determining cause of the rain. But whichever may be placed as antecedent or consequent, abundant and well distributed rain is found associated with large forest growths; and if these forest growths are extensively removed, the rains diminish or become capricious, droughts and flood alternating, while in

regions destitute of all vegetable growth, rain is unknown, as in the strong lines of the poet:

——"Afric's barren sand,
Where naught can grow because it raineth not,
And where no rain can fall to bless the land,
Because naught groweth there."

Humboldt, speaking of the effect of removing forests, says: "In felling the trees which covered the crowns and slopes of the mountains, men in all climates seem to be bringing upon future generations, two calamities at once —a want of fuel, and a scarcity of water." Herschel enumerates among the influenees unfavorable to rain, "absence of vegetation in warm climates, and especially of trees. This is no doubt one of the reasons of the extreme aridity of Spain." Aridity and barrenness, indeed, is the general characteristic of that whole country. The insane folly which has caused the people to denude the country of trees, has modified no doubt unfavorably, a climate already too dry, and strikes with astonishment and horror one new from the delicious freshness and verdure of England and our eastern States. The Spaniard, and above all, the Castilian, has an inate hatred of a tree; if he does not cut it down for fire-wood, he cuts it down because it harbors birds that eat his grain. Forests and brush alike disappear before the inevitable axe, until, as often occurs in Castile, the traveler may look for leagues over the country without seeing a tree or bush to break its uniformity. This foolish extinction of the forests has been the source of innumerable evils to the country—evils which are continually acting upon and augmenting each other. Unrestrained by any vegetation, the rain water rushes down the steep sides of the hills and over the plains, wearing them into deep gullies, and carrying off the finer and most valuable parts of the soil. The rivers, terrible and dangerous torrents in times of rain, shrink and dry up almost immediately afterwards, and the water, for which the country is gaping, hurried off to the sea, becomes lost for all useful purposes. Extreme aridity of the atmosphere, continually diminishing rainfall, and impoverishing the country, are but consequences of the denudation—a condition which nothing can now remedy but a strong energetic action on the part of the people to replant and irrigate it.

Asbjornsen says: "Numerous examples show that woods exert an influence in producing rain, and that rain fails where they are wanting; for many countries have by the destruction of their forests, been deprived of rain, moisture, springs and water-courses, which are necessary for vegetable growth. In Palestine, and many other parts of Asia and Northern Africa, which in ancient times were the granaries of Europe, fertile and populous, similar consequences have been experienced. These lands are now deserts, and it is the destruction of the forests alone which has produced this desolation. On the other hand, examples of the beneficial influence of planting and restoring the woods are not wanting. In Lower Egypt, both at Cairo

and near Alexandria, rain rarely fell in considerable quantity—for example, during the French occupation of Egypt, it did not rain for sixteen months—but since Mehemet Ali and Ibrahim Pacha executed their vast plantations, (the former alone having planted more than twenty millions of olive and fig trees, cottonwoods, oranges, &c.,) there now falls a good deal of rain, especially along the coast, in the months of November, December and January; and even at Cairo it rains both oftener and more abundantly, so that real showers are no rarity."

Boussingault, a most careful observer and guarded writer, says: "In my judgment, it is settled that very large clearings must diminish the annual fall of rain in a country."

It is a matter of common observation that springs are frequently dried up by clearing the ground above and adjacent to them. A great many instances might be given. Marschand says: "The Wolf spring, in the commune of Souberg furnishes a remarkable example of the influence of the woods upon fountains. A few years ago this spring did not exist. At the place where it now rises, a small thread of water was observed after long rains, but the stream disappeared with the rain. The spot is in the middle of a very steep pasture inclining to the south. Eighty years ago the owner of the land perceiving that young firs were springing up in the upper part of it determined to let them grow, and they soon formed a flourishing grove. As soon as they were well grown, a fine spring appeared in the place of the occasional rill, and furnished abundant water in the longest droughts. For forty or fifty years this spring was considered the best in Clos du Douds. A few years since the grove was felled and the ground turned into a pasture. The spring disappeared with the wood, and is now as dry as it was ninety years ago."

Dr. Piper, in his "Trees of America," says: "Within half a mile of my residence there is a pond, upon which mills have been standing for a long time, dating back, I believe to the first settlement of the town. These have been kept in constant operation until within some twenty or thirty years, when the supply of water began to fail. The pond owes its existence to a stream which has its source in the hills which stretch some miles to the south. Within the time mentioned, these hills, which were clothed with a dense forest, have been almost entirely stripped of trees; and to the wonder and loss of the mill owners, the water in the pond has failed, except in the season of freshets, and what was never heard of before, the stream itself has been entirely dry. Within the last ten years a new growth of wood has sprung up on most of the lands formerly occupied by the forests, and now the water runs through the year, notwithstanding the great droughts of the last few years."

It follows also, from the facts above recited, that *clearing a country of trees increases the suddenness and magnitude of floods and torrents;* trees causing the surplus water to pass off through the rivers more uniformly throughout the

season. As the trees are removed, the waters of heavy rains rush unimpeded directly to the valleys and are carried off within a short time, leaving the bed almost or quite destitute of water during the dry season. About one-fourth of the water falling in the form of rain, snow and hail in this state is carried off by rivers.

We need not have gone beyond our own state, nor referred to times longer than our own limited experience to find examples of the evils resulting from this change in the flow of rivers from one of regularity and uniformity to one of periodic floods and dry or nearly dry beds. Such has been the change in the flow of the Milwaukee river, even while the area from which it receives its supply is but partially cleared, that the proprietors of most of the mills and factories have found it necessary to resort to the use of steam, at a largely increased yearly cost, to supply the deficiency of water-power in dry seasons of the Year. Until this was done many large mills were closed for want of water in the latter part of summer and early autumn; while the floods of spring are increased until they are sufficient to carry away bridges and dams before deemed secure against their ravages. The Menomonee river, a small tributary of the Milwaukee, has been effected in the same way and to a still greater degree, because a larger proportion of the water-supplying area has been stripped of its forest trees. Several of the mills that formerly found sufficient power on this stream, have been entirely abandoned; others are propelled a large share of the time by steam. Down its channel during and immediately following heavy rains, great floods sweep along, doing more or less damage; followed in a very few days by dry pebbly, or muddy banks, and bed, in which only an occasional pool of water can be found. A small stream formerly run into the river within the sixth ward of the city of Milwaukee; it had a nearly uniform flow, and was seldom destitute of water, even in the dryest summer: in former times the beaver built his dam and constructed his curious houses upon it; but now, since the clearing away of the trees, it is only a passage way for the heavy spring rains. During the remainder of the season its bed is dry.

What has happened to the Milwaukee river and to these smaller streams, has happened to all the other water courses in the state from whose banks the forests have been removed; and many farmers who selected land upon which there was a living brook of clear, pure water, now find these brooks dried up during a considerable portion of each year.

HOW TREES PROTECT THE SOIL.

Another serious evil resulting from clearing away the forests *is the washing away of the soil* by the rains. The degradation of the soil by rains, especially on side hills, commences when the trees are removed. At first a slight break is made, along which the descending currents flow, carrying with them the softened earth, to be deposited upon the plains below, or carried off by

rivers. The removal of the natural turf or sod of the prairies has the same effect upon the soil, especially in those districts where the particles are fine, and therefore more easily suspended in water and washed away by the rain. Even the slight interruption of the protecting vegetable carpet, caused from an Indian trail, is often sufficient to cause frightful gullies in a very few years. All steep hill-sides are liable to this evil when the trees or the sod are removed. On the margin of the steep banks of lake Michigan these deep gullies are formed, making it necessary to remove the "lake shore road" from time to time farther from the water. Advantage is often taken of this process, to secure the filling of village lots in low grounds, by directing the earth-bearing currents upon them, and thus avoid the far more expensive mode of filling by the intervention of a "contractor." The curiously shaped mounds of earth representing animal and even human forms, left by the former inhabitants, could not have been preserved to puzzle the brain of the modern antiquary, but for the protection of the matted roots of the forest trees or of the prairie sod, with which they have been covered. When these are removed, the form of the mound is soon lost by the wash of rains.

We hence see that trees are required, especially on steep side-hills, and where the soil is light, to protect, by their roots and otherwise, the very soil from being dissolved and carried away by rains.

To realize the importance of this constant absorption of the soil, we have only to refer to the deep and broad valleys every where excavated, and to the deltas of large rivers, where whole states owe their very existence to the accumulations of earthy matter brought down from their channels above, including among its particles the richest soil of the uplands. The quantity of sand and mud carried into the Mississippi river by the principal tributaries from this state, especially the Wisconsin and Chippewa, is such that the current of this great river is checked in its onward flow, and formed into lakes. With the exception of Lake Pepin, immediately above the bar caused by the Chippewa river, these lakes have already been completely filled by the moving sands from above. This lake remains, only because the supply of earthy matter from above is less abundant, and requires longer time to accomplish the object. Already has the amount of earthy matter, brought into the Mississippi river from the surface of our state, been so much increased, by the destruction of the forests, and the breaking of the sod, that it begins to disturb the former condition of things; the water is no longer clear and dark, from decomposed vegetable matter, as it used to be, more sand accumulates in the stream, and a noticable quantity of saw-dust and chips from the lumber regions of the St. Croix, Chippewa and Wisconsin is also deposited along the banks. So important is this action deemed by competent engineers, that it is mentioned in a recent government report, as one requiring attention; though the gradual rise of the bed of the river, occasioned by these increased deposits, may be so slow that its effects may, for the present, be disregarded.

TREES MAY PRODUCE RAIN.

It is asserted by some meteorological writers, that trees attract clouds from a distance, and cause them to discharge their watery contents in places over which they would otherwise have been wafted, to dispense their treasures upon far distant lands. Though it is not probable that this is so to any considerable extent, it is evident that the coldness of the air in and about forests, causes them to act in the same manner as do mountains in condensing the vapors. Whatever tends to cool a moist atmosphere saturated with aqueous vapor, causes rain; and it may often happen that the conditions are such, that the slight depression of temperature caused by forests is sufficient to produce this effect.

On the hot and dry plains of our south-western territories we often see clouds passing overhead that reserve their contents until they have passed from those almost desert regions. These clouds frequently present all the usual appearance of rain in the higher regions of the atmosphere, and the fertile giving drops are seen to fall far down towards the earth, only to be dissolved and dissipated in the lower strata of air heated by the reflection from the parched earth, which these rain drops do not reach. It is quite possible and even probable, that a forest, could one be induced to grow there, would so cool the surface as to cause these showers of rain to reach the ground and thus render such forest permanent.

HOW TREES AFFECT THE WINDS.

Besides the very important influence forests exert upon the temperature and humidity of the air, they afford protection from the bad effects of high winds; both from the cold north-west winds of winter, and the hot, dry, south-west winds of summer. Any one exposed to the full blasts of either of these winds upon a high prairie, would very gladly welcome the friendly protection of forest-trees, among which he could pursue his avocation with comparative ease and comfort, listening to the whistling of the fierce winds above the tree-tops, but free from their evil consequences. To clear away the forests from the state is *therefore to expose it and all its inhabitants to the biting and blighting effects of these winds which will sweep over the surface with unabated violence.*

If the trees would not stop entirely the strong currents of the wind to which the state of Wisconsin is subjected from its vicinity to the great lakes on the one hand, and the greater plains and prairies on the other, being itself in part a prairie; and that which was not prairie at the first settlement fast becoming so, they would certainly have great influence in modifying those currents. Whether we adopt the theory that the motion of the wind be that of a soft body rolling over the surface of the earth, or if a body sweeping along like the current of a river, slightly retarded by contact with the upholding surface, need not be discussed or decided. In either

case the moving current must rise above the tree tops, and leave the surface almost undisturbed. Very much of this effect will be produced by belts of trees, especially if they be closely planted.

Any obstruction to a current of the wind will affect that current as it passes over to a distance farther than is generally supposed. Thus, Blequerel states: "In the valley of the Rhine, a simple hedge, two metres in height, is a sufficient protection for a distance of twenty-two metres," or a wind-break—thick belt of trees, will protect a width of space eleven times its height. Experiments on the seacoast, at Nahant, where the winds strike with full force upon the sandy beach, have proved that a barrier formed with pickets, or narrow boards, set alternately, so that the currents of air can pass among and through them, and not be compelled to rise in a solid sheet over them, is a more effective wind barrier than the solid body of a house or wall, and much less likely to be blown down. Apply this principle to a thick-set tree -belt, of deciduous and evergreen trees, sixty feet high, and the protection reaches six hundred and sixty feet. Such a belt placed around a lot 40 rods square, containing ten acres of land, will completely protect it from the effects of all winds that may blow.

The effect of a very slight obstruction to the operation of the wind, will have been noticed by every observing man, who has planted his winter wheat with a drill. Mr. Lyon, the secretary of the state board of Agriculture of Michigan, in 1865, says: "It is presumed that during the seasons from 1861 to 1865, few of us failed to observe that even the protection of a ridge or dead-furrow, running north and south through a field of wheat, was sufficient to preserve a streak of green where all else was brown and bare; and that the shelter of a fence was the means of preserving a still greater breadth; while the interposition of a hedge of oak grubs, or a body of timber invariably secured the preservation of a fair crop over a still greater breadth of ground, often amounting to an entire field."

In many parts of that state as well as in Wisconsin, the farmers having learned their ideas of farming from farther east, and where another and different climate prevails, harrow in their wheat, and then roll the ground smooth Such sowings are here almost usually entire failures, while where the ground is left rough either with the cultivator or drill, a crop may be expected. The reason why the crop is secured, when protected from the bitter, biting W. S. W. wind, is not hard to find; for besides the shelter from the wind, it encourages the snow and moisture to lie on the ground and give the grain the warm covering of snow which God has prepared to protect the earth and vegetation through the winter, When vegetation is covered with snow it is almost always sure to live through the winter's cold. But we have no surety of this covering, or of its equal distribution over the surface of ground laid open to the full sweep of fierce winds.

Cutting away the forests causes the snow to *accumulate in drifts, leaving portions of the land bare and unprotected while other portions are buried in accumulated*

masses of snow, or it is speedily evaporated by the currents of dry air from the arid plains. Consequently obstructions which prevent the snows from blowing into drifts, also prevent them from melting and drying away by the action of the winds.

Every cultivator of winter wheat knows the advantages to his crop from a uniform covering of snow remaining upon the ground during the winter; it keeps out the frost and protects the tender roots from those sudden and extreme changes of weather, to which they would otherwise be subjected. "Winter-killing" is one of the results of the alternate freezing and thawing of the soil, which by the expansions and contractions, always accompanying changes of temperature, break the roots from the stem and thus destroy the plant; all this is prevented by a slight, even, covering of snow. In some parts of the state where the snow falls early and is kept in its place by surrounding forests, it is not found necessary to dig potatoes from the ground until spring; the covering of snow being sufficient to protect them from injury by the severest frosts. In such places the ground is seldom or never frozen.

The importance of warding off the cold north-west wind that often depresses the temperature below the zero point, is sufficiently apparent to all; and it is almost equally important to secure protection against the hot, dry winds that often blow with such force, and produce such blighting effects, from the south-west. This protection can easily be secured by belts of trees.

We shall elsewhere show, that at least 18.75 per cent. of the land in this state is required to be cultivated with timber, in order to the occupancy of the land itself, and to the comfort of the people. Should this timber land be distributed in belts around every ten square acres, the belts will be nearly one rod wide, or around every forty square acres, nearly two rods wide on every side of these square fields; and when the fields are joined to other fields similarly enclosed the belts will be doubled; thus giving to each ten acres at least a sufficient belt to form a perfect, compact protection to the field. With such belts, it may be presumed that our spring wheat might be changed to winter wheat, which from its greater quantity and quality, and consequent higher price, would more than compensate for the less than two acres of land included in the timber belt.

Says J. J. Thomas: "Isaac Pullen, a well-known nurseryman at Hightown, New Jersey, showed me last summer (1864) several belts of evergreens which had sprung up from his nursery rows to a height of twenty-five or thirty feet in ten years, and he stated that within the shelter of these screens his nursery trees, as well as farm crops, averaged fifty per cent. more than on bleak and exposed places. I have known an ordinary English thorn hedge, which had been allowed to run up without shearing, twenty feet or more in height, to shelter and save from winter killing a crop of wheat as far as its influence extended, while beyond this the grain was nearly destroyed; yet this narrow

hedge, only a few feet in thickness, formed a very imperfect screen when compared to a mass of trees several rods in breadth."

Wall protection is well known to gardeners, and every skillful horticulturist is aware that tender plants will survive the severe winters when surrounded or overshadowed by evergreens, that would die without such surroundings; and every woodsman knows equally that the ground seldom freezes in the thick set forests. Every observant farmer must have seen his young plants of grass and grain frozen up by the frosts, beaten about and torn entirely from the ground by the winds.

If tree belts in New Jersey have been known to increase the production of the land fifty per cent.; and if one half of this increase could be realized in Wisconsin, the surplus farm products of the year 1866 would have netted the state the sum of $17,300,000. This sum would have been added to the wealth of the state with but very little additional expense. The estimated value of nine of the principal crops of 1866 is $69,500,000.

If lands could be made to yield one-fourth more income, their value is increased correspondingly; and the hundred and twenty milions aggregate value of farm lands in the state becomes $157,500,000.

If the extreme cold of winter can thus be moderated, it would prevent the destruction or injury of many of the crops, and the finer fruits we attempt to cultivate; and thus extend northward the area over which they can be produced with certainty.

But winter is not the only season of injury to crops. Sweeping tempests beat down grain fields, level the heavy grass of the meadows, and break down the corn. Orchards are severely whipped about, destroyed and dried up by the blasts that sweep over them in summer.

On the 14th and 15th of June, 1861, one of these very hot dry winds blew from the south-west over a considerable portion of southern Wisconsin and northern Illinois; its origin and progress has not been studied; we know not from whence it came, whither it went, nor what further mischief it produced in other portions of the country. Its effects upon young trees exposed to its full influence, were like that of a hard frost, killing the leaves, which remain on the trees in a crisped, withered and blackened condition, for a number of days afterwards. The effect upon the person was that of suffocation, and excessive dryness of the skin and throat. During its continuance the barometer at Milwaukee fell from 29:59 inches on the morning of the 13th to 29:00 at 2 p. m. of the 15th; the "elastic force of vapor" in the air was diminished from an equivalent of 0.514 inches of mercury at 9 p. m. of the 14th to 0.350 at 2 p. m. of the 16th; and the "relative humidity," or proportion of moisture in the air, as compared with that which it was then capable of holding, was reduced from 69 per cent. at 7 p. m. of the 14th to 34 per cent. at 2 p. m. of the 15th. Such extreme dryness is quite unusual even in Wisconsin.

Fruit trees, especially the more tender and valuable kinds were injured, the

leaves and even young twigs being blasted and killed; and the fruit torn from the stem. Occurring just at the time when wheat was forming its heads, in some counties, and the whole plant in a tender, rapidly growing condition, it caused a rust that severely injured the crop. The injury to fruit and ornamental trees was much augmented by the mechanical effect of the violent wind, switching about the branches and leaves. Cherries and plums were especially injured, the fruit falling from the trees as though a hard frost had cut them loose from the footstalks. Fruit-growers who had watched the young fruit with interest, saw it fall to the ground when the "hot wind" came.

Passing through the dusty streets of cities and villages these high winds sweep away the loose particles in the form of clouds of dust. If the soil consisted of loose sand, much of it would be driven before the wind like the sand storms of a great desert.

During the continuance of these "dry storms" the electrical condition of the air is disturbed; the positive electricity being reduced to zero, or converted into negative, gives rise to lightnings and hail.

Orchards and crops protected by a sufficient belt of trees on the south and west side were found to be uninjured; and the damage resulting from this one storm, was, doubtless equal to the cost of such protection around a very great number of farms.

The south-west winds in Wisconsin, especially when the shape of the ground is such as to concentrate their force, have the effect of causing trees to lean towards the north-east; as may often be seen in the openings where the trees do not protect each other by growing in masses.

There is on the borders of the upper Wisconsin river, and stretching far towards the east and west, a district of country embracing several counties, underlaid by the "Pottsdam sandstone," where the soil is thin and sandy, with only sand below. This light, thin soil will yield but a very few crops, with our usual careless culture, before it will become exhausted, and the trees and sod being removed, there will be no protection against the motion of this sand by every wind that blows; hence the *clearing away of the trees* from this sandy *district, will so loosen the soil that it will be blown away by the wind* The peculiar structure and arrangement of the distorted layers of some portions of the sandstone at the Dells of the Wisconsin river and elsewhere, seem to indicate, that there was a time when this district was covered by a desert of loose drifting sand, such as can be seen in the great deserts of our day. Now, since nature has clothed these sandy places with fertility, arrested the motion of the loose particles by covering the soil with a dense growth of forest trees and bushes, it becomes us to beware how we interfere with this new order of things, lest by the thoughtless destruction of the ameliorating causes we bring back these lands to their former condition of barrenness and sterility. What has been once, may be again! On the other hand, if we study the laws by which the condition of a country is improved,

and so operate as to assist rather than to retard nature in her efforts, we shall certainly be pursuing the wiser course.

That this is not an idle suggestion may be shown by the experienoe of other countries. The burying of several towns and villages in England and France by blown sand is upon record; near St. Pol de Leon, in Brittany, a whole village was completely buried beneath drift sand, so that nothing was seen but the spire of the church. A part of Downham, in Suffolk, England, in 1688, was overwhelmed by sand which had traveled five miles in a century and covered more than 1,000 acres of land. A considerable tract of cultivated land, on the north coast of Cornwall, has been inundated by drift sand forming hills several hundred feet above the level of the sea.

The prevailing winds in Wisconsin, being from the westward, the villages and cities towards the east will be endangered, by loosening and thus setting this sand a-drift.

Along nearly the whole eastern shore of Lake Michigan, sand hills are found; the sand probably thrown up by the waters from beneath the water. These immense "dunes" are now confined to the mmediate shore of the lake by the dense forest behind them. A struggle is going on between the sand and trees, for the mas·ery of the situation; and already many large trees are buried half their length while still maintaining their original position. When the thoughtlessness of the people shall have removed these trees and sent them to Illinois and Wisconsin in the form of lumber, or burnt them in the log heap, they will very soon have cause to regret their folly.

TREES AFFECT THE ELECTRIC CURRENTS.

According to the very careful, patient and exceedingly delicate observations of Dr. A. Wislizenus of St. Louis, continued through several years, it appears that there is almost always more or less positive electricity in the atmosphere; most in winter, least in summer, corresponding inversely with the temperature; with a regular daily fluctuation, the greatest amount being at 9 A. M. and 6 P. M.; the least at 3 P. M. and 9 P. M. It is when the amount of positive electricity in the air is small or none, that we must look for thunder-storms, hail, rain, or high winds; all of which are usually accompanied by *negative* electricity. Now, any thing that tends to keep up a due equilibrium, to prevent the occurrence of negative electricity in the air, will therefore, by just so much, diminish the liability to storms with thunder, hail or dry winds. In some distr cts in Europe, where hail storms are so frequent as to cause considerable damage to crops, the experiment has been tried of preventing their occurence by very numerous lightning-rods (called paragreles), and with great success. With the exception of the beech, our trees may be considered as so many paragreles, carrying off the surplus electricity before it has time to accumulate in distructive quantity. Trees and lightning-rods do not attract the electricity from the clouds, as many suppose, but only afford a convenient conductor over which it can pass

more readily than through non-conducting vacant air. In this country the amount of danger by hail is so small that no artificial protection is deemed necessary.

TREES PURIFY THE AIR.

Forests afford other incidental benefits to man besides their effect in modifying the climate, affording a supply of wood, &c. They purify the air by absorbing the carbonic acid gas, which, when existing in sufficient quantity, is destructive to animal life, and by emitting, at least during sunshine, oxygen gas. They are supposed also to destroy that unknown something that we call miasm in the air, and thus prevent sickness.

TREES ENRICH THE LAND.

By their annual quantity of leaves, detached bark and twigs, and by their fallen trunks, they supply the soil with a larger amount of vegetable matter than they consume, so that its fertility is always increasing; they constitute one of the grand provisions of nature for the restoration of exhausted lands. Newly cleared land is always most productive; and leaf mould is sought for by the skillful gardner, as the soil most to be relied upon, when he wishes to rear some rare and delicate flower; it is the richest in the elements of plant-growth of any kind of natural soil.

SUMMARY VIEW OF FACTS AND CONSEQUENCES.

While there is no doubt but that these very decided changes of climate can be produced by man, by the rearing or by the destruction of forests, it must be remembered that after all, they do not materially change the great climatic laws due to the latitude in which we live; though we can protect the ground occupied by our growing crops from the fierce winds; those winds will not cease to blow; though we can secure shade, the piercing rays of the sun will in no wise be abated, and though we may prevent the undue evaporation of water from the soil, the quantity of rain will be but little if any changed. We here have the ready explanation of the great differences of of opinion upon this subject among men; the changes being local and *not* general. It may be true that the annual quantity of heat received from the sun upon a given quantity of land is the same through all time, yet it will be found to make a vast difference with the condition of that land, whether this heat is, or is not, permitted to strike the ground.

From the facts already given above it must be quite evident that clearing away the forests of Wisconsin will have a very decided effect upon the climate and productions, and therefore upon the inhabitants themselves. The summers will become hotter and more oppressive; the winters colder; both the cold blasts of winter and the hot winds of summer will have full unobstructed sweep over the land; the dryness of the ground will be increased; springs dried up; rivers cease to flow at some seasons of the year, and become great floods at others; the soil on sloping hills washed away; loose

sands blown over the country preventing cultivation; snow will accumulate in great drifts in some places, while other places are left bare and unprotected; the ground become frozen to great depth; vegetation retarded in the spring; the productiveness of the soil diminished; thunder-storms will be increased in number and violence; and there will be more hail and more heavy, damaging rains.

Under these changes of climate and productiveness, the people being deprived of so many of the means of comfortable living, will revert to a condition of barbarism!

While we are holding out inducements for the oppressed of all the earth to make new homes in our midst we are planting the seeds of decay, that will sooner or later render their homes miserable, and send these people and their posterity to other, more favored lands, for that home they will have failed to find here.

Of the consequences of the destruction of the forests to the future inhabitants of the state we can only judge from the experience of other countries where selfishness, folly and want of proper appreciation of the wants of the future, have already brought upon them the evils that may soon be looked for here. Consult the history of Egypt, of Palestine, of Greece, of Italy, and we shall see that the original fertility and productiveness of a country may be destroyed; a country capable of sustaining a dense population of happy, prosperous and civilized people, may be converted into one of comparative sterility where the scanty population living in tents, or rude huts, are but little above the lowest of the human family. Such may be *our* future unless we profit by their example.

GENERAL CONSUMPTION OF WOOD.

