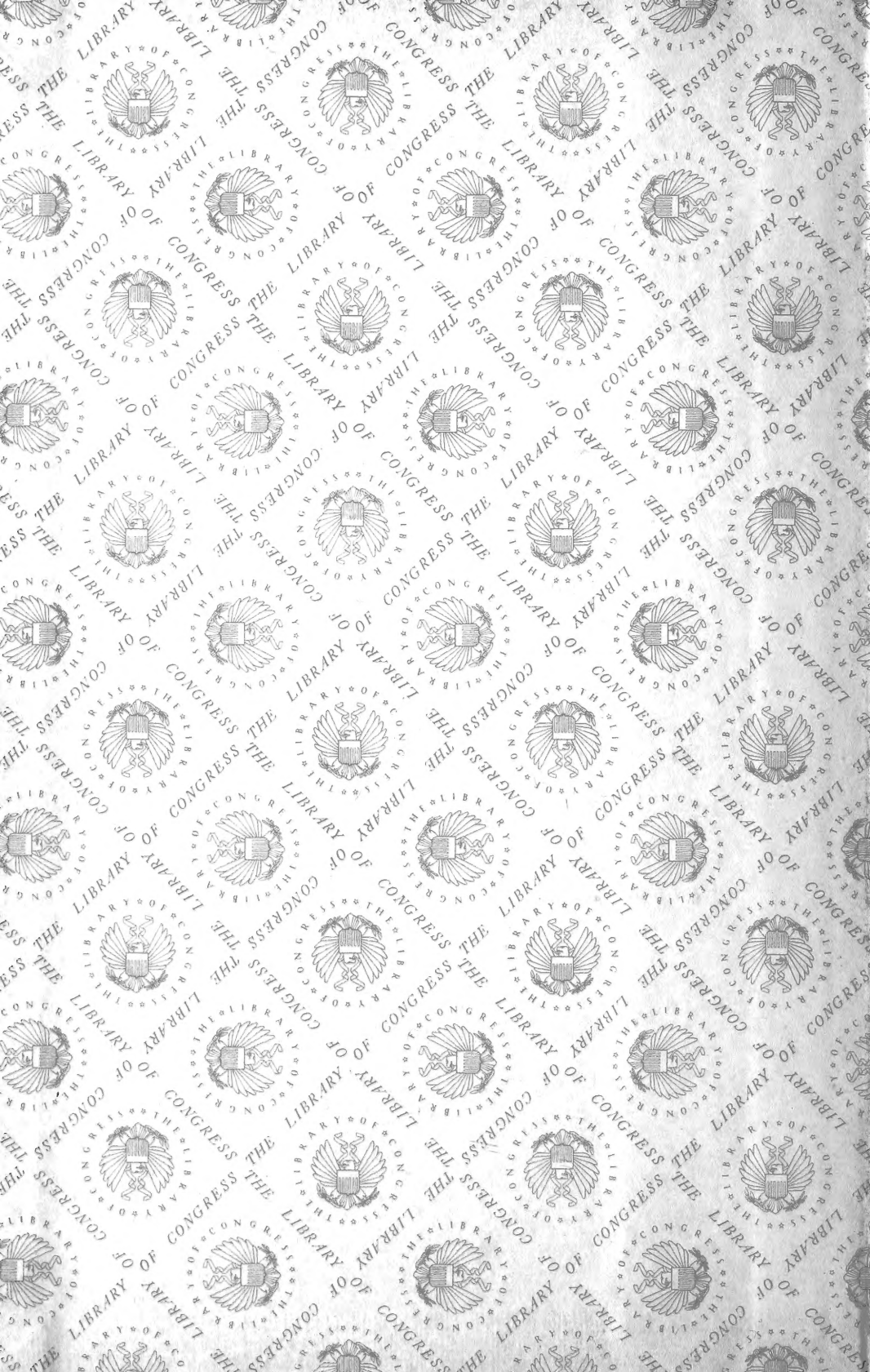


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THE
FOREST TREE PLANTERS'
MANUAL.

"EMBODYING SUCH INSTRUCTIONS AND DIRECTIONS FOR
TREE PLANTING AND CULTIVATION AS EXPERIENCE
AND OBSERVATION HAVE DEMONSTRATED TO
BE USEFUL AND RELIABLE."—*Vide Resolu-
tion of Ex. Committee.*

SECOND EDITION OF 6,000.

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BY LEONARD B. HODGES.

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PREFACE.

THE object of this work is concisely stated on the title page. It will be practical, and will embody such practical suggestions and experiences in forest culture, as are known to be reliable. It is intended as an aid to all who are interested in forestry, and to all who are trying to redeem the treeless regions and render them not only habitable, but desirable for permanent homes.

No attempt will be made for originality, but all available sources of information will be invaded and plundered for the benefit of all who are trying to make homes on the great western prairies.

L. B. H.

Preparation of the Soil.

EXPERIENCE has demonstrated beyond cavil, that a proper and thorough preparation of the soil, is a prerequisite of success. Were I to fit up a ten acre piece of prairie for the planting of a tree claim under the provisions of the Congressional Timber Culture Act, this is about the way I should do it.

I would break the prairie in June, from the 15th to 25th, if possible. I would break it about three inches deep, and do it well. No baulks or "cut and cover" should be tolerated. The sod should be all cut clear and all turned over; whether "kinked" or jointed down flat, makes no difference, so you only break in the proper season and do it well. In the following October you will find the sod tolerably well decomposed, and also an inch or so of soil beneath the sod. Then, either cross-plow or back-set, going from one to two inches deeper. The following spring this soil is in good condition for a crop. Any kind of a hoed crop is preferable to small grain, because to grow corn, potatoes, &c., profitably, requires thorough cultivation, and just this thorough cultivation which your hoed crop demands, is just the treatment the soil needs in fitting it up for tree planting. Another year of such cultivation before the trees, cuttings, or tree seed is planted, is advisable, if you have time. If not, go ahead with your planting.

Under the provisions of the Timber Culture Act, as amended, you can grow two hoed crops as above, and plant your young forest trees, seeds or cuttings, in the fall, after harvesting the second hoed crop, or in the following spring. You can raise two crops of wheat, or other small grain, instead of the hoed crop, if you choose, but in so doing you do not prepare the ground so thoroughly for forest culture, and you are pretty sure to sow more or less foul stuff with your small grain, which entails an endless amount of hard work in its extermination; for it must be exterminated promptly if you expect your young forest to prosper as it should. No weeds or foul stuff should be allowed to go to seed.

Clean culture till the trees have so far grown and developed as to completely shade the ground, is just what you must have to produce the most satisfactory results, after which the annual falling of the foliage mulches the ground and renders further cultivation superfluous.

The foregoing remarks are intended to apply to the common average undulating or rolling prairie. There is, however, a very large amount of very smooth and level prairie in western Minnesota, especially in the valley of the Red River, where the treatment should be somewhat different. Much of this land is covered with a short, thin growth of the meanest sort of slough grass. The sod is tough, very tough; in fact, *tough* is

no name for it. Unless broken in the proper season, it might as well not be broken at all. If you break it too early, the grass grows up through it much more luxuriantly than ever before. If you break it a little too late it bakes down like an adobe brick, and requires time, frost, air and moisture to slack it. There is no particular use in trying to raise any kind of a crop on such land the next year after breaking. My own experience in the treatment of this sort of prairie, is to break the last of June and first of July. Let it lay for about a year, and then either back-set or cross-plow, bringing up as much fresh dirt as you can. In fact, I would summer fallow it the next season after breaking, and I think the second season after breaking the sod I would sow it to wheat. By this time the ameliorating influences of sun, air, frost, moisture and summer fallow, will have so far operated on the obtuse and refractory nature of the soil as to have changed to a great extent its naturally sour, cold, disagreeable character, and put in condition to begin to repay the labor heretofore bestowed upon it.

There are latent virtues in such land well worth developing. Once brought out, and you will be amply repaid for the extra time and labor it has cost. Most any kind of good manure is a sovereign panacea for this sort of prairie; not because the ground is lacking in fertility, for it is not, but because the manure acts as an alterative, neutralizing the sourness of the soil. This sort of land, once thoroughly conquered, will prove of inexhaustible fertility, and, I feel confident, would then produce a thrifty growth of Black and Gray Ash, Basswood, Red, White and Rock Elm, Hackberry, Cottonwood, Box Elder, White Willow, Tamarac, Soft Maple, Ironwood, Wild Plum, Cherry, Crab Apple, and probably other varieties of timber, and will prove to be admirably adapted to wheat, oats, barley, all vegetables, and timothy, blue-joint and red-top grasses.

MANNER OF PLANTING.

The Timber Culture Act, as now amended, allows great latitude in this direction; but the fact that the doctrine of thick planting is officially endorsed and required, must not be lost sight of. Your trees when planted must average not more than four feet apart each way. This requires some twenty-seven hundred and thirty trees to be planted on each and every one of the ten acres.

The two primary objects, shelter and fuel, are constantly to be kept in view. Those once secured, the aesthetic and ornamental naturally claim proper attention. No vegetable grows more luxuriantly, with proper care and cultivation, than the Scotch Pine. No tree, unless we except the pioneer tree, the Cottonwood, is better adapted to the greater portion of our treeless region. A double row of Scotch or White Pine—rows eight or ten feet apart—breaking joints in planting, trees eight to ten feet apart in the rows, will, in five or six years from planting, form a timber belt and shelter so close as scarcely to admit the flight of a bird through its dense foliage of living green.

And I can truthfully say about the same thing of our own native White Pine; while from year to year, far beyond the limits of an ordinary human life, they continue to grow, increasing in size and in value, monuments of arboreal beauty. But unfortunately, like too large a proportion of the good things of earth, their high price places them beyond the reach of the great majority of poor men who wander over our great prairies in search of tree claims and of homes; and as I am writing this as much in

the interest of the poor man as of any other class, we must talk about something within his reach—something sure to grow, something cheap, rapid in growth, absolutely hardy, something that will “git up and git.” The Cottonwood will do all this, and so will the White Willow. The fellows who are too poor to grow them successfully, have no business on the prairies.

PROPER DISTRIBUTION OF THE 27,300 TREES WE MUST PLANT ON THE TEN ACRES.

There is once in a while a fellow who will plant it all in one grove forty rods square, and put his house, barns, stables, stock yards, right in the middle of it. Others will plant a timber-belt five rods wide along the north and west lines of the quarter section, while others will plant a strip two and a half rods clear around the whole quarter section. Where the quarter section is tolerably uniform in surface and soil, either way has its merits and advantages. Should, as is often the case, the quarter section be cut up more or less with ponds, lakes, marshes or running streams, then the plan should conform to the topography. It also happens that a quarter section, every other way desirable, has at least ten acres of sandy or gravelly knolls. In such case, plant them by all means with the varieties suitable for such localities, and in a few years you will transform them into the most valuable portion of your quarter section.

CLOSE PLANTING.

I had supposed the reasons for close planting had been so fully set forth, and the advantages so apparent to every thinking man, that nothing would be necessary to say on this subject in this work. Yet, scarcely a day passes, when I am not called upon for the reasons. Not wishing to cumber these pages with any surplusage on any branch of forestry, and yet, in deference to many whose views on many subjects I entertain great respect, I hereby present the reasons that incline me to favor close planting in starting a young forest.

In the study of forestry, nature is our greatest and best qualified teacher. To the close observer, the pages of her great book are spread wide open through the primeval forest, over the wide spreading prairies—everywhere—covered with characters so legible, that the way-faring man, though a fool, need not err. I have now in mind a young forest in Minnesota, that I regard a model. Twenty-five years ago I passed over the ground on which this young forest now stands. It was then what we would term “grub prairie,” thickly studded with Jack-oak grubs from six to twelve inches high. There were patches of Hazel among them. There were occasionally, feeble scattering specimens of Aspen. Curious to know of the development that might occur if this piece of ground had a fair show, I protected it for years from the fires that had for ages annually swept over it. Soon the grubs began to send up strong, straight, thrifty leaders. The Aspen came along the next season with great vigor. In a year or two more, Butternut trees began to appear, (probably planted by the provident squirrel, who must have carried them more than a mile, as no bearing trees were then standing any nearer.) Soon the Bass wood put in a strong delegation. For the first ten years that patch of ground grew into a perfect thicket, so dense as to be nearly impenetrable. Shading the ground from the rays of the sun; holding the mois-

ture from too rapid evaporation, the annual shedding of the foliage, mulching the ground and answering all the purposes of thorough cultivation; this dense mass constantly shooting upward toward the sky. Then began the demonstration of the doctrine of the "survival of the fittest." At that period, there could not have been less than ten thousand young trees to the acre. Gradually, the more vigorous began to assert their supremacy. Gradually, the feeble, the dwarfs and pigmies began to disappear, and at the close of the second decade, the underbrush had nearly disappeared, and a noble grove of Oak, Basswood, Butternut, Aspen, &c., good for twenty cords per acre, stood, where twenty years previous nothing but Jack-oak grubs, Hazel-bush and grass covered the ground. To emphasize the lesson, nature is repeating the lesson so taught in a thousand localities in Minnesota, always with equal and uniform success, wherever her young plantations are protected from fire and cattle. And yet, with all this overwhelming testimony, conclusive, in proof of the great value of close forest planting, educated men, college graduates, authors, editors, &c., quite frequently evince a disposition to lock horns with me on this subject. Ye blind guides and fools, throw away your musty books, and your still mustier notions, and get out into the thickets and brush and tall timber, and stay there twenty years, and you will learn something. And now I have my hand in, I will call in other testimony on this point, and so far as I am concerned, close this discussion, and quit answering letters from fellows who think they can grow a forest by planting trees twelve feet apart on the unbroken prairie.