What substitutes for wood can be found in this State to supply its place, and thus diminish the demand, as well as the necessity for its consumption, is another important question for consideration. The geological age of the rock formations is such as to preclude the hope of ever finding coal in Wisconsin; and peat, though an important item, that may hereafter be much used for fuel, can never supply the place of wood to any considerable extent. The cheapened processes for the manufauture of iron has induced the substitution of that material for wood in many important cases, but so much wood is consumed in its production that this is scarcely an advantage. The same may be said of brick as a material for building. Stone may be substituted for wood in building houses, fences, making pavements, &c., with the greatest advantage. Our numerous stone-quarries afford excellent building material, in any desired quantity; and as the unsettled portions of the State become more fully explored and developed, there is no doubt but that these quarries will be increased in number and in value. Granite, and even marble may, some day, become important items of consumption and export from Wisconsin.

It is quite certain that no substitute can be found to supply the demand for

wood, and, therefore, it must either be preserved or its growth provided for.

There is no coal in Wisconsin, and all that may be used in the State must be brought from a distance of at least 300 miles, and at an expense greater than the first cost, and thus place it entirely beyond the reach of the common people for fuel, even in our cities and villages. We must, therefore, look to our forests for our supply of fuel. The county of Rock contains 36,033 inhabitants; it also has 720 square miles of territory, or 50 inhabitants to the square mile This is about an average of the population of the southern counties; and gives to each square mile 10 families of 5 persons each. To supply the present population with fuel for all purposes, including what is used in the houses, shops, schoolrooms, stores and offices, it will take at least three cords of wood to each person, or 108,099 cords of wood every year for the use of the people of that county. Culculating again 40 cords of wood to the acre, and allowing that the same land may be cut over once in 25 years, and it will take 67,562 acres, or 94 acres to each square mile to grow the fuel of the county. If to this be added the land necessary to grow the timber for buildings, fences and other uses in which wood is indispensible, we shall not over-estimate, if we set the amount at 120 acres, or 18¾ per cent. of all the terriotry of the country, as necessary for this purpose.

If this amount of land be stretched out in one belt it would be one mile long and 60 rods wide, or placing it on two sides of each forty acres, it would be 7½ rods wide, leaving a surplus sufficient to require a double row of trees along the highways. The French and German economists have estimated the amout of land necessary to be covered with trees in those countries, excluding fruit trees, at one-fourth the entire surface. The remaining 6¼ per cent. of forests might be advantageously placed upon the broken and more barren lands, where other crops would not grow, and along the roadside.

The quantity of land here given might be perhaps reduced one-third by thickly planting only the most rapid growing of the hard woods, that are rated also high as fuel; and giving to them careful culture and trimming.

CONSUMPTION BY RAILROADS.

The railroads of this State must ever consume vast quantities of wood for for fuel, sleepers, bridges, piles, cars, buildings and other uses where it is absolutely indispensible. Take the Milwaukee & Prairie du Chien railroad as an example, and the amount of all may be arrived at It takes 150 cords of wood as fuel for each mile of this road to move its freight, for one year. Apply this rate to all the roads in the State, already nearly 1,200 miles in length, and we have an annual consumption of 180,000 cords of wood burnt. If 40 cords of wood be cut from the acre, it will take 4,500 acres to be cut over every year to supply this demand, and as the same land if replanted to to trees, cannot be again cut over, under 25 years, it must take 112,500 acres of land to grow wood for railroad fuel, even if there be not that increase in

the amount of business, which is more than probale to happen. This land stretched out the entire length of the roads would give a strip 48 rods wide.

Besides this demand for fuel the roads in their first construction require 2,880 sleepers per mile, to produce which will take the bodies of at least 1,440 trees. These must be supplied anew once in six years; and as only oaks, red elm, cherry, black walnut, tamarack, red pine and hackberry will answer for this purpose, and as the trees must be at least a foot in diameter, the trees cannot be grown in less than 30 years. The roads also require similar and larger timber for bridges, piles, turn-tables, depots, cars and other uses. These trees will require enough more land to make the strip, when completely and thoroughly planted and protected, 80 rods or one-quarter of a mile wide the entire length of every railroad in the state; or 197,000 acres of land to supply them with fuel and timber. Such a belt of timber evenly divided by the line of the road, would effectually check all driftings of the snow on the track during winter. Considerable drifting might also be prevented by planting the ground enclosed by the railroad fences, on either side of the track, with cedars, pines and larches. Although coal and peat might be used for fuel, still the other demands would remain to be supplied with wood.

HOW CHEAP WOOD AFFECTS THE COUNTRY.

Cheap houses, cheap fuel, cheap bread and cheap transportation for passengers and freights, are among the fundamental elements of a nation's growth and prosperity. A nation that produces the raw material for manufacture and commerce, at low cost—whose people provide their own houses and raise most of what they consume—which moves its people, its products and manufactories, quickly and cheaply, is in the best condition to establish the most complete division of labor, and to give to every man the results of his ability, energy and skill. The question of cheap and abundant wood must enter largely and constantly into each of these departments of industry and living.

The growth of most of our western cities, especially along the great lakes and rivers, has been the wonder of the civilized world, and deservedly so. Their progress has generally been attributed to the cheap and productive soils in their immediate vicinity, and doubtless in a great measure this is true; but any one who studies closely and carefully the elements that have contributed to that greatness, will find cheap lumber and cheap fuel the greatest of all. A few years ago when Chicago and Milwaukee and other places on the lake shore were making such wonderful strides towards becoming what they now are—opulent cities—when our inland villages and cities were keeping pace with these emporiums; pine lumber could be had in the lake ports for about eight dollars per thousand feet, and good fire wood for three dollars per cord. At such cheap rates for building materials there was no reason why buildings, stores and warehouses should not spring up on every

hand, as if by magic. Bread at the same time was cheap and men flocked here to escape the hunger which pressed them in other countries. Wood was cheap to supply them with fuel for their houses, and to transport them to our shores by steam. The same materials of lumber and fuel have doubled, tripled and quadrupled their former prices, and those cities, villages and towns continue to thrive, because they have grown rich and are able to pay more; and by the opening of new and better means of transportation, the costs of moving the people and the freights yet remain comaratively cheap. But this march in the road of improvement cannot always remain. Cities like men can never become so rich that they can continue to increase in wealth after they have to pay more for building materials, than the buildings will pay interest upon when they are constructed; nor will men remain after rents excel wages.

In the erection of ordinary buildings of brick and stone, except cut stone walls, with wooden floors and joists, it is estimated that the cost of timbering, flooring, roofing, wainscotting, the finishing of entrances, cornices, cupulas, doors, window-sashes and blinds, makes an expense for wood work exceeding all the brick and stone work. If the walls are of bricks, then it required wood to burn them from the clay, making one-third of the expense. The lime is burned with wood, and half its value arose from that item. The clay is in the bank, the rock is in the quarry, and wagons composed greatly of wood must carry these to the kiln, and then to the place where they are to enter into the building. But we have not gone far enough back yet. The brick-maker, the lime-burner, the stone-mason, the brick-layer, the plasterer, the painter, the carpenter, the common laborer who tends to all these, and the farmer who feeds them, have all needed wood in their houses for fuel, in the construction of their dwellings to shelter them, and in their stables to protect their animals. But if we come to the building itself. The hogsheads and lime-boxes, the hod and scraper, the mortar-bed and board, the pail and water barrel, the hoe, shovel-handle and rake, the tressels and and scaffolds, inclined planes and ladders, the plumb and trowel, are wood. As with the mason, so with the carpenter, the plasterer and painter, every thing they grasp to work with is first of all wood.

There were in the United States in 1860, 3,362,337 dwelling-houses, besides all public buildings, churches, educational institutions, stores, manufactories, depots, warehouses, barns, &c. How large a proportion of these were brick and stone we cannot tell, but by far the great majority were of wood. What proportion of their cost came of wood? A little hardware, a little paint, a little masonary, a little plastering and all else is wood. The barns for keeping the hay and grain must be wood, or else a space must be left next to the wall for the air to circulate. The out-houses and fences are generally of wood.

But these houses, barns, out-houses and fences give one-half the value to

the entire farm, as it is assessed to pay the taxes of the government; and the value of the farms in the United States in 1860, was $6,654,045,007, and these buildings then were worth $3,327,022,503.

All these houses, barns, out-houses, fences, &c., must be replaced in about twenty years, or if some remain others of equal value will be constructed. The whole must come from the trees. At the present rate of destruction where is the timber to come from? What provisions are the land-owners making for the future? What step does the state take in order to keep up the assessed value of its lands?

But we must not stop with the additions made to the assessed value of the lands by the use of wood; the additions made to manufactures are not less important than those to the real estate, and from which the government draws a revenue. When we compare the different manufactures of the United States with each other, we shall find that those in wood out-strip all the others. The value of the manufacturers from the grist mills in 1860, reached $223,144,396, and of cotton fabrics $115,137,926. The value of the sawed and plained lumber as it came from the mills, was $96,000,000. The products of the grist mills gave employment to 19,000 professional bakers, and those of the cotten mills employed 96,000 tailors and tailoresses, while the lumber gave work to 242,958 carpenters, all of whom are men. The pig and bar iron and iron machinery manufactured was valued at $94,460,481—less than the raw lumber as it came from the mills. There were also 29,223, cabinet makers, producing $22,701,304 worth of ware; and 3,510 musical instrument makers, producing $5,791,807, from wood. More than 60 other trades dependant in whole or in part upon wood as their material for manufacturing, employed 500,000 men, the value of whose workmanship is not given, but if estimated at $1,000 each, gives a total value of $500,000,000 for those trades—nearly equal in value to the manufactures of the grist mills, cotton, woollen and iron establishments.

In 1860 the ship tonage of the Union was 5,539,812 tons and worth $40 per ton, giving a value of $221,592,480—nearly the whole of which was composed of wood. The woodwork in the railroad superstructures, bridges, cars, engines, depots, engine and car-houses of the United States has been estimated at $216,000,000—equal to one-fifth of the entire cost of the roads; and these are the least durable portion of the roads. An estimate for the fuel, repairs, fences, &c., for the roads, require $141,085,104 annually. Alltogether, then we reach the same conclusion as to manufactures, as in relation to real estate, that one-half the values on which taxes are levied, has its origin in or is composed of wood. But all this use of wood is accompanied by an enormously increasing consumption, and the wood must be replaced by other wood, which has to be grown.

Here is an interest outreaching all others in value, which has received no fostering care from the government, nor scarcely any attention of public

men, less from the landowner. The whole country is beginning to feel the want of timber for buildings. The demand for lumber is now so great that in the midst of the pineries of this state, a poor man cannot to-day build his wooden house for the same amount of money, that ten years since he could have built the same, after the lumber had been carried from 400 to 600 miles by water and rail from that same pinery. It now takes four times the money to buy the lumber for the house, and consequently four times the number of days' work to earn the necessary money with which to do it. The poor man is therefore no longer the owner of the house he lives in, but he is a renter, paying often fifty per cent. upon the cost of the building. These men of all others require cheap lumber in order to give them cheap houses.

The walls of the house may be formed of stone, or brick, or grout or even adobes, but still there exists the same unvarying need of lumber for the floors, roofs, doors, casings, &c., which will cost as much as the walls themselves, if brick or stone, and more than the grout and adobes. For these purposes, dear as lumber is, no other material so cheap and good as wood can be substituted for it. If it be the duty of government to legislate for the contentment and happiness of the people, then it is its duty to do all in its power, without serious oppression to other interests, to furnish the people with cheap lumber. This it can do by encouraging its growth.

Since writing the above the circular of Woolner and Garrick, lumber dealers at Chicago, dated August the 1st, 1867, has come to hand, in which is the following table, showing the amount of lumber received at that port:

RECEIPTS.	LUMBER. FEET.	LATH. PIECES.	SHINGLES PIECES.
Receipts for 1860,	255,147,000	30.509.000	133,578,000
Receipts for 1861,	249,308,000	32,667.000	79,356'000
Receipts for 1862,	299,365,000	23,880,000	131,225,000
Receipts for 1863,	393,074,882	41 665.000	152,485,000
Receipts for 1864,	480,165,000	63,805,000	133,360,000
Receipts for 1865,	832,869,856	62,555,000	276,510,000
Receipts for 1866,	698,048,715	78,405.000	399,038,000

Taking this table as a basis of calculation, and allowing that one hundred feet of lumber is equal to one thousand pieces of lath or shingles, and we then have for the 78,555,000 laths, and the 399,038,000 shingles, 4,715,930 feet of lumber; which being added to the 698,048,715, makes the whole amount 702,764,645 feet received during the year 1866. Comparing the years from 1860 to 1866 inclusive with each other, it will be found that there has been an annual increase since 1860 of 63,710,969 feet of lumber, which will give for 1867, 766,475,314 feet. The table of receipts up to August 1st, compared with former years, indicate that it will exceed that amount.

RECEIPTS.	LUMBER.	LATH.	SHINGLES
	FEET.	PIECES.	PIECES.
Receipts from Jan. 1 to Aug. 1, 1865, ...	291,413,989	25,636,000	111,246,250
Receipts from Jan. 1 to Aug. 1, 1866, ...	297,213,627	42,001,300	216,423,500
Receipts from Jan. 1 to Aug. 1, 1867, ...	382,602,673	61,662,150	211,389,000

Again allowing that a sound stem fifty feet long, and 24 inches in diameter, or four logs 12 feet, may be cut from a tree ; at that rate it will take 878,456 such trees to make the lumber landed in Chicago last year, with an increasing ratio requiring 79,639 trees each year, and gives 958,095 trees for the lumber of 1867, and 1,037,734 for 1868. This is for a single point where lumber is received.

The same report informs us, that "Canada lumber has only arrived in limited quantities, and of but very ordinary quality, the prices to be realized, after deducting duty, not warranting any extensive shipments." Consequently the lumber landed at Chicago, must have been cut in the forests of Wisconsin and Michigan.

Allowing again that the amount of lumber received at the other lake and river ports in Wisconsin and Michigan and not reshipped to Chicago, together with what has passed out of these states by the Detroit and Mississippi rivers, equals the amount received at Chicago, and then there will be taken from the woods of these states 1,532,950,626 feet of lumber, requiring 1,916,189 trees. Two millions of large pine trees cut from the forests of two states, in a single year, to supply the lumber demand of that year!

How long will these forests last? This to our people is a serious question indeed. Some estimates may be made. Suppose there are now left 7,500 square miles in each of these states, which will give 19,200 trees each, or thirty trees to the acre, yielding 24,000 feet of lumber; then on these 15,000 square miles there will be 288,000,000 for cutting. If there was no increase in the cutting, but just 2,000,000 were cut each year, then the forest would last 144 years. But the increased demand of about 160,000 trees is such that the annual cutting is doubled in less than thirteen years, and therefore the whole amount must be cut in fifty years—less than one-half the time necessary to produce similar trees. When that time comes, when the famine of lumber is on us, the taxable property of the state will loose a large per centage of its value, and manufactures of lumber must almost cease, with with its use in buildings. And another and severer wind than any that now reaches us, will come to us unrestrained from the north. That will be a sad day for the state. But come it surely will, unless the people shall immediately take steps to renew their forests.

THE NECESSITY OF CHEAP MOTIVE POWER.

Cheap motive power is not less essential to the happiness and prosperity of a nation, than is cheap bread and cheap houses. Machinery for manu-

facturing and transporting freights and passengers are moved by steam, and the cheaper the price of fuel, the cheaper must be the manufactured articles, freights and transportations. Stationery machinery may be moved in some instances by water power, at cheap rates; but water is not always where such machinery is required, never where a locomotive power is required. In such a situation steam alone seems adapted to the purpose; and the generation of steam requires the consumption of fuel.

There is no coal in Wisconsin, and we may never expect it will be cheaper than at present, when the nearest coal bed is 300 miles distant. Such a distance over which so bulky an article is to be transported must keep the price of coal as fuel beyond the reach of the poor man, and the general manufacturer as a motive power. Bituminous coal as it is delivered in its wet state, contains less heating properties, pound for pound, than dry wood, and is far less pleasant and cleanly for use. Therefore even black jack oak, which when dry weighs about 3,500 pound to the cord, when this can be obtained at $8.00 per cord, is cheaper than coal at $5.00 per ton—a good deal lower than it can be bought. The people, therefore, will not look to coal for fuel; neither will railroads or manufacturers.

If we turn to the peat bogs and expect to find cheap fuel in them, almost innumerable difficulties and obstructions will present themselves, in mining and preparing the article for fuel, all of which must enter into its cost; and thus tend to keep the prices up as compared with wood. Moreover, the peat bogs are far from inexhaustable. Nations are not men, whose life is less than four decades. Nations live for centuries, and the multiplying generations out-live the nations themselves on the earth's surface. On this question of fuel, we are to calculate by ages of the earth, and not by the life of man. Fuel will be required so long as man shall inhabit the earth, for his comfort and for his existence. Without fuel humanity would cease to exist. Viewed in this light, the deposits laid up during uncounted periods of time, and creation's rounds, in the shape of coal, petroleum, and peat, and which man is now drawing out and using for fuel or wasting, must be exhausted.

An acre of land contains a superficial measure of 1,636½ cords. But peat raised from its bed and manufactured shrinks one-half in bulk, in manufacturing and drying. Now suppose that 3 solid feet of peat are equal to 4 solid feet of wood in weight, and heat giving properties; then a bed of peat must be 6 feet deep to equal a pile of wood 4 feet high which would cover the same ground; or an acre of peat 6 feet deep is equal to 1,636½ cords of wood. Although some of the peat beds are much more than that depth, it is doubtful if they will average more. Such beds where they can be drained easily, are readily worked out. After which the peat will not again be reproduced on it, any more than the coal will again return to fill the cavities of the earth; at least not in the probable period of a nation's existence. The quantity which any bed will produce may be easily calculated, by allowing for every six feet in depth an equivalent of one cord of dry hickory wood.

It is submitted, whether these bogs will do more than furnish a supply of fuel, until forests may be raised, should we begin immediately in the work of planting. But peat cannot be depended upon for a permanent supply of fuel, as the beds must be exhausted much sooner than the boal beds of those States which have them. Both must be exhausted in time, if worked by man. We do not make these remarks to disparage peat as a fuel of good heating qualities, but as a warning against depending upon it to the neglect of depending upon wood as a permanent source of supply for fuel.

There is another consequence of digging out the peat bogs, and especially such as cannot be completely drained to the bottom of the bed, which ought not to be overlooked. When the peat that now fills the basin of the bogs shall be dug out, that basin will fill with foul, stagnant water, and so render the country around unhealthy; whereas the water now in the bog is charged with antiseptic material, which renders it free from all malaria.

Again, it is submitted whether more fuel cannot be obtained in the periods of time, from the bog by properly preparing, and planting it thickly with black-ash, tamarack, red-maple, and other trees that it will produce, without empyting the the basin, or injuring the peat for the use of future ages, than by digging out the peat now, and making a stagnant pool valueless to posterity, and detrimental to the State.

The statisticians of England have cast the period of the coal beds of that country. An article in the London Times, dated April 19, 1866, speaking of the duty of England to set herself at once to work paying off her public debt while her supply of coal shall last, says: "But we must look beyond this century. IN THREE GENERATIONS—that is in the days of our children's children—we are told that *all the coal of these islands that lies within four thousand feet of the surface will be exhausted if we go on increasing our consumption at the present rate.* Coal is everything to us. Without coal our furnaces will become idle, our factories and workshops will be as still as the grave, the locomotive will rust in the shed, and the rail be buried in weeds. Our streets will be dark, our houses uninhabitable; our rivers will forget the paddle-wheel, and we shall be again separated by days from France, months from the United States. The past will lengthen its periods and protract its dates. A thousand special arts and manufactures, one by one, then in a crowd, will fly the empty soil, as boon companions are said to d sappear when the cask is dry. We shall miss our grand dependence, as a man misses his companion, his fortune, or a limb, every hour and at every turn reminded of the irreparable loss. *Wise England* will then be the *silly virgin*, without oil in her lamp. We shall be surrounded and overwhelmed by the unprofitable lumber of buildings and machinery that we cannot use, and with cities we cannot occupy; for who will care to live in Manchester? Who will be able to live in the metropolis? It is not so difficult to imagine the state we shall return to, for it takes only a middle-aged man to remember it. They would be sorry to be called *old* who

can remember large towns lighted with oil lamps; the first steam vessel timidly creeping along our shores, or up our rivers; and the hardly credited rumor of a steam engine on a tramway! But the process of learning will not be slow, and neither easy nor pleasant. To be sure, as coal becomes scarcer and dearer, we shall learn economy. We shall warm our houses more scientifically and improve our machinery. But in the meanwhile our descendants will witness another process equally exhaustive; the population will follow coal wherever it is found, whether on foreign or colonial soil. Our manufacturers will be beaten by those who then have this advantage over us, and the working classes will accept the invitation of the master that bids the highest. That is what they must do for it is the law of existence. It is not easy, or at all possible to forecast any point at which the various conflicting causes may fix the future of English labor, but we may as well expect a large population in Salisbury Plain, as a Manchester, a Liverpool, a Sheffield, a Birmingham *without coal* and *cheap coal too!*"

This gloomy picture, though prophetic, is not overdrawn; and represents a country without coal or wood, such as Wisconsin may become without the fostering care of the people shall be extended to our forest trees. These alone can save the people of the state to the state. Cut away our forests, denude the state, and the years are not distant when the agriculture of the state will change to pasturage and stock raising; because the winds which are already more severe than the winter wheat can bear, will become too severe for the spring crops; then there will be too little fuel to keep the 50 inhabitants on each square mile of the southern counties warm and cook their food. Men must give place to oxen and sheep. Public parks and gardens, school houses, manufactories, stores and depots, will be converted into sheep-pens, cattle stalls and hay barns. The small farm with its neat house, orchard and garden, its fields of yellow grain and tall corn,—the home of the happy family, will become part of a cattle range, for these alone can retain a foothold, until that other more distant day shall come when the winds and droughts shall reduce the plains of Wisconsin to the condition of Asia Minor. Trees alone can save us from such a fate.

HOW WOOD EFFECTS FREIGHTS.

Elsewhere has been shown the amount of wood consumed by the railroads of the state. The first construction of the roads, consumed for sleepers about 150 cords of wood to the mile, worth as mere wood, at present prices, $6 per cord, or $900 But these sleepers have been, and must be again, replaced every six years, at an increasing price, thus giving an annual expense of $150. The Atlantic railroad, laid in the lumber portion of New York, had paid, in 1862, for fencing, $728 a mile. The bridges of the same cost $826 a mile, and stations and buildings $760, and the cars cost about as much more. The Wisconsin roads are not more cheaply built and maintained. Estimat-

ing that the fences, bridges, stations, cars, &c., must be rebuilt in ten years, and these items amount to $307 40 per annum, to which add the cost of sleepers, and $750 for 150 cords of fuel, at $5 per cord, and the amount is $1,057 40 per mile, for the single item of expenditure in wood by the railroads, every year. One thousand dollars a mile, makes $1,200,000 spent by all the roads for this item.

People complain of the high prices of freights. Such should remember, that this one item of expenditure has not only increased in quantity since the roads first began to be constructed, but also, that it has doubled in value, not only to the road itself, but to all its employees, and thus has increased their wages. This increased cost of running and maintenance is not at the cost of the roads, but falls upon the people who make use of the road for transportion. If by any means this item of expenditure could be reduced, say one-half, then the roads could afford to reduce the prices charged for freights, and people and their productions would be moved cheaper from place to place; the roads, at the same time, making as much or more money than now.

Railroad companies are not the only ones interested in cheap motive power. The manufacturers, and through them, the people are everywhere equally interested. If fuel could be cheaply furnished, places now drooping, almost dying out for want of manufacturing motive power, would spring into life. Towns would grow up where now are only pastures. Raising trees will accomplish all this and more.

CORN CANNOT BE SUBSTITUTED.

It has been stated that corn may be profitably raised for fuel, on various places on the prairies. A thing is profitably produced, only as it is compared with another of the same kind, and is equally good or better, and more cheaply produced. Apply this rule to the production of fuel by raising corn and hickory trees, and then an estimate of value may be made of their respective profitableness. An acre of land will produce 60 bushels of corn, weighing with the cobs 70 pounds fit for fuel; or 4,200 pounds to the acre. The same acre would produce in 25 years, 105,000 pounds of corn. But if it were planted to hickory trees, it would yield in 25 years forty cords of the very best quality of wood, which at 4,468 pounds per cord, would give 178,720 pounds, 7,105 pounds each year; or 2,905 pounds a year more than the corn, nearly ⅔ more solid fuel than the corn product would give, and if the brush were cut up, and which would be every way equal to corn, it makes twice as much, or equal to a yield of more than 120 bushels of corn to the acre—an amount not to be expected at all.

If the expense of producing fuel from the two articles be taken into account, it will show still more strongly in favor of the hickory wood. To raise corn the land must be plowed and planted twenty-five times and hoed twice or more each year, and manured, unless all the stalks and leaves are

left on the ground; otherwise the land will be exhausted; more time will be taken in gathering and housing the corn than in cutting and seasoning the wood. On the other hand, the hickories require one preparation of the land and cultivation for three or four years, after which the trimmings and nuts will more than pay all charges for rent of land and labor in caring for the trees. The land will grow richer year by year, and is planted for many successive crops; and such crops of 40 cords of wood will be produced in less time than was the first one, or they will greatly exceed the amount. To produce the equivalent of fifteen cords of wood—the necessary amount for the consumption of one family, it will take sixteen acres of land. Three-eighths of an acre of hickory trees is sufficient for the same purpose. But as the land can be cut over but once in twenty-five years, it will take 9⅜ acres to produce fifteen cords for twenty-five years. This amount may be reduced by cutting and using all the brush. Thus there may be a saving of nearly one-half of the land that would be taken to produce the equivalent of corn, and which would yield no other production to assist in paying rents on land. Moreover the trees would give an advantage by being planted in the form of a timber belt in acting as a shelter from the winds.

Similar and even greater results would be reached by planting the more rapidly growing trees, as the white maple, elm, butternut, locust, walnut or ash, which would grow higher, and could be cut in a shorter time, although the wood might be lighter. Moreover corn yields more ash than any of the woods, thereby extracting from the soil a larger amount of salts, and especially of potash, without which no soil can be made to produce vegetation.

In conclusion, we say that the most certain, lasting, cheapest and best means of creating and maintaining a full supply of cheap fuel, is secured by trees; and that to get trees, it is best to plant the seeds and raise them. Other sources of supply are transient and can be soon exhausted, but trees will grow with time itself, reproducing themselves while they purify the atmosphere, and adorn the surface of the earth.

THE DUTY OF THE STATE.