Prof. E. Gale, of the Kansas Agricultural College, Manhattan, says:

"The value of close planting can be realized much better after the very sad experience of 1874. There are several points that may be urged for close planting. The force of these observations will be much better appreciated when we have carefully examined the facts which can be adduced by experience. Trees should be planted closely.

1. For the mutual protection of the trees.
2. For economy in culture.
3. For immediate protection.
4. For the purpose of securing available timber.
5. For the purpose of securing early returns from our planting."

Again. In speaking of that clause in the timber culture act of 1873-4, permitting trees to be planted twelve feet apart, he says:

"Trees thus planted will not serve the purpose of a forest, but virtually become an open orchard."—*Correct.*

Dr. Franklin B. Hough, in his very valuable report on forestry, referring to this point, says:

"Opinions very generally agree as to error in the clause allowing a space of twelve feet between trees at first planting. In fact, this open spacing appears to be in opposition to sound principles in sylvaculture, and is to be regretted, because on the prairies, and on the great western plains, where planting is most needed, the drying winds that prevail at certain seasons cannot well be endured by trees, unless so closely set as to shelter one another from the earliest period. Such plantations would, of course, require trimming from time to time, as the trees became larger and required more room."

Horace Greeley says:

"Plant thickly, and of diverse kinds, so as to cover the ground promptly and choke out weeds and shrubs, with full purpose to thin and prune as circumstances may dictate."

Judge C. E. Whiting, of Monona county, Iowa, remarked in 1869, that he had at first planted Cottonwood eight feet apart each way, giving each tree 64 feet of ground. They grew well, but too many branches in proportion to the amount of body wood. He had adopted the rule of planting three feet each way, giving nine square feet to a tree, and in this order they grew tall and straight, soon shaded the ground, and in three years needed no further cultivation than thinning as became necessary, by removing alternate rows and drawing out the poles with one horse and chain.

In the Forestry Annual of the Iowa Horticultural Society, Judge Whiting, one of the committee charged with the preparation of the Annual, from his own experience, (perhaps the most extensive of any person in the country, in this branch of forestry,) says :

"I have in belts around my fields, varying from single to twenty rows of trees, mostly planted so close as to take 4,356 to the acre; (the amended timber culture act only calls for 2,730 per acre), about 40 acres of timber. The trees in these belts vary as to time of planting; some are eighteen years old, and some only one year planted, the greater portion, however, are from five to twelve years of age. The needed thinning of these belts furnishes all the wood that is wanted on the farm, including stakes and rails to keep the fences in repair; posts for all repairs needed, and many for new fences I annually build in extending my farm. There is not a stick of needed timber on the farm, from a pea-bush, a grape-vine stake, or a binding pole, up to a fair sized saw log, that cannot be had from my groves, without cutting a single tree that does not need thinning out from the groves."

But why cumber the ground with further testimony? The foregoing is conclusive, unimpeachable and unanswerable in proof of close planting.

I submit the case to the jury without further comment.

The farm of Judge Whiting is on the line of railroad from St. Paul to Omaha. It consists of some 1,800 acres, and his closely planted young forests are the admiration of every one who has the good fortune to see them. They are an unanswerable argument in favor of close tree planting.

VARIETIES OF TREES SUITABLE FOR YOUNG FORESTS, IN MINNESOTA—ALSO, FOR PLANTING ALONG THE HIGHWAYS.

In the elucidation of this topic, I begin by inserting a paper I prepared for the State Horticultural Society, and read at its annual session in Rochester, January, 1878.

PLANTING TREES FOR SHADE AND ORNAMENT ON STREETS AND ROADS—WHAT TREES TO PLANT, AND HOW TO PLANT THEM.

The foregoing is the heading of the accompanying article. The text was furnished by Prof. Lacy. I don't know what book he got it out of; neither do I care.

There ought to be a good many sermons preached on that text to all the people of Minnesota. Right here in Rochester, it don't seem so necessary. The people here have appreciated the importance and necessity of this work, and have taken hold of it in earnest. The changed appearance of this town site, as between 1854, when I first camped on it, and now, 1878, is due more to tree planting than to any other one class of improvements.

Great as has been the change in this immediate vicinity within so short a time, still greater changes have occurred in other localities. Villages and cities originally built on the open prairie, without a tree or shrub in sight, whose streets and avenues were formerly raked fore and aft by the fierce

blasts of winter, and scorched by the blazing suns of summer, have, by the intervention of the tree planter, been converted into bowers of beauty, protected alike from furious wind and blazing sun.

No investment of time and money is more satisfactory or more permanently useful, than that employed in planting forest trees along the lines of our public highways. In a prairie country like ours, no investment adds so much to the beauty of the country, or the ready cash value of the real estate so adorned. The prosecution of this good work appeals alike to the best judgment and most cultivated taste.

Much has been done in this direction, but far more remains yet to be done. We have done just enough to thoroughly demonstrate the practical nature of the work, the thorough adaptability of our prairie soil to develop magnificent specimens of forest trees.

In the tree planting returns of 1877, the number of rods planted to trees and hedges along the public highways of Minnesota, is given as 265,633, equivalent to 642 miles and 192 rods. The returns are imperfect, incomplete. One thousand miles would be much nearer the mark. This is a good beginning, but only a beginning.

Have any of you figured on the probable number of miles of public highway in the prairie portion of Minnesota? There are full five hundred prairie townships in what is known as the treeless region of Minnesota. Then there are at least half as many more prairie townships in other comparatively well timbered counties, like Olmstead and Dodge. This rough estimate, which I think is below the actual figures, gives us 750 townships of prairie. Allowing thirty-six miles of public highway to each township, gives us 27,000 miles. This must be doubled to give us a row each side of the highway, making a total of not less than 54,000 miles yet to be planted along the highways of the prairie regions of Minnesota; enough to reach twice around the globe and some four thousand miles to lap over. Who can correctly estimate the climatic effects and the ameliorating influences following so grand a work? I assume, as a matter of course, that in the treeless region, the planting would be close enough to form staunch and permanent wind breaks.

The protection thus afforded to growing crops, would of itself be of inestimable value. The protection afforded to orchards and other fruit growing institutions, would alone amply repay the cost, while the comfort afforded to man and beast, would be beyond the power of figures to express.

VARIETIES OF FOREST TREES BEST ADAPTED FOR THIS WORK.

This is so largely a matter of taste that no list that could be made would suit every one. This task must conform to facts and to common sense. The adaptability of the soil to each variety of forest tree, must be recognized. The natural limits that have been assigned to each variety of forest tree, must be borne in mind, and then the peculiar service required in the particular locality to be benefitted, and, finally, the pecuniary ability of the owner of the real estate must be taken into account.

For merely shade, in my opinion, no tree can excel the White Elm (*Ulmus Americanus*). As an ornamental shade tree it is absolutely unapproachable. It is undoubtedly the most "magnificent vegetable of the temperate zone." It is long-lived, hardy, and a rapid grower. But it needs room to spread itself. Planted sixty feet apart, their tops will interlock long before reaching maturity. The White Elm will do well on any Minnesota prairie, from Iowa to Manitoba, but grows more rapidly on river bottoms and rich, moist soil. It seems to possess the advantage of withstanding the bad effects of dust and smoke, and would consequently be better adapted to planting in

large towns than most other varieties of trees. In this connection, let me warn the fellows out on the broad prairies, not to plant too large White Elms. I have seen them transplanted from two to three or four inches in diameter, trimmed to bare poles, tops cut off say twelve to fifteen feet from the ground, and in three years develop so much top that the wind would blow them over so far as to leave them standing at a very acute angle. They seem to develop top more rapidly than root. On the rich, moist, alluvial soil of the western counties, plant small trees.

SUGAR MAPLE, ROCK MAPLE—*Acer Saccharinum*.

The Sugar Maple, as a shade and ornamental tree, cannot be too highly prized. It is indigenous to Minnesota, but is more particular about its location than the White Elm. In this state it prefers well drained localities. A locality in which the White Elm would flourish to perfection, would, in many instances, prove fatal to the Sugar Maple. I have had but poor success in planting them on level prairie, with deep clay subsoil. Such localities should be underdrained for the Sugar Maple. I very much doubt if they can be made to live where the ground is saturated with moisture during the growing season. On the second bench of the streams, and along the banks and sides of ravines, on any tolerably good soil, and on hill sides, the Sugar Maple flourishes and reaches its best proportions. Poor, sandy soils are not suited to the growth of the Sugar Maple, neither are most of the rich bottom lands of the Red River Valley.

BLACK WALNUT—*Juglans Nigra*.

All things considered, I am strongly inclined to the belief, that the Black Walnut is the most valuable forest tree that can be grown in Minnesota. Its growth is very rapid, and when fully developed, is one of the largest of our forest trees. It prefers a rich, moist soil, but will flourish and make a very satisfactory growth on any number one prairie, not too far north. The Minnesota valley seems to be the northern limits for this tree in that portion of Minnesota west of the Mississippi river. I have never seen any Black Walnut amount to anything, north of the valley of the Minnesota river. They are a tender tree when young, and we occasionally get a winter in which they require considerable protection. As a shade and ornamental tree, it sometimes rivals the White Elm. When planted as a shade tree, give it plenty of room, that its natural habit of throwing out a low, broad top may be encouraged. Bryant tells of a Black Walnut tree at three feet from the ground, twenty-five feet in circumference. "At the height of twelve or fifteen feet, the trunk divides into several branches, each of which by itself would constitute a large tree; the whole forming an immense canopy, overshadowing an area one hundred and fifty feet in diameter."

BUTTERNUT—*Juglans Cinerea*.

When grown in open ground, throws out a low, spreading top; is a hardy, rapid grower, and in all respects a desirable shade and ornamental tree. This tree and its first cousin, the Black Walnut, ought to be considered in the double character of not only forest but fruit trees. A Black Walnut orchard, or a Butternut orchard, propagated from the seed planted on the right kind of soil, would soon throw in the shade any apple orchard in Minnesota; would come into bearing as quick, would grow faster, stand more grief, and bring more bushels of either fruit or dollars, in the long run. I suggest, as a practical measure, the offering of liberal premiums to encourage the planting of Black Walnut and Butternut orchards.

LINN, LINDEN, BASSWOOD—*Tilia Americana*.

This is another very desirable shade tree. Rapid grower, hardy, long lived. Will grow and develop well on any good farming land, but prefers a rich, moist, cool soil. Furnishes good shade and shelter for man and beast, and also bountiful crops of flowers, from which the "little busy bee" manufactures a most excellent article of honey. Basswood, suitable for transplanting, is not easily found in large numbers in our native forests, and the main source of supply for shade trees must be from propagation in forest tree nurseries.

WHITE ASH—*Fraxinus Americana*.

One of our most valuable forest trees. Very hardy. Rapid grower, and when planted wide apart, throws out a beautiful, wide spreading top. Most of the prairie soil of Minnesota is well adapted to the growth of the White Ash.

This tree will do its best in a cool, deep, moist soil. It don't amount to much on a warm, dry, sandy soil; is not afraid of cold weather; deserves a higher rank in public estimation. For general planting on our northwestern prairies, no forest tree merits more general cultivation and attention. It is easily propagated from seed, and can be furnished by millions; cheap as corn fodder.

BLACK ASH—*Fraxinus Sambucifolia*.

For merely a shade and ornamental tree, perhaps preferable to White Ash; will grow best on ground too wet for White Ash; will flourish and develop magnificently on ground too wet for most any other timber, except it may be Tamarac.

COTTONWOOD—*Populus Angulata*, or *Populus Monilifera*.

The highly refined, fastidious and aristocratic element of our large towns and cities, unite in despising this noble tree. But who cares? It has its own merits, merits that will cause it to be propagated, cherished, nourished and protected by willing hands and loving hearts, until the great interior treeless region of the North American continent shall have been reclaimed and become one of the traditions of the past. When the marble monuments vainly erected to perpetuate the memory of the names of its traducers, shall have crumbled into dust; when even the State Horticultural Society has ceased to exist, even then will this monumental tree shed its blessings and its cotton alike upon the just and unjust.

I propose to stand by the Cottonwood. Whether planted on a sand bank or a river bottom, in the door yard or in a desert, on the prairie or in the timber, the result is a great, sturdy, healthy forest tree. It is a success, and that's why people plant it. It don't fool away years of precious time getting ready to do something, but it is up and coming from the word go. It is emphatically a pioneer tree. This and the White Willow will do more to prepare the way for the cultivation of fruit trees than any other agencies I can think of.