In view of the dangers thus shown to be threatening the future welfare of Wisconsin, it surely should be the duty of some competent authority to make such efforts as may be deemed necessary to avert them. Should an enemy appear upon our borders threatening us with these disasters, money would be at once raised without limit, men would be pressed (if necessary) into the service, and every effort made to repel the invasion; and surely it can be no less the duty of the state to interpose its authority for the same object when no such extraordinary exercise of power is needed. The labor of the wise and good for many generations past, has resulted in the civilization of the nineteenth century, and shall it be said, that for a want of prudent foresight, the men of that century neglected the means necessary to prevent its destruction. The eminence now secured is certianly worth preserving; and

if it is the duty of the government to so shape its policy as to secure the greatest good to the greatest numbers, it surely cannot be deficient in authority to act in a matter of so much importance.

A state that finds authority to regulate the times and seasons when its citizens may catch fish, or shoot game, may certainly assume such as may be needed to preserve the civilization of the present times; it would require no greater stretch of power to regulate the cutting of timber where it would obviously entail a public calamity, or to encourage its production where it is so much needed for the public good.

One of the most serious evils this state has to contend with is the purchase of large tracts of land by persons who reside in some other states, or who, if residing here, still have no permanent and living interest in the land. It is purchased by such persons, not for the ordinary, legitimate and proper purpose of converting it into a farm or homestead for himself and family, but solely with a view of stripping it of its valuable timber. Leaving the worthless trees and bushes to encumber the ground, he sells it for what it is worth, and renews his depredations upon other lands. He builds fine houses in a distant place—he destroys the fair face of nature here. Surely there should be some means devised to compel such men to spare at least a belt of these noble trees for the purposes contemplated in this report. Their interest should be made to yield to that of the men who are to become the permanent occupants of the land, and whose interest in the state will induce them to improve and adorn it, rather than to injure and destroy it.

EXPERIMENTS NEEDED.

There are many questions with regard to the growth of trees within this state; their effect upon the local climate, and the production of crops; what trees are best suited to our soil and climate; what improvement, if any, can be made in the quality of wood by cultivation, &c., which can only be satisfactorily answered by a series of careful experiments on a large scale, and continued through a long time. Such experiments could best be made on the Experimental Farm about to be established in connection with the State University. Every valuable tree that will grow in this state should find a place there, and all material facts in regard to their culture and use ascertained and made known.

The principal facts in regard to the climate of Wisconsin should be more accurately ascertained and made known. Very many observations have been made and recorded at different localities, and extending over a great number of years; but to render them useful they should be collected and published in a volume, and their full import deduced by a careful study and comparison of their results.

These observations might be made at each of the normal and other higher public schools of the state, as part of the consideration for the amount of

public moneys supplied for their support; and especially if the apparatus were furnished them by the state.

PECULIARITIES OF CLIMATE.

People are apt to look upon the climatical zones of the earth as identical with the zones of latitude, or but slightly varied from that relation. Hence we often hear the expression of one place lying in the same latitude as another, as meaning that the two have a similar climatology. This is only true when all other relations are identical, and not otherwise. Two countries on the same parallel, equally elevated, equally distant from the sea, on the same side of a continent, exposed to wind of the same character for temperature and aridity, and influenced by the same kind of ocean currents, will have an identical climatology; so two islands in the same mid-ocean, as in the great Pacific, will be alike in climate. But change any of these conditions and the whole climatology is changed.

The island of Ireland and Newfoundland lie in the same latitude, one on the west and the other on the east side of a continent, in the region of the same prevailing west winds. In Ireland the thermometer seldom goes below the freezing point, or rises above 65 degrees. There the west wind comes from the warm ocean, and moisture falls in the form of rain; and the meadows and pastures are always green. In Newfoundland the west wind in winter comes from a continent, chilled by passing over high snow covered mountains, and severe cold and snows wrap the country more than half the year in the embrace of winter.

The change is the same or still greater when one country lies on the coast of the ocean and the other far inland; thus Wisconsin, with the same latitudinal position as the four northern New England States, has much hotter summers and colder winters than the corresponding latitudes of those states.

The climatographers, from a series of thermometrical observations at different places through years, and from the temperature of the water drawn from wells of the same depth beneath the surface, have established the average temperature of a large number of places upon the earth's surface, for the year and for the different seasons of the year. Comparing these with each other and joining those places which correspond, isothermal lines have been drawn. These isotherms for different seasons of the year, differ from and cross each other. This is particularly the case in this state; and accounts for some of the peculiarities of our vegetable productions.

Although many observations have been already taken at different places in the state of Wisconsin; and the record of them has been preserved; yet many more at these and other places all over the state, ought to be taken before there would be sufficient to determine all that is required to be known to designate all the peculiarities of climate in different parts of Wisconsin. These observations ought to be taken in as many towns as practicable, and continued for a long series of years; while they should be reduced at least

every month in the year, and reported to some central point, or the original observations sent in and the reduction made at the central point.

Observations have already been taken in 60 different places in this state, by 92 observers, covering an aggregate of 350 years; the records of which have been preserved, and most of these might still be procured and their results worked out for the benefit of the people, if the means could be provided. It seems a pity to lose all the benefit of the labors of these observers for want of so small a sum; especially as we know how many very important facts in regard to the specialities of our climate would thus be made known.

Most of these observations are beyond our reach, and all are at present in such condition, that the time and expense necessary to reduce them to practical use, have put it out of our power to make proper deductions from them. Therefore we are obliged to omit some things which these would show, without that particularity which we would choose to have made, if they had been reduced.

The annual isotherm of 45 degrees of temperature, passes nearly east and west through Portage City and Concord, New Hampshire, making but slight deflections from a straight line, on account of the influence of the great lakes and the mountains of New York, Vermont and New Hampshire.

The isotherm of 45 degrees, during the spring months, enters the continent at Boston, passes Albany along the south shore of Lake Ontario, through Detroit, around the south end of Lake Michigan, through Portage City, and thence by St. Paul to the valley of the Saskatchawan river. This line is spread out some seventy miles wide, as it passes over New York, and is very crooked, showing in a remarkable degree the affect of high lands and the cool lakes. On the west of us it passes twice above the 50th parallel of latitude, and once, in New Mexico, it goes below the parallel of 36½; an isotherm, but one degree colder than this last, passes nearly parallel with it, and within about twenty-five miles distance, until it reaches a point north of Portage City, whence it runs near Berlin, Oshkosh and Green Bay, into Lake Michigan.

The isotherm of 70 degrees in summer, passes through Wisconsin in about the same direction as that of the spring line of 45 degrees, except running farther east in Wisconsin, but it reaches the south end of Lake Michigan from Harrisburg and Pittsburg, in Pennsylvania, and near the line of the Fort Wayne railroad.

The isotherm of 48 degrees in the fall, must be drawn from Copper Harbor, on Lake Superior, through Green Bay and Fond du Lac, thence west by Portage City to the Mississippi river.

The isotherm of 20 degrees in winter runs by about the same line as the last, but makes its great bend near Madison, and thence bears a little south of west; while a line but a little warmer passes by the south end of Lake Michigan. The line of 20 degrees from the north end of Lake Huron, runs

to Ogdensburg and Plattsburg, and strikes the ocean at Portland, Maine, being considerably bent south by the mountains of Vermont and New Hampshire.

Whoever shall take his map of the state, and trace these isotherms, will perceive that they have crossed each other at or near Portage City where the governmental observations were taken some years since, from which one element of them has been calculated: that the winter and fall isotherms are almost at right angles to those of the summer and spring, and are almost equally varying from the mean annual line, but on opposite sides.

From what we have been able to gather, we think we have discovered, that near the center of Wisconsin there exists an axis extending from somewhere near Plover, in Portage county, south into the state of Illinois, along which, at different seasons of the year, sharp curves in the isotherms are made to vibrate, and that along the same axis considerable change takes place in the amount of water fall during the year.

The isotherms that most effect vegetation, are those of 70 degrees in summer, and 20 in winter—the one operating upon the growth of vegetation and the production of annuals; the other destroying many perennials which survive in other places on the annual isotherm. The first allows the variety of corn, melons and other summer annuals grown in central Ohio and southern Pennsylvania to perfect in southern Wisconsin; while the second is fatal upon all the tender trees, such as pears and peaches.

Those who have heretofore lived where the isotherms, at different seasons of the year, ran in nearly or quite paralel lines, might be readily mistaken in the climate of Wisconsin, by knowing the winter or summer temperature, and comparing that with the same temperature in his native place. Such persons might meet with as fatal results as would the man from this state, who, having only a knowledge of the winter temperature of Ireland or England, should plant his field with corn, and expect a harvest of ears; or that of the man from Newfoundland, who having no knowledge of Wisconsin temperature, except of winter in Columbia county, should refuse to plant corn or cucumbers, because he thinks they would not grow by reason of such cold in summer as he had been accustomed to experience.

From the fact, that the high temperature of summer, forces forward a growth, and the dry atmosphere induces perfection in the new wood, early in the fall, it may safely be expected, that those trees, which thrive along the annual isotherm east of us, will survive the colder temperature of our winters, and especially, if we shall afford such trees the shelter of others which have proved themselves hardy; for a similar reason, we may expect trees, from colder mean temperatures, to take up their abode in the southern counties, if sheltered from the hot winds. Hence, we have been induced to recommend several trees, not natives of the state, for cultivation, as the chestnut, tulip, some species of the hickory and the European walnut, and also of the white

and red pine, Norway spruce, and Scotch pine and larch, and shall speak of them as if they absolutely existed already and were thriving where we desire them to grow.

SUGGESTIONS FOR PRACTICE.

Among the duties assigned to the present commission, is that of suggesting the best method of preventing the evils that threaten the future progress of our state in wealth and population by the too rapid destruction of the forests. This would obviously be, to encourage the growth of trees in all those portions of the state where they are deficient, and their preservation where they are still sufficiently abundant. At least one-sixth of the entire surface should be devoted to wood—and one-fifth would not be too much—to supply the wants of the present and future population, and to secure the needed protection to crops, &c. Lands least suitable for ordinary culture should remain, or be planted in wood. But to secure the greatest benefit from tree-culture, belts of timber should be reserved or planted. With proper tree-belts the number of our agricultural products might be increased; the annual product of the crops now cultivated would be increased; the the quality of these products would be improved; the health, comfort and enjoyment of both "man and beast" would be promoted; and with judicious management these tree-belts would very soon yield an annual income, that would amply repay their cost, in addition to all their incidental advantages.

It is believed that this object might be accomplished by offering, under proper regulations, a bounty of one per centum of the assessed value of all lands, not exceeding one-fifth of the tract of which it forms a part, upon which the owner has planted trees in such manner as to secure the required protection; and a similar bounty should be allowed to such as shall reserve a suitable number of trees for the purpose, when clearing new land; or if deemed more advisable, proper tree-belts might be exempted from taxation.

OF TREE-BELTS.

No positive rule can be laid down, which shall be applicable to trees in all places which shall be best for tree-belts; but judgment, knowledge, observation and skill must be exercised in regard to each piece of ground. Much information may be elicited by observing what trees grow naturally upon a given quality of soil; and the planter will not be likely to go far astray who shall follow such an index. Thus, where the burr and white oak, and shell-bark hickory, is the prevailing timber; on that ground and the adjoining black mould of the prairie, he may expect, that the shag-bark, shell-bark and pig-nut hickory, the white and burr oak, white ash, sugar and silver leafed maples, white pine, Scotch larch, black walnut, butternut, cherry, locust, basswood, tulip-tree, white elm, red elm, hackberry, Norway spruce, beech and cedar will thrive well; and of those trees he may make either his forest or tree-belt.

Where the land is sandy, and the prevailing timber is black jack oak, with some hickories and burr oaks, hickory, locust, burr and black jack oak, red pine, Scotch pine, Scotch larch, Norway spruce, cedar, and chestnuts will thrive. As this sand becomes more dry, only pines, larch, spruce, red cedar, and black jack oak may be expected, but the growth will be slow of course. Where the land becomes moist but not swampy, the white elm, hackberry, white and black ash, butternut, hickory, white pine, swamp white oak, birch, tamarack, red maple and white cedar will be timber to choose from; and in still wetter land, the tamarack, red maple, black ash, birch and willow will grow. The overflowed river lands must be planted with such trees as the natural growth may indicate.

But in making all plantations, the planter must not forget the great principle of rotation, which governs every well informed farmer; whether we adopt the theory, that roots, besides drawing from the soil such properties as are required by each variety of plants, until all those which they can reach are exhausted; or that the roots have also the power to cast off waste or deliterious matter, makes no difference with the fact, that if the same kind of plants grow for a sufficiently long period of time in the same ground, the soil will become unfit for their longer production, until it is renovated. In scientific farming this renovation is affected by manuring the surface of the ground, and by a rotation of crops, which require other ingredients from the soil. Acting on this principle, it would seem, that ground which has been producing the long tap-rooted oaks, should be planted with maples, butternuts, locusts, basswoods, elms and pines, whose roots spread nearer the surface; and that oaks, on the other hand, should be placed on the prairies, which have been producing grasses. To those who have observed the changes which take place in the timber that grows up as the second crop where old trees have been cleared away, will find a cause for that growth in this principle underlying the necessity of rotation of crops.

The forms of the tree belts, as well as the trees of which they are composed, may be varied almost infinitely. Before we suggest any form at all, we will premise: that in all belts, those rows of trees next to land which must be plowed, or mowed, as well as highways, should consist of such trees only, as strike their roots nearly perpendicularly, or if not, of such as do not send up suckers naturally, nor because the roots may chance to be wounded or cut by the plow. This rule will suggest, the oak, the pines, the larches, the hickories and the cedars. They should also be disposed naturally to grow in a perpendicular, or pyramidal form, so that they shall not shade the ground by throwing out long horizontal branches; this rule excludes the oaks; and lastly the outermost tier should be an evergreen of well known hardiness, and one that will retain its limbs and foliage near the ground. This rule will leave the red cedar, as the first and best choice, though the white might at times be taken. These trees answer all the conditions. In the second tier of trees, the hickories fill all the conditions, and the pine

and larch would be rejected only because they grow too high for this place.

It is elsewhere shown that 18¾ per cent. of the land is required to be covered with timber, and that such per cent. will put a belt of seven and one-half rods along two sides of every forty acres of land, lying in a square form. If this strip be divided into fifteen equal parts, it gives to each part one-half rod wide; which may be again divided into rows, one-fourth of a rod apart. We have already indicated the propriety of planting the two outer-parts or four rows with cedar. The adjoining parts each two rows wide should be planted with hickories. This disposes of four parts. The remainder should be so planted, that the tallest trees be placed in the centre, and that indicates the three or five center parts should be planted with pines, Scotch larch and Norway spruce. The remaining parts between the pines and hickories, where trees less tall than pines, and yet taller than hickories, are required, indicate that the black walnut, tulip tree, white oak and sugar maple, cherry and chestnut should be used, next to the pines; and maples, butternuts, cherry, ash, locust, basswood, hackberry, oak, chestnut, birch, beech and willow will be proper next to the hickories. This form may be varied by enlarging the central coniferæ, or leaving them out entirely. It must also be varied to suit the soil.

We have stated that the best and cheapest way was to plant the seeds of the trees where they are required to grow. Acting on this principle, and having prepared the land by thorough tillage, the planter divides the ground into rows, one-fourth of a rod apart, lengthwise. He then plants the two outer rows with red or white cedar, so as to have a tree two feet apart, in the row. The next two rows are planted with hickory-nuts one foot apart. The next six or eight rows are to be planted so that the leading trees that are designed finally to remain for timber trees shall stand one rod apart in the rows, but quincuncially, and the space between these trees may be filled up with hickory, hackberry, oak, maple, locust, ash and other trees; care being taken that trees growing with nearly equal rapidity be placed together. All these, except elm and red and white maple and birch may be planted in the fall. The seeds of these last mentioned ripen and are planted in June, and grow the same summer, and will be excellent trees with which to fill up vacancies. The six or ten rows of coniferæ must be planted in the spring, as the cones of these are gathered after it is too late to plant the seeds. Only pines, larch and spruce can be planted in these rows, as other trees would overgrow them during the first few years; after which they will shoot up faster than any other tree. These may be planted as thick as recommended for hickories, with the design of cutting the most of the larches and spruces when of proper size for hop-poles and stakes. Also many of the young pines must be cut for small timber, to make room for those to be grown into large trees. This trimming must be done with due care, so that the trees be neither too crowded, nor allowed too much space.

Where the belt or forest is designed exclusively for fuel, then all the rows inside of the cedars and hickories may be planted with such trees as shall make the best and most fuel, at 20 years of age, and one-half of the belt may be cut away at a time, leaving only the cedars. When the cut portion has grown up, twenty or more feet, the other half can be cut. If kinds have been used in forming the belt or forest, which send up shoots and suckers, or if small seedlings have started, there will be no risk about the forest or belt springing up again even too thick to stand and so as to require a great deal of thinning out.

Timber belts may either be reserved in clearing lands, wherever it can be found sufficiently thickly planted by nature with valuable native trees, or be made by planting. They should run in such manner as to afford protection from the severe prevailing winds; but no farther from belt to belt than will afford the required protection. We have indicated for level land forty rods apart as a very proper distance. If the land is more or less hilly discretion must be used in placing the belts, and irregularity in their position will be necessary. They may be allowed to occupy a hill side, or its brow, the borders of a ravine, or other irregular surface which cannot be advantageously tilled without liability to wash. But wherever they are, however located, no cattle or hogs should at any time be allowed access to the growing belt, as the one would consume the nuts and the other destroy the young trees which are to keep the shelter perfect and afford the succession of trees when the old ones are cut.

SOME OTHER ADVANTAGES OF TREE BELTS.

The strip of land occupied by the tree-belt is far from being so much land lost to the farmer. Beside the protection and shelter it would afford by warding off the winds from the men, the stock and the grain; assisting its growth by making a moist strip of air around the field, and thus not unfrequently protecting the growing crop from frost by collecting and holding the vapor on a cool summer night, the trees shed many of their leaves on the land, where they decay, greatly enriching the soil. When the timber has once grown up, what can be more convenient than access to this storehouse for a stake, a pole, a lever or other timber desired for use. No other acres would be of equal value to the farm. Wood land is to-day more in demand in the thickly settled portions of the state, than wheat land, and higher prices paid for it.

It is not unknown to us all that many countries are fearfully wasted by the depredations of insects; also that the most devastating of these insets are such as are seldom seen on the wing during the period of their ravages. Thus the locust and grasshopper have, from time immemorial, devoured the vegetation of some countries at the east. The ravages of these insects have furnished the theme for the illustrations of the poet and orator in the east, when describing the wrath of God against the sins of the people; and

they are still looked upon by the superstitious as sent by Him in judgment Says the prophet Joel, they are a nation "strong and without number, whose teeth are the teeth of a lion, and he hath the cheek teeth of a great lion. He hath laid my vine waste, and barked my fig tree. * * A fire devoureth before them, and behind them a flame burneth; the land is as the garden of Eden before them, and behind them a desolate wilderness; yea, and nothing shall escape them."

The grasshoppers on the dry plains, between the Missouri and Pacific, are not less destructive to such few crops as the industry and perseverance of man forces from the dry grounds by means of the irrigating streams, that flow from the mountain ranges, than are the locusts of Arabia. Against the march of the innumerable hosts, the farmer opposes sometimes with success his watering ditch, filled to the brim with the flowing streams, where countless myriads find a watery grave. Bnt woe betide the man whose crops have no such guardian ditches. Over such a plantation the march of the devastating army is as rapid, as destructive, as the armies described by the prophet. We may well rejoice that the Mississippi and Missouri interpose their broad channels to the advance of such armies, and act as guardian angels to our corn and wheat fields. After the days of ravagings and feastings are past, mounted on strong wings, rising above these broad streams and the tree tops they seek a new place where they may deposit their future brood of devourers.

Hear Marsh on the remedy: "The insects most injurious to rural industry do not multiply in or near the woods. The locust which ravages the east with its voracious armies is bred in vast open plains, which admit the whole heat of the sun to hasten the hatching of the eggs, gather no moisture to destroy them, and harbor no bird to feed upon the larvæ. It is only since the felling of the forests of Asia Minor and Cyrene, that the locust has become so fearfully destructive in those countries; and the grasshopper which now threatens to become almost as great a pest to the agriculture of some North American soils, breed in seriously injurious numbers only where a wide extent of surface is bare of woods."

The chinch bug of the prairies, which is equally dreaded, by those who know their ravages, can never traverse a belt of thick timber of seven or eight rods in extent to devast an adjoining field. The cool damp soil of such a belt presents an impassable barrier to their march; the same as to the grasshopper. Another devouring pest has appeared among us whose origin seems to be traced to the dry western plains—the ten-striped potato bug—whose ravages is to-day more dreaded than the rot which produced a famine in Ireland. Other forms of insect life now swarming on those arid grounds, may multiply upon us as we cut away our guardian trees, and drive off our forest-loving birds, which feed upon them as they have made their appearance among us. If the open plains breed these myriads, and forests arrest their march, the law of protection is plain; and he who raises the barrier,

does an act worthy of his country, and he who cuts it down commits a crime against his race.

"Another important advantage," says J. T. Thomas, "has been occasionally afforded by the shelter of wood lands. It is well known that rust in wheat is commonly most prevalent on low and mucky lands; yet at other times, and in its most virulent form, it seems borne on the wind, and often destroys thousands of acres on all kinds of soil, in one sweeping blight. An instance of this sort occurred in northern Indiana in 1840. Early and late sown, on compact and spongy soil, on hill and dale, cleared land and prairie, were all alike affected. In every instance, however, where the crop was sheltered by wood land, it was least injured. An extensive farmer of Ontario county, New York, informed me, some years ago, that out of two hundred acres of promising wheat which he then had growing, all was completely destroyed except *those portions* sheltered by woods; the total loss being four or five thousand dollars, most of which he believed would have been saved had his land been protected by timber belts."

There are farmers, not a few, in Wisconsin who will call to mind instances of similar destruction of their wheat crops by a sudden spread of the rust over their field; and all their promising hopes blasted at once; where they expected thousands of wheat, they found only worthless straw, which they were obliged to remove by the aid of fire.

OF CUTTING TREES FOR WOOD.

The time of cutting trees as well as the number of trees which may be grown upon the acre, so as to procure the greatest quantity of wood from the acre, in a given period of time, are points that cannot be definitely settled, so as to be equally applicable to all pieces of land, or to all parts of the same piece.

If we take single trees fully established and growing rapidly, and examine them some useful deductions may be made on this subject. Let our sample tree be 12 feet high, and 4 inches around, or $1\frac{1}{3}$ inches in diameter, making an annual layer of $\frac{1}{2}$ inch of wood, then by counting the wood deposited on the branches and ends of the top as equal to the amount deposited on the body of the tree, and we have an annual deposit four inches wide, one-half inch thick, and 12 feet long, or two superficial feet of wood one inch in thickness. Take another tree growing with the same rapidity, but 60 feet high and 16 inches in diameter, or 48 inches around, and the result of the annual growth would be a deposit 48 inches wide and 60 feet long, making 120 superficial feet one inch in thickness—an equivalent to the growth of 60 trees 12 feet high—a number which would occupy four times the space occupied by the sixty foot tree. Similar results will be found by a comparison of other trees of different sizes.

From these comparisons this rule may be deducted: Whenever trees cease to lay on a greater amount of wood annually than would be laid on by

the smaller trees that would stand upon the same space, and planted at suitable distances to make a thrifty growth, then the large trees should be cut away, and their place supplied by smaller trees; if the object be to get the greatest amount of wood. But if the trees possess any particular value for their fruit, or will continue to increase in value by age, without detriment to the timber already formed, as would be the case with pines and cabinet woods, then it will be more profitable to continue them in existence. At the same time it must be remembered that, if the trees stand in a grove or timber belt, they will greatly retard the growth of the small trees which are beneath them.

This rule will be found changing to suit all kinds of soil and timber; and will indicate to the grower that every tree that shows signs of decay, should be at once cut down, to make room for others. Also, that in most cases, for mere fuel, the maximum of wood producing property, in our native forest trees, will be reached between 20 and 30 years after the trees are firmly established. Eighteen years is the time allowed by law in France, in which owners may cut over their wood-lands. But experiments made in Massachusets, have proved that 20 to 30 years is much preferable. We have made our estimates for 25 years.

When trees are cut off in the winter, they will send up sprouts from the roots, except such trees as never do sprout. Also by cutting in the winter the small trees which are growing on the ground, receive the sun and commence their vigorous growth in the spring of the year. Trees cut in the summer, or even after vegetation has commenced, and until some time after all vegetation has ceased will be certainly killed. The young trees are also likely to be killed at that time by being broken down, and damaged at a time that will kill them.

In cutting down as well as in trimming forests or timber belts, all the chips and brush should be removed from the ground. This fuel could be either bound in bundles, or cut short and put in baskets or boxes for convenience in handling, and be all sold by the pound as is done in France and some other places. It would make excellent kindlings at all times, and in summer would make a fine quick fire, and thus save much wood that would be otherwise used. Such fuel would find a ready market, as soon as its merits were understood; and machinery might readily be adapted to cutting and preparing the brush.

PROPOGATION OF TREES.

In this report, a scientific or elaborate description of the different methods of growing trees cannot be given. All trees may be propogated by layerings, many by cuttings, while all our native trees and the more common exotics, valuable for forest trees may be grown from seeds. Valuable varieties may be multiplied and perpetuated by budding, grafting and inarching. All who will give a little attention to the subject can grow them in some of these

ways. The nursery-man succeeds better than others only because he has given the subject more consideration. An acre of trees can be grown with a little different knowledge, but without exercising any more skill than the cultivator would exercise in keeping the same land in corn. The culture of trees in Wisconsin requires no better preparation of the soil in the first instance, and no better after-cultivation, than a majority of other crops.

The cost of producing seedling trees of maple, ash, oak, elm, pine, spruce, tulip, birch, cherry, cedar, and similar trees, whose seeds can be had in abundance for the mere cost of gathering, and without expense for transportation, will not exceed two dollars for 1,000 trees when a year old. This estimate is intended to include the cost of seeds, preparing the soil, hoeing, weeding, &c., for one season. A few others like the hickory, butternut, walnut, beech and chestnut, the seeds of which possess an intrinsic value, would cost as much more than that price, as the seeds are more valuable, and as their bulk and weight would increase the expense of transportation.

Although trees may be grown at the cost named to the grower, yet, no one must expect to buy such trees at the mere cost of raising them; because he who grows trees for sale will expect to make a profit on his skill and labor. These cheap trees are such as are grown in seed-beds, at the rate of millions to the acre, and are taken up the first year for the purpose of sale at that age, or to be transplanted to the nursery row, where they are to stand until they are removed to their final place of growth.

Where rapid and strong growth is required, it is better to plant trees where they are finally to stand, than to make use of the seed-bed and nursery. What may be lost in rent of land, is more than compensated by saving the labor of transplanting, and in amount of growth.

FORESTS AND TIMBER BELTS.