I have enumerated enough of the deciduous trees. I could easily have extended the list to twice its length. But "Enough is as good as a feast."

EVERGREENS.

I shall not branch out much on evergreens; had rather wait and hear from John Kepner. I desire to say a good word for the Scotch Pine. I find it absolutely hardy, and a thrifty, good grower on the broad prairies of Kandi-

yohi and Stevens counties; have had them growing out for nearly four years. They always look bright and healthy. They are, undoubtedly, a good tree to plant by the roadside. It is the great lumber tree of Scandinavian nations of northern Europe. It delights in buffeting old Boreas; is admirably adapted for wind-breaks, and will be used extensively for this purpose just as fast as the prairie farmer becomes able to pay for it.

I have experimented with various sorts of evergreens on the prairies, and have had more comfort from the Scotch Pine than all others combined.

The European Larch, about which volumes have been written, has so far proved hardy, healthy, and a rapid grower on the main line of the St. Paul & Pacific railroad, where it has been planted as an experiment in different localities and on widely varying soils. From experience so gained, I should not be afraid to go in tolerably heavy on the European Larch.

HOW TO PLANT THEM.

It is all surplusage trying to tell this crowd how to plant trees. You know as much about it as I do; but it may be this paper may fall into hands not so experienced as yours. And so I commence by saying, the first thing to do is to prepare the ground. In commencing *de novo* on the prairie, I should first break the sod in June. I should let it sweat till October. I would then back-set it, bringing up two or three inches of new ground. (I am supposing you are preparing to plant along the highway the whole length of your farm.) In the spring I would plant it to potatoes. I prefer potatoes for this purpose, because the ground gets worked over more in growing this crop than any other you would be likely to plant. After digging the potatoes in September, I would then plough the ground as deep as I possibly could; the deeper the better. And then I would harrow thoroughly. I would have all the holes dug before I took up a tree, and I would dig big holes, not very deep, but a good ways across; deep enough so as you can throw in dirt, good mellow black soil, forming a little mound in the bottom of the hole to set the tree on. Then while an assistant holds the tree in an upright position, manipulate the fine, soft, mellow earth all among the roots, spreading them out full length, so they nestle and lay comfortable like and natural. If any of the roots are bruised and mangled, trim them off smoothly with a sharp knife, and also cut out all dead roots.

Too much care cannot be exercised in transplanting forest trees. In taking them up get all the root you can, especially small fibrous roots. Don't allow the roots to be exposed to sun or wind. Don't let them freeze while out of the ground. Plan your work so as to have the least possible number of hours intervene from the time the tree is lifted from its native spot till it is in the ground again. Should unavoidable delays occur, heel them in, or better still, bury them all over in loose earth, taking them out as you plant them. After getting the roots comfortably arranged, shovel the fine, black, mellow soil in, pressing it firmly. You don't want to tramp it.

I think most good sized trees, especially the Cottonwood, do better planted somewhat deeper than they originally stood.

Don't drown your trees with water. Many people heave in several buckets of water in each hole. This is unnecessary. Your tree don't want to stand in a mortar bed. More trees are killed by too much water than by too little. If possible, mulch thoroughly as soon as planted. Mulch with any good manure. Chip manure is best. Old hay or straw is good.

If the ground is reasonably moist when the planting is done, good, thorough mulching will protect the tree from drought far more effectually than indiscriminate bucketfuls of cold water. Cold water is a good thing in its place, but needs to be used with some judgment.

Don't mutilate your trees. This trimming up to bare poles and then cutting the top off may be necessary in very exposed localities, as too much top resists the wind to such an extent as to loosen the hold of the roots to the soil. This won't do. In such localities plant small trees. A tree no larger than a rawhide riding-whip, with its full complement of fibrous roots, will soon get away from such trees as are usually planted along highways; *provided, always*, you plant it in ground which has been thoroughly prepared, and then give it the same care. protection and cultivation you do your corn when you get fifty bushels per acre. If I was in a hurry, and couldn't wait, and must have big trees at once, I would take up root enough so there would be no necessity of cutting off the top; only trimming the top into symmetry. It would be, perhaps, necessary to steady and brace it against the wind until well rooted. How to do this your own ingenuity should suggest.

AFTER CARE.

In planting a line of shade trees along a public highway, I should aim to dedicate a strip of ground at least one rod wide to this purpose. I should plough that strip and harrow it at least twice each year, between May and August, keeping down all weeds and grass. Every year I should work the mulching when well decayed, into the ground, replacing it from year to year, until the tree is firmly established and able to help itself to food and drink. Bear in mind that a young tree needs care, protection, food and water, as much as a young steer, and the better treatment either gets, the better it grows and prospers. The mulching and cultivation is to the tree what corn, hay and water is to the steer.

I cannot too strongly condemn the infamous and brutal treatment given to trees by men who ought to know and to do better. The man who handles trees in transplanting, as he would fence rails or posts, deserves to lose them, and generally does. To illustrate: last spring I saw a large box of ornamental trees, mostly evergreens, on the platform at Willmar. After lying there exposed to wind and sun several days, I saw them opened. The moss and other mulch they were packed in had prevented the roots from drying, and had they *at once* been properly planted, could have been saved. It seemed a whole neighborhood had clubbed together, and each one's package was bound up separately. These packages were taken from the box and laid on the platform, where for several days they were exposed to drying winds and scorching sun. They were all killed within twelve hours; but those fellows would come every day or two and carry off a bundle and plant them, all the same; and you can't make one of them believe that a nurseryman is any better than a horse thief.

We must preach to the people that a tree, if not exactly animal, is, at least, a living, breathing organism, as susceptible to good or bad treatment as anybody; as quick to appreciate good treatment as you or I, and as quick to resent bad treatment. In fact, there are few classes of living beings who tolerate less bad treatment than trees.

WHEN TO PLANT—SPRING OR FALL.

This is a question often asked. I do not consider it of as much importance as many do. It is not half as important as a thorough preparation of the soil, mulching and thorough cultivation. With most forest trees it really makes but little difference. For several years I have planted largely, commencing in the fall as soon as the leaves fall; planting until winter comes, heeling in or burying what is left, and in the spring commencing again and planting right along till 20th of May, or until the leaves start. Some sea-

sons there is no perceptible difference between spring and fall planting of most varieties of trees. Should it set in very dry, as it sometimes does early in spring, and continue dry for several weeks, your spring planting will suffer to a certain extent, limited, however, by the amount of mulching and cultivation the trees receive during the season of trial. Should there be a reasonable supply of moisture during the spring and early summer, no appreciable difference would be likely to be observed. Large sized trees, whether planted in the fall or in the spring, will quite frequently go through the first season making a good, healthy, vigorous growth, and if June and July of the next season is unusually hot and dry, succumb to the withering influences of the season. This, however, is largely prevented by mulching or cultivation.

Small forest trees, one, two and three years old, usually, and so far as my experience goes, have always escaped this peril. I have sometimes thought the transplanting of large forest trees from the forest to the open prairie, more hazardous in the fall than in the spring.

Sometimes facts prove it to be so, and then again facts prove it not to be so.

The fact is, you can't most always tell.

With a thorough preparation of the soil, and prompt, clean culture, your trees, if properly handled and planted, will, as a rule, outlive the fellow that plants them.

There are many other varieties of forest trees not enumerated in the foregoing paper, which deserve notice as eminently worth cultivating on the "Tree Claim." There are others well worth trying, some of which, although thus far having nearly failed, will yet, under more favorable conditions and with more skillful culture, become acclimated and accustomed to their new homes, and ultimately add largely to the value and attractions of the prairie regions.

NOTES ON THE BIG WOODS.

BY N. H. WINCHELL.

The following valuable paper, from the pen of Prof. N. H. Winchell, which I extract from "Transactions of Minnesota State Horticultural Society, 1875," gives a good idea of the varieties of forest timber indigenous to the soil and climate of Minnesota :

"The Big Woods" of Minnesota, consist of a southward spur from the forest-covered portion of the State, covering a strip about forty-five miles wide in the centre of the State, and reaching nearly to the Iowa State line. By this spur the prairies of the State, at least, those in the southern part, are divided into two parts, the greater of which lies on the west of the Big Woods. The great material advantage the farmers of Minnesota occupying the prairies have over those who, in other States, are much further removed from timber, is easily seen, while others, who prefer timbered land to prairie, have the choice of thousands of acres yet unoccupied in the region of the Big Woods. The boundary of this southern prolongation of the northern timber is not well marked, the trees gradually becoming thinner and smaller, and more and more restricted to the valleys of streams, till the country is changed to a treeless prairie. Around the outskirts of the woods, small oaks and aspens constitute almost the only arboreal vegetation; but, within the woods, a great variety of hardy, deciduous trees are found, mingled with the usual species of shrubby vegetation. The general surface is much more rolling than in the prairie region, on the east or west, and the soil seems to be coarser, with more frequent boulders. Yet there are, also, extensive flat tracts in the Big Woods, that are as level as any prairie region.

In general, the Big Woods may be thus bounded: Beginning a few miles west of Minneapolis, the eastern edge of the Big Woods crosses the Minnesota, in a line toward Lakeville, in Dakota county. Continuing in a southerly direction, it passes

about a mile east of Cannon City, and of Owatonna, when it takes a short bend to the west and northwest, passing about four miles north of Waseca, and near East Janesville, in Waseca county. In Blue Earth county, it is variously modified by the valleys that are tributary to Minnesota from the south. Continuing west, about six miles south of South Bend, it turns north and crosses the Minnesota, sending out a spur northwestward, which follows, indefinitely, the Minnesota valley. Running along the west side of the Minnesota, distant from it about four miles, it begins to bear off toward the northwest, at St. Peter, and passes five miles west of Henderson. Between Arlington and New Auburn, in Sibley county, the timber line is on the east of the direct line. Near the former village, about four miles north, are some large patches of timber, containing large oaks on the west of the main road, and the line seems to swell several miles to the west, but at Arlington, the timber is entirely on the east of the town. Between New Auburn and Glencoe, the timber line runs about a mile east of the main road, and about three miles east of Glencoe. It is found again, at four miles north of Glencoe. Thence, it continues west and northwest, to Darwin, on the St. Paul & Pacific Railroad. North of that, its exact location has not been traced. It seems to run still northwestwardly, and to include the region of small lakes, in Pope, Douglass and Otter Tail counties, and the region known as the *Leaf Mountains*, in the wooded portion. North of the St. Paul & Pacific railroad, the Big Woods widen out rapidly, both to the east and west, merging into the general forest of the northern part of the State. The term is strictly, and originally, only applicable to the spur that includes the Lower Minnesota valley, extending nearly to the Iowa line. The writer has crossed the spur in a number of directions. In passing from Farmington, in Dakota county, to Shakopee, in Scott county, the following species of trees and shrubs were seen. For ten or twelve miles after entering the woods, very few large trees were seen, the oak shrubs being the largest, and almost the only tree-like vegetation. About half way to the Minnesota river, the maple and large elms, bass and iron-wood appear.

TREES AND SHRUBS OF THE BIG WOODS.

Oak shrubs. Apparently *Quercus ilicifolia*. Wang.

Hazelnut. *Corylus rostrata*. Ait. (?)

Burr Oak. *Quercus macrocarpa*. Michx.

White Oak. *Quercus alba*. L.

Wild Red Cherry. *Prunus Pennsylvanica*. L.

Trembling Aspen. *Populus tremuloides*. Michx.

Choke Cherry. *Prunus Virginiana*. L.

Wild Plum. *Prunus Americana*. Marshall.

White Ash. *Fraxinus Americana*. L.

Thorn. *Crataegus*.

Rose. *Rosa blanda*. Ait.

June Berry. *Amelanchier Canadensis*. Var. *Botryapium*. Torr. and Gray.

Round-leaved Cornel. *Cornus circinata*. L'Her.

Common Elder. *Sambucus Canadensis*. L.

American Crab-apple. *Pyrus coronaria*. L.

[The young twigs and the under surface of the leaves are very woolly pubescent.]

Black Cherry. *Prunus serotina*. Ehr.

Frost Grape. *Vitis cordifolia*. Michx.

American Elm. *Ulmus Americana*. L. (Pl. Clayt.) Willd.

High-bush Cranberry. *Viburnum opulus*. L.

Two or three species of Willow. *Salix*.

Green Ash. *Fraxinus Vividis*. Michx. f.

Prickly Ash. *Zanthoxylum Americanum*. Mill.

Cockspur Thorn. *Crataegus Crus-galli*. L.

Red Raspberry. *Rubus strigosus*. Michx.

Black Currant. *Ribes floridum*. L.

Cottonwood. *Populus monilifera*. Ait.

Large-toothed Aspen. *Populus grandidentata*. Michx.

Bass. *Tilia Americana*. L.

Red Mulberry. *Morus rubra*. L.

Ironwood. *Ostrya Virginica*. Willd.

Sugar Maple. *Acer Saccharinum*. Wang.

Soft Maple. *Acer rubrum*. L.

Alternate-leaved Cornel. *Cornus alternifolia*. L.