To grow trees in a forest or timber belt from seeds, the land should be well and cleanly cultivated or fallowed the summer before planting, so that it shall be as clean of weeds as possible, and mellow. Before planting it should be marked out, so that ther need be no mistake about where every seed is planted, as that will greatly facilitate after culture. Two or more seeds should be planted in each hill or place where a tree is desired, to insure the growth of at least one tree at the point. If more than one come up and grow they can be used to fill vacancies, or sold, as the grower shall see fit. Trees thus grown will send their strong tap-roots deep into the soil, and bring moisture and nourishment from below, as well as from the surface; and thereby they will stand firmer against the force of the winds, than transplanted trees, Such trees will not be retarded, perhaps killed, by the transplanting which the seed bed and nursery process requires, and consequently will never require to be headed back on that account. The labor and expense of transplanting, no inconsiderable item, will be saved by planting the seeds where the tree is to remain. Altogether, a man may better afford to plant and kill

five seedling trees, than be at the risk and cost of transplanting one from the nursery, if his sole object is to grow a forest tree.

In planting seeds the bed where they are to lie, should be made level and never more than two inches below the general surface of the ground. The seeds should be deposited, one or two inches apart, and covered as evenly as possible. The smaller the seeds the less should be the covering as a general rule, but none need be covered more than one inch deep. Extra seeds being allowed for such as do not come up, and such as may burn or rot off when small. The soil with which they are covered should be mellow, and if it contain a large allowance of vegetable material, so much the better, as in that case the covering will retain moisture without liability to bake in drying. After they come up they require about the same care as beets or carrots, and must be kept clear of grass and weeds until they are large enough to produce sufficient leaves to shade the ground completely.

If the plantation of trees be intended for a tree-belt or forest, such a plan must be adopted as will give sufficient space between the rows and trees to allow the horse-hoe or cultivator to pass; then in the vacant spaces some low growing crop, like bush beans, dwarf peas, onions, turnips, beets, carrots and parsnips, might be planted; remembering all the time that these last are but the temporary crop and only planted, not for themselves, but to assist in part paying for the the cultivation of the greater crop of trees, during the first years of their existence. Tap roots should never be grown, after the roots of the trees have so extended themselves as to be endangered in taking up the crop of roots. After that period only such crops as produce no roots to be dug should be grown. Such crops, without damaging the young trees, would be a real benefit; as they would induce manuring the ground, and secure thorough cultivation of the surface. No crop should be attempted where hickory nuts or other seeds are planted as thick as for growing hoop-poles; that is in rows four feet apart, and 12 to 18 inches in the row. Such rows ought to occupy the entire ground after the second year, and never allowing room for more than the cultivator to pass; though a small crop might be made, if the land were worked by hand only; but it is doubtful if it would pay for the summer work which would be required.

FORMS OF PLANTING.

Trees in forests and belts designed for timber or protection against winds may be variously planted, as they may be designed for different purposes, reference also being had to the kind of trees used. Such trees as are designed primarily for their fruit, and ultimately for timber, such as chestnuts, butternuts, walnuts, and hickories, might be planted in squares one rod apart, or 160 to the acre, or at 8 feet 3 inches apart each way, thus giving four trees to the rod square, or 640 trees to the acre of land. This would be a good distance for maples designed for making sugar; and for the coniferæ intended to be grown into large trees for timber. This form might be secondarily

attained from a thicker plantation thinned out. Apple trees might be used to make this kind of plantation, which being a very fast grower and trimmed high, and after bearing fruit for several years, enough to pay a large rent on the land, would become tall trees with large trunks of valuable timber, and tops making fuel of an excellent quality.

For fuel, and small straight timber, the trees might be grown, either primarily or secondarily, in rows 49½ inches apart, and 8 feet three inches in the rows, standing quincuncially. This form places eight trees to the rod, while they are almost six feet from each other, and gives 1,280 to the acre. Another form of planting for the same purpose would place them in the square form, 5½ feet apart, and would give nine trees to the rod, or 1,440 to the acre. This last form would be more difficult to attain as a secondary result, but would be a very good form to use, where other crops are grown in the early stages of its growth.

All these forms may be ultimately reached, except the last, by planting seeds at 49½ inches between the rows, and at half or one-fourth that distance in the row; with the express intention of thinning them out at the proper age, so as to leave the final form required. Different varieties of trees may also be used which are intended to be cut away, as the planter shall deem most profitable for that purpose. For this last purpose no species offer more advantages, than hickories and white oaks among deciduous trees and larches among coniferæ.

Different forms of plantations will suggest themselves to each planter, according to the use for which he is planting. But however the trees may be planted, they should be induced to shade the ground as soon as possible, so as to kill out all other vegetation. In this last, the leaves will greatly aid while it mulches and enriches the trees, and aids their growth.

When the land is valuable, as is generally the case in Wisconsin, it is obvious that the management, which gives the quickest and the heaviest return of timber, will prove the most remunerative and profitable. Thorough cultivation gives the greatest and most rapid growth of the young trees, making at least once and a half, and often two fold difference in the first ten years of their existence. This is accomplished best by planting the trees in rows, through which the cultivator can be passed, thus keeping it clean. This cannot be done by the uncertain mode of sowing the seeds broadcast, or setting the trees at random, moreover it gives greater evenness to the plantation.

TIME OF PLANTING SEEDS.

No one specified time can be named in which the seeds of all trees can be planted, as they mature at different periods of the year; and retain their vitality for various lengths of time. As a general rule, the best time to plant is soon after the seeds ripen. That is not always convenient, nor is it always absolutely necessary. Yet with some kinds, a delay of a few weeks is

almost certain to result in a complete failure, as such seeds die in drying Others retain their vitality for months or years. In the description of the different trees, the time when each ripen its seeds, will be noted; also whether they can be kept or not, with any peculiarity which may be required in their management.

HOW TO PROCURE SEEDS.

The seeds of those trees which are native and convenient, may be procured, by such as want them, in person, or by assistants sent out for that purpose. Generally all may be had of the seedmen, if application be made at the proper season; which should be done a short time before the kind desired ripen. If the seedman be honest and intelligent he will send out only fresh seeds, and such as will be sure to grow. Persons wanting seeds can often procure such as they need by an exchange of other seeds, with persons resident in the neighborhood of the native trees, by making use of the provisions of the post-office laws, by which four ounces of seeds may be sent for two cents to any part of the States. When exchanges cannot be made, several persons who desire the same kind of seeds may dispatch a gatherer after them to a distance; and when neither of these methods will succeed without too great expense, they may be procured from the large dealers in forest seeds.

In an exchange of seeds it will often happen, not only that seeds may be procured, but also much valuable information be obtained in addition by the correspondence.

Many of the seeds of the forest trees can be gathered by the simple process of picking them up when they fall; but in some cases they are too small to be thus gathered, or armed with such appendages as make them float to such distances, as to prevent that method of procuring them. In such cases they must be gathered from the trees. This is especially true of the betulaceæ, salicaceæ, and the coniferæ. The mode of gathering these seeds require a more detailed statement.

WHEN TO GROW TREES.

Nearly every man we meet is ready to confess that he sees the necessity of having the trees growing in the country—some, because on every cold day in winter the wind pierces through the thickest under and over clothes they can wear, and yet be able to handle the pitch-fork and grain-scoop to feed the farm stock—some, because they flounder through the drifting, blinding snow as they pass along the public road, and know that a slight belt of cedars or other evergreens would check both the wind and the snow. The poor man, with his wife and children, repeat, "Oh, how cold it is!" as they are hovering over the two small sticks, part of a small load of second rate green wood, for which he has paid at the rate of $12 per cord, and which are now smouldering in the stove—not enough fire to raise the temperature of the room above the freezing point, whose poor inmates dare not add another

stick, as they have no means to get more; this man wishes wood was plentier. The owner of the half section of prairie, whose house and barn is all unsheltred, and whose wood lot is two miles away, feels the need of trees nearer home. More than all these, the man of reflection, who from the past reads the future, and sees how the scattering groves are melting away before the axe; how every seed gathered by the hogs, or the young tree that starts into existence is eaten off by the cows and sheep, and the very roots dug up to convert the place where the small trees grew into a pasture, sees the want of wood that is surely pressing on the people. He sees the famine of wood that is as certain to follow this waste, as is the famine of bread to succeed the failure of grain. All see the necessity, the want, the danger, but know not, or say they know not the remedy; or they ask, where are the million of trees to come from to supply this want—to cover the acres required for growing fuel and timber. To produce the timber belts all over the land? Two words answers the inquiry—"GROW THEM."

Yes, plant the seeds, and the snows and rains, the sunlight and the dews, will make them germinate, and the genial soil will make them into trees, each "after his kind." Plant the little floating seed, that in June falls like a snow-flake, yet contains the germ of the elm, and in after years, but within the period of a man's existence, its long arms will stretch over an eighth of an acre, and it will give cords of wood. The acorn rescued from the paw of the squirl, the craw of the pigeon, or the jaw of the hog, will, in the same time, become the "giant of the forest," if it be planted in October but one inch under the light soil, and tended for four short seasons.

"But I can't wait, I want the trees to-day." Who asks you to wait? Men and trees are things of time; and time moves in spite of you. Plant the next seed that ripens, and in ten years afterwards, while you are making up your mind, whether you had better wait a few years for them to grow or not, there will be another to-day, and you will have the tree you desired ten years before, without waiting at all. Time has made the germ into a tree—the rows of little seeds into timber-belts. Then, delay no longer. Begin now.

How often do we meet with men, who with abundance of means will tell us, that they would like above all things to have the trees growing. They care nothing for the expense—nothing for the narrow strip of land on which they are to grow, but they cannot wait so long! These men have made this same excuse for the last ten, fifteen or twenty years/ and still not a tree is planted—still the wind howls over their fields and buildings bleaker than when they settled on their present farms, because they or their neighbors have cleared away the scattering burr oaks, that gave them some shelter—still they go miles for the fuel they burn. They have from the very first felt the same want of the trees, the belt of timber, the protection, but they have waited and hesitated years enough to have had to-day just what they so much desire. Let such wait no longer. Let the seeds be but planted and while

men sleep and dream of cool shades in summer and protection in winter, the seeds will become trees.

But how long must they wait? Take any or all of the following trees: white and red elm, silver and red maple, which may be planted the 15th day of June, white and black ash, chestnut, walnut, butternut, thornless and common locust, all of which may be planted in October; and the evergreens, white, red and Scotch pine, Norway spruce, and the Scotch larch, which can be planted in the spring; and ten years from the day of planting they will attain a height from 15 to 25 feet, and five years more they will reach from 30 to 50 feet, having required no hoing except for the four first years of their existence. The silver-leafed and Lombardy poplar, the river cottonwood, the Balm of Gilead and white willow, all of which grow from cuttings set in the spring, will perhaps make more height and bulk of wood, but then the timber is of very little worth for any purpose. From these rapid growing trees, good selections can be made.

It is far better to grow trees from seeds in the spot where they are to remain, than to attempt to transplant them, even when the nursery belongs to the planter; and it is worse than useless to depend upon getting trees from the native forests. A tree already growing, may as well be left where nature planted it, as to be dug up, half killed and set in another place. That adds nothing to the number of trees in the world; but raising a tree from a seed is like a new creation. The man who wants trees should buy his seeds, hire poor men, women and children to gather them for him, or better still go with them to select and take only such as he wants, then he has them alive and sure to grow, if he plants them at once, or places them where they will be safely kept until his land is ready to receive them.

Time and money are both saved by planting seeds rather than by transplanting trees; as any one will see who shall note the difference in time that it will take to plant one thousand acorns, even where they are covered with a handful, or half an inch deep with leaf mould or fine compost, or to transplant one thousand trees three years old. The acorns may be planted by a man in less than a day; transplanting the trees will take two men more than a week. An acre of land may be planted with several thousand seeds of different kinds in a day; while it would take twice as many men more than a week to put out the same number of trees; and requires to be all done in the busy seeding time of spring.

Most men have been discouraged in undertaking the work of planting timber, by supposing that all plantations must be made only by planting trees raised by the nurserymen from seeds. A little reflection will correct this error; as well as show that the nurserymen could not possibly supply what ought to be the present demand for trees. The county of Rock requires the produce of 86,400 acres of trees for its full supply of fuel and timber for other purposes for all time. Now, if we suppose that but one-half of this amount or 43,200 acres only are to be planted anew; then as the trees in the

nursery do not grow more than twice as thick as they are required in the timber belt, we shall have no less than 21,600 acres or 33⅓ sections, almost a whole township to be planted in nursery for trees to plant that single county —an amount too great for the nurserymen to undertake to supply, after they have supplied the ornamental, fruit and other trees, which now take all their time.

One hundred and twenty acres of thin or half nursery but thick forest is required for every section; the care of which can only be had by every land-owner becoming his own nurseryman, and making the nursery the identical strip of land on which the trees are to remain. There they should receive a smooth, clean surface and mellow culture, and they will thereby, at least triple their growth while yet small, and sometimes six or eight fold what they would do, if left in hard, uncultivated soil. It is not to be expected that the land-owner, who requires eight belts 3¾ rods wide, or four of 7½ rods wide, and each half a mile long, will start them all in one year, as that would require him to plant thirty acres of trees; but he could plant one or two of these each year until all were planted.

Trees which grow directly from seeds without transplanting, are thriftiest, straightest and best. Transplanted trees, on the contrary, require years to become well established, and to assume a vigorous growth; and most likely they have lost their upright shoot, from which it will take them years to recover. They are more evenly grown from seeds than by either transplanting, or allowing them to come up of their own accord, as they will do where large trees have been cleared off. Another, and perhaps the greatest and best reason of all for planting, by means of seeds, is the fact, that the planter thereby secures just such trees as he desires most, without the shrubs which are found such encumbrances in the native forests; whereas some of the most valuable of trees, such as the oaks, hickories, walnuts and others that send long tap-roots deep into the soil can scarcely be grown otherwise.

The man who wants trees for forests or belts, must plant good, sound, fresh seeds, at the proper season, in suitable soil, and tend them for four years, as well and faithfully as he tends his corn, and he will never repent the little outlay. He must throw away the oft repeated expression, "I cannot wait," with the more injurious one, "There is time enough yet," and begin action to-day by saving seed, preparing land or planting, and he shall not wait; for the trees will cover the land designed for them, while others are waiting for the result.

PLANT THE BEST TREES.

In growing forest trees something besides square feet of timber is to be considered. One kind of timber is often worth many times as much as another; thus, a hundred feet of black walnut or cherry planks, are worth from six to ten dollars, while the same amount of pine may be had from two to four dollars; and poplars would not pay for cutting; and the fork of a wal-

nut, white oak, or curled maple, for vaneering, would be worth a dollar for a square foot. The butt of a thrifty growing hickory or white ash, eight feet long and one foot in diameter, may bring from one to two dollars, while a similar stick of Lombardy or other poplar would not be worth over fifteen cents. As mere fuel the hickory and ash are worth nearly three times as much as the poplar. Yet the valuable tree will occupy no more ground to produce it than the almost worthless one, and still give the required size in about the same time. This consideration of value should always be kept in mind in planting trees. A tree should not be chosen for planting, simply because it is a very rapid grower, nor yet be rejected because it is of moderate growth. The true questions to ask and answer is this, which tree will be most valuable at the end of twenty or more years.

The planter should remember he is planting a tree for its value at the end of 25, 50, 100, or even 200 years hence, not for what it may be in five or ten years. The man who plants the seed may see the tree when it is 50 or 60 years old, and may feed on its fruit at ten years. Let him, therefore, plant trees for their value, not merely for their rapid growth. Acting on this principle, there would be no hesitancy in choosing between a balm-of-gilead and a red cedar, or a river cottonwood and a swamp white oak. The valuable tree would be selected, and the almost worthless one rejected.

Timber is required for various purposes. Men want pine, tulip-tree, butternut and basswood to work easy under the plane—white ash, hickory and oak for strength and elasticity—hickory, oak and sugar maple for hardness and stiffness—young hickory, white oak, white elm and black ash for suppleness—black walnut, cherry, butternut, oak, white ash, chestnut, maple and birch for cabinet work—beech for hard compact wood which will wear smooth, for plane stocks and other tools—pine, spruce larch and oak, for long straight timber, for buildings and ships—Hickory, black ash, and white oak for hoop-poles—tamarack, larch, cypress and pine for hop-poles, stakes and trellises—cedar, locusts, oak and black ash for durable posts for fences, and other purposes,—willow, black ash and oak, for baskets. They want all for shade, for forest and for fuel. But least of all they want the whole family of poplars, notwithstanding they are rapid growers.

TREES CLASSED BY RAPIDITY OF GROWTH.

Forest trees may be classed by the rapidity of their growth into four classes. 1. Trees of very rapid growth, or those making an annual increase of more than an inch in diameter. 2. Trees of rapid growth, or making an annual increase of more than one-half inch. 3. Trees of moderate growth, or making an annual increase of more than one-fourth inch: and 4. Trees of slow growth, or making less than one-fourth of an inch in diameter each year.

In the first class, we place the elm, silver and red maple, white and black ash, chestnut, locust, white and Scotch pine. Scotch larch, black walnut, but-

ternut, cypress, tulip tree, Lombardy and other species of the poplars, and white willow.

In the second class will be found the hickory, red pine, white oak, cherry, Norway spruce, sugar maple, box alder, bass-wood, black jack oak, hackberry basswood.

And in the third class we place the red and white cedar, beech, birch, hemlock, black spruce, tamarack.

It is not pretended that these lists are in all particulars exact, or that the different trees will always make the growths here indicated. Instances may occur in which trees here placed in the third class may make a growth to entitle them to a place even in the first class; and so too, trees in the first may fall back to the third. It is only designed to indicate in a general way what may be expected when the trees are growing in good soil adapted to their full development, with proper culture. Of all these trees we shall speak more at length when describing the particular species.

The trees of slow growth and placed in the fourth class are either too small or too short-lived to be of value as forest trees, and will be omitted from this report.

TREES CLASSED BY VALUE AS FUEL.

A vast mistake exists in the minds of most men, in regard to the relative value of different kinds of wood to produce heat. Certain kinds of wood are always preferred by the purchaser, because, when he buys or obtains wood, and has prepared it for use, as fuel, he wants it as solid as possible and therefore, to last as long as possible. Yet, it may happen, that the wood not so desirable may be procured for so much less than the better wood, that it will be a saving to take the cheaper article, and prepare and use a greater quantity. The rule may be stated thus: The greater the density of completely dried wood, and the greater the proportion of the charcoal in the wood, which it is proposed to purchase, the greater will be its value as fuel. To this rule there are what may appear slight exceptions. A wood may be light, and yet be very resinous, and thus make a strong bright flame, while another of much greater specific gravity, will make but little flame, yet the first may produce a more intense heat in the puddling furnace, or in the boiler of the steam engine, by reason of the flame, than the last, which has most charcoal. But such woods are not economical to buy for the purpose of heat ng houses, or for cooking, where hot, burning and durable coals are preferable to flames.

Marcus Bull, some years since, published some carefully prepared experiments upon American woods, to test their qualities as fuel. One of his tables is based upon shell-bark hickory, weighing, when thoroughly dried by stove heat, 4,468,75 pounds to the cord, estimated as 1,000 or unity. The table contains forty-six different kinds of wood, some of which are little more than underbrush, and seldom reach the fire, except to be burnt out of doors. Of those woods, but four are placed below one-half of unity in value and density.

These are Lombardy poplar—lowest, white pine, Jersey pine and white birch; which stand respectively: 40, 42, 48, 48—poplar being the lowest on the list, while the pines are above, both in density and proportion in charcoal. We have extracted from that table twenty-six kinds of the woods, all of which, with two or three exceptions, exist as natives of this state, and those have some corresponding wood. By the use of this table the values of our own woods may be discovered For example, we desire to know the value of our black jack oak. It will be found to correspond with the pin oak of the table, and stand at 71; and basswood must be placed next to tulip tree, and be about 50, or one-half the value of hickory.

Although Mr. Bull appears to have prepared his table with great care; yet very many will doubt if sugar-maple is placed in its true positton either as regards its specific gravity or quality as a heat-producing wood; in as much as in the public estimation it is held nearly equal to hickory. This disparity may be readily accounted for by supposing that the specimens experimented upon by him were cut when the tree was in full flow of sap, and that it had been exposed to the action of the elements, until decomposition had commenced, as it readily does. This idea is confirmed by the fact that sugar maple charcoal ranks higher than any northern wood, and as compared with hickory coal it is 114 to 100.

Greenwood also contains water in different proportions, both as to kinds of wood, and different specimens of the same kind. This amount is sometimes as high as fifty per cent. A difference also exists as to the qualities of the water contained in the wood, as to its capability of being expelled by seasoning; thus the acidulous properties of red oak will not permit it to become completely dried by mere action of the air; and, therefore, it frequently happens that wood placed high in a table of values of fuel, based on woods thoroughly kiln-dried, ought in actual practice to be placed much lower in a table for every day use.

COMPARATIVE VALUE OF DIFFERENT KINDS OF WOOD FOR FUEL.

Nos	Kinds of Wood.	Specific Gravity of Dried W'd	Value as Fuel.	Proport'n of Charc'l per 100 p'ts of Wood.
1	Shell bark Hickory	1,000	100	26.22
2	Pignut Hickory	949	95	25.22
3	Swamp White Oak	885	86	22.76
4	White Oak	885	81	21.62
5	Red Heart Hickory	829	81	22.90
6	White Ash	772	77	25.74
7	Post Oak	775	74	21.50
8	Pin Oak	747	71	22.22
9	Apple Tree	697	70	25.00
10	Red Oak	728	69	22.43
11	Black Walnut	681	65	22 56
12	Beech, white	724	65	19.62
13	Birch, black and yellow	697	63	19.40
14	Sugar Maple	644	60	21.70
15	Yellow Oak	653	60	21.60
16	White Elm	580	58	24.85
17	Red Cedar	565	56	24.35
18	Wild Cherry	597	55	21.70
19	Soft Maple	597	54	20.64
20	Yellow Pine	551	54	23.75
21	Tulip	563	52	21.81
22	Butternut	567	51	20.76
23	Jersey Pine	478	48	24.88
24	White Birch	.....	48	.....
25	White Pine	415	42	24.35
26	Lombardy Poplar	397	40	12.89

TREES RECOMMENDED FOR CULTIVATION.

In giving the description of such trees as are natives of this state, or such as are adapted to the forests of Wisconsin, we have made use of the descriptions of Gray's "Botany," Darlington's "Flora of Chester County," Fuller's "Forest Culturist," and "The Vegetable world," by Louis Figuier, without quotations. In the same manner we have made free use of the papers on the culture and management of "Forest Trees," and "American Forests," found in the Reports of the Department of Agriculture of the United States, 1864 and 1865. Sometimes using their ideas; sometimes expanding, changing, or abridging their descriptions, and sometimes copying them; and again combining and weaving these books and papers together in the same sentence, with our own observations and examinations, in regard to our climate, and the adaptation of certain trees to our wants.

MAGNOLIACEÆ. (*Magnolia family.*)

None of this family is known to exist as natives of Wisconsin; it consists of trees and large shrubs, with large showy flowers, of calyx and corrolla colored, and placed in rows of threes. Stamens and pistils numerous, also in rows, the latter mostly packed together around and covering the prolonged receptacle, cohering, and in fruit, forming a sort of fleshy or dry cone. Seeds one or two in each carpel; leaves alternate, not toothed, marked with minute transparent dots, feather vaned. Bark aromatic and bitter. Flowers, single, large, sweet scented. The family is named after Magnol, Professor of Botany at Montpelier, in the 17th century.

MAGNOLIA ACCUMUNATA. (*Cucumber tree..*)

Leaves oval, pointed, green, and a little pubescent beneath, scatteri n g

thin, five to ten inches long. Flowers pale greenish yellow, three or four inches broad, and very fragrant. The fruit cone two to three inches long, and when young resembles a small cucumber; hence its name, cucumber tree. Bark and cones highly aromatic and bitter, and are often used as a tonic.

This is the largest and best timber tree of all the magnolias, often growing 70 feet high, with a fine, straight stem of soft, light-colored and fine-grained wood, not very liable to check in seasoning, resembling the wood of the tulip tree; and is much used for making wooden bowls, trays, &c. As this tree grows plentifully in New York, in our own latitude, in the rich woods, with the sugar maple, we may presume that it can be produced here by planting the seeds; and be made profitable, since it is a very rapid growing tree and sends up suckers from the stump to perpetuate itself when once cut down. Such as have been tried, have proved hardy.

There are other species of the magnolia, as the *magnolia umbrella* (umbrella tree,) with leaves from one to two feet long, and white flowers from seven to eight inches broad, and rose-colored fruit; and the *magnolia* macrophylla (great-leaved magnolia) with leaves two or three feet long, and white flowers nearly a foot broad, and fruit two or three inches in diameter, which make excellent ornamental trees; but the latter is more tender than the cucumber tree.

To gather the seeds of the magnolias, the cucumbers must be picked as soon as any of the carpels begin to open in September and show the seeds, and spread on a dry floor where they can dry sufficiently to allow the seeds to be shaken or picked out by hand. They must be immediately mixed with sand and put in a cool cellar until spring or sowed in a light, sandy loam, as they loose their vitality if allowed to become dry or become heated in the fruit. Mice are very fond of the seeds, and care must be taken to guard them. The trees have large, fleshy roots, but are easily transplanted, and can stand in the seed bed without damage for two years, where they may be protected, as that is their most tender period.

LIRIODENDRON TULIPIFERI. (*Tulip tree— White wood— Yellow poplar.*)

This tree, one of the most magnificent of the American forest trees, is a sub-order of the magnoliaceæ, and but one species is known to exist. Sometimes it grows 140 feet high, and six feet in diameter, with a straight, clean stem 80 feet high. The leaves are very smooth, with two lateral lobes near the base, and two near the apex, and appear as if they were cut off by a broad shallow notch. The three sepals are reflexed petals six in two rows, making a bell-shaped corrolla two inches broad, greenish yellow marked with orange. The seeds which resemble a long slender key, are formed into a cone while growing, from which they break away when dry and float off from the tree. They die on drying. The name is Greek, from *lirion*, a lily or tulip, and *dendron*, a tree.

The tree flowers in May and June, and the seeds ripen about the time the leaves fall, and should be gathered in the cone and sown as soon as ripe in moderately dry soil. They may remain in the seed bed two years if desirable, and receive protection during winter; but as the roots are large and

succulent, care must be taken in transplanting; or rather the best method would be to sow them where they are to grow, receiving the same care and protection as in the seed-bed. The wood is light colored, greenish-white, soft and light, not hard enough to receive a polish. It is much used in cabinet work, for various purposes, and is especially adapted for foundations on which vaneers are laid; also for panels for carriages, where toughness or a hard surface is not required. It holds glue and receives the oil of paint exceeding well. Perhaps no native tree shrinks more in sersoning than this, as it shrinks not only sideways but endways as well; but when once thoroughly seasoned it remains fixed, and does not warp or twist like many hard and tough woods, by subsequent working.

There is some difference in the quality of the timber, as it comes from different locations. The best is grown in a deep rich soil; where this is a very rapid growing tree. As the wood is little used except as sawed lumber, only large trees are desirable in the forest, yet as an ornamental tree we possess few that excel it, as it will grow in the open grounds in a conical form, and produce an abundance of its beautiful tulip shaped flowers in the spring. Since this tree possesses so many good qualities, and no serious fault, we hope to see it extensively raised in the southern counties of this state. There can be but little risk in introducing it here, inasmuch as it grows all over New York, and high up in Michigan. Probably it is not here naturally, because of the same reason that has produced the prairies; the fires have killed it.

ACERACEÆ. (*Maple family.*)

Trees, with opposite dotless leaves, without stipules, yielding a sweet sap, small flowers, and a two winged fruit. From the back of each carpel grows the wing, converting the fruit into a pair of separable, one-seeded samaras. Seed nearly without albumen, variously coiled, and the leaf like cotyledous crumpled.

ACER. (*The Maple*).

The trees in this tribe have flowers with calyx five-lobed—petals five or none —stames six to eight, rarely five, mostly polygamons. The leaves are simple, palmately lobed, mostly heart-shaped at the base. The latin clasical name ACER, maple, is derived from the Celt word *ac*, meaning hard.

ACER SACCHARINUM (*Sugar maple, rock maple, or hard maple*) all the common names are derived from the qualities of the trees; the first from its sweet sap, the others from the character of the timber, it being one of the firmest grained of our woods The leaves are three or five lobed, deep green above, and paler beneath; flowers a greenish yellow, appearing with the leaves, in clusters, on pendulous flower stems; and are eagerly sought for by the honey bees. The seeds are broad winged, and ripen in autumn, falling from the trees with the leaves; and should be planted soon after in rich mould, an inch deep; or kept in a cool dry place, where vitality would not be excited until early spring. The seeds come up about the time the parent tree puts forth its leaves.

This tree which is well known in all the states north of the 40 parallel, possesses many valuable properties, one of which is its sweet sap, which flows from the tree while the frost is leaving the ground, before vegetation begins,

and from which large quantities of sugar are yearly manufactured. The yield may be estimated from eight to twenty-five pounds annually. The wood is hard and firm, and ranked with the beech, birch, walnut, white elm, oak, white ash and hickory in producing charcoal; but as wood fuel it is placed by many next to the hickory. The timber is extensively used in cabinet work, mill-gearing, and naval architecture. When the grains are wavy or undulating it is called curled maple, and when contorted, bird's eye maple, according to the form of the undulations. Both these when polished are of exquisite appearance, and when kept dry are not less durable than the oak.

Few, if any, forest tree excels this for beauty of symetery, and deepness of shade; and where the soil is adapted to its cultivation, few trees excel it in rapidity of growth, as under favorable circumstances it often acquires a height of eighty feet. R. S. Fay in the *Country Gentleman* of 1862, says: "I lately measured the trunks of a row of sugar maples set out eighteen years ago in the town of Sennett, Cayuga county, N. Y. They stood by the road side, had received no care, and now average one foot in diameter, and thirty feet high. Had these trees stood in closer plantations, their diameter would have been less, but their heighth greater."

It prefers a calcareous soil, rich in vegetable mould, which will be greatly enriched by the vast abundance of leaves. Good wheat land is generally well fitted for its growth; and it will thrive to perfection on all the black prairie grain soils of Wisconsin; which its deep shade would render more moist and thus conduce to its own growth.

The value of an acre of sugar maples of twenty-five years plantation may be thus estimated. One hundred and sixty trees one foot in diameter, will yield ten pounds of sugar each, or 1,600 pounds, at 15 cents, $250, or deducting three-fourths for labor and expenses, leaves $62.50. This will be its minimum annual yield for fifty years or more.

The timber would advantageously increase in quantity until the trees were 100 years old; but would give a profitable yield of timber when the trees would average twenty inches, as at that size they would give a cord of wood to each tree or 160 cords; and which could not be estimated in the tree at much less than $5 per cord; giving the value of the acre of timber at $800. This estimate will not appear high, when it is remembered, that twenty-five feet in length of each tree can be sawed into lumber, making 300 feet to each tree, or 48,000 feet of sawed lumber, worth at present prices $30 per thousand, or $1,440; and the balance of the trees go to the cord wood, giving eighty cords to the acre. The interest on the value of the land, the cost of planting and taxes would be paid by the trimmings, leaving the land as valuable as when the trees were planted, and the sugar and timber may be estimated as profit for care and forethought. These estimates are based on the trees being planted on soil properly adapted to their growth; that is, on about one-half the lands lying south of town sixteen in Wisconsin. North of that the proportion of land adopted to sugar maple culture is less.

ACER NIGRUM (*black maple.*) This is only a variety of the preceding, and is very similar in its growth and general appearance, but does not come into leaf quite as early in the spring, and has a denser and darker foliage. The timber cannot be distinguished, nor is there any marked difference in the growth of the tree, or sap. Both these maple are better adapted to the forest culture than as shade trees for road sides, as they delight in spreading their feeding roots near the surface of the ground, and require the mulch of the leaves.

ACER DASYCARPUM (*white or silver maple.*) Leaves deeply five lobed, with sinuses rather acute, silvery white, and when young downy underneath, the divisions narrow, cut-lobed and toothed—flowers greenish yellow, on short pedicels, appearing before the leaves—Fruit woolly when young with large divergent wings; ripens between the 1st and 15th of June, generally about the time the leaves are fully expanded; and must be sown immediaaely, as at that season of the year the heat will excite its vitality and destroy it unless in the ground. When planted in mellow mould, less than inch deep, the seed will spring up in from seven to ten days, and attain the height of twelve to twenty-four inches the first year. This is the most rapid growing of all the maples, often making twenty feet high in three or four years. It succeeds in most soils, but prefers a rich black one like the sugar maple. Hence it will sometimes thrive where the other will die. Its wood is fine grained and considerably used for a variety of purposes, but is not as hard or valuable for cabinet work, and mill geering, or for fuel as the sugar maple. The tree is often used for sugar making.

This tree seldom attains a height exceeding 50 feet or two feet in diameter, and is consequently short-lived. As a fuel producing tree its maximum value may be assumed at 20 years of age. From its long graceful branches and silvery foliage, it is highly prized as a shade tree. But this long branching top renders it very liable to be badly broken by the winds, and loads of snow and ice. Still it deserves particular attention from those who desire to procure a quick supply of wood and a large yield from the acre. For the purpose of growing wood it might be planted at the rate of 640 trees to the acre, or 8¼ feet apart, or at 5½ feet 1,440 trees could be grown, letting it occupy the entire ground. At 25 years after planting, a crop of 160 cords of wood might be expected. Every 15 years afterwards a similar crop might be cut from the young shoots and volunteer trees, while the trimmings would meet the interest on the purchase money, first expenses, and taxes on the land. The wood, though less valuable than the sugar maple, is preferred to the oaks for kitchen fuel.

ACER RUBRUM (*Red maple, swamp or soft maple,* for it takes all these names in different localities.) Leaves three to five lobed with sinuses acute, whitish underneath, the lobes irregular serrate and notched acutely, the middle are usually longest—flowers on very short pedicels, deep red or scarlet, rarely pale or yellow, appearing very early in the spring before the leaves; seeds ripen like the silver maple, but are not quite as large.

The small branches are deep red in winter, and from them and the flowers it takes its name, red maple. Its habits, timber and rapid growth correspond so nearly with the silver maple that no special description is required. In fact the two appear to be almost varieties of each other, like the sugar and

the black maples. Although generally found native in swamps and overflowed lands, and along the margins of streams, it thrives far better on drier lands. In the former situation it is a short lived and small tree, in the latter it equals the silver maple in size and age. It furnishes a striking example of the fact that trees are not always found in situations best adapted to their full development; and that much is yet to be learned by experience in regard to tree planting.

These three are the only American varieties which are deserving of culture, though three others might be used for ornamentaion. These are ACER PENNSYLVANICUM (*Striped maple, striped dogwood or moosewood*) Leaves 3 lobed, quite pointed and large, flowers like the sugar maple—a small tree of no value for its timber, but quite ornamental for the peculiar color of the young limbs, large leaves and seed wings. ACER SPICATUM (*Mountain maple*) is only a tall shrub. ACER NEGUNDO, (*Ash leaved maple.*) This is sometimes called NEGUNDO ACEROIDES, and *box elder.* Flowers diœcious, from the lateral buds; the sterile in clusters on capillary pedicels; the fertile in drooping racemes. Leaves pinnate with 2 to 5 leaflets. It is a small tree with light yellowish green branches, has been used only as an ornamental tree. The sap is sweeter than the sugar maple; and is recommended by the sylvaculturists of Illinois, for culture as a sugar tree. It thrives well on the rich prairies of that state. The wood is very similar to the siver leafed and red maple. It is native along the Mississippi, from Prairie du Chien down, and hardy.

ACER PLATANOIDES (*Norway maple*) leaves similar in appearance to the sugar maple but larger, seeds also larger, ripens at the same time. It is no better in any particular than the sugar maple; and in some particulars is inferior, yet might be grown to give variety to the maple grove.

ACER PSEUDO PLATANUS (*Sycamore maple,*) is another foreign species—a coarse growing tree with large dark green leaves, is a rapid grower. The wood is hard and moderately fine grained. Though these foreign species have been introduced, and are valuable for timber trees, they do not equal the native species for cultivation.

The maples may all be worked on each other; and the silver leafed and red may be grown from cuttings set in moderately moist ground, using for that purpose, wood two or three years of age, as such branches strike more readily than the new wood. These means of propagation seem scarcely necessary, when we consider the facility with which they may be grown from seeds; and would scarcely be resorted to unless to secure some special character in timber, foliage or manner of growth, which it was desirable to multiply by propagation,

TILIACEÆ. (*Linden family.*)

This order produces trees, with mucilaginous properties, fibrous bark, and valvate calyx, &c., as in the Mallow family; but the petals imbricated in the bud, the stamens usually polyadelphous, and the antlers two-celled. It is represented in northern regions only by one genus.

TICIA. (*Linden—Basswood.*)

But one species of this tribe is a native of Wisconsin. Fruit a sort of woody globular nut, one-celled, and one or two seeded, ripens late in summer or early autumn, and should be sown immediately after being gathered. The seedlings produce numerous small fibrous roots, and are easily transplanted. The name is clasical latin.

TILIA AMERICANA. (*American Linden—Basswood.*)

Leaves obliquely heart shaped, serrate deciduous stipules, deep green on both sides, globrous or nearly so. Flowers cream colored, honey bearing, fragrant.

This familliar tree is rarely called linn tree, lind, whitewood, but commonly basswood; the last name is now obsolete in England, and is derived from and alludes to the use made of the inner bark in the manufacture of mats and cordage. Bark on the young trees smooth, of light green or gray color, becoming rough and deeply furrowed on old trees.

The wood is white, soft and very light when seasoned; does not then split readily, and is much used in cabinet work in making drawers, and carriage making where wood requires to be bent or moulded into shape; for which last purpose no other wood is so well adapted. It takes paint well and then polishes highly. It is often used for clapboards to houses, and also for inside work, but in either case it must be painted or oiled to insure durability. When dry it burns freely and makes a good quick fire.

The inner bark of this tree is much used by nurserymen for tying in buds, and by gardners for tying up vines, raspberries and other plants; and is called bass. To prepare the bark for use, it is stripped from the trees in the spring, about the time the leaves expand, when it comes off very readily; it is then put into water—a running stream is best,—and allowed to remain there until it will separate into thin layers; two or three weeks will usually suffice for this purpose; it should then be taken out, stripped of the outside bark, and laid up in a dry place until wanted for use.

The tree is a very rapid grower in rich land, making a large tree sometimes 80 feet high and three feet in diameter. It sends up sprouts from the stump so as to propagate itself when cut down, but seldom from its roots. It is an excellent neighbor to other trees, and vegetation is not much injured by its roots.

Another valuable property of the American basswood is its very sweet honey-bearing flowers. Those persons who keep honey bees for pleasure or profit, should plant this tree plentifully within their reach, because there is no flower of its size that yields better honey, or in greater abundance. Persons who keep bees in the neighborhood of bass-wood trees value the honey gathered from them in preference to all other, not excepting the white clover.

The foreign species possess no peculiar advantage over the American in their wood, leaves or rapidity of growth, and are not as sweet flowered or so hardy. The basswood ought to be planted in all forests grown on rich, dry soil.

ROSACEÆ. (*Rose family.*)

This numerous family with regular flowers, and a five sepaled calyx, united at the base—petals as many as the sepals, and inserted with the numerous distinct stamens on the edge of the disk, that lines the calyx tube, gives us

but one large timber tree, with many very important fruits and fruit trees, some of which like the apple and pear grow to a good size, but are cultivated exclusively for their fruit.

CERASUS SEROTINA. (*Wild black cherry.*)

This tree is a species of the tribe cerasus of the sub-order *amygdaleæ* (almond family) in the order Rosaceæ. Leaves are lanceolate-oblong, taper pointed, serrate with incurved short and callous teeth, thickish shining above—flowers are elongated racemes—fruit a globular drupe, without bloom; stone almost globular, and smooth, purplish black when ripe, with a pleasant vinous flavor.

The bark is smooth, reddish brown on the young wood, with light spots, and epidermis revolute, and bursting at first in laminæ, and afterwards becomes rough and dark colored; and possesses strong tonic properties, and is much in medical use.

The tree is a rapid grower, on soil adapted to the white oak and sugar maple; where it makes a stem 50 or 60 feet high, and often two feet or more in diameter at the base, and with branches spreading irregularly. The wood is often variegated, but generally brownish red, close grained and hard, taking a good polish, and is in great demand for cabinet work, and when without gum spots brings high prices. The seeds ripen in August and September, and should be planted immediately, as they die upon drying. The tree is considerably infested by the tent worms, that should be destroyed, as they sometimes strip all the leaves from the tree, and from thence are transferred to the imported cherry and apple trees.

Black cherry timber is durable, and makes good fuel, and lasts well as sleepers for railroad ties. On the whole the tree deserves cultivation; and except for the worms would be an excellent shade tree near the houses.

LEGUMENOSÆ. (*Pulse family.*)

This vast family of herbaceous plants, shrubs and a few trees, with papillionaceous flowers, producing a legume in fruit, contain more distinct tribes and species, than any other natural order of plants; yet it has but three species of trees worthy of mention as capable of cultivation in Wisconsin. These are the *robinia*, *gymnocladus* and *gleditschia.*

ROBINIA. (*Locust tree.*)

This tree belongs to the loteæ, or melitot tribe, a suborder in the natural family of leguminosæ, and to the galegeæ, a sub-tribe, and has three species, the *pseudacacia viscosa* and *hispida.* Flowers showy in hanging axillary racemes. Leaves odd-pinnate. It is named in honor of John Robin, herbalist to Henry IV of France, and his son Vespasian Robin, who first cultivated the locust tree in Europe.

Robinia pseudacacia, (common locust, or false acacia,) has loose, slender racemes; flowers, white and fragrant; branches with spines, otherwise smooth.

Robinia vicosa, (clammy locust,) has clammy branchlets; flowers crowded in the racemes, tinged with rose-color, and nearly inordorous.

Robinia hispida, (bristly rose-acacia,) has very large and handsome rose-colored flowers, but is a mere ornamental shrub in the gardens.

GYMNOCLADUS. (*Coffee tree.*)

This tree belongs to the cassieæ, or senna tribe, another sub-order of the Leguminosæ. Flowers whitish, in axillary racemes. Pod oblong, flattened, very large, pulpy inside, several-seeded. Seeds very large, flattish. The name is from the Greek *gumnos*, naked, and *klados*, a branch, alluding to the stout branches destitute of spray.

There is but one species in the Northern States, the *G. Canadensis*, Kentucky Coffee-bean tree. It is a rather large tree, with rough bark, stout branchlets, not thorny, and very large unequally, two-pinnate leaves; has been cultivated as an ornamental tree, and give very valuable and durable timber, growing very rapidly. The tree grows in central New York, and plentiful in Ohio, and west to the Missouri, and may be no more tender than the common locust.

GLEDITSCHIA. (*Honey locust.*)

This tree belongs to the same sub-tribe as the last. Pod flat, many seeded, a sweet pulp usually surrounding the flat seeds. Thorny trees with adruptly one to two-pinnate leaves, and inconspicuous greenish flowers in small spikes. The name is given in honor of Professor Gleditsch, a botanist contemporary with Linnæus.

But one species the *tricanthos* (three thorned) is found in the Northern States. The thorns stout usually tripple or compound—leaflets lanceolate —oblong, somewhat serrate; pods linear, much elongated, often twisted, filled with sweet pulp between the seeds. The tree grows large and rapidly, with durable wood, but its cultivation cannot be recommended.

Fuller speaking of it says: "The honey locust has been much extolled as a hedge plant, and quite extensively planted in some sections for that purpose. It is doubtful if it will ever become popular for this purpose, as it is naturally a large tree, consequently requiring severe pruning to keep it in check. There are many other plants better suited for hedges, and which do not produce such enormous thorns. If there ever was a tree that ought to be proscribed and exterminated, I believe this to be the one. The thorns on old trees are often six to ten inches long, and so hard and sharp that the man or beast that approaches them is in danger of being mortally wounded. Every little clipping from a hedge must be carefully picked up, or there is danger of some animal stepping on it, and having its feet pierced by these natural bayonets."

It is doubtful if the tree is entirely hardy as far north as Wisconsin.

The common locust has been more extensively planted for its timber than any tree in this country. It is a native tree, found in the woods of Pennsylvania and the South, but was carried to Europe and cultivated there by Robin; and one of its varieties is a native of the Rocky Mountains in New Mexico and Colorado. Many acres were formerly planted on Long Island, New Jersey, and other places, the remmants of which may still be seen. The seeds were scattered in the original forest, leaving them to take root as best they could, and when they had grown to a few feet, the native trees

were cut out, leaving the locusts. In a few years these seedlings became large enough to be cut and sold to the ship builders, or used for fence posts—in which last condition they have been known to last fifty years, and still appeared sound.

The rapidity of growth and durability of the timber in the east, induced the farmers of the western states to plant the locust largely upon the prairies, both for a hedge plant and for timber. In both of which capacities, it has proved a failure. The timber grown on the rich prairies, is not more durable than the white oak; and the borer having attacked the tree has killed it and destroyed the timber, while yet alive.

If the locust had some good qualities, it also has several faults. It produces a great number of seeds, which are scattered and come up just where they are not wanted. It also produces suckers from every rounded or knotty root of the tree, and often at great distances from it; while spreading its fibrous roots over the ground, it destroys nearly all vegetation within its reach. It is eradicated from the land with great difficulty. Its further culture should be discouraged, especially on all rich soils; even if it should be grown on the nearly barren sands. The tree cannot be pronounced as entirely hardy in Wisconsin, as it was often effected by the frosts, before the borers commenced their ravages.

The loss of the locust is perhaps to be less regretted, than it would otherwise be, if another and native tree shall meet the expectations of those who have given it a partial examination, in more than supplying the place of the failing locust.

Whether this tree be a species of the *gleditschias* (honey locust) or *algarobia* (carob tree) which produced the wild honey of St. John, is not yet determined by us; but it resembles the latter rather than the former tree. At Prairie du Chien it is called "island locust," and may be designated as *thornless honey locust*, until its true species is determined.

The tree grows large, often 70 feet high, with a foliage less than one-half as large as the common locust, and much darker green, the pods are an inch broad, and from six to ten inches long. The wood is fine grained, compact, very hard and heavy; color of heart wood, reddish brown, between cherry and walnut; polishes highly when dry; valuable for cabinet work, for wagon axles and other purposes, where firm, stiff wood is required; and as fuel ranks with or above hickory. It is found quite abundant on the islands and banks of the Mississippi and Wisconsin rivers at Prairie du Chien, where it is overflowed every year, also on the dry sand hillocks, in both of which localities it flourishes vigorously. Some trees are also growing near Bridgeport in the stony banks of the Wisconsin, some of which are 60 feet high, and more than a foot in diameter. Two trees were found growing near the outlet of the Mendota or Fourth Lake, in Madison, on the high bank, where it received the full force of the west winds, as they swept over that sheet of water and ice during the winter. A shoot from one of these was taken up and

planted in one of the most exposed places in the city, in the stiff yellow soil, where it grew nearly as rapidly as the common locust. This last was destroyed by the grading of the street in 1866. It is also found in Grant county near Lancaster, and in Green county along the Sugar and Pecatonica rivers; on the east side of Lake Winnebago, and at Grand Kaukanna. Some trees were found in the rich woods of Richland county, nearly two feet in diameter, which have been cut, and their bodies sawed up into various sorts of timber at Richland Centre. Some of this was used as axles for lumber wagons, and preferred to sugar maple or hickory; and some made into cabinet furniture, and received a high polish with a beautiful appearance. It also grows on the Black river.

The specimen on which we have most experimented, grew on the dry, sandy hillocks of Prairie du Chien, and at the height of three feet from the ground it measured four inches in diameter, and yet had been growing but nine years. These instances sufficiently prove its rapid growth and adaptability to most soils of the State, and especially to the dry, sandy portions, and it only remains to prove its durability as posts, to fully establish its reputation as more than a substitute for the locust.

As a cabinet wood it must be exceedingly valuable, on account of its color, fineness of grain, compactness, hardness and weight, since it sinks readily in water, and takes a fine polish; and from its stiffness and hardness it will be valuable where those qualities are required, while as fuel it must stand unrivalled.

The beans do not fall from the pod, as that does not commonly open, and they require to be soaked in boiling water before planting to make them germinate. The nearly ripe pods would be as greedily devoured by horses, mules and goats, as are the pods and beans of the *mesquite* of New Mexico, which it more nearly resembles than any other tree. The tree has little or no disposition to send up shoots like the locust.

The following is extracted from a letter from J. Allen Barber, Esq., of Lancaster, Grant Co., dated June 30, 1867: "The honey locust growing at this place all sprung from seeds gathered by me on the banks of the Mississippi, at Prairie du Chien, in 1843, from pods washed on shore. The trees grow as rapid as the common locust, is more beautiful in foliage, trunks and limbs; has a smooth compact bark, and is in all respects preferable to the common locust—throws up no shoots or suckers, and will grow wherever the common locust will. * * The timber is more compact than that of the common locust. * * They are hardy, untroubled by disease or insects of any kind."

The Hon. S. Mills, of Madison, says he observed this locust in the neighborhood of Rock Island, where it grew more than three feet in diameter, and where it was cut into cord wood, splitting very freely, and other uses made of it. He considers the wood as equal to hickory for fuel, and as exceedingly durable.

Wm. M. Rasdall, Esq., of Madison, says that on his native plantation near

Bowling Green, Kentucky, there was a grove of locusts, growing on the river bottom, some of which were many thorned, (the honey locust) and others thornless. A marked difference was recognized by the common people and negroes in the foliage and timber of the two; the thorny having much larger leaves, the timber was difficult to split, and less durable than the thornless, which split readily. He was told by his father that posts of the latter were set around the garden for fence in 1805. In 1860, he was at the place, and found several of the posts still firmly standing where he had first known them, and apparently as sound as when he first knew them. It did not sprout from the roots, and was highly esteemed as a fuel tree.

From all we have been able to learn of this tree, we consider it of great value as an ornamental and forest tree, and hope to hear that every seed it may produce in this state will be carefully planted and preserved. An apparent variety is sometimes found which has a stout thorn of an inch in length, at each leaf. This will show itself the first year, and may be destoyed.

OLEACEA. (*Olive Family.*)

Trees or shrubs, with opposite and pinnate or simple leaves. A small family of which the olive is the type, also represented by the lilac, the privet of foreign origin and two indigenous genera of which the ash constitutes one tribe.

FRAXINÆ. (*Ash Tribe.*)

Trees with opposite and pinnated leaves, of 3 to 15 either tooted or entire, odd leaflets; fruit is a 1 or 2 celled samara or key, flattened winged at the apex. The small flowers are in crowded panicles or racemes from the axils of last years leaves. The name *Fraxinus* is supposed to be derived from the Greek *phrazis* (a separation) from the facility with which the wood is split and separated into grains. There are several varieties, but only the most valuable will be noticed.

FRAXINUS AMERICANA. (*White Ash.*)

Leaflets 7 to 9, oblong, ovate, pointed, entire glaucose underneath, at length the branchlets are smooth, with white dots. Samaras produced on long slender panacles; fruit linear, spatulate, obtuse, with a long narrowed base, ripens in autumn, and should be planted as soon as gathered. Bark on old trees grey, rough, deeply furrowed, with smooth greenish, grey branchlets. The tree is of large size, with a stem 40 to 60 feet high—wood very white, except the heart wood of old decaying trees. It requires a deep, rich soil, in which it grows very rapidly; rivalling the elm; is also very ornamental, forming a large round head when grown as a single specimen.

FRAXINUS QUADRANGULATA. (*Blue Ash.*)

Leaflets 5 to 9, lanceolate, eliptical, serrate, pointed at both ends, almost sessile, downy underneath; the young branches and pith 4 angled—samaras from 1 to 1½ inches long and three-fourths of an inch wide, obtuse at both ends. A large tree with a stem like the white ash, yielding as valuable timber, with which it is often confounded. It will grow on drier land than the white ash, and is an equally valuable variety for all purposes. It is doubted if this valuable species is a native of Wisconsin and it should be introduced.

FRAXINUS SAMBUCIFOLIA. (*Black Ash, Swamp Ash.*)

Leaflets 9 to 11, sessile, by an obtuse base' elliptical—lanceolate, pointed, more or less hairy on the veins beneath—samaras elliptical—oblong, very

obtuse at both ends. A slender tree with a stem 40 to 60 feet high, of very tough coarse-grained wood readily separated into grains, when it is used for flat hoops and baskets. A truly valuable variety for growing in low wet soils.

All the species of the ash mentioned, are worthy of cultivation in the various soils on which trees may be desired. All but the black ash prefers the same soil as the sugar maple and the elm, and as they are tall growing trees, may be grown at the rate of from 1440 to 320 to the acre; or 160, with a similar number of the hickory or sugar maple, which the white and blue ash will outgrow. If the larger number of trees be started to the acre, all should be trimmed to single stems of 40 feet, and removed to 160 as soon as the trees reach a foot in diameter at two feet from the ground. Ash timber, like hickory and oak, is all the more valuable for making a rapid growth, and being coarse grained.