Bitternut. *Carya amara*. Nutt.

[Rare, east of Spring Lake.]

Butternut. *Juglins cinerea*. L.

[Very rare, except at Spring Lake and westward.]

Slippery Elm. *Ulmus fulva*. Michx.

Staghorn Sumac. *Rus typhina*. L.

Tamarac. *Larix Americana*. Michx.

Box Elder. *Negundo aceroides*. Moench.

Wolfberry. *Symphoricarpus occidentalis*. R. Br.

Panicked Cornel. *Cornus puniculata*. L'Her.

[The most common species of Cornel.]

Between Shakopee and Mankato, the following additional species were seen in the valley of the Minnesota :

Kentucky Coffee Tree. *Gymnocladus Canadensis*. Lam.

Red Cedar. *Juniperus Virginiana*. L.

Black Walnut. *Juglans nigra*. L.

Hackberry. *Celtis occidentalis*. L.

Blue Beech. *Carpinus Americana*. Michx.

Yellow or Gray Birch. *Betula lutea*. Michx. f.

[This birch has oblong catkins, and spreading obtuse lobes on the scales, the latter being three lines long. The hickory grows to about six inches in diameter, and then is invariably winter-killed. A large tract has lately been cut for fuel, near St. Peter. The hackberry is used for fuel, and for furniture. It frequents the heaviest timber. The butternut is rarely large. The box-elder sometimes exceeds three feet in diameter. In the absence of the sugar maple, its sap is used in the Upper Minnesota valley, by the Sioux Indians, for making sugar and syrup, of which it is said to furnish a very fine quality.]

In traveling through the Big Woods, in 1874, the white birch, (*Betula alba var-populifolia* spach.) was noted in Hennepin and Carver counties. The bittersweet, (*Celastrus scandens*, L.) is, also, abundant in the Big Woods. There is a species of oak that appears like red oak, (*Quercus rubra*, L.), that frequents the outskirts of the Big Woods. It is sometimes associated with the burr oak, in the "openings," and sometimes is found in company with the trembling aspen. It makes a smaller tree, generally, than the burr oak. Besides these, the Virginia creeper, (*Ampelopsis quinquefolia*. Michx.) and the blackberry, (*Rubus villosus*, Ait.), have been seen. At Jordan, in the valley of the Minnesota, the black raspberry was noted, (*Rubus occidentalis*, L.) The white pine grows near Minneapolis, (*Pinus strobus*, L.) and in Mower county; it is found along the rocky banks of the streams in Mower county. The black ash, (*Fraxinus sambucifolia*, Lam.), has also been observed in the Big Woods; but it seems not to be common. The red-berried elder, (*Sambucus pubens*, Michx.), has been seen at Minneapolis; also, the sweet viburnum, (*Viburnum Lentago*, L.), and the strawberry bush, (*Euonymus Americanus*, L.) Two species of spiræa, the ninebark, (*Spiræa opulifolia*, L.) and the common meadow sweet *spiræa salicifolia*, L. were noted at St. Peter.

Although, according to the foregoing boundary of the southern end of the Big Woods, they extend, *en masse*, only to about the center of Blue Earth county, the area of continuous timber is extended considerably further south, through the agency of the valleys of the Blue Earth, the Cobb, and the Maple rivers,—tributaries of the Minnesota, that run northward from the water-shed, that lies along the southern State boundary line. Consequently, there is more than the usual amount of timber, for prairie lands, in Faribault and Freeborn counties. In those counties, as the suppression of the prairie fires is rendered more complete, by the forming of the soil, the scattering shrubs of oak, and the aspens, that are *avant couriers* of encroaching forests, bring on more and more the character and aspect of a wooded country. Other species then gradually venture out from the sheltered valleys, and flourish on the open tracts. It is in some of these more southerly spurs from the main body of the Big Woods, that the shag-bark hickory (*Carya alba*, Nut.) sometimes appears.

The existence of this great spur of timber, shooting so far south from the boundary line, separating the southern prairies from the northern forests, and its successful resistance against the fires that formerly must have raged annually on both sides, is a phenomenon in the natural history of the State that challenges the scrutiny of all observers. While it holds mines of wealth, open to the practical economist, it

affords to the scientist a rich field for observation and study. With timber, comes the fauna that is peculiar, in our latitude, to timbered regions. The fauna is strikingly different from that of the prairies. The bear, the wolf, the deer, a great number of forest warblers, the numberless winged insects, that would otherwise be restricted to the northern half of Minnesota, are, by this spur of timber, brought into a much more southern latitude. The deer, at present, roams over the whole of this tract, from north to south. It furnishes shelter for thousands of birds that winter among us, but which, otherwise, would become exterminated, or driven from the State. It has, also, its climatic effect, and its sanitary influence. It is eminently a region of small lakes. What may be the cause underlying, that has wrought this wonderful diversity in the heart of our great State, is a subject for legitimate investigation, but the limits of this paper do not permit me to enter on that. It is only possible here to give a few notes, and to call attention to some of the salient points. That this tract is destined to be one of untold benefit to the State, cannot be questioned. It is as yet but sparsely inhabited, and the details of its natural history are unknown.

The following have been noticed by Mr. L. M. Ford: Two varieties of the wild gooseberry, (*Clematis Virginiana*;) a well known climber, blooming in August; the Dutchman's pipe, (*Aristolochia syphoa*;) another climber; one variety of the honeysuckle, (*Lonicera*;) the leather wood, (*Dicra palustris*;) a dwarf sort of thorn, heavily laden with fruit in autumn, probably *Crataegus coccinea*, and near Minneapolis, the trailing juniper, (*Juniperus prostrata*.)

The first report of the commissioner of statistics, of Minnesota, (1860), gives the following account of the natural distribution of its timber.

"The Great Coniferous District.—The elevated and broken region, north of latitude 46°, and east of the meridian of the outlet of Red Lake, may be described in general terms as a *forest country*; these lines, in general, being the southern and western limits of the pine, and other coniferæ, in Minnesota, and including an area of 21,000 square miles. Pine is the prevailing wood of this district, but intermingled with a considerable proportion of birch, maple, aspen, ash and elm. The alluvial bottoms of the extreme northern branches of the Mississippi, support a heavy growth of basswood, elm, aspen, butternut, ash, birch, hard and soft maples, linden, balsam-fir, and some oaks. It is observed, that whenever the cone-bearing woods are burned off in this district, the hard woods take their place. The sugar-maple, which, according to Blodgett, marks the range of Indian corn, extends northward nearly to Rainy Lake, where it yields abundance of sugar to the Indians. In the Red River valley, the sugar-maple is found all along its trough, and finds its northern limit beyond the 49th parallel, on the elevated southern water-shed of Lake Winnipeg. On the rivers flowing into Lake Superior, hemlock, cedar, spruce, fir and birch prevail.

The Zone of Pine.—The principal pine forests of Minnesota, which constitute one of the main resources of industry and wealth, stretch in a broad belt near the southern border of the great northern forest district, from the eastern side of Pine county, in the Upper Saint Croix valley, northwestward across the water-shed to the outlet of Red Lake. The principal pineries where lumber is bought, are upon the headwaters of Kettle, Snake, Rum, Crow-Wing, and the Upper Mississippi, and recently upon the extreme upper waters of the Red or Otter Tail rivers.

Belt of Oak Openings.—Below latitude 46°, the pine, hemlock, spruce, birch and all the *Coniferæ* generally disappear with the forest-line. A narrow range of cedar and tamarack swamps, between Saint Croix and Crow Wing rivers, and some pine, mingled with large maple, oak, ash, and small birch and spruce, intervene for half a degree further, when the oak becomes the prevailing tree on the uplands, distributed in groves and large parks, its growth usually dwarfed by the annual ravages of prairie fires. These oak openings characterize the whole delta of rolling prairie, below latitude 45° on the east side of the Mississippi. The soft maple, elm, ash, willow and alder, line the bottoms of the Rum and Elk rivers.

The Bois Franc, or Big Woods.—West of the Mississippi, the western flank of the great coniferous forest of the north, extending with a thick border of hardwood west of Otter Tail river, and around Otter Tail lake, terminates upon the valley of the Crow Wing, where it merges its characteristics in a new forest growth of the deciduous forms, which stretches in a broad angular belt across the great prairies

of the southeast and south, and generally known as the Big Woods. This belt wood forms a deep fringe, of from ten to twenty miles in width, along the western slope of the Mississippi, from the Crow Wing valley to the Sauk, at Saint Cloud. Crossing into the valley of the Crow river, and keeping a general south-easterly course, it occupies a large strip of country between the Mississippi and Minnesota rivers, nearly one hundred miles on its longest side, with an average breadth of forty miles; its western limit being formed by a line crossing the counties of McLeod and Meeker, diagonally, through the middle, and its eastern, by a line drawn from near the mouth of Rum river to Carver, on the Minnesota. Throwing its left flank across the Minnesota, at Louisville, its main body crosses the river between Belle Plain and Le Sueur, and covers nearly the whole of Le Sueur county, with its right wing extending south-westward to Blue Earth river, in Blue Earth county, and its left occupying about one-half of Rice and Scott counties. The area of the tract of country covered by the Big Woods, is about 5,000 square miles, of which 4,000 is occupied by the division north of the Minnesota, and 1,000 by its southern division. The woodland district is full of lakes, and in some sections, the dense mass of forest is broken by small prairies. The varieties of timber in this district are mainly oak, maple, elm, ash, basswood, black walnut and hickory.

Southern Belt of Valley Woods and Oak Openings.—Besides the tract above described, there are no large forests in Minnesota, west of the Mississippi. But nearly all the streams have narrow fringes of woodlands, and some of the valleys east are dense masses of timber. The wide bottoms of Minnesota and Mississippi have a deep border of thick and massive woods, in which the large cottonwood and maple are conspicuous, with white and black walnut, butternut, linden, box-wood and hickory. The Zumbro valley, Wabashaw and Dodge counties, support some large tracts of forest growth. The Root river also affords a considerable body of thick woods on the borders of Fillmore and Olmstead counties, in which all the varieties of the Big Woods are reproduced. But the oak openings and groves which are scattered through the uplands along the streams form a large resource of the prairie population for domestic and mechanical purposes.

The Sparcely Wooded District.—The Upper Valley of the Minnesota and Red River sustains no forest growth, except upon the trough of the main and tributary streams and the margins of the lakes. The minor streams of the Upper Mississippi are, however, poorly timbered, a few scattering trees only marking their course over the naked plain.

On the Red River a narrow fringe of thick woods of the hard varieties, commences at Graham's Point and continues to Pembina, while all the streams on the east and west sides afford narrow strips of timber, generally from fifteen to twenty-five miles apart, while the intermediate plains above latitude 46°, are dotted with clumps of poplars, willows and other aspenoids.

The foregoing extracts seem to be necessary and valuable in this connection, in order to exhibit at a glance the natural home of the different forest trees of Minnesota.

I give it simply as my own experience in forest-growing on the prairies, that it pays to conform to the natural habits of the trees; that is, I would plant the Black Walnut, Black Ash, Basswood, Elm, &c., in a deep, moist, rich soil, instead of on high, dry, poorish soil. And I would plant the Pines, White Ash, Larch, &c., on lighter, dryer soils. I would carry this idea into practice in the planting of a tree-claim; giving each particular variety, as near as possible, the same sort of soil, location, &c., as where the finest growths are found in the native forests.

We will now give some attention to the individual character of forest trees, from Dr. Hough's report, pp. 556 to 566. I find much valuable information, which he credits to the Iowa State Horticultural Society.

This society, in 1872, began to offer premiums to encourage tree-planting, and it has for the past four years printed annually, for gratuitous distribution among planters, a pamphlet* containing instructions for procuring,

**Forestry Annual of the Iowa Horticultural Society.* Four numbers of this have been published, beginning in 1874. The pamphlet for 1877 embraces 24 pages.

storing and planting of seeds, cuttings and plants, with hints on best species and varieties, modes of culture, &c., for artificial forests and shelter-belts in that State.

The importance of this subject has been also frequently discussed for many years, as well in the public journals as by speakers at agricultural and horticultural fairs, so that it may be truly said of Iowa, that no State in the Union has so generally been awakened to the importance of tree-planting. In fact, the great prairies needed no argument to prove the desirability of planting, as well for fences and fuel as for shelter and ornament. Some of the practical suggestions of the Annual, which appear to be of more general interest, are here given:

SHELTER-BELTS.

These are wind-breaks for the shelter of domestic animals and crops, and their advantages are set forth by Judge C. E. Whiting, one of the committee charged with the preparation of the Annual, from his own experience, as follows:

"I have in belts around my fields, varying from single to twenty rows of trees, mostly planted 4,356 to the acre, about 40 acres of timber. The trees in these belts vary as to time of planting; some are eighteen years old, and some only one year planted, the greater portion, however, are from five to twelve years of age. The needed thinning of these belts furnishes all the wood that is wanted on the farm, including stakes and rails to keep the fences in repair; posts for all repairs needed, and many for new fences I annually build in extending my farm. When my walnuts get a little larger, I will have all I need, and many for sale. There is not a stick of needed timber on the farm, from a pea-bush, a grape-vine stake, or a binding pole, up to a fair sized saw log, that cannot be had from my groves, without cutting a single tree that does not need thinning out from the groves."