White and blue ash timber is largely used in the manufacture of farming implements. One can scarcely name a tool, some part of which is not, or ought to be, made of ash or hickory, where lightness, strength and elasticity are required. The carriage maker resorts to these woods in the construction of his wheels, axles, thills, bodies, and other parts of his light and fine carriages, when strength and lightness are to be combined with elasticity. The European farmer prizes American manufactured implements more than those made of the same patterns at home, simply because we have and use better timber, and that timber is ash. The timber is about as durable as the oak, and many trees have been split into fence rails. Considerable quantities are also worked up at the cabinet makers, and ash furniture has many admirers; for this purpose the highest parts of the stems, and more brittle timber is even preferable to the tough wood required by the implement maker. Under all these uses, ash trees and lumber is rapidly passing away, and prices are raising in value; and before others can be produced large enough to be sent to the saw mills, the lumber must command double its present price.

As fuel all these varieties deservedly hold a place next to the hickory, being better than the red hearted wood of the hickory. It burns with a cheerful flame, kindles rapidly, even when green, and gives a hard hot coal. The wood not adapted to manufacturing purposes can always go to the fire.

The black ash is not less valuable for its timber than the others, for certain uses. The wood is more durable for fence posts and rails, and railroad ties than the white ash; for hoops, the splits are in extensive demand, and is the most economical of wood for that purpose. The tree delights in a soil too wet to produce grain, and is not damaged by standing water which only covers its roots. For timber belts which sometimes require to be located in such lands, no deciduous tree is better adapted than this. It may be grown at the rate of 640 to the acre or eight and a quarter feet apart every way. For that purpose the land might be thrown into small mounds, leaving the water to stand on more than one-half the surface. Its own young shoots

would make a sufficient undergrowth for breaking the winds; and the young poles are nearly as good as hickory for hoops. As fuel it ranks higher than the maple, but requires to be dry when used, as the green or wet wood of this variety can scarcely be burned. An acre or two of wet land cannot be more profitably planted, than with this tree. Planted in rows like hickory when grown for hoop poles, it would afford as great a yield, as it grows more rapidly; and the larger ones would make excellent hop poles, being more durable for that purpose than the oaks. The mere trimmings of ten acres of ash forest, grown as thickly as it ought to be, would supply a farm with abundant fuel for all the summer months, and give great satisfaction to the good wife, from the readiness with which she could kindle her fire. Under every phase of the case, the ash requires a prominent place in sylvaculture.

There is but one foreign variety which is worthy of cultivation, and even that has no advantage over the white, blue and black ash of America, in the value and uses of its timber. The foliage being a little darker, it is preferred as an ornamental tree, and can be advantageously introduced to give variety to the plantations.

All the kinds are readily worked on each other; but as they are so easily grown from seeds, and produce such an abundance of fibrous roots the first season, and can be so safely transplanted, even when of considerable size, it seems scarcely necessary to graft or bud them. The native species which deserve the most attention as timber trees, are the *Americana* and *quadrangulata*, (white and blue) for high and dry situations; and the *sambucifolia* (black) for low, wet soils. These are the most rapid growing, and make the most valuable timber.

ULMACEÆ. (*Elm family.*)

Trees and shrubs with alternate, roughish leaves. This order is distinguished from the Mulbery tribe by the want of milky juice; and consists of the elm family proper, with its winged fruit; and the celtideæ, with the fruit in a drupe.

ULMUS. (*The Elm.*)

Mostly trees. Fruit a one eelled and one seeded membranaceous samara, winged all round. Flowers purplish or yellowish, in lateral clusters, preceding the leaves; which are strongly straight veined, short petaled and oblique or unequally, somewhat heart shaped at the base. (The name is clasical Latin.)

Probably no tree (the oak excepted) has been more extolled than the elm, and no tree better deserves the praise bestowed. Noble, graceful, ornamental, fast growing, and useful, why should it not receive the praise, the homage of the nations who, like Wisconsin, possess it? In Europe and the United States, great cities, towns, streets, noblemen's and gentlemen's country seats, have received names derived from this tree. It is the boasted ornamentation of New Haven, not less widely known than Yale College. A row of tall elms, a few years ago saved the city of Albany from conflagration. We praise the tree, but give it little patronage or protection, cutting down

a hundred where we plant one, destroying what ought to be cultivated, not alone for ornament, but for its valuable wood, and fine shade and protection.

All lands which will produce corn and wheat, or good grass, will grow some variety of the elm. Trenching upon the borders of the marsh, where contending with the black ash, tamarack and alder, overtowing the sugar maple, spreading its long limbs over the oaks on the dry ridges, or hiding them beneath the pines; it rivals all the trees in the forest in the breadth of its range. In all these places no trees mount so rapidly, or make so much wood in a given period of time. Its wood contends with the oak for strength, and the hickory for suppleness, entering into and absolutely necessary for the manufacture of many implements of industry; and as fuel when dried and housed, as all fuel ought to be, it takes a high rank, between the hickory and maple.

But three marked species with one sub-family are all we shall notice as worthy of cultivation.

ULMUS AMERICANA. (*White Elm.*)

This is the largest of the elms, with leaves smooth above, downy underneath, oblong-ovate, pointed, sharply double serrate; flowers in umble like clusters before the leaves in April. Fruit oval with wooly-fringed margins. It is much the largest of all the elms, often growing to the height of 80 to 100 feet, with a stem six feet in diameter, and a very rapid grower in rich, moist land.

This lofty and wide spreading tree, with its profusion of slender, drooping spray, is particularly adapted for shade and street rows. The wood is tough, close grained and much valued by carriage makers and others for bending, into carriage and wagon bows, and into plow handles, and other purposes.

ULMUS RACEMOSA. (*Corky White Elm.*)

This species differs but little from the preceding, in leaves and flowers, which are in compound racemes, and the branches are mostly corky ridged, or winged, which render them less slender and drooping. The tree grows as rapidly as the white elm, and the wood is tougher and closer grained. This valuable tree is not very common in this state, and flourishes in drier land than the white elm.

ULMUS FULVA. (*Red or Slippery Elm.*)

This is a very rapid growing tree on dry, rich soil, but of medium sized, and short lived, not lasting more than forty or fifty years; but the root may be kept alive when the tree is cut before it reaches a great age. Its heart wood is reddish yellow, is more brittle than the other varieties; but is superior for fuel, and sufficiently durable for sleepers for railroads.

The inside bark from which it takes its name, *slippery*,, is used for medicinal purposes. This species when small is extensively used for wagon and carriage hubs, and by many is thought to be unequalled for that purpose, as the wood is fine grained, compact and not liable to check or crack open like oak and some other kinds of timber; and it holds the spokes firmly.

The seeds of all the elms ripen in Wisconsin from the first to the fifteenth of June and are scattered by the winds in a few days after they mature. To

secure them they should be gathered from the trees as soon as they turn brown, and the kernel becomes firm. They should be sown in good friable soil soon after they are gathered, as they retain their vitality under the most favorable circumstances but a few weeks, they should be planted before the first of July, less than an inch deep.

The greater portion will come up in a few days, and grow a foot or more the first year, and in about three or four years are fit to transplant from the nursery. Cattle are exceeding fond of the young twigs and leaves, and must be kept from them during the winter, spring and early summer months. When planted in suitable soil, their roots extend to a great distance, completely taking possession of the subsoil, yet allowing grass to grow well under the drip of the trees. Few trees can successfully maintain their ground when competing with the elm, in fact nothing except the soft or red maple, and some varieties of the cottonwood; but as the elms, especially the white ones, attain an age four times as great as those, and are much larger, it is best not only to give them the entire ground, but not to crowd the space with the elms, unless it be the intention to remove them at an early age. Small trees remove from the nursery best, as larger ones have long slender roots, which cannot be extracted from the soil without destroying them.

CELTIS. (*Nettletree—Hackberry.*)

This is a sub-order of the ulmaceæ. Flowers greenish, appearing with the leaves. Fruit a globular drupe, with thin flesh. Name is ancient Greek for lotus, as it is supposed that the fruit was eaten by the Lotophagi.

CELTIS OCCIDENTALIS. (*Sugar-berry—Hackberry.*)

Leaves roughish, obliquely ovate, sharply serrate, often heart-shaped, or half heart-shaped at the base. Fruit dull purple or yellowish brown, sweet and edible, as large as bird cherries; ripe in autumn and remaining on the tree during winter.

In Wisconsin the hackberry grows rapidly to a fair sized tree, and 60 feet high, with yellowish white wood, nearly as supple as black ash, and is in some places called hoop ash. It splits freely and may be used as a substitute for ash, and also where elm would be required. The wood makes good fuel, and can be grown at the rate of 640 or more to the acre, on any land fitted for the growth of the sugar maple, into trees from 12 to 18 inches in diameter. The tree has the aspect of the elm, but less liable to branch, and sometimes it may be found two feet in diameter, with a straight and sound stem. Although this tree is considered valueless in the eastern states, it is very different in Wisconsin, and can be propagated from the berries.

JUGLANDACEÆ. (*Walnut family.*)

Trees with alternate pinnate leaves; the sterile flowers in catkins, with an irregular calyx; the fertile solitary or in small clusters, with a regular three or five lobed calyx. Fruit a kind of dry drupe, with a bony endocarp, (nutshell), containing a large four lobed seed. Cotyledons fleshy and oily.

JUGLANS. (*Walnut*).

Trees with alternate odd-pinnate leaves of many serrate leaflets, from naked buds—sterile flowers in long simple lateral catkins—fertile, solitary or several together on a peduncle at the end of the branches—fruit a kind of dry drupe, with a fibrous-fleshy indehiscent epicarp, and a rough, irregularly furrowed bony endocarp, or nut shell—bark, strong scented, or resino-aromatic—pith in plates. The name is contracted from *Jovis glans*, the nut of Jupiter, from its excellence.

JUGLANS CINEREA. (*Butternut—White Walnut*).

Leaflets fifteen to nineteen, oblong-lanceolate, pointed, rounded at the base, downy, especially underneath, not always directly opposite, like the ash—petioles and branchlets downy with clammy hairs, from which it derives the specific name (*cinerea*) *ashy*—fruit, oblong, clammy—nut pointed—shell deeply sculptured and rough with ragged ridges—kernel sweet, rich and very oily, from which it takes its English name, *butternut;* ripens in September. The tree grows from 30 to 60 feet high with wide spreading branches; light colored bark and smooth until the tree becomes very old, and then it is slightly furrowed.

The wood is fine grained, of a light brown color, rather soft and easily worked with tools, receives a good polish, and is much admired in cabinet furniture in its natural color. By means of stains which the cabinet maker knows how to employ it is made to take the colors and shades of mahogony and black walnut, and from which it can scarcely be distinguished. As these woods increase in value, the butternut must come into requisition; and it already commands a heavy price equal to one-half that of black walnut, and is rapidly rising in value. It seasons readily, and no wood lays in place better, when put into work, forming the best of wood as a basis for laying veneers. Though a light wood and splitting freely, it possesses considerable strength and durability, lasting well for top rails to fences.

The butternut requires a rich soil, as it sends its roots near the surface as well as deep and to a great distance for food. It is therefore one of our most rapid growing trees, its leaflets are not apt to be blown far, and it enriches the soil instead of exhausting it. For timber it might be planted at the rate of 640 to the acre and thinned down at 15 or 20 years. Such planting would give a fair length and straightness to the body of the tree. As fuel it burns freely when dry and is easily prepared for the fire.

If few shall think of planting the butternut for timber, who may be induced to plant trees of far less value for that purpose, every farm should have a few trees to produce nuts, which they will seldom fail to bear. Many a man can look back to the time in his youthful days, when the cracking of butternuts was the main feature of the evening enjoyment in the old homestead. Farmers should remember those days, and also that a few trees if planted only by the road side, where their sparce shade will do no damage to the track, and where their long arms will have abundant room to stretch themselves, and produce a surplus of nuts for the upgrowing children and perhaps children's children—may cause those sons and daughters to send back a

thought, a blessing to that old homestead, and to the good man whose forethought added another value to his home. In planting trees do not forget this truly valuable one, which outstrips the apple in growth, comes into bearing from the seed in the same number of years, and adds a gusto to the fruit of the apple, which must be tasted to be enjoyed. A tree may be seen in yard of Mr. C. C. Church, in Madison, the seed of which was planted in October, 1860, transplanted in the spring of 1862, and bore nuts in 1865, and now, in 1867, promises a fine crop.

JUGLANS NIGRA. (*Black Walnut.*)

Leaflets 11 to 21, ovate—lanceolate, taper-pointed, somewhat heart shaped, or unequal at the base, smooth above, the lower surface and petioles minutely downy. Fruit spherical, roughly dotted, the nut corrugated; epicarp much more fleshy than on the butternut; kernel sweet, with a strong flavor much admired by some, to others quite disagreeable, less oily than the butternut; ripens the first of October, when the epicarp must be beaten off, to allow the nut to season for use. The nut is then black, from which and the bark it derives its specific name black.

The black walnut is a large handsome tree, more rapid growing than the butternut—few trees in the American forest making more wood than this. The bark on the young as well as old trees, and on the large branches and stems is very rough and deeply furrowed, and with the epicarps of the nut is used for dying woolen cloth, giving, with a mordant of iron, a darker shade than the butternut. It requires a soil similar to the sugar maple, which it outgrows, and reaches the same height and age; sends a tall, straight, limbless stem to the height of fifty feet on an average, in the forest, after which its large limbs begin.

The wood is purplish brown becoming almost black with age, fine grained, and may be highly polished, rivalling the mahogany in the cabinet shops, and even preferred by most people to that expensive wood. It is the darkest and richest colored of any of our native woods, and must always be in demand for manufacture. Its popularity has been rapidly growing within the past few years, and not undeservedly so. Prices have raised within the last twelve years from $30 to $60 per thousand and is still going up in the woods of Indiana, so that at present prices it only requires a tree with a stem forty-eight feet long, and twenty inches in diameter at the centre, to bring in the city of New York, $100. But this first of all our lumber trees is rapidly melting away before the intense desire of gain, and improvident destruction of those who possess the living trees, without a single effort to supply its place. The timber is not only desired by the people of the United States, but is in demand in the European markets.

A single gun factory in Europe, during the first two years of the rebellion, consumed 98,009 walnut trees to supply gunstocks for the American market. This fact will give some indistinct idea of the consumption of lumber in great factories of cabinet ware, where the amount of wood required for the smallest article, exceeds that required for the stocking of a musket.

Although found in Western New York, it is not a very common tree in that state, but was found abundant in the western states. The heart wood is very durably, lying on the ground perfectly sound some years after the bark and sap wood have fallen off. Farms may still be found in Indiana, Illinois and Missouri, which are mainly fenced with black walnut rails. It is probably not more than twenty years since these rails were cut and split from trees, that would have made 1000 feet each of sawed lumber. The large forks of the tree being many times more valuable than the straight grained wood, for vaneers. Had those trees thus wasted for rails, and the most valuable forks consumed in the log heaps, been allowed to remain until this time, each tree would now have been worth more than acres of the land they helped to enclose, and on which they once were growing. If this be called killing the goose that laid the golden eggs, what shall be said of those who committed trees similar in value, to the log heaps and fires to clear the land from this golden encumbrance, for the purpose of planting ten hills of corn where a hundred dollar tree flourished before ?

The black walnut in good, rich, calcareous soil, grows as rapidly as the silver leafed maple ; and like the butternut, comes into bearing when quite young. For nut bearing it should have plenty of room, as it has a wide spreading and rather open top ; but for the timber, where the tree is grown for the stem, it would be better to grow it at the rate of 320 to the acre, and when they they had reached 12 feet high, to plant silver leaved or red maples to crowd the trees and prevent the tops from spreading. The maples might be cut away for fuel as soon as they had accomplished their object As the wood increases in value by the age of the tree, the black walnut should not be cut for timber until it was apparent that it had nearly ceased to grow. When trees have reached their maximum value which may be placed at from 50 to 75 years from the seed, each tree may, at that time, be estimated at $100; and the acre of 160 trees at $16,000, what other enterprise will pay the same rate for capital and labor invested? It may be safely said that few investments can be made with greater certainty of success, than in planting and growing the butternut and walnut. The fact that they have grown in Wisconsin and attained great age, size and beauty of wood, is conclusive proof that our climate is adapted to their growth in perfection, and the same thing may be again expected. When planted on good land, and cared for while young, they may be looked upon as certain.

JUGLANS REGIA. (*English Walnut.*)

Is the only foreign species that deserves any attention. The nut of that species is well know in our markets. The trees much resemble the butternut in appearance, and might be mistaken for it without close examination. It is a large tree and quite hardy as far north as Albany, in New York, and bears fruit. The tree is worth of a trial sufficiently to test its quality of hardiness. Large quanties of the nuts are annually imported and consumed ; and it cer-

tainly is poor policy to incur the expense of importing an article which may be grown just as well where it is consumed as at the place of exportation. The wood is as heavy and firm as the black walnut, though lighter colored, and exceedingly useful to the cabinet maker. In every view it is well worthy a trial to prove whether it will succeed.

This tree was originally a native of Persia and the east; but was known to and cultivated by the Greeks and Romans, by whom it was much valued for its wood, as well as for its nut. There is no record of its introduction into Britain; but it must have been done at an early day after the Roman conquest. In many parts of Spain, France, Italy and Germany, the nut forms a great article of food to the people. In all these countries the walnut-tree is extensively cultivated; the district of Bergstrasse, between Heidelberg and Darmstadt, is almost entirely planted with them, and in some places, according to Evelyn, in his days, "no young farmer is permitted to marry his wife until he brings proof that he is father of a stated number of walnut-trees."

All the juglans may be worked on each other by grafting and budding, so that choice varieties of fruit may be propagated, with ease.

CARYA. (*Hickory.*)

These trees are a sub-order of the juglandaceæ—tree tall pyramidial—sterile flowers in slender lateral catkins, mostly in threes on a common peduncle—fertile flowers two or three together at the end of the branches—fruit globular, with a somewhat fleshy, and at length leathery epicarp or husk, which splits into four valves, and falls away from the smooth and slightly 4 to 6 angled, incompletely 4 celled endocarp or nut shell—leaves odd-pinnate, 5 to 13 leaflets, three terminals larger than the other pairs. The two kinds of flowers proceed from the same scaly buds as the leaves; the catkins are borne below the leaves—pith continuous. All the varities flower at the same time in May.

The hickory, exclusively American, is a well known tree, found in almost all parts of the United States, and possessess very many valuable properties. Its wood has no equal for fuel, and is the standard with which all other fuel is compared; though there is some disparity among the wood of different trees and species; the white and thrifty wood being ten per cent. better than the more porous red-hearted. In its several species it is found in almost all kinds of soil, high or low, wet or dry. Sandstone regions have their hickories as well as limestone, but seldom of the same species; all are more or less valuable; and even trees of the same species are so various as at times to induce the opinion that they are of different varieties or species.

The tree increases about as fast as the oaks and sugar maples, when in suitable soil, and properly cultivated. Hickory hoop-poles are always in demand, and command a large price. For that use there is but little difference in the species. Plantations for that purpose alone would be very valuable, as will be seen by any one who will make the calculation. An acre of land 10 by 16 rods or 165 by 264 feet, may be planted 66 rows four feet apart, and 165 trees at one foot apart in the row making 10,890 trees on the acre. At six years from the seed, these trees, if properly cultivated and trimmed, would

be 12 to 15 feet high, and large enough for hoop-poles, which at forty dollars per 1,000, when cut and placed at the depot for market, amounts to $435.60, with a good deal of small wood fit for summer use. This calculation is based on the supposition that all the trees are cut. The trees might be expected to sprout, if cut as they ought to be, in the winter, and two could be allowed to grow on each stump. In five years more these would give us 15,000 poles, worth as much as the first by the pole, or $600. To produce these last no other cultivation would be required except to thin out the shoots the first year, and give them a little trimming afterwards. A similar produce would be continued for several successive crops, once in about five years. All the trees should be cut at every cropping, so that all might start on an equality, for the new crop.

Another calculation would show a still greater produce from the acre. If in the first cutting every fifth tree be spared, in every other row, there will be 33 trees left in 33 rows or 1,089 for further growth. These would stand 5 feet in the row, and the rows eight feet apart, allowing ample room for the erect growing trees to develope into timber. There would then be 9,801 poles, worth $392.04. The second crop would not be greatly deteriorated by the trees, if they were properly trimmed up yearly, until their clear bodies were at least 15 feet high, which might be considered a fair length, though more might be attained. The third and fourth cuttings would not be as good as if all the trees had been cut down, but each crop might be safely estimated at 12,000 poles, worth $480, each crop. At the end of 20 years the 1,089 trees would average ten inches, for 15 feet in length, and when the value of the timber of such young thrifty wood is taken into consideration, $1.50 a tree would not be a high estimate, giving an additional value of $1,633 50 instead of the $174.24 which the same trees might have made if cultivated and cut for hoop-poles

In all these calculations it is to be remembered that the ground is left full of green roots from which sprouts may be expected, for future crops of poles, and new trees. Other calculations might be made and results equally astonishing arrived at.

For ornamental purposes few trees excel the hickory in the variety and beauty of its foliage, and in its erect symmetry; cone-formed by lateral branches, it is far more pleasing than the sharp pointed Lombardy poplar, with its long perpendicular growing limbs. The leaf is a pure deep green, and its thick shade invites to its coolness The tree is almost free from all noxious insects, except a single variety of the tent worm, easily destroyed. As an ornamental tree, to last for a period of forty years, it rivals and in the the estimation of many, excels the sugar maple and the elm. If the last gives nothing but shade, and the other a foretaste of maple sugar, this equal in shade gives a promise in early life, and at last yields its rich nuts as the compensation for the rod of land which it honors with its presence. This

rich harvest of nuts detracts nothing from its other valuable properties; for if the round green nuts are detected through the dense foliage, they add to rather than detract from the whole pleasing effect.

In the manufacture of implements of use it enters more largely than perhaps any other tree, especially where hardness, elasticity and strength are required. A volume might be filled with merely the names of the articles which are wholly or in part made of hickory wood. To the American, accustomed as he is to the use of this valuable wood, it seems that no other can be substituted for it, which will combine so many advantages.

But we need not stop with a bare consideration of the hickory as a timber tree. The nuts of this and the other juglans tribe possess a virtue which has been allowed by Americans to pass without notice. All are aware with what eagerness the sweet kernel of the hickory, the butternut and black walnut, are sought for by men and the nut eating animals; yet few have thought of the amount and quality of the oil which may be produced from these nuts. Walnut oil has never been expressed in America, but in Europe the nut of the *juglans regia* has been used for that purpose for some years past, and it holds a rank with the oil of almonds, and poppy seed as a salad oil, and is much above the oil of olives for the table.

G. P. Marsh (*Man and Nature*) says "the walnut yields one-third the oil produced in France, and in this respect occupies an intermediate position between the olive of the south and the oleagenous seeds of the north. Two and a half acres w ll produce nuts of 500f value ($94). It is stated by Cosino Ridolfi, that "France obtains three times as much oil from the walnut as from the olive, and nearly as much as from all the oleagenous seeds together; and twelve trees to the acre is equal to a capital of 1000f."

The writer in the New American Encyclopedia states that the oil expressed from the walnuts, is in general use as an article of diet in those districts in which the tree abounds. And serves a still more important purpose in the preparation of fine colors. It is preferred on account of the complete and rapid manner in which it dries, and the facility of obtaining it perfectly limpid by diffusing it upon water in large shallow vases. In copper plate print ing at Paris it is considered indispensibly necessary for a fine impression, either in black or colors. It is also used in mixing paints, which it does much better than linseed oil.

The smooth shelled hickory nuts could be ground as well as the nut of the *juglans regia;* and the bitter nut of the *carya amara*, which is about as rich in oil as any of the hickory nuts, might well be employed in the manufacture of table oil. The shell of this nut is very thin, probably fully equal to the foreign walnut. The bitter principle is found exclusively in the inner integument which surrounds the kernel, separating all its parts. This bitter principle is not soluble in the oil of the nut, and will not therefore be communicated to the oil. None of the northern hickories bear more nuts, or nuts in which the kernel bears a larger proportion to the weight of the nut. Some

of the sweet nuts are also thin shelled, with large proportionate kernels. It is submitted that means will be found of obtaining the oil from the black walnut and butternut, notwithstanding their thick shells, and dry exterior covering. In all the experiments for producing at home whatever is consumed, it certainly seems that attention ought to be turned to this manufacture of oil of walnuts and hickory nuts.

The thin shells of some of the varieties of sweet nuts, are often combined with the most valuable timber, and it may be expected that the attention of cultivators of the juglandacæ, should propagate trees with direct reference to this quality of thin shell and excellent timber; thus rendering the trees much more valuable.

The following varieties are recommended for cultivation:

CARYA ALBA. (*Shell-bark or shag-bark hickory*).

Leaflets 5, minutely downy underneath finely serrate, the 3 upper obovate-lanceolate, the lower pair much smaller, all taper pointed. Fruit depressed gobular; nut somewhat flattened, nearly pointless, with a rather thin whitish shell, and large kernel—grows in rich, moist woods—a tall and handsome tree, the old trunks very rough from the exfoliation of the outer part of the bark, which loosens in large strips adhering by the middle or one end—wood valuable as timber, the standard as fuel, while the nuts are the principle ones in the markets. Buds very conspicuous in the spring, with large scales.

CARYA SALCATA. (*Thick-shell-bark-hickory*).

Leaflets 7 to 9, in form like the preceeding—fruit oval, 4 ribbed—nut strongly pointed, nearly smooth, sometimes ribbed, or slightly flattened, with a thick yellowish shell, nearly as sweet tasted as the last; more common in the western than in the eastern states. Wood tough and valuable. Large tree. Bark, rough ribs, semi-cleaving, from which it takes its name, *Salcata*.

CARYA TOMENTOSA. (*Mocker nut—white hearted hickory.*)

Leaflets 7 to 9, oblong or obovate-lanceolate, slightly serrate, roughish underneath, as well as the petioles, aments hairy—fruit globular or ovoid, with a thick and hard husk, which splits almost to the base—nut somewhat 6-angled, the shell very thick and hard, of a light brown—kernel small and sweet. A tall, large sized tree with a rough furrowed bark on old trees, quite smooth when young. Its wood is tough and light colored, there appearing to be but very little, or what is usually termed, heart wood, even in the largest trees. The tree is well suited for growing upon high, dry soils, where it is more generally found than in the deep soils; and is found from the Missouri river to the sea board. For cultivation for timber it deserves the first rank, excelling even the *alba*. It derives its specific name from the hairy leaves, petioles and aments. The entire nuts differ in size, from three-fourths of an inch to two inches in diameter, made by the thickness of the husks. The tree grows in Ohio, but may prove tender in Wisconsin; yet it should be experimented with.

CARYA GLABRA. (*Pig-nut*)

Leaflets 5 to 7 ovate-lanceolate, serrate, smooth (from whence its name *glabra*)—nuts somewhat pear shaped, with a thin husk, splitting about half way down, and generally adhering when the nut falls. Shell hard and tough—kernel small and variable—sometimes sweet and in others bitter. A large tree with a close bark, very tough and valuable wood, light colored; common almost every where; thrives well on dry, sandy and stony land.