"About five miles of my timber belts are so planted that I have commenced using the standing trees for fence-posts. Where a tight fence is not needed, with the use of the barbed wire, and a little change in the staple, the use of these live posts is a perfect success. Strongly and urgently as I have heretofore advocated the planting of thick belts of timber around our fields, each year but confirms me in the opinions then expressed. The land that remains will, year after year, produce larger and more certain crops than the whole field would produce without such protection. I also repeat, that, in spite of all the learned discussions and scientific theorizing in regard to the cause of our timberless prairies, our cultivated forest trees, year after year, grow right along, with immense rapidity, in blissful ignorance of all the reasons *why they should not grow*."

The species of trees used in shelter-belts, either on the farm boundaries to the north and west; or, to the north and west of dwelling, barns, orchard, garden, &c., will depend greatly on the position of the homestead, as to soil and location in the State. The settler, absolutely without tree-shelter, wishes, naturally, to reach results as quickly as possible. Fortunately the willow, the cottonwood, the silver poplar, and the box-elder, all very easy to propagate, as noted in speaking of varieties, are all wonderfully rapid in growth under good cultivation; and, above all, are perfectly hardy, even in the northwestern part of the State. Taking all things into consideration, it is best to put these rampant growers on the outside of belts, adding from year to year the varieties, like elm, ash, black cherry, honey locust, the evergreens, &c., as time and means permit, inside of the iron-clad vanguards placed on the outside. The rapid-growing soft woods, starting readily from cuttings, are the most available for urgent present needs, and the novice in tree-planting is more certain of success with them in his first efforts, than with rooted plants of the slower-growing, but more valuable timbers. Besides cuttings cost nothing usually, and are readily obtainable. We append notes on managing cuttings in this connection, as these trees are most frequently used in shelter-belt plantations.

How to Prepare Cuttings.—Very early in winter, before severe freezing, cut in lengths of about a foot. If the limbs to cut are plenty, choose them from three-

fourths to one and a half inches in diameter. Cut them at the lower end with a clean cut, sloping at acute angle, to facilitate pressing in the earth when planting. If sharpened on all sides, as is frequently done, roots are emitted less freely from the lower end. Tie in bundles with willows, with the lower ends nicely evened, so that when placed on the ground in the spring, every cutting will touch the moist earth. Pack the cuttings in a dry goods box, with moist prairie soil, putting the box where it will not get too dry or wet, and will not freeze. With the first warm weather of spring, clean off a spot under an old straw-stack, level the surface carefully, and set the bundles butt end down closely together upon the fresh, moist earth; then cover them over with straw, so as to keep them from the air. By the time the ground gets warm enough to plant, the base of the cuttings will be softened and calloused, and most of them will have emitted small roots.

Mark out your ground one way three feet apart. Plant the cuttings about a foot apart in the rows, at an angle of forty-five degrees, using a clean, narrow spade, and press the earth down firmly with the foot. Cuttings should be put down about the whole length. When they start, allow only one sprout to grow. Cultivate carefully. The following spring it can be seen how the plants stand in the rows. If the cuttings are prepared, kept and set right, nearly all will grow, and the surplus plants can be taken up and set in other ground. Allow the plants to stand about three feet apart. If many have failed, transplant, so they will set right. As a rule, it is not best to transplant. A tree six years old, and never transplanted, is usually much the largest.

We may here remark, that in addition to the willows, the white and yellow cottonwood, lombardy poplar, large aspen, silver poplar and balm of Gilead, may all be propagated in this way, as noted in speaking of varieties. The instructions for managing cuttings will, however, not be repeated.

*We may here, also, note that the red maple, white maple, ash-leaved maple and basswood, may be propagated readily from two-year old wood, put out in the fall. Cover lightly over the rows, before cold weather, with straw or prairie hay. Rake this off as the plants start in the spring.

Evergreens for Shelter-belts.—In eastern Iowa, nearly all of the hardy evergreens may be grown successfully, and form, beyond all doubt, the most perfect shelter-belts that can be planted. But, in the central and western portion of the State, north of the forty-second parallel, evergreens, even of the hardiest type, need shelter; yet this is no reason why they should be ignored in the perfecting of shelter-belts. For reasons before noted, the rapid-growing soft woods are best for outside planting, and are just what is needed to give requisite exemption from wind-sweep to belts of pines or spruces planted under their lee.

For the portions of the State most in need of shelter-belts, the Scotch pine is, beyond all doubt, the best evergreen for this use in the whole list. We can fully indorse the statement of Prof. C. S. Sargent, who says:

"The rapidity of its growth in all situations, and its economic value, make the Scotch pine the most valuable tree farmers can plant for screens and wind-breaks about their fields and buildings, and for this purpose it is recommended, in place of the more generally planted Norway spruce, which, though of rapid growth in its young state, does not promise, in our climate, at least, to fulfill the hopes which were formed in regard to it."

This pine is specially partial to free circulation of air, growing quite feebly in crowded positions; hence, it will not do to plant it as closely as white pine, although, as with other trees, it is best to plant, with a view of thinning out when the poles are of size to be of practical use. We may here remark, that the poles of Scotch and white pine, cut in summer and stripped of bark, are very strong and durable, when nailed on posts for fencing.

The white pine will succeed vastly better with outside shelter on the west and north exposures, and will attain height fully as fast as the Scotch pine. Plant in rows eight feet apart, with plants four feet apart. The trees thus crowded will attain height rapidly, and when the poles attain size for nailing on fence-posts, they will be straight, and nearly uniform in size from end to end.

The Norway or white spruce, coming next, may be planted the same as Scotch pine. The white spruce is, perhaps, the most compact and beautiful, but the Norway is the most rapid in growth, and is the most plentiful in the nurseries.

Evergreens, twelve to eighteen inches, of all the sorts here named, may be ob-

* While this is possible, do not rely too much on it.—Ed.

tained of leading nurserymen, who make seedlings a specialty, at very low rates. Taking into account the first cost of plant, the loss from shipping, dying out, &c., the chances for success, with the ordinary farmer, are too doubtful, except on a small scale*, for the shelter of home buildings, where the addition to the landscape view, summer and winter, will well repay the cost of purchase and after care, saying nothing of their perfect effectiveness in arresting wind and storm. The deciduous trees, such as we specify as valuable for farm uses, are good enough for shelter-belts, and the annual thinnings are far more valuable for varied uses. Our main idea, under the heading of shelter-belts, is to recommend strongly the planting of all forest trees as shelter belts, rather than in the form of isolated squares, as is too common. Plant any of the kinds named in the succeeding list, but plant in the order suggested, as many trees do famously well, planted east or south of a heavy belt of hardier trees, which would utterly fail in open exposure to wind-sweeps.

PLANTATIONS FOR FUEL, FARM USES, AND MANUFACTURING PURPOSES.

To economize space, we place the varieties of trees best suited for these varied purposes under one heading, making comments as to relative value for specific purposes and management of each timber tree separately.

GREEN ASH (*Fraxinus viridis*).—For fuel, and for all the manifold uses for which light, firm, elastic, and durable timber is wanted, as well as handsome, light-colored finishing lumber, the white and green ash are our most valuable trees, and their greatest value is attained when grown on deep, rich soil. The white ash, (*F. Americana*), in our dry atmosphere, and sometimes very dry soil, makes comparatively slow growth, while green ash, on soils favorable for our best corn crops, will, in ten years, be as large as the ash-leaved maple (*Negundo aceroides*) of same age. For all uses, its timber is very similar to white ash, with which it is confounded by most of our citizens. It grows in many parts of Iowa, while the white ash is not common. The seeds ripen in October, and soon fall after frost. A good way to keep them, is to place them on the surface of a garden walk, putting a box over them, and cutting a trench around the box to keep water from running under them. They will not grow if kept too dry. With most people, it will be best to purchase the plants of nurserymen, or to cultivate the first year in a seed-bed. Usually, about one-fifth of the seed grows. Transplant where they are to grow at one year old. It is, however, better for the trees to plant the seed where the trees are to grow, say six or eight seeds in a hill. They will then retain their tap-root and grow with more vigor, but will require more hoeing.

How to Plant.—After deep plowing and thorough harrowing, mark the ground, as for corn. If seeds are planted, cover shallow, not more than an inch. If transplanting, press a clean, bright spade about two-thirds its length perpendicularly at each intersection of the marks, then draw the handle back, so as to move the bottom of the spade three or four inches forward, then press in the spade the balance of its length, and push the handle forward, which will leave an ample hole to receive the roots; after the spade is withdrawn tramp the ground firmly on the roots, and leave the plant standing perpendicular.

HONEY-LOCUST (*Gleditsia triacanthos*).—It is thought by many to be the best to select the seed for timber-growing purposes from thornless trees; yet it often happens that nearly all the plants from seeds gathered from very thorny trees, will prove thornless, if kept thriftily growing. On account of rapidity of growth and value of timber for fuel, posts, furniture, &c., we regard this native tree as being very valuable. In some of the interior counties remote from the river bottoms, where this tree is found native, the idea seems common that this tree, like the common black locust, is subject to attacks of the borer, and is also liable to sprout, &c. For the benefit of this quite numerous class, it may be well to state, that honey locust—or more properly, three-thorned acacia—is nearly allied to the Kentucky coffee-tree botanically, and that the borer has not been known to attack it; nor does it sprout to greater extent than the maple and most other forest trees.

The seed ripens in autumn, and may be gathered any time during the fall or winter. But the sooner pods are gathered after falling to the ground the better. In Cedar county, on Cedar river, and at many points on the Iowa, Des Moines, Mis-

*This remark, although applicable to Western Iowa, does not apply with equal force to Central and Northern Minnesota, where evergreen wind-breaks have so far proved successful.—En.

souri, and, indeed, most of the rivers of the State, pods may be gathered in quantity grown on thornless trees.

Before planting, scald the seeds severely. Part of them will swell. Sift these out with a coarse fanning-mill sieve. Scald the remainder again; repeatedly scalding and sifting, until all are swelled. The ground should be ready, and the seeds at once planted. They will come up in two or three days if the weather be favorable, and their upright growth is so rapid, that less care is needed in picking out weeds from among the plants, than with any other forest-tree seedlings. Keep the weeds down carefully with good culture during the summer. Take up the plants in the fall and heel in carefully where water will not stand. If left standing in seed-bed, the plants are often injured during the winter. After the first year, the plants are perfectly hardy, if seed from our native trees be used. We may here note that the seed sold in the eastern markets is mostly imported. The plants produced from the foreign honey-locust seed prove as tender in our climate as the peach tree. No valuable tree in our list bears transplanting with as little check to growth, as the honey-locust. Put out the plants with a spade, as recommended for the ash.*

BLACK CHERRY (*Cerasus serotina*)—The great value of this tree for posts, fuel, manufacturing, &c., has been too much overlooked. Plantations in this State, and in Illinois, demonstrate it to be one of our most desirable trees for cultivation, attaining a size in twelve years about equal to scarlet maple, with same care. When planted thickly, say in rows four feet apart, and eighteen inches apart in row, the poles run up tall and straight. The trees taken out in thinning can be utilized for poles to nail on posts for fence. Cut in summer, when they will dry quickly, they will last many years. When used for posts, if thoroughly dried, the writer has found them to last as long as the best burr-oak. He has posts yet sound that have been set fifteen years, and made from trees only ten to twelve inches in diameter. The seed may be gathered in most of our groves and thickets. Wash off the pulp, dry the surface of the pits in the sun, then pack in pure sand in small boxes or nail kegs. If kept in cellar, where they will not get too dry, they will grow; or they may be buried where they may be severely frozen. In the latter case, they will be found to germinate very early in spring, and must be sown before much started. Plant and manage same as ash. If planted where wanted, all the better, as transplanting sadly retards growth.

EUROPEAN LARCH (*Larix Europæa*).—In Europe, this is regarded as their most valuable forest tree for artificial groves. It is especially grown for railroad ties, posts, vine stakes, fencing, fuel, and about all the economic uses of the farm, and even in the shipyard, whole ships having been constructed of larch timber. It is, in our country, one of the most rapid growers we have, under proper treatment. But we may suggest that a careless manager had better select some other tree. The indications are that it will not prove as desirable here as in Europe, perhaps mainly on account of too rapid growth on rich soils. On their clay soils it produces a better grade of timber.

Purchase plants that have been once transplanted. Be sure to secure the plants very early in the spring. The leaves start very early, and the plants should be in the ground before this occurs. If much started, they can hardly be saved in the open air, unless the weather be very favorable. Remember that it will not bear exposure of root, any more than the evergreens. In planting keep the roots in mud and water, under no circumstances allowing them to get even partially dry. Plant the same as ash and honey-locust.