CARYA MICROCARPA. (*Small-fruited hickory.*)

Similar in fruit and leaflets to the last, but the shell is very thin and the kernel sweet and large in proportion to the size of the nut. The tree is large and wood excellent. This is a valuable variety for nuts, even excelling the pecan, but may prove tender in Wisconsin, of which it is probably not a native.

CARYA AMARA. (*Bitter-nut.*)

Leaflets 7 to 13 oblong-lanceolate, serrate, smooth; fruit globular, but variable, with ridged or prominent seams opening half way down; nut inversely heart-shaped; shell very thin; kernel apparently intensely bitter, and remarkably corrugated by the bitter integument. A graceful tree with close bark, and small pointed buds nearly destitute of scales, covered in winter with a yellow pubescence. Wood not as hard and heavy as the other varieties, but valuable for bending, being the most supple of all the hickories. It thrives well in moist land and swales, where it is almost springy ground, and is particularly adapted for such locations.

The hickories all strike a long tap root, and it is very difficult to transplant them from where they have come up after they are more than a year old. They are best grown by planting the nuts where the trees are desired, and cultivate them there till they are four feet high after which they will shade the ground, if planted thick, and will only require trimming. All the hickories can be worked on each other. And no variety of tree will pay better for cultivation. Plant the nuts as soon as gathered in autumn, or keep on the ground under leaves till spring.

CUPULIFERÆ. (*Cup-bearing.*)

This family embraces some of the most valuable timber trees in America, including the oaks, chestnut, beech and hornbeam. The leaves of these are alternate, simple, straight-veined, and monœcious flowers; sterile in catkins, fertile solitary or clustered, furnished with an involucre which forms a cup or covering to the nut or nuts. Seeds filled with the embryo; cotyledons very thick and fleshy. The nuts must be planted before they dry as they die on drying, and are apt to mould and rot by too great and moist heat.

QUERCUS. (*Oak tribe.*)

Sterile flowers clustered in slender and naked drooping catkins; fertile ones scattered or somewhat clustered, with a 3-lobed stigma enclosed by a scaly bud-like involucre, which becomes an indurated cupule (cup, from which the order takes its name,) around the base of the rounded nut or acorn. Cotyledons remaining under ground in germination. All flower in May and shed their nuts in September and October.

QUERCUS ALBA. (*White Oak.*)

Leaves smooth, pale or glaucose underneath, bright green above. Cup hemispherical, roughish, naked, much shorter than the ovoid or oblong acorn. Nut an inch long, variable in flavor, sometimes sweet and quite good, in others bitter, or almost tasteless. The bark on young trees is rough but not furrowed, becoming somewhat scaly on old trees; color, grayish white.

Wood, light color, very tough and very valuable; and used for more purposes than any other timber. This is the largest and tallest of all the oaks, reaching from 60 to 100 feet high, and from 2 to 4 feet in diameter.

The white oak is rather a slow grower, until the root is firmly established, after which it makes wood rapidly, often laying on an inch of wood in four

years; but the wood is so valuable, that it deserves to be extensively planted for timber, in all parts of the state, where it does not already exist. Take away the white oak, white ash and hickory, and the wagon and carriage maker would lose the three most valuable materials which enter into the composition of his work; so too with the maker of farming implements. White oak is also extensively used for building material, for railroad sleepers, for fence posts and rails, in which situations it is ranked with the most durable timbers. The sawed lumber is apt to warp considerably in seasoning, but it retains its place afterwards, especially if kept dry or painted.

QUERCUS OBTUSILOBA, Q. MACCROCARPA and Q. OLIVÆFORMIS, are generally included under the common name of Burr oak, because the cup incloses most of the acorn, and there is considerable resemblance in the appearance of the bark and trees.

QUERCUS BICOLOR OR PRINUS. (*Swamp White Oak.*)

This is one of the chestnut oaks, with leaves coarsely sinuate-toothed, not lobed—cup hemispherical, often a little mossy-fringed at the border, inclosing less than one-half the oblong-ovoid acorn.

This oak grows rapidly into a large tree, in soil too moist for the *quercus alba*, along with the red maple and black ash. It is found native in all the wet grounds of the state, and is almost the sole species growing in the overflowed lands of the Wisconsin and other rivers. The tree is tall and straight, with a good body, though apt to produce small limbs on the stem, if the tree is at all isolated. It grows with about the same rapidity as the white oak, but is not as long lived, hence trees more that two feet in diameter are rare. The wood is as valuable in every way as the white oak, and for the purpose of growing timber in the moist soils in which it grows it would be very profitably cultivated.

These two white oaks are the only ones which can be fully recommended in every particular as worthy of cultivation as forest trees, and with them, both the wet and dry rich land may be converted into forests. Oaks like the hickory will grow alone or with other trees, thus occupying part of the surface or all. The white oak as fuel ranks higher than maple, and with the lower grades of hickory. The small trees are nearly as valuable as hickory for hoop-poles, so far as suppleness is concerned, and when once formed and driven are more durable, especially when placed in a moist situation; nor is it so subject to the attacks of the powder-post worm, which not unfrequently destroys the hickory.

QUERCUS COCCINEA. (*Scarlet Oak.*)

Leaves oval in outline, deeply sinuate; acorn globular ovoid, one third or more immersed in the thick and somewhat top-shaped conspiculously scaly cup. The long petioled shining leaves cut two-thirds to the mid rib, turning bright scarlet in autumn.

This oak is often known in this state as *black jack*, and is found on lands in which sand either on the surface, or in the subsoil predominates; and in the

most barren sands, is often short and disposed to rot and decay. On the more tenacious soils, the tree is a rapid grower, but may be considered as short lived, seldom showing an age much above 50 yaars. When it grows rapidly, the wood is coarse-grained, but not very porous, yellowish brown, and is highly esteemed for fuel, and preferred to white oak for that purpose. Grown at the rate of 640 to 1280 trees to the acre, and cut whenever the tree begins to show signs of dying, say at 30 years, it would probably produce as large an amount of timber and fuel as could be procured from any other oak; and a new growth might be expected from the acorns which would have before sprang up, and formed strong grubs over the ground. many fine clumps of timber, of these oaks, have grown from what were mere scrubby bushes at the first settlements of Wisconsin. The timber is considerably used as building material, and especially as hewed sticks. It is full as durable as white oak for fence posts, and rails, and railroad sleepers.

There are several other species of oaks natural to the state, but for general cultivation these are all that can be recommended. Oaks are easily and best obtained from the acorns, which must be kept as described for chestnuts, and should be planted where the tree is wanted. If they are grown in the nursery they must be dug up and transplanted at the end of the first year, as they will then have produced a large fleshy tap-root; and unless this is shortened there will be no lateral roots, but the root will continue to penetrate the ground, as it often does to the depth of several feet. This makes the tree a good neighbor to other trees and plants. Of all our forest trees, the oaks have the fewest faults and most virtues.

CASTANEA. (*Chestnut*).

This is another of the cupuliferæ, with leaves oblong-lanceolate—pointed, serrate with coarse pointed teeth, smooth and green on both sides, strongly straight veined. The flowers appearing later than the leaves; the sterile ones near the ends of the branches, in long and naked cylindrical catkins; fertile flowers at the base of the sterile, 2 or 3 together in an ovoid scally prickly involucre. Nuts coreaceous, ovoid, three together or two or one by abortion, in the hard coriaceous and very prickly involucre; cotyledons very thick, somewhat plaited, cohering, remaining under ground in germination. The centre nut is flattened on both sides, if the three mature, if two mature they are flattened on one side, if but one it is ovate. The American variety of *castanea vesca* bears a smaller but sweeter nut than the European. The clasical name is derived from the town of Castanea, in Thessally, famous for its chestnuts.

This well know tree is not, as it is thought, a native of Wisconsin, but many suppose it may thrive on the sandy, gravelly hills of the southern counties and that trials to that effect should be made. It has been planted, and produced nuts in some places in the state; yet it may require the protection of other trees. It is worth the attention of every land owner in the state who is possessed of a piece of ground suitable to its growth, to make the experiment. Though it does not grow equally well upon all kinds of soil, like the oak, still it is found growing over so wide a range that suitable soil

may be expected to be found in this state. It prefers a dry, sandy or gravelly soil to an alluvial, clayey or moist one; even upon very poor sand and gravel it will grow very rapidly. Rocky hill sides, where soil can be found sufficient to start it, may yet be covered with this valuable tree. Experiments heretofore made with it have undoubtedly failed from placing it upon soil unsuited to its production.

To induce farther experiments with the tree, some of its excellent qualities will be pointed out. The nuts always command a price higher than any other nut in the market; they are now worth from 9 to 10 dollars a bushel in New York city. One crop of the first quality of nuts from a tree 20 years old would more than pay for the almost worthless land on which it grows, and of the planting and care of the tree. Though it would require a somewhat large topped tree to produce a bushel of nuts, it does not therefore necessitate an old tree. Here size of nut would act a conspicuous part. The larger and earlier the nut the more sure and greater the yield.

For nut bearing the trees might require to be planted at the distance of 33 feet each way, or 40 to the acre of land, as that distance would allow space for them to head. Allowing for each tree a half bushel of nuts, and but $5 per bushel, we have a yield of $100 to the acre—a return far above that of any cultivated crop, raised and gathered at the same expense. In the southern counties of Europe the chestnut forms a large share of the food of the people, being cooked in various ways, and eaten raw. Our American nuts are richer and sweeter than theirs.

Several years may pass before such a yield as we have supposed is produced; but it is to be remembered that we are supposing these trees to occupy lands which otherwise would bring little or no return; therefore there can be no loss in waiting for the growth of the trees, except the small amount of interest on the investment. Should the trees be planted on lands which could not be cultivated with other crops, it would be as well to plant as high as 640 trees to the acre, and give them the entire ground as soon as their shade covered it, and commence to thin them out as the trees reached sizes for stakes, trellises, rails, posts, fuel and the thousand other purposes for which their wood is valuable.

A few other kinds of timber may be more durable than chestnut, but none of equal value can be so rapidly and easily grown. When the tree becomes large it is more valuable than when young, and the more rapid the growth the more valuable the timber. Look into the work shop of the cabinet maker, and see it converted into many useful articles of furniture. You cannot enter a railroad car, a steamboat or hotel without seeing chestnut timber employed in some article of furniture, or portion of the structure itself. The very coarseness of its grain when properly filled with oil and varnish to receive a polish, gives to the wood an almost endless variety of forms and matchless beauty for furniture and casements.

When the chestnut is cut down sprouts will almost invariable spring up from the old stump and grow with surprizing rapidity, so that a forest once planted is one for all time, if the trees are cut in the winter. If these sprouts are thinned out when small, so as not to crowd, they will grow from eight to twelve inches in diameter, and twenty-five to forty feet high in ten years.

As an ornamental tree in the open common, the chestnut is one of the best of trees, sometimes presenting a broad oval, and at others a cone shaped head. Scarcely any two trees bear nuts exactly alike, thus a great variety may be produced and selected from for profitable multiplication. The great object for Wisconsin would be large early nuts, and fast growing trees. The native rather than foreign trees should be selected. So too for planting, nuts from the high hilly portions of New York and Massachusetts would be preferable to seeds from Pensylvania and Ohio, as they would be more likely to produce hardy trees. It must not be forgotten, that the chestnuts grow from the mountains of Vermont to the foot hills in Georgia, and have acclimated themselves to each latitude, in which they are found.

The seeds should be kept through the winter by placing them in wide drills or other smooth clean ground, as soon as possible after they are gathered, and fill the interstices with loose friable soil or sand, then covering them two or three inches deep with leaves, and small sticks placed on them sufficient to hold the leaves during winter. In early spring they may be taken up before they sprout, and be buried an inch and a half deep in light dry sandy soil, in the nursery or where they are to remain; or they may be planted at the first where they are to grow, by covering them with rotten manure, muck or leaf-mould, but very shallow. They may be budded or grafted at any age. If they are grown in the nursery they must be transplanted the first year, to shorten the tap-root.

FAGUS FERRUGINEA, (*Red and White Beech.*)

The beech belongs to the family of Cupuliferæ, of which the oak and chestnut are prominent examples. It is a common tree in most of the northern states, grows to a large size, often 70 feet and more, and two or three feet in diameter. It is found abundant along the shore counties of Lake Michigan, from Racine northward. The largest trees are found in deep, rich, loamy soil; but is common in stony land, with or without a strong admixture of clay. The roots spread very widely and keep near the surface, often exposed. It is a tall, straight tree, and will thrive at the rate of 1280 to the acre, and wherever it will grow would make an excellent windbreak, when grown in belts. The timber, if not classed with tough woods, is extremely hard, and is used for a variety of purposes where a fine hard surface is required. Mechanics tools, such as planes, saw handles, &c, are almost exclusively made of beech. It makes fuel excelling maple when dry; and is used for building timber in many sections where it grows, being often hewn forty feet in length. It is very durable timber when kept dry.

The young trees are often used for hoop-poles, and such are constantly springing up from the naked roots in great abundance, if cattle are not allowed access to them, as they are as fond of the beech leaves as the most nutritious grasses. The tree is far from being a slow grower; though it would take years to become most available for either fuel or timber. No timber tree will more surely reproduce itself than the beech when cut off in the winter. Though a good neighbor to several other trees, it will itself occupy the entire ground.

There is but one American species of the tree, the difference between the white and red wood depending on other causes, than the species.

The sharply three sided nuts, usually two in each, urn-shaped and soft prickly coriacious involucre, ripens early in September, and the nut falls out. They are the sweetest kerneled of oil nuts, and are greedily eaten by all the nut devouring animals and birds, as well as men. A superior table oil could be made from the nuts, as the shells could be easily removed if necessary. The trees commence bearing at about ten years of age, and increase their quantity with age. The nuts should be planted like the other cupuliferæ, as soon as gathered, where they could not be disturbed by the nut eaters, and they will come up in the spring. The classical name *fagus* is derived from the Greek verb *phago*, to eat, in allusion to the esculent nuts of the tree.

The remaining species of this family of trees, consisting of the water beech (*carpinus*) and ironwood (*ostrya*), although valuable as wood and timber, are too small trees, and of too slow growth to be valuable for cultivation. And the hazel-nut *corylus* is a mere shrub.

BETULA. (*Birch.*)

Trees or shrubs, with both kinds of flowers in separate scaly catkins. Fruit a broadly winged and scale-like nutlet, or small samara; ripens in June and should be then planted in moist sandy soil, or be mixed with sand and kept till spring for planting—Foliage entire, mostly thin and light—Sterile catkins, long and drooping, terminal and lateral, formed in summer, remaining naked through the succeeding winter, and expanding their golden stamens in early spring, preceding the leaves—fertile catkins, oblong or cylindrical, lateral, protected by scales during winter, and fully developed with the leaves.

There are several native species of birch in Wisconsin, some of which grow to a size large enough to be sawed into lumber. They can be propagated by cuttings in moist sandy land, and some succeed best in moist soil.

Betula Papyracea, (*paper birch, canoe birch.*)—Bark of the trunk is white externally, separable in thin paper-like sheets, very durable and used by the Indians for making their canoes. Is a large tree with a fine grained light colored wood. Found in wet lands in the north parts of the state.

Betuta Excelsa, (*Yellow birch.*) Grows in moist springy ground, common in the north—tree 40 to 60 feet high, with yellowish silvery bark, the outer layers exfoliating in thin revolute stripes. The thin young leaves and twigs are aromatic with a winter-green flavor—wood hard, white, takes a satin polish The tree yields an abundance of sweet sap, which is manufactured into vinegar.

BETULA NIGRA. (*River or Red Birch.*)

A rather large tree of rapid growth, 40 to 70 feet high, and 2 feet in di-

ameter, with a smooth reddish brown bark, the outer layers exfoliating in broad thin revolute laminæ or sheets—Wood compact, heavy, light red color; and receives a fine polish. Found in abundance along the overflowed lands of the Wisconsin river, and will succeed in all deep alluvial soils. Timber is valuable for cabinet work.

BETULA LENTA. (*Cherry Birch or Black Birch.*)

A rather large tree 40 to 70 feet high, with dark chestnut-brown bark, reddish-bronze colored on the spray—Bark and spray strongly aromatic, and are sometimes employed in domestic brewings and diet drinks. Timber rose-colored, fine-grained, hard, compact, and as valuable for cabinet work as the cherry, which it resembles. It is a thrifty growing tree on soil adapted to the sugar maple, and its long virgate drooping spray and large green leaves give it a very graceful appearance.

There are other varieties of the birch, but they are all small and undeserving of cultivation. The paper and yellow birch are peculiarly fitted to grow in cold springy land where no other large tree will thrive. The red birch is equally well adapted to the sandy bottoms of our overflowing streams, where by its roots it will protect the land from washing, and out-lives and outgrows the red maple and black ash, and even the cotton wood. All these varieties produce fuel which when dried is equal to the sugar maple for producing heat. The most valuable variety, the cherry birch, if found in Wisconsin, is rare, and should be introduced immediately, as one of the best of American forest trees for this climate.

SALICACEÆ. (*Willow family.*)

This family of trees and shrubs, with both kinds of flowers in catkins, on different trees, has the seeds in a kind of pod, clothed with a long silky down, and must be saved like the birch. It includes the willow proper, and the poplars.

Several native species of the *Salix* (willow) grow in this state and others have been introduced by nurserymen and others. The soft light wood of all the species is nearly valuless, except such as produce oziers for making baskets; and there can be no object in growing any of them for forest trees.

POPULUS—POPLAR. (*Aspen. Cotton-wood. Balm of Gilead.*)

All of this sub-order of the Salicaceæ, are very rapid growers when young, except the *populus tremuloides* (American aspen,) which last is out grown even by the white oak. There are, native in this state, as many as seven distinct species. The wood of all is light, and possesses very little durability and value as a timber. It checks, warps and springs so much in seasoning as to ruin it as sawed or hewed timber. As fuel the willow and poplar rank the lowest of American trees, bearing the relation of 40 to 100 as compared with hickory.

Although for a period of 10 or 15 years the poplars may grow with great rapidity, so as to have merited the reputation of the most rapidly growing tree we can plant, yet after about that age they grow less and less rapidly. In a period of 30 years or more the Lombardy popular, and balm of gilead (*P. canadensis,*) the most rapid growers of the poplars, will be out-grown by

the elm, the red and silver leaved maples, the butternut, black walnut, and the thornless locust; and will no more than keep pace with white, red and Scotch pines. And in fifty years, the Norway spruce, Scotch larch, and white oak will overtake them; so that they may be classed with the short-lived trees, when compared with the trees above named.

Nearly all the species are infested with worms. All send up numerous suckers, and at great distances from the tree. At the time the leaves commence to grow, the scales of the buds fall to the ground, and there are blown about, and in some of the species, these scales are covered with a tarry, balsamic substance, which fastens to everything, on which it is pressed; and whenever the tree stands near the sidewalks and houses, there gummy scales are often carried by the shoes into the house and left fastened upon the floors and carpets. The numerous sterile catkins, after having sent out their polen, floating everywhere on the winds, fall to the ground again covering the walks; while in summer the fertile catkins give off their clouds of cotton, which float for miles from the trees, filling the air, to the great annoyance of all. The two foreign species which are found in cultivation, the pyramidial Lombardy poplar (*P. Dilata*) and the white poplar (*P. Alba*), are equally objectionable to the others, except that in the first of these only trees bearing sterile catkins have been introduced, and consequently no cottony seeds are produced. The seed bearing trees ought never to be planted near houses. We dismiss this whole class of trees by stating, that even where rapid growth of trees and shades are desired, the ground had better be planted with other and more valuable trees.

CONIFERÆ. (*Cone-bearing—Pine family.*)

Trees or shrubs with resinous juice, mostly with awl shaped entire leaves, and monœcious or diœcious flowers in catkins, destitute of calyx or carolla. Embryo in the axis of the albumen and nearly its length. Wood destitute of ducts, composed chiefly of homoginous large woody fibre, which is marked with circular disks on two sides.

This great family of trees embraces some that in the economy and advancement of the country have played the most important part. Among which are the pines, the firs, the cedars, the cypresses and the larches. All but the cypress and larch are evergreen, and nearly all the genera and species are in some form used for timber and fuel. We are apt to overlook the chief value of these trees, and their timber in planting forests or shades, because they do not appear to hold out such great pecuniary advantages, in so short a time as do the deciduous trees. Although they grow as rapidly and their wood is as valuable, yet it takes more years to attain the maximum of wealth to be reaped from a single tree. Other trees are cut when small, so are some of these; but the best, the pines and the hemlock which are chiefly used for boards and plank, sawed timber and shingles, require large trees grown in shaded situations, so as to be free from knots and cracks, and have good length of stem. Notwithstanding these trees grow as rapidly as other trees,

yet 50 or more years are required to produce such trees as are demanded for sawing into lumber; and even at that age, years continue to add value to the timber in increasing proportions.

The evergreen forests of Wisconsin have been and still are more valuable than placers of gold in the gulches of the Rocky mountains, if we simply count the dollars which the lumbermen have extracted from them by the aid of toil and machinery.

The pines of this state have contributed materially to build cottages and palaces, not only in this state, but in all the states washed by the Mississippi and Lake Michigan. Scarcely a dwelling, church, school-house, public or private building can be found, to which they have not contributed more or less. The plentifulness of the timber has hitherto kept down the price, and it has not been appreciated. Great forests have been robbed of their best trees, for the sake of a single log, or a few shingle-bolts; other trees and forests have been wantonly destroyed. The young trees, designed by Providence to replace the old, have been ruthlessly cut away to make a place for an experiment in growing corn on sands so destitute of vegetable matter, that corn could not grow, until the pines had for ages more shed their needly-shaped leaves on the barren surface.

It would seem as if the woodman, axe in hand, had found himself in the midst of the dense evergreen forest, and forgetting all of earth beside, and because his vision was bounded by the trunks and branches of large trees, he believed all the world was pine; and that fate had placed him there to hew out an opening, and let in the light of the sun; that the quantity and extent were what they appeared to his limited vision—infinitely large and therefore inexhaustable. His vision could not extend just over the tree tops, within the day's flight of the pigeon, where was spread out a region far greater than his forest, on which no tree rears its head; and where all and more than all, the trees which surround him, are wanted for its use.

The time has already arrived when we begin to feel that there is a scarcity of pine timber; where it was but a few years ago, sold for $10 for a 1,000 feet, it now readily brings thrice its former prices, with no prospect of being any cheaper.

This increase is not owing to a scarcity of labor, as some tell us, or to an increase of currency, as others say. Although these causes may have some effect at present, yet it is mainly owing to the difficulty in getting the trees from which the lumber is made, which has raised the price. In a few years more, if lumber continues to advance, and there is no reason why it should not, it will be beyond the reach of the poor, or even the middle classes, and these must resort to other materials from which to construct their abodes; and as in Europe with no intermediate material between mud and stone walls, the rich will live in this, the poor in that.

The rapid strides which we have made in advancement, may be attributed

as much to the cheap pine lumber as to the enterprise and intelligenee of the people expended upon the prolific soil of the state. This cheap lumber has built our houses and our barns, our stores and fences, and given to the people their long stride in the race of nations. But while those trees have been destroyed to build a state, no efforts are made to replace them with others; on the contrary, if the young trees are not broken down and killed, the fire is allowed to run over the land and complete the devastation man had commenced; whereas, if they had received proper care and attention, the forests of evergreens now cut down and gone, would in 40 or 50 years have been replaced with another nearly equal to the first.

If in planting belts and groves of trees for timber, shelter or protection from winds, a free use were made of such evergreens as would thrive on the soil occupied, they would grow all the better for admixture; and within a lifetime, the pines would become saw logs, and the cedars split into fence posts. Retaining their foliage during winter, they afford protection at a time when it is most needed. A belt of these surrounding a farm, mingled with others, or alone, or at least such portions as contains the buildings, orchard and garden, gives a cheerful, comfortable appearance to the place; and both man and beast will live longer and be more comfortable and happy than when exposed to every gale of winter, when for more than six months of the year nothing appears life-like—nothing to break the force of the blast as it comes over drifting snows. If they take room, and shade the ground, they shelter while the live, and pay a large rent in timber when they die. Cherish them as good friends.

PINUS. (*Pine Family.*)

Fruit a cone formed of the imbricated and woody carpellary scales which are thickened at the apex (except in the white pines,) persistent, spreading when ripe and dry; the two nut-like seeds partly sunk in excavations at the base of the scale, and in separating carrying away a part of the lining in the form of a thin and fragile wing. Leaves evergreen, needle-shaped, in fascicles of 2 to 5 from the same slender buds, sheathed by the scarous bud-scales at the base. Flowering in May and June; the cones maturing the seeds in the autumn of the second year. The name is classical latin.

PINUS BANKSIANA. (*Gray or Northern Scrub Pine*)

Leaves are in pairs, short, oblique, divergent—cones ovate-conical, usually curved, smooth, the scales pointless. This species is generally a stragling shrub or low tree from five to twenty feet high, but on the almost barren "Potsdam sands" of Wisconsin, it fills an important place, and grows into a tree fitted for many uses. It seems to flourish best in soil too thin for growing any other tree, even the jack-jack-oak. In its early years it out-grows all other evergreens, and has been said to make a tree five inches in diametre in ten years from the seed, and at about four years of age to grow eight and ten feet in one season. At such times the upright shoot is tender and brittle, very jucy, and may be eaten, but is neither palatable nor nutricious, and

leaves a bad effect upon the mouth. It reaches 60 or 80 feet in height, and timber may be hewn from it 30 or 40 long, and eight inches square. It is short lived, and the largest trees often rot while yet alive, and break down. Seldom does it grow large enough to be cut into boards. As it grows old it become resinous, and then if cut and dried, it makes a hot flaming fire. It seems fitted for the purpose of creating a soil on the light sands where it is found, and to prevent them from blowing into drifts, and ought to be kept growing thereon, until a soil capable of producing something else is formed.

PINUS RESINOSA. (*Red Pine, wrongly called Norway Pine.*)

Leaves in pair from long sheaths, semi-cilindrical, elongated, dark green, 5 to 6 inches long. Cones ovoid-conical, about 2 inches long, sometimes aggregated in large clusters; the scales pointless, dilated in the middle.

Large trees with smooth straight stems—reddish and rather smooth bark; and compact yellowish wood moderately resinous, very durable, and valuable for joists and flooring, as well as fencing boards. A rapid grower on all dry soils, and thriving on the most sterrile sandy lands in the state. Next to the white pine this is our most valuable species of pine; and for some locations and uses, is preferable. As an ornamental tree, its dark green foliage and long leaves make it rank above the Austrian pine, which it much resembles, and excells in growth.

Two other species closely resembling this are found in the northern states. These are the *P Rigida* (pitch pine), with very rough and dark bark, hard wood saturated with resin, and grow 30 to 70 feet high; and *Pinus Mitis* (yellow pine) But they do not make as large trees, nor as valuable timber for any purpose as the red pine, and grow in similar soil; therefore they cannot be recommended.

PINUS STROBUS. (*White Pine.*)

Leaves in fives, very slender, 3 to 5 inches long, rather glaucous, the sheaths deciduous: cone narrow, cylindrical, nodding, a little curved 4 to 6 inches long; scales of the cones pointless and not thickened at the end, but very slightly upwards; open early in winter, the seeds soon falling out. The tree is large and the tallest of all our natives, sometimes towering in a single stem to the height of 160 feet, and almost perfectly straight, one-half of which is clear of limbs. This tree furnishes the immense quantity of white pine lumber so well known throughout the country.

No other tree yields such invaluable, soft and lightish white or yellowish wood, which in the large trunks is nearly free from resin; and although no wood cuts easier and smoother under the plane, it is more durable than white oak. The young trees in the forest generally have but few branches and leaves, but in the open ground, it is sufficiently dense to form a good shade, and makes a handsome cone topped tree. Its best location is on rich corn land, with other trees, to which it is a good neighbor, or massed by itself at the rate of 640 to the acre, in which situations it will mount upwards with the most rapid growers. The white pine grows in soils quite moist, almost swampy, though not as well as on drier lands.

There are several foreign species of pines to be found among the nursery-

men, the best of which are the Austrian for ornament and Scotch for timber. These are rapid growers, but not more so than the two native varieties above mentioned. And as their foliage is inferior to the natives, and their timber no better than the red pine, and greatly inferior to the white, we cannot see why they should be prefered to such as we know have stood the test of ages in this state.

The young trees may be grown in the nursery, and transplanted to where they are to grow; but with these as with most other trees, the best way is to plant the seeds where the tree is to remain. It is cheaper to tend the very young tree than to transplant it and then tend it. And time is gained by the planting process, and the tap root is better.

All the coniferæ grow slowly at first, and will be overgrown by the deciduous trees during the first five years of their existence, though afterwards they mount upwards faster than any other tree. Therefore in planting these trees, their own rows should be exclusively coniferæ, but not necessarily all of the same tribe or species. Thus pines, spruce and larch may be planted in the same row, and they will grow up about together.

ABIES. (*Fir and Spruce family.*)

In this sub-order of the coniferæ are found the firs and spruces. The sterile catkins are scattered or somewhat clustered towards the end of the branchlets—scales of the cones thin, flat, not at all thickened at the apex, nor with a prickly point—seeds with a persistent wing. Leaves are scattered, short, frequently two ranked, otherwise nearly as in the pines The name is classical Latin.

ABIES BALSAMEA. (*Balsam Fir.*)

Leaves narrow, and about an inch long; cones three to four inches long, and an inch wide, erect, violet colored when young—bark with numerous blisters, from which the well-known Balsam fir or Canada balsam is taken.

It grows naturally in cold, damp woods and swamps; where it makes a slender tree of but little value, and is short-lived. When the tree is young it looks very well in cultivation, but at about ten or fifteen years the lower branches die, and it becomes a tall, spindling, ill-looking tree. Its cultivation is not recommended, except as a specimen, where so many better trees can be found.

ABIES CANADENSIS. (*Hemlock Spruce.*)

Leaves linear, flat, obtuse, one-half an inch long, dark green above and silvery underneath, on light elegant spray-like, often drooping, branchlets. Cone oval, of few scales, little longer than the leaves, hanging, terminal.

It is a large tree, and most graceful of all the spruces, as well as the most valuable, almost rivalling the pine, when all its parts are considered. The bark is a light reddish brown, and the most valuable material for tanning leather we have. All parts of it are used, and it is the main dependence of the tanners. The timber is coarse grained, and is of first quality for joists and other building timbers, as it never springs, holds nails well, is stronger

than pine, and is very durable when kept from contact with the ground. It often attains a height exceeding 100 feet, and a stem four feet in diameter, and has been split into rails, and sawed into shingles, as well as timber, plank and boards. The knotless portions being generally entirely free from resin, it takes and holds paint remarkably well. It grows nearly as fast as the pines, and prefers a light, dry, hilly or even rocky soil, where it might be planted at the rate of 1,440 to the acre or 66 inches apart—one-half being cut away when the trees are a foot in diameter, and suitable for small hewing timber. Its dark, dense shade preventing evaporation, makes such dry soil appear almost swampy. When found in wetter swampy soil, the tree seldom reaches a large size; while in heavy clay it is tender and often winter kills.

This is the most beautiful native evergreen we possess; and great exertion should be made to make it grow in all parts of the state, as one of the most valuable of trees.

ABIES NIGRA. (*Black Spruce.*)

In this state this spruce is little more than a shrub, and is not a rapid grower; but that is not much to be regretted since we have already so far introduced the *Norway spruce* (ABIES EXCELSA), that that tree may as well be planted as the native variety. This last is a magnificent tree and succeeds well in almost any good soil. It grows very rapidly, both in height and size; and when planted thick or with other trees, may be made to produce excellent timber for hewing, and other building purposes.

Some of the species discovered in the Rocky mountains, grow to immense heights, often over two hundred feet, making large trees, with beautiful foliage and really wonderful cones in their structures as well as beauty. Trees from there would be a great acquisition, and it would pay for the farmers to procure seeds from that dry, open region for their own planting. Trees from which timber fifty feet long may be hewed are not unfrequent in the mountains near Taos, N. M. A species of balsam fir (ABIES BALSAMEA), in the same neighborhood, with an exceeding thick foliage, and leaves more than an inch long, may also be obtained, at the same place. But after all it is doubted if any species will give greater satisfaction, either for timber or ornament, than the Norway spruce and hemlock.

LARIX. (*Larch*)

Catkins lateral and scattered, bud-like. Sterile flowers nearly as in the pines, but the pollen is of simple spherical grains. Cones ovoid, erect, the bracts and scales persistent; otherwise as in abies. Leaves deciduous, soft, very many in a fascicle, developed in early spring from lateral scaly and globular buds, which produce the same or the second year, shoots on which leaves are scattered. Fertile catkins crimson or red when in flower. The name is ancient Greek.

There is but one species in this state, LARIX AMERICANUS (*Black Larch, Tamarach and Hackmatack*) with leaves almost thread-like; cones ovoid of a few rounded scales. The *Red larch* is but a variety of the American.

The larch is a coniferæ, though the leaves are deciduous, in autumn. It is a tall, slender grower, with heavy, coarse-grained, durable and valuable wood, wherever light straight timber, such as hop-poles, is required. The trees should be cut in the winter, and the bark stripped off in the spring. Unless this be done the poles will soon decay from retaining moisture under the bark. It is also a valuable wood for fuel, but burns rapidly, and with great heat, being much used for puddling iron, and in other places where a hot flame is required. It grows naturally on low, wet, even swampy grounds, in all the northern states and Canadas; yet it flourishes far better when brought out and planted in dryish soil. When the American larch is planted on such land and tended the same as the European or Scotch larch, it grows much more rapidly than in its native swamps. Those who desire to make plantations of the larch, should take into consideration the character of the land to be planted; if it be wet then the American larch should be chosen; if it be dry then the European larch should be planted. For timber trees the European is much preferable, as it grows as large as the pines.

The value of larch plantations is manifest from the fact that it has been for many years past profitably planted as a forest tree in Europe. Tens of thousands of acres of larch have been planted in Great Britain, for the timber which it yields; and because such plantations have proved the most valuable investments which can be made. The same is true of France, Germany and some other European countries. In most cases lands have been used for this purpose, such as exists in great abundance in Wisconsin, in the sandy regions, that are of little or no value as farming lands; and which become all the more valuable from the leaves and small spray which would be annually cast on the ground, to enrich or rather form a soil out of these sands.

Of late great excitement has sprung up among our farmers in the cultivation of the hop in Wisconsin. Have those cultivators once thought where they shall obtain the 1,700 poles required to each acre of hops? Tamarack and white cedar poles are now worth from 10 to 20 cents each; and when those now in use are decayed, as they will be in a few years, we have no large source of supply.

The larch may be planted as we have recommended for planting the hickory for hoop-poles, with a surety of as great a yield of poles; but with this difference, that the larch seldom sends up a shoot from the stump, but it requires a new plantation whenever the trees are felled. Every tree which can be grown will be wanted, in this state, before it can be reared to sufficient size for use. The large trees can be sawed into good boards, plank and other sawed timbers, or be hewed into large building timbers, for which purposes it is eminently adapted. The larch makes excellent piles for docks, or for the foundation of buildings in wet grounds. That it will last for ages we have abundant proof. Larch piles have been taken up where it is positively known that they have been driven more than a thousand years, and yet they were sound and uninjured. So too, larch logs have been dug from peat bogs

buried 12 to 15 feet deep, and where they must have been buried before the Adamic period, and yet such logs were sufficiently sound to be cut into timber. But although the timber lasts thus when completely immersed in water, it is not valuable as fence posts when on dry land, since it will decay rapidly at the surface of the ground, if allowed to remain the year round. For hop-poles it is preferable to any other tree. Another valuable quality about the tree is, that it may be planted in wet ground, with the black ash, red maple and white pine to complete timber belts.

CUPRESSINEÆ. (*The Cypress family*)

These are trees of a sub-order of the coniferæ, with fertile flowers, consisting of a few carpellary scales, without bracts, bearing from one to several erect ovules on their base, the orifice upward, forming a closed strobile or a sort of drupe fruit—buds naked. This sub-order contains the *thuja* and *cupressus* (abor vitæ and white cedar,) *taxodium* (cypress) and *juniperus* (red cedar).

THUJA. (*Arbor Vitæ.*)

Flowers monœcious on different branches, in very small terminal ovoid catkins. Fertile catkins of few imbricated scales, fixed by the base, each bearing two erect ovules; dry and spreading at maturity. Trees with very flat two ranked spray, on which the minute and oppressed scale-like persistent leaves are very closely imbricated. The name *Thuja* is from a Greek word applied to a resinous evergreen, but what kind is doubtful.

THUJA OCCIDENTALIS. (*American arbor vitæ*).

Leaves ovate-rhombic, with a gland on the back, in four rows on the two-edged branchlets;—cones small, not more than half an inch long, pointless, one-seeded—Seeds small, broadly winged all round, ripe in the fall and may be kept till spring before sowing. Usually found in swamps and in cool rocky banks.

In Wisconsin it grows in extensive "cedar swamps," and bears the name of white cedar. The trees grow from 30 to 60 feet high, with recurved branches; yielding a pungent aromatic oil, with light wood, but exceedingly durable.

This tree is readily propagated from cuttings planted in frames early in autumn and protected from frost in winter. In making cuttings it is best to take the young wood with a small portion of the old wood attached. The soil in which they are planted should be at least one-half sand or sandy loam, and the remainder a good, well decomposed leaf mould, or other old and rich soil. If planted in September or early October, they will usually be rooted by the first of May following, even when no glass is used for coverings. They should be shaded from the direct rays of the sun until winter sets in, then covered sufficiently to keep out the frost. Transplant the next spring.

In this state the tree grows to a large size, even in its native places; and when planted on the dry sandy lands, it makes an excellent growth. Where a thick timber belt is needed for protection, and the land is moderately moist, no trees except the red cedar on the dry land excels it. If planted thickly the tree will shoot up into fine poles, admirably fitted for hop-poles,

and nearly as valuable as tamarack. They may be placed on moist and even swampy lands. Of late it is considerably used as a border or evergreen hedge for ornamentation, and bears the shears well.

JUNIPERUS. (*Red Cedar—Savin.*)

Flowers diœcious, or occasionally monœcious in very small lateral catkins —Fertile catkins ovoid, of three to six fleshy, one to three ovuled, coalescent scales; in fruit forming a sort of drupe or berry, scaly-bracted underneath —Seeds one to three, bony. Evergreen trees or shrubs with awl-shaped or scale-like rigid leaves. The name is classical Latin.

JUNIPERUS VIRGINIANA. (*Red Cedar or Savin.*)

Leaves four-ranked, much crowded on the young plants, and primary or rapidly-growing shoots, awl-shaped and somewhat spreading, in pairs or threes, on the older lateral twigs very small and scale-like, closely imbricated, triangular-ovate—Berries small, with blue bloom.

The red cedar wood is well known as one of the most durable. It is laid down in the books, that the tree is one of the slowest in growth. This statement may be true in the eastern states, or generally; but is far from true in Wisconsin. Trees may be seen in Madison, and other towns of the state, which were taken from the banks of the lakes, twelve or fifteen years ago, and which at that time were not more than three feet high, and an inch in diameter, and planted in the yellow and richer soil, where the hickory and black jack oaks flourised, and which are now fifteen feet high, and ten to twelve inches in diameter. In fact, they have grown about as fast as the sugar maples and white oaks, in the same situation. In the city of Janesville and its vicinity, trees may be seen, which in fourteen or fifteen years from seeds have grown into trees twelve inches in diameter at the butt, and twenty-five feet high; even out-growing the Scotch pine which stands near them.

We have no tree which will endure as great changes in climate, wet and dry, hot and cold, as the red cedar. It will find its root-hold on the ridges and clifs of rocks, and is the first tree one meets as he approaches the Rocky mountains, after crossing the treeless plains, where it stands on the dry hill side, or hangs in the clifts of the rocks, where scarcely any other vegetation is found; and it may be found in the wet sands of the islands of the Wisconsin river and other streams. It is one of the densest of our evergreens, and is the very best tree to oppose to the full blasts of the storms and winds of both summer and winter, in the most exposed situations. For posts to set in the ground there is no tree which lasts so long; and even if it do take years to grow it to sufficient size for posts, it will last until another tree may be grown, if the seed be planted when the post is set.

It may be propogated from cuttings under glass; but the safest way is to make use of seeds. These may be gathered in autumn, and mixed with muck or leaf mould and placed in the open ground until they germinate, which often takes two years. Some bruise the berries so as to break the resinous coverings and then the seeds come up the first year.

This is the only speeies worthy of cultivation, which can be grown in Wisconsin. A very large tree, of the red cedar family, with excellent wood can be found in the mountains in southern New Mexico, but it is doubtful if it would be hardy here. If it should be, it would be a great acquisition to this class of timber trees. But the one we have deserves the most careful attention of the tree-growers of the state, and few trees will better repay the little attention this tree requires.

TAXODIUM. (*Cypress.*)

A deciduous trees of large size in the south. Flowers monœcious on the same branches. Sterile catkins, bearing 2 to 5 anther cells. Fertile catkins ovoid, in small clusters, scaly with 2 ovules at the base of each scale. Cone globular, closed, composed of very thick and angular somewhat shield-shaped scales, bearing two angled seeds at their base- Leaves linear, very small, numerous, two ranked on a very slender stalk; bark pale-colored, smooth; wood light, but very durable; trees grow very rapidly, with a straight stem. The name is compounded of *taxos* (the yew) *eidos* (resemblance).

Although the tree is a native of the southern states, being seldom found in quantities north of Virginia, yet it is found in the swamps in New Jersey as far north as New York, and when transplanted to dry land is found to be perfectly hardy in that latitude.

Says Fuller: "The valuable qualities of the cypress have been in a great measure overlooked by those who require stakes in gardens, nurseries and vineyards. Good cypress stakes can be grown much cheaper, and at home than one could transport them ten or twenty miles, even if they cost nothing more; besides the convenience of having a supply always at hand when wanted is not a small item. Red cedar stakes, eight or ten feet long, in the vicinity of New York, are worth from sixty to eighty dollars per thousand; and cypress stakes can be grown to that size in five or six years from seed, and they are almost as durable. Ten thousand cypress trees can be grown on an acre if planted in rows four feet apart, and one foot apart in the row; and if they are worth but five cents each at the end of five years, it will give us a return of $500 per acre; and allowing fifty per cent. of the amount for cost of seed and cultivation, we then have a fair return for the use of the land. The cypress is not very particular as to soil, but it will grow more rapidly in moist soil than in dry. * * I have grown them successfully in high, dry, gravelly soils, where scarcely any other tree would thrive, and I am quite certain that any one can grow their own stakes much cheaper than they can usually buy them. The young trees should be cut in spring, and the bark taken off; then place them where they will become seasoned before they are used."

If this tree be what it is here represented, it certainly deserves a trial, by not only the nursery men, but by others and especially by the hop growers, as an easy means of supplying themselves with poles; and by all land owners for the sake of the posts for fences which might be thus produced. We would recommend for trial seeds procured from the most northerly groves on the

Mississippi river; and that they be planted in well sheltered positions. They send down a strong tap root, and if they are designed to be transplanted they must be taken up at one year of age; but until it is determined that they can resist the cold winters, it is best to let them grow without being taken up.

HOW THE SEEDS OF THE CONIFERÆ, &c., ARE COLLECTED.

The seeds of the birch require but a short notice, as more will be learned of the manner of gathering and saving them in describing thoes of the coniferæ. The nutlets of the birch are produced in small catkins, which open on the ripening of the seeds, in the month of June, and the naked nutlets, being then broadly winged all around like the seeds of the elm, but much smaller and lighter, float away in the breeze to find a new home at a distance from the parent tree. They can only be gathered by picking these catkins, and letting them dry and open, where the seeds will be saved. They can be planted immediately in damp sandy soil, or leaf mould, and being scarcely covered, and kept moist, they germinate and make a growth not unlike the elm the same year. Or they may be mixed with sand and kept till next spring. This last method only has the effect to lose one year's growth.

The seeds of the order salicaceæ, which includes the willows and poplars, are produced on those tree only, which bear the fertile flowers; and are found in pods of various forms of round and oblong-ovate. A cottony appendage is attached to each seed, sufficiently large, when expanded to bear it up; and these pods must be picked before they open, in order to save the seed. These seeds also ripen in June, and should be planted immediately. The whole of this order grow readily from large cuttings; and, if care is taken, none but those trees bearing the sterile flowers need be propagated, as is now the case with the Lombardy poplar, and so the pest of the cotton is avoided.

The seeds of the pines and other coniferæ, have to be gathered in a somewhat similar manner. Whether these cones have matured their seeds in one or two summers, all ripen their seeds in October and November, and they must be gathered in the cones. When the cones have opened their scales, the seeds in most instances being armed with a broad wing will carry themselves to a great distance off, where they cannot be found by human sight.

The inhabitants of Griesham, a German village in the pine forests near Darmstadt, in the Grand Duchy of Hesse, were the first to collect these cones, in order to save the seeds for market. They placed the cones in the rooms of their houses, where the warmth and dryness of the air caused the cones to open, and the seeds to fly out and they were caught on the floor. Thus nearly every villager became a seedsman on a small scale, for the supply of his own neighborhood.

From that simple beginning has sprung the large establishments in Ger-

many, and especially that of Keller at Darmstadt, who was himself a native of Griesham. The establishments of Dawson, at Edinburgh, and of Villemorin, Andrieux in Paris, are connected with Keller by business relations. The poorer people of the forest neighborhood, and especially of Griesham, during the autumn and winter months, are engaged in gathering the cones of the pines, fir and larch, which they bring and sell to Keller's factory and its branches, This gives employment during the winter to nearly a thousand men, who are scattered over the forests of the Duchy, and find renumeration for their labor.

The gatherers of the fir-cones, particularly those of Griesham, which are distributed in greater and less fellowships throughout the pine-forests between the Rhine, Main and Neckar, are clad in coarse canvass garments. Woolen clothing would be a hindrance to them in climbing trees often a hundred feet high. In rough and stormy weather a worn-out soldier's cloak protects their limbs, and a light cap the head. With climbing-irons fastened upon stout boots or laced gaiters, these "pine-tree birds," in boldness, activity and sureness of foot vying with the squirrels and woodpeckers, clamber swiftly, with vigorous steps, which resound far through the forest, to the summit of the trees, even up to the slender topmost branches, and the snapping of the twigs to which the cones are attached announces their busy labors. They collect the cones in a linen sack thrown over the shoulder, and fish down those upon the highest and most slender twigs with their only implement, a pole about an inch thick and eight or ten feet long, provided with a hook at the end, and in mounting the trees carried suspended in the button-hole. When the industrious workman has filled his sack with pine-cones redolent of resin, he descends from his airy throne as quickly and securely as he ascended, empties the contents of his sack in a heap, warms himself at his fire, made of empty cones, and then is ready again for work, which continues thus until the gathering gloom of evening puts an end to his day's toil.

A late writer thus describes the process of saving seeds: "In Thuringia, also, this gathering of pine-cones is carried on very industriously. 'Often one hears,' says Schacht, in his famous book 'The Tree,' 'a rustling in the topmost branches of the fir-tree, and looks up, expecting to espy a squirrel busily at work, and sees instead a man suspended at the giddy height. It is a 'cone-climber,' who is clambering with wonderful activity from branch to branch, from tree to tree, in order to gather the pine-cones. The boldness of these people goes so far, that they will in a thick wood, when sitting amid the top branches of a fir, set the tree rocking to and fro, and, when its branches approach the summit of a neighboring tree, spring with a quick, dextrous leap from the one into the other."

"The process of obtaining the seeds from the cones is conducted in the following manner. The factory contains three great hot-air kilns, or ovens; the place of the fourth was taken during the past year by a steam-heating

apparatus, the principal object of which is to obviate, or at least to lessen, the danger from fire, and to increase the germinating power and the good quality of the seed obtained. Seventeen layers of hurdles are so thoroughly warmed and dried by the heating apparatus, containing some fourteen hundred square feet of superficies, that the time within which the 'Kleng process' is completed, by the opening of the cones and the falling out of the seeds is shortened perhaps one-quarter, although the degree of heat employed is very considerably lower, and consequently the seed thus produced retains far more germiating power, because the whole artificial process corresponds much more nearly to the natural. For example, the ovens heated by the fires directly, and those warmed by steam, filled at the same time with cones taken from one and the same heap, the seeds being afterwards taken out at the same time, and immediately subjected to germinating tests conducted in the same manner, yielded in a week, the former 81 the latter 93 per cent. of grains capable of germination. Everywhere have the experiments in germination made with seed obtained from Keller yielded results exceeding the percentage promised, a fact which has gradually extended the trade of this establishment to the most remote regions. The rapiditv with which the space occupied by the hurdles in the steam-kiln is warmed is surprising. In one hour the same degree of heat is attained which, by the method hitherto employed, of heating with hot air, was only reached in two or three hours. Besides this, the readines with which the temperature and the draft of air can at all times be regulated, is not to be valued too highly; and still further must be added the fact, that the great risk of fire incident to the former apparatus is entirely done away with. It may well be said that science has here indeed given evidence of progress.

"The cones, after being freed from the needle-leaves and dirt, are spread upon hurdles which are placed over the ovens and the steam heating apparatus. After the process of drying is completed, in the course perhaps of twenty or four and twenty hours, the cones are transferred to the wire-shak ers or screens, adjacent to the ovens, and in these, by means of the rotary motion given to them, the seed is separated from the cones. It has then by the removal of the beards by a particular apparatus adapted to this purpose, to be prepared for cleansing, which is effected by means of sieves and fanning machines.

"The separation of the seeds from the larch-cones is accomplished by a method which differs somewhat from the above. These cones, when taken from the kilns, are passed through machines expressly devised for this purpose, by which they are torn in pieces. The seeds intermingled with scales and pieces of wood are then placed in a cleansing apparatus, and their preparation completed by means of a stamping mill, which crushes the fragments of wood with which they are mixed. A steam engine moves all the machinery in the establishment. On an average, one hundred and sixty Hessian malter (560 bushels) of pine-cones and thirty malter of larch-cones are sub-

jected to treatment daily, giving a result of five hundred and three hundred pounds of seed.

"The establishment sends yearly to the different quarters of the globe some twelve hundred hundred-weight of pine, fir and larch seeds. Most of the German governments, Belgium, Holland, England, Denmark, Sweden and Russia, many parts of Africa, and of late especially America also, obtain seeds for planting of new forests from this establishment. Above all, however, France obtains from here the seed which she employs to clothe her mountains again with verdure. In France, forest culture has become one of the most serious questions, on account of the annually recurring inundations. The revolution too, as is well known, exercised but little forbearance toward the woods belonging to the state and the different communities. All the mountains were denuded with an unsparing hand of their forests, which would not grow again of themselves. Were it not possible to restore them by the aid of forest culture, the future economical ruin of a portion of the country would have been determined.

The largest demand is for pine-seeds, but besides the fir and larch seeds already mentioned, the seed of the black pine, of maple, ash, and elm trees, of lindens and locusts, white firs and Weymouth pines (*Pinus Strobus*), is likewise collected and prepared, though not in such large quantities.

"The sending-out of seeds by the establishment to its customers is distributed through the year as follows: the seeds of the deciduous trees, with the exception of the elm, at the end of October, or beginning of November; those of the white firs, at the beginning of December; those of the other evergreens, in the middle or toward the end of March; the elm tree seeds at the end of May, or beginning of June."

We may soon expect to see similar establishments to these in existence in the United States to save the seeds of our own pines, spruces and other trees, which far exceed in value the forest trees of Europe. Till then the seeds must be collected by those who desire them.

In procuring seeds for planting, those grown, as far as may be, in a similar or colder climate should be preferred to those from a warmer one; except where it is desired to make experiments for choice varieties.

IN CONCLUSION,

The commissioners having brought their work to a close, will state again that in their opinion, no other interest so much demands the immediate attention of the legislature of Wisconsin, as does that of increasing and preserving so much timber as shall be needed for future use by her people. The state has freely given support, premiums and rewards to its penetentiaries, eleemosynary institutions, to its agricultural societies for the products of the farms, the manufactures and handicrafts of its people, to its public schools and institutions of learning and to its roads, highways and other public uses; but hitherto this great interest, from which one-half the entire

value of all the taxable property of the state has been raised, has received no attention whatever.

Whether this course ought to be continued, and if not what remedy shall be adopted by the state, is for the legislative power, and not for this commission to determine; and to that august power it must be left at last. So too, must be left to the same power the final responses to the third and fourth propositions of the act under which we have been appointed, viz:

III. Whether, owing to the want of information in individuals and the shortness of their lives, it is the duty of the state to interpose its authority to prevent an undue destruction of forest trees where they now exist, and to encourage their cultivation where they are now deficient.

IV. Whether any and what scientific experiments or investigations should should be made to ascertain the best methods of growing and managing forest trees.

The necessity for the information on the several points here contemplated has been felt by the commissioners at every step of their work; and it must be felt by all who shall undertake to follow them, as it has been by such as have gone before. Private enterprise cannot be expected to perform the herculean labor of making the experiments necessary to procure all that is needed; and in-as-much as when obtained it must result more to the public good, than to that of the individual, so no one man or society of men ought to be expected to perform it, without public aid.

Before determining what shall be done towards making experiments and gathering the requisite information, it is first necessary to settle the question, shall anything more be done, and how much? After that point is determined the manner and means are mere matter of detail.

Seeing the subject in this light, we respectfully submit the whole matter to the future action of the legislature, content, if we have given any light upon or excited any interest in this most important subject, and with the belief that the time is not far distant when it will receive that attention which its importance demands.

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