For the first year or two after transplanting, they will be found to make very moderate growth. After that they climb up rapidly. The ash and locust will need thorough culture but two years. The larch will not shade the ground as early, and will need four years of careful culture. We will add, if plants of two years' growth be purchased, that have not been transplanted from the seed-bed, do not think of setting in the open field. Plant quite closely in bed, and give partial shade for one or two years. It pays to grow larch, but the idea must be kept constantly in mind that when young it is very delicate and tender under our dry air and hot sun, and must be handled in all respects like young evergreens, with the additional care that it must be transplanted very early in spring.

BLACK AND WHITE WALNUT (*Juglans nigra* and *J. cinerea*)—These are well known and valuable trees, especially the black walnut. They do not transplant without

*The Honey Locust is not quite hardy enough in Minnesota to justify extensive planting.—Ed.

great check of growth, and the nuts, therefore, should be planted where wanted for belt or grove.

Judge C. E. Whiting, of this committee, who has had more experience in growing this timber than any man, probably, in the west, reports as follows :

"If I were to plant a section of timber for an investment for my children, I would have it all black walnut—a tree will grow to sawing size sooner than pine, and even now in our markets it is quoted at three times the price of pine. It is very durable, if put in the ground dry, for posts. Fifteen years ago I planted cedar and walnut posts at the same time, and also posts of white oak. All are now decayed about equally. Always plant the walnut where you want it. Will transplant well, but loses, in losing its tap-root, years of growth. Seven bushels of walnuts, with the shucks on, will plant an acre. During the winter I put in trenches, not too thick, and cover with leaves."

Plant before sprouting if possible. Mark the ground out as for ash, and plant the nuts early and deep so that they will not dry.

YELLOW COTTONWOOD (*Populus monilifera*).—The opinion is common in central and eastern Iowa, that cottonwood is only valuable on the prairies for wind breaks, as the wood has little value for fuel or for any uses of the farm or workshop. The variety, if it be merely a variety, abundant on the Missouri, and also found sparingly on the Des Moines, Iowa, Cedar, &c., in central and eastern Iowa, known as yellow cottonwood, really has an economic value, aside from its value for shelter belts, that should be better understood by our prairie settlers. Bryant says of this variety : "Its heart-wood is of a yellowish color, not unlike that of the tulip tree. It grows in the same situation as others of its kind, and is split without difficulty into rails. Shingles have been manufactured from it which lasted a considerable time. When sawed into lumber it does not warp like the cottonwood generally. If *Populus angulata* and *P. monilifera* are really distinct, it is a matter of uncertainty to which this variety belongs. The subject should be investigated." Judge C. E. Whiting has grown this tree extensively for a number of years on the Missouri bottom, in Monona county, and has expressed his views as follows :

"We have in the Missouri bottom both the white and yellow cottonwood. In speaking of the cottonwood as a valuable timber, I speak alone of the yellow. I have fence-boards of this yellow cottonwood upon my farm that have been in use fifteen years, and they are yet good. My house is sided with cottonwood ; has been built ten years, and looks as well as any pine siding in the country, and stays to its place as well. It is really better as fencing than pine, being tougher and stronger. It stays to its place as well and is equally durable. I need hardly say it has no rival in rapidity of growth, as it far outstrips the willow. Along the bars of the Missouri are millions of seedlings. They grow up upon these bottoms over a great extent like prairie grass. There are enough of them to plant groves over every prairie in the State. I went ten miles from home, and in one day took up 13,000, eighteen to thirty inches in height, for my own setting. With ground ready a good hand can set from 2,000 to 3,000 per day. The fall is the best time to get seedlings from the Missouri bottom, on account of the high water in the spring. I set cottonwood posts from old trees in the bottom in the spring of 1860. I moved this fence last fall, and nine-tenths of them are yet good. The yellow cottonwood, split up green and put under a dry shed to dry, is good enough for my folks to use for fuel.

"Of my first planting of cottonwood twelve years ago, the best of them now measure sixteen inches in diameter. We would make plantations very thick. I now plant 4,356 trees to the acre. This shoves them up straight and symmetrical. In this way we get the dead sure thing on the side-branch business. Cottonwood can be readily grown from seeds. Being upon the river bottom in June, I noticed the cottonwood trees were loaded with seed ; had one cut down and loaded the wagon with branches with the seed attached. I furrowed some ground quite deeply with plow ; strewed the limbs in the rows, and my success in growing many thousands of seedlings was most perfect."

In the interior sections, where seedlings cannot readily be obtained from the river bottoms, the yellow cottonwood may be grown from cuttings about as readily as the willow. The evident advantage would also ensue of propagating the right variety. On the Missouri bottom the seedlings of the common cottonwood are, of course, intermixed with the more valuable variety.

CATAPALTA (*Catapalta bigonoides*).—Experience has demonstrated this tree to have a special value for extended planting. Although naturally a tree indigenous farther south, it seems to have a peculiar tendency to adapt itself to northern limits. A variety now grown quite extensively in central Iowa seems as hardy as any of our native trees. The writer has trees now five years set, large enough for small posts for wire fences, which have had open exposure north of 42d parallel, during the past severe winters. In Cedar county are to be seen many trees which have been out from ten to fifteen years, which show its habit of rapid growth to continue after it attains considerable size. In its native forests it attains considerable size, growing from 50 to 80 feet in height, with a diameter of from 18 to 25 inches. Its flowers are very showy, and its odd cylindrical pods attract much attention. It is very durable for posts. Posts are yet sound in Illinois which have been set, it is claimed, forty years. The plants are very easy to grow from seeds, which may be kept dry until time for sowing. But in all cases secure seed grown on northern trees. In Cedar county, and near Muscatine, the seeds are quite abundant. The trees flower and bear seeds abundantly when quite young.

WHITE AND SCOTCH PINES (*Pinus strobus* and *P. Sylvestris*).—These have been referred to in this report as very desirable for shelter-belts. Our people have been slow to plant them for timber trees, as their most evident use as such is for sawed lumber. Admitting this as their special use, several considerations should induce their extended planting.

First—Their rapidity of growth. Very many reported cases of growth on the prairies of white pine, in partially sheltered localities, confirm the statements of relative growths made by D. C. Scofield, of Elgin, Ill. His plants were set when from 6 to 12 inches in height, and after twelve years' growth he reports European larch 30 feet high and 8 to 12 inches in diameter; and white pine 35 feet in height and 6 to 12 inches through. The writer has white pine trees twelve to thirteen years planted, 14 inches in diameter and over 30 feet in height.

Second—The poles thinned out as before stated are valuable for fencing.

Third—An evergreen plantation breaks up the monotony of prairie scenery, and adds in this way a moneyed value to our real estate in case it is offered for sale.

Plants of white pine can be bought from dealers who collect them in the pineries, as low as two to three dollars per thousand, in quantity. Such plants should be set in beds for two years, and screened by light brush-covered shed. They may then be set where wanted. Pine and larch may be grown advantageously intermingled in the same plantation. As before noted, the Scotch pine may be judiciously planted as a protection to white pine or larch plantations on west or north sides. Evergreen plants can be procured of parties in Illinois, who grow them from seed and send them out once transplanted at low rates. Robert Douglas, of Waukegan, Ill., whose long experience in prairie-tree growing gives a practical value to his opinions, advises the extended planting of white and Scotch pines intermixed with the larch. He says:

“Most European planters prefer mixing pines with larches, as this adds to the appearance of the plantation and gives a choice in thinning. We would advise planting a few rows of the admixture on the margin of the plantation, at least, and in all cases where the plantations are placed along the outer boundaries of the farm, we would advise a free admixture of evergreen.”

As evergreen plants are usually shipped from a distance, the instructions of Mr. Douglas in regard to handling and setting are appended:

“When the trees are received from nurseries the boxes should be immediately unpacked, and the roots dipped in a puddle made of rich, mellow soil, about the thickness of paint. Place them in a cool shaded place till ready to plant, and while planting expose the roots as little as possible. If not ready to plant for a few days, keep the roots moist and tops dry. Set the trees a little deeper than they stood in the nursery, and tread the earth firmly about the roots when planting—*this is very essential*—drawing a little loose earth up to the trees to prevent the surface from baking.”

RED ELM* (*Ulmus fulva*).—This tree has not received the attention it merits from tree planters on our prairies. It is peculiarly a tree adapted to dry climates, no better proof of which could be found than the fact that it fails to ripen seeds in the humid air of England and France. Its special claims to attention for extended planting may be briefly summed up as follows:

*Sometimes known as the Slippery Elm.

(1) It is beyond all question hardy, even in the most exposed position on our prairies.

(2) It grows on rich soil with great rapidity. The writer has trees grown from seed in six years larger than box-elder (*Negundo aceroides*) of the same age, and receiving the same treatment.

(3) The seeds are easy to gather in nearly every portion of the State, and require no more skill in handling and planting than the soft maple.

(4) No tree in our whole list seems so free from disease and injury from insects, worms, &c.

(5) No tree, not even the larch, has so large a proportion of red or heart-wood when young. Even in the branches of young trees only one or two inches in diameter, the perfect wood forms the principal part.

(6) Grown thickly in artificial groves, it runs up straight and tall, and when the poles are large enough to split for two rails they divide as freely and easily as young chestnuts, and the rails are about as durable, even when laid up in worm-fence. Nailed on to posts they will last fully as long as white oak.

(7) When the poles are only large enough for a grape-vine stake, or a small post for wire fence, if cut in summer, peeled and dried before setting, they will last longer than burr oak, set green, from old trees.

(8) It is a historical tree of our country, and associated with every memory of the early days, without regard to position, as it seems the one ubiquitous tree, nearly everywhere present in the native forests of our country. It is among the first in the spring to exhibit its blossoms and hue of cherry green, and in the autumn, with the advent of the early frosts, it presents a display of shaded leaves, running from lightest violet and the deepest crimson, to all shades of orange and yellow. Other things being equal, even beauty has moneyed as well as æsthetic value in the arrangement of the landscape view in tree planting.

This special commendation of the red elm may be received with some doubt by those who have given the matter little attention. The idea is not intended to be conveyed that exclusive plantations be made of any one tree. But example and habit have too much influence in guiding tree planting. The soft maple, for instance, has become over our State the popular tree for general planting. Let us suppose the red elm has become equally popular. It grows as rapidly, it is far hardier, it is freer from insect ravages, it is worth far more for fuel, it is excellent for rails and even posts, its lumber is valuable for stable floors, bridge planks, wagon hubs, and many other uses, the trees require little if any care in the way of pruning, &c. If it could supplant the maple the gain would soon be very apparent.

The seeds of the elm ripen in May, usually before the trees come into full leaf. The seeds are light, and being surrounded by a membranous wing, they are widely scattered by the wind. Sow at once on gathering, and by all means sow where wanted, if possible. They may be planted in corn-hills to excellent advantage. They usually grow about one foot in height the first season. Planting with corn is an advantage, as the plants are sometimes injured when very young by direct exposure to our dry air and hot sun of July and August. The plants transplant readily, but if you want rapid growth never break the first tap root.

CORKY ELM (*Ulmus racemosa*).—This tree in habit of growth is much like the white elm (*Ulmus Americana*) but its wood is far more valuable. This elm is so often confounded with the white elm, and is so usually mixed with it in its native haunts, that the masses might fail to get the unmixed seeds. The corky elm will be likely to grow as rapidly as the red elm, but its wood having less value for manifold uses than the latter, its extended culture cannot as yet be advised. For ornament and for shelter, however, we may say the white elm in all its northern varieties is not surpassed. Michaux was right when he said that the white elm was "the most magnificent vegetable of the temperate zone." Isolated trees for shade or landscape effect, or any of the white elm varieties, are not excelled. The American elms, as grown from seed, all run into varieties puzzling the botanist.

SILVER-LEAF MAPLE (*Acer dasycarpum*).—This variety, and also the red maple (*Acer rubrum*), are well known plantation trees in every neighborhood in the west. It is economy of time, and a great increase of growth is attained by planting where wanted as recommended for the ash. But seedlings may be transplanted readily if plants are readily obtainable.

While it is unfortunate for the timber-growing interests of the State that the soft maples of late have been so exclusively planted, we are not willing to advise the total neglect of these trees. Failure often ensues by neglect to gather seeds at just

the proper time. When the wild crab-apples are in full blossom, the seed is usually just right. Before planting it is best to soak the seeds in water until just ready to sprout. Then place in moist earth.

BLACK MAPLE (*Acer nigrum*).—This is usually called sugar maple, but its growth is very much more rapid under culture than the *Acer saccharinum*. For fuel and sugar-making it is specially worthy of culture. For five or six years after planting its growth is rather slow. After this it compares favorably with our other valuable trees in this list. Seeds ripen in the fall. Pack in sand not too moist, or turn down on walk, and treat as ash seeds, which is generally best. Plant where wanted if possible, as growth is much impeded by transplanting.

ASH-LEAVED MAPLE (*Negundo aceroides*) *—This tree is one of the easiest of all to propagate, and for great amount of fuel in a short time it has no superior. In Illinois it is being planted for sugar-making. Its wood in the older States, and in Europe, is used in cabinet work. Gather seeds in fall; keep under box as with ash, and sow where wanted. Under any kind of culture where a cottonwood will grow, this tree will flourish equally well or better.

HACKBERRY (*Celtis occidentalis*).—Our native variety of hackberry grows very rapidly under culture, and has a special value for making flat hoops for apple and flour barrels. It splits very freely, and if cut in summer, and the bark peeled, the rails when nailed on posts last many years. For fuel it is about like soft maple. The fruit is about the size of peas, and is usually abundant on our river bottoms. Wash the sweet pulp from the seeds and mix with sand for early spring sowing.

RED MULBERRY (*Morus rubra*).—This is a very handsome ornamental tree, growing very rapidly during the first years after planting, and soon attaining size suitable for grape vine or other stakes, and even for posts. The timber is strong, compact, and very durable. If dried before set in the soil, it is questionable whether we have any timber, doing well in rich soils, as durable for posts or stakes as this. A drawback to its culture is the scarcity of seed, the birds generally getting the fruit as fast as ripe. Wash the pulp from seed and mix with sand for early spring sowing, either in seed-beds or where wanted. Plant the mulberry where sheltered from the west and northwest by belts of trees like elm or cottonwood that will better stand the rake of our dry, cold winds. It also does best on porous, deep soils, as long continuous drought seriously injures and even kills the trees on soils with the blue clay too near the surface.

YELLOW BIRCH (*Betula excelsa*).—This tree thrives exceedingly well on deep, rich, and moderately moist soils, with porous subsoil. It makes excellent fuel, and is valuable for many manufacturing purposes where a strong, fine-grained, handsome wood is desirable. It is only recommended for variety. It grows readily when transplanted; and the lover of trees will always be pleased to have it in a general collection. The seedlings are not so easy to grow in our dry air as those of most forest trees, and the seed, of which there is an abundance in the market, is usually not in a condition to grow. The plants may be bought in any quantity in the pinery regions, at low rates.

LARGE ASPEN (*Populus grandidentata*).—Unlike the common aspen, this tree rapidly attains, under cultivation, considerable size. The wood has no great value for fuel, yet it has a special value for farm uses that should not be overlooked.

(1) It grows when planted, closely, very straight, and the poles—cut in summer and peeled—flattened on one side, make very strong and stiff rafters for sheds, and even barns. When large enough for hewing-sticks, it is fully equal to white pine for frames of barns.

(2) No timber in our list will attain, under good culture, size sufficient for two rails as soon, that is equally strong and durable, if cut in summer and peeled. In lengths of eight or nine feet nailed on good posts, they keep in place better than oak, and will last fully fifteen years.

All things considered, it is best to grow this tree from cuttings; yet, where seed can be procured, the plants grow with as much certainty as the cottonwood or maple.

We may add that a plat of the aspen on the open prairies is ever an object of

*By some botanists called *Acor negundo*.

interest in contrast with other trees. The leaves tremble in the lightest breeze when the foliage of other trees is motionless.

WHITE POPLAR (*Populus alba*).—This tree is usually voted a nuisance as a shade on account of its wonderful tendency for suckering; but this tendency to sucker would be no objection in forest culture. The size which this tree will reach in prairie in ten years is a matter of wonder and surprise. It is probable that we have no tree with valuable wood that will reach saw-log size as soon as this. Like the elm, the intrinsic value of this tree has been overlooked. Let us enumerate:

- (1) It propagates from cuttings of any size, even more readily than the willow.
- (2) It is valuable for about the same uses as the famous tulip tree (*Liriodendro tulipifera*), of Ohio. It makes very superior flooring, wainscoting, and even finishing lumber for houses. The boards used for siding, or for fencing, are vastly superior to any of the poplar family, except it be the yellow cottonwood. For dry goods boxes, bowls, trays, carriage bottoms, trunk making, chair seats, &c., the wood is counted in Europe superior to pine or whitewood.
- (3) When thickly planted it runs up very straight, and the poles cut in thinning can be utilized by nailing on posts for fence, for rafters, sleepers, &c., as with the aspen. As with the latter, the trees for this use should be cut in summer and peeled, when they are quite durable if kept from the ground.

WILD RED CHERRY (*Cerasus Pennsylvanica*).—This is a small-growing tree in its native haunts; but it behaves so well under cultivation that it deserves a place in our timber plantations. It is peculiarly a northern tree, being found on nearly all soils, from the Atlantic coast to the head waters of the Mackenzie river, in British America. It is very nearly allied to the common cultivated cherry, and exhibits in its seedlings a marked capacity for variation and improvement. A variety is in common cultivation in the south part of Benton county, Iowa, which bears heavy annual crops of fruit, which is considered excellent for culinary use. The fruit is fully as large as that of the black wild cherry, and of pleasant flavor. The wood of this tree is exceedingly hard, fine-grained, and of a reddish hue, and would be valuable for many uses in cabinet work, were it not for the natural small size of the tree. Grown thickly in artificial groves, its poles are straight and tall, and valuable for such farm uses as nailing on posts, fence-stakes, vine-stakes, light fence-posts, &c. If dried before putting in the ground, it lasts as well for posts as black cherry. The pits kept in sand through winter grow as readily as those of black cherry. It transplants readily, and sprouts can be secured in nearly all parts of the State for setting in groves. It will not pay to grow this timber except for home use on the farm.

WHITE WILLOW (*Salix alba*).—Perhaps it may not be proper to include the willow among the timber trees proper, having a special value for farm uses, or for manufacturing. Yet, where grown thickly, the poles are straight and uniform in size, and if cut in summer and bark peeled off, they last for several years nailed on posts for fence, and the fuel, if dried under cover, has a greater value for summer use than is generally supposed. It is specially mentioned in this connection, on account of its combined adaptation for wind-breaks and fences on the bleak interior prairies. If any one doubts the expediency of growing the white willow on an extended scale, let him pay a visit to Story county, Iowa. Several years since, Col. John Scott, of that county, earnestly advocated the extended planting of this tree for fences, for fuel, and for the arresting of wind-sweeps on their bleak, broad prairies. In the portion of the county where its planting has been general, one can now hardly realize he is upon prairie in driving along the streets, lined on both sides for miles in extent with combined fence and wind-screen. Where best known, the wonder is expressed by prairie settlers how they got along before its advent in their neighborhood. Thomas Wardall, of Mitchell county, who has had a long prairie experience, writes of the white willow as follows in a report on hedges for the north:

Seventh.—We tried the white willow. This has come to us at the north as a "God-send." Not because it makes the best hedges, for no one is so foolish as to assume that, but because a stock-proof fence can be made of it in brief time, and at small expense, which at once is a fence and a wind-break. A combination of this kind the denizens of our northern prairies can appreciate. The variety mostly in use in our section, and in Minnesota, will not bear plashing, or even weaving, and will not lose the tree-habit of growth, by being headed back. So we have by mutual consent abandoned all attempts at hedge making proper, and we aim to se-

cure a close bottom at once, then give protection from stock for two years, and we have a profitable investment in what will become a solid wall of live timber in a very few years; at once a fence, a valuable screen from the sweeping winds of summer and winter, and which will give a constant supply of passable firewood from the tops. And now for the plan for forming such a stock barrier, to which I will ask special attention. Let every northern farmer plant out a willow grove, with good, large cuttings, in early spring. Plant four feet apart, both ways, and cultivate well for two or three years, and a large growth will be secured. When five years old, trim out all but one plant to each hill. Cut off stakes five and one-half feet long from these trimmings. Sharpen these stakes and drive them eighteen inches deep in a well prepared fence row. When the soil is soft in the spring, the driving can be done without bruising the bark. Let the stakes be driven closely, not more than six inches apart. Nail a stay-lath near the top. A three-inch barn-batten answers the purpose well. Mulch heavily or cultivate well and often. In two years, a fence may be made that may be depended on to turn stock, but which will have the one fault of not being beautiful:

The Iowa Horticultural Society fixed upon the 20th day of April, 1874, and afterward, annually, unless changed, as a day to be devoted to the planting of trees and seeds of trees, designed to form permanent groves, or for ornament. This day proving cold and stormy the first year, planters competing for premiums, were allowed the next year to select the time most convenient.

In earlier numbers of the Forestry Annual, the following suggestions, are also offered:

Prairie farms need shelter most on the west, next on the north, next on the south, while their usefulness on the east is not so great, though sufficient to call for planting. * * * A good combination for an evergreen belt, is two or three rows of white pine for center, two rows of Scotch or Austrian pine on each side, and two rows of red cedar, or arbor vitæ outside of these, making ten or eleven rows, and giving, by different rates of growth, a belt with a conical cross-section, and limbs from the ground up. Another good combination is made of Norway spruce for center, white spruce next, and black spruce and red cedar, or arbor vitæ outside.

The Scotch pine is, in many localities, found well adapted to outside rows, from its hardy habits. It needs more room for growth than the white pine. In planting wind-breaks, it was recommended that the outside rows should be nine feet apart, and plants five feet apart in the rows. It was remarked, that people, generally, are apt to over estimate the time it will take to secure returns of fuel from artificial groves. Cottonwood needs to be thinned the fourth or fifth year. If properly grown and cultivated, the poles then cut out will average $2\frac{1}{2}$ inches in diameter at the bottom, and twelve feet long. From a full stand, one-half, or 1,775 poles, would be cut at this period from an acre. Green ash needs thinning at six or seven years, and makes poles as large as those of the cottonwood, at four or five. Those who have tried it say that it pays better to raise wood for fuel, than to haul the supply needed five miles for ten years.

As for wood grown for other uses than as fuel, it was estimated that a crop of ash for hoop-poles, or larch for stakes, might be grown in from seven to eleven years; and of oak and hickory, in twelve to sixteen years. Larch would grow to a size for posts in twelve to fifteen years; and for telegraph poles, in eighteen to twenty years, on valley lands. Walnut, hickory, elm and other tie timber, might be fit for use in from fourteen to eighteen years. Cottonwood might be sawn at fifteen years, and white pine in thirty.

As some of the foregoing varieties of timber are more cheaply propagated

from cuttings than in any other way, I again plunder the transactions of the State Horticultural Society for a paper on the subject, prepared by me for its annual winter session at Owatonna, January, 1877.

THE PROPAGATION OF TREES BY CUTTINGS.

A paper on "The Propagation of Trees by Cuttings," by L. B. Hodges, Esq., of St. Paul, was read, after which the paper was ordered on file for publication, and Mr. Jewell moved a vote of thanks to Mr. Hodges for his humorous and instructive essay, and also a rebuke for his reflection on the religious intelligence of the members of the society. The resolution was passed amid laughter and applause.

The following is the paper in full:

When a small boy, more than forty years ago, in the pleasant village of Canandaigua, N. Y., my attention was arrested by a magnificent great willow on the premises of Judge A——, one of the pioneers of that region. It was a tradition among the boys, that this immense tree grew from a willow switch which the Judge cut in Connecticut and used as a riding whip during his horseback journey from Connecticut to Western New York; and for over thirty years of my manhood passed on the broad prairies of the Northwest, I have often seen and heard of similar willows with very similar histories. Now, this is all well enough *per se*, but when intelligent and educated gentlemen, on the strength of such occasional and isolated circumstances, affirm that all you have got to do in order to grow the willow, the cottonwood, or the Lombardy, is to simply stick a cutting in the ground in most any sort of a hap-hazard way, they are simply leading the multitude astray and doing harm rather than good. The object of this paper is to furnish to the people interested in the propagation of forest trees by this particular method, such practical information as a long and varied experience has proved to be correct.

If this sort of experience is in conflict with tradition and preconceived notions, why so much the worse for the traditions and notions. I begin by saying that the proper preparation of the soil is not only of primary importance, but also a prerequisite condition of success.

SOIL AND ITS PREPARATION.

Your ground must be good ground, it must be thoroughly subdued and mellow before planting; and right here I propose to point out and expose the practical nonsense and absurdity of the proposition that a cutting will grow anyhow, so you only stick it in the ground. Acting on this absurd proposition, hundreds of thousands of all sorts of cuttings have been stuck in all sorts of ground by all sorts of people. The *results* are well illustrated in the parable of the sower.

(Before going to bed to-night, you fellows who haven't read that parable for twenty years or more, had better look it over.)

Soon after the passage of the Timber Culture Act of 1873, I read in one of the most ably-conducted and widely-circulated of our country papers, an editorial showing the settler how to grow a forest under the provisions of said act. *Boiled down*, it simply amounted to this: Strips of breaking two or three furrows wide, said strips twelve feet apart and the cuttings to be stuck twelve feet apart in the strips, in the raw, unsubdued sod; no further labor or expense necessary—result, a forest. I promptly denounced the absurdity

of such teachings, but for all that, a heap of fellows had to try it on. It would be a good time now for them to report what luck they have had.

In the pursuit of knowledge under difficulties, my curiosity has led me over quite a large number of tree claims which have been planted in good faith in accordance with such teachings.

Candor compels me to say that when you find a muley cow climbing trees stern first, it will be up one of the trees so propagated on one of those tree claims.

The Northern Pacific Railroad company expended a number of thousands of dollars in just about that sort of a way of propagating forest trees from cuttings, and succeeded in demonstrating that it was just as easy to drive a government mule through the eye of a needle, as to grow forest trees in any such way as that.

The idea of getting something for nothing, is a bad one. There must be an equivalent, a *quid pro quo*.

In your dealings with each other, this idea of something for nothing may work, *occasionally*,—but you can't bulldoze the prairie with any such nonsense.

The cuttings plunged full length into a deep, rich, mellow soil, under the vivifying influences of heat and moisture, soon begins to expand its buds, and throw out its slender, threadlike, fibrous roots. If the ground has been properly prepared, those roots at once begin to draw nourishment for the incipient tree; the buds grow into branches, and in a few months you have a thoroughly developed forest tree, and the better cultivation you give this young tree, the sooner you get a tree that is of some use in the world.

On the other hand, the cutting stuck in the raw sod, makes a failure in trying to get its roots into the hard earth in a vain attempt for nourishment; struggles along in a feeble, quiet sort of a way till dry weather sets in, and then quietly starves to death without a struggle or a groan, and the innocent author of this miserable abortion wonders what ails his trees, and sometimes gets mad, and uses "cuss-words" about the man who sold him the cuttings.

To go back to the starting point: break your prairie in June; break shallow—back-set or cross-plov last of September, turning up two or three inches of fresh dirt.

If in a hurry, (to save your claim) harrow thoroughly, and plant your cuttings right along up to the time the ground shuts up, and if not through, finish up the job early in the ensuing spring. If not in a hurry, it is a good practice to raise a crop before planting cuttings. A hoed crop is best, and if well cultivated leaves the ground in admirable condition for tree-planting. If you sow small grain before planting, you can't be too careful in getting your seed *perfectly clean*.

A few grains of wild buckwheat, or, what is more to be dreaded, pigeon grass, will give you an infinite amount of trouble, and by increased labor in keeping it down, double the cost of growing the forest.

In growing a wind-break from cuttings, for a single row, I would prepare a strip of ground not less than $8\frac{1}{2}$ feet wide, by deep ploughing and thorough harrowing.

I would have the ground as mellow as an ash-heap.

I would draw a line lengthwise along the center of this strip, and about every twelve or eighteen inches would plunge the cutting in nearly or quite full length, and at once tramp the mellow earth firmly around the cutting; and then I would keep that strip of ground clean as a hound's tooth. I wouldn't allow a weed or blade of grass to grow on that strip dedicated to the wind-break; and I should keep the cultivator running up and down the

margin each side the row of young trees pretty often till harvest time, after which, if any weeds or grass had put in an appearance, would pull them up, carry them off and burn them up.

I should repeat this process the next season, and in the fall would mulch heavy with good manure.

I think by that time you will have that strip of prairie pretty well bulldozed, and a wind-break started that won't dry out or freeze out, and which will stand and grow in spite of grasshoppers or other enemies.

TIME OF PREPARING CUTTINGS.

As far as the willow is concerned, most any time will do.

I have cut them nearly every month in the year, yet would prefer cutting and planting right along through the month of May, as being then liable to less loss and better growth.

I confess, in my own experience, to more satisfactory results with cottonwood cuttings cut and planted in October and November than in any other month.

As far as willow, cottonwood and Lombardy cuttings are concerned, good, fresh, healthy ones are about as sure to grow (in Minnesota) if properly handled, and under the most favorable circumstances, as either corn or potatoes. *Failure* is not necessary. Do your work intelligently and thoroughly, and at the proper time, and *success* is the rule.

CARE OF CUTTINGS TILL PLANTED.

In the fall of 1874 I caused to be cut and hauled together enough white willow to make five hundred thousand cuttings. I reduced some of this brush to cuttings in the fall, tied them up in bunches of a hundred each, set them up on end in trenches dug about a foot deep, threw a foot of dirt over them and let them lay till spring. The balance was stacked in good shape, covered with a layer of slough hay—threw enough loose dirt over it to keep the wind out, and let the thing go till it thawed out in the spring—then uncovered it, worked it up into cuttings and planted them. They came good and grew well, and I never knew any difference between those buried in trenches or those of the stack. Whenever, in the course of human events, I found a lot of cuttings drying up and apparently worthless, before planting I would "swell 'em up" by throwing them into the most convenient lake, pond or stream. But a good way is to keep them buried in the trench until you are ready to plant.

There are plenty of cottonwood trees in Minnesota propagated from cuttings in the manner I recommend, now big enough to make a cord of wood each—17 to 20 years from the cutting.

You can grow 300 such trees to the acre. Can you grow anything that will pay better?

Is there any better way to "conquer the prairie," or to bulldoze and intimidate old Boreas?

From Dr. Hough's report, page 554, I clip the following as worthy of a place here, and also because it touches some points that were overlooked in the preparation of the foregoing paper.

Mr. J. L. Budd, now of the Iowa State Agricultural College, furnished for the State Horticultural Report of 1868, p. 111, an article upon this subject, from which we condense the following:

The red maple (*Acer rubrum*), silver maple (*A. dasycarpum*), ash-leaved maple (*Neyundo aceroides*), cottonwoods (*Populus monilifera* and *ungulata*), balm of Gilead

(*P. balsamifera*), Lombardy poplar (*P. dilatata*), white poplar (*P. Alba*), sycamore (*Platanus occidentalis*), and white willow (*Salix alba*), will grow from cuttings, and all thrive on the western prairies. They should be cut early in winter, before severe freezing, in lengths of about one foot. They should be chosen from three-fourths of an inch to an inch and a half in diameter, and the lower end with a clean cut, without bruising or mashing. Of maples the two year old wood is best; of the other kinds it makes but little difference, if the growth is free and healthy. Tie in bundles with willows, the lower end nicely evened, so that when placed on the ground in spring every piece will touch the moist earth. Pack the bundles in a dry goods box with moist prairie soil, putting the box where it will not get too dry or wet, and will not freeze. With the first warm weather of spring clean off a spot under an old hay-stack, level the surface carefully and set the bundles, butt-end down, closely together, upon the fresh, moist earth, then cover them with straw so as to keep them from the air. By the time the ground gets warm enough to plant, the base of the cuttings will be softened, and most of them will have small roots.

WHITE WILLOW, (*Salix alba*.)

My own opinion of this valuable vegetable is too well known in Minnesota to justify me in repeating the arguments I have used in its behalf, lo, these many years. A few extracts and opinions from other and more authoritative sources, and I then cheerfully submit the character of this old friend to the jury.

Again quoting from Dr. Hough's report, page 108:

1. *Salix alba*, the white or Huntingdon willow, a fine tree which in proper soil will, in twenty years, make an average of two cubic feet a year. The wood is light, tough, easily worked, and proper for tool handles, hoops, cooper work, &c., and its bark is used for tanning, and in medicine as a tonic and astringent, being recognized in our pharmacopœias, and sometimes used as a substitute for Peruvian bark. Its active principle, *salicin*, is also used as a remedy in intermittent fevers. This willow has been already widely introduced, and in the prairie region of the north-west it is valued above all other trees as a wind-break. It makes a very good fuel, and its wood is useful for a great variety of purposes.

Professor Sargent mentions a willow between Stockbridge and Great Barrington, Mass., planted, it is said, as a cutting in 1807, that now, at four feet from the ground is twenty-one feet eight inches in circumference.

An English writer, in speaking of the willows, says that the white willow, when unpruned and grown naturally in favorable conditions, is the handsomest of the willow family, whether we regard its general outline, habit, or the peculiar whiteness of its foliage, which forms a pleasing contrast with the darker green of other trees. It comes forward rapidly on the deep river banks and rich alluvial bottoms, too damp for most other timber-trees. In Great Britain within a few years willow timber has come universally into use as blocks for brakes in railroad cars, so that wood of good size has become scarce and high-priced. The charcoal of all willows of suitable size is used in making gunpowder. Among other uses to which certain kinds of willow are used in Europe, and for which it is especially adapted, are paddle-wheel floats, and for shrouding water wheels, cart-linings (being not liable to splinter,) turner's uses, shoe lasts, wythes for tying, &c. Something has been said of its incombustible properties, but more than facts will justify.

WILLOW HEDGES.—In Northern Iowa, where the Osage orange is too tender for the climate, the white willow has been found to answer an excellent purpose as well for a hedge to stop cattle as for a wind-break.

Mr. Thomas Wardall, of Mitchell county, gives the following advice in the cultivation of this tree:

I have seen cuttings planted on the same day, and with the same soil and treatment in all respects, except that part where mulched and part were not, and where the former succeeded well, the latter utterly failed. I have seen cuttings when not mulched, make a nice start, but perish in the heat and drought of summer. I have seen large cuttings, driven into an unbroken prairie-sod, make a fine growth when

a sufficient mulch was applied to subdue the native grass. But in this manner of planting, the mulch should be heavy, and should extend at least five or six feet on each side of the rows to give the plants a chance. It would be better, within a year or two thereafter, also to break a greater width outside of the mulch, as the sod would interfere with the growth of the trees, as soon as the roots should reach that distance. Straw, hay, stalks, manure, sawdust, anything that will mechanically serve the purpose of mulch, will answer, but manure would stimulate the growth very satisfactorily. * * *

Cutting back may be resorted to in cases where there has been a poor stand, but not where the plants stand within twelve or fifteen feet of each other. The trees should not be plashed down or woven together, but should be stimulated to make a strong, upright growth. Late planting is even worse than close planting. This is especially true if the buds have started before the cuttings were made, or if they have been allowed to dry before setting. While young and tender, the shoots must be guarded from live stock. Calves will eat the tender shoots, and keep them shorn so close as to kill out the strongest plantings while young. Shallow planting, thin soil, standing water on the surface, grass and weeds to smother the plants, are all to be avoided or remedied. In short, avoid everything that interferes with a good stand and a vigorous growth, and you will never have cause to call the white willow a humbug. * * *

The amount of fuel that may be cut from a rod of fence, taking all above the height of three feet, is much greater than most persons would think, and its reproduction on the same spot, without further labor, makes it a crop of no mean value on the open prairie. * * *

Mr. O. B. Galusha, in a lecture at the Illinois Industrial University in 1869, in speaking of the white willow, says :

I regard this as probably combining more desirable qualities for cultivation in groves, for lumber purposes, than any other variety of the soft-wood, rapid-growing deciduous trees, and am decidedly of the opinion that this and the golden variety are the best deciduous trees within my knowledge for wind-breaks or screens, but wish to be distinctly understood as not recommending this tree as a hedge-plant, or the planting of this or any other one sort to the neglect of other desirable varieties. Strong cuttings of this tree seldom fails to strike root at once in mellow soil, and will make a growth of from two to six feet the first season. It thrives in all kinds of soil, making as much wood in a given number of years as any other known sort, not even excepting the cottonwood, growing into a large tree, sometimes four feet in diameter. The wood is of rather fine texture for a light wood, making a fair article of soft lumber which bears a fine polish. It is also valuable for making wooden ware, bowls, trays, &c. It also splits freely, which is a desirable quality in making fence-posts, rails, railroad-ties, and fire-wood. * * * The golden willow is similar in growth and texture to the white, but I think does not make so large a tree. I have measured about a dozen trees of this variety (golden); which were planted by the roadside fifteen years ago last spring, and find the average circumference of the trunks at three and a half feet from the ground to be five feet three inches. A white willow * * * which has grown from a small cutting put in thirteen years ago last spring, now measures six feet two inches near the ground, forming a head or top thirty feet across. This variety, when planted in groves, grows tall and almost perfectly straight. I have carefully computed the expense of raising ten acres of trees of this variety, and converting them into lumber, and find the entire cost not to exceed \$10 per thousand feet. This estimate is based upon actual measurement of the growth of trees. The land itself is valued at \$40 per acre, with interest upon this amount, together with expenses computed as before, at six per cent. compound interest. I take ten acres in these estimates of growing artificial groves because it is desirable to have trees enough together, or in close proximity, that the cost of putting up and removing a saw mill would be but a trifle upon each thousand feet of lumber sawed.

The value of the willow in preventing erosion in the banks of rivers and streams, for holding the soil liable to washing away in valleys, and for filling up the channels worn by small streams in loose gravelly soil, and preventing further gullyng, must have been noticed by every observing person. This office is performed by the multitude of long tracing roots that it sends through the damp soil wherever they find nourishment, the shoots by which it multiplies and spreads from the roots, and sometimes when crowded, by the prostrate branches.

Such willows, when abundant and of large growth, also serve a useful purpose by

preventing injuries from floating ice in rivers, and they are turned to profitable use by engineers for holding in place the new deposits of mud formed under the shelter of jetties and other hydraulic improvements.

Samuel Edwards, of Bureau county, Ill., writes to the Germantown Telegraph, of the white willow as a timber tree as follows :

"It has been grown here since 1845, and the more we become acquainted with it the better we like it. No other tree has made as rapid growth ; a cutting set in 1845 is over four feet in diameter. Many are planting it all over the prairie region for timber ; much is being set for hedge screens, which are cut down every few years at four feet from the ground, affording a great amount of fuel and poles for fencing.

"Formerly small sized cuttings were set, but for some years stakes five and a half feet in length, from one to three inches in diameter, have been preferred, setting them 18 inches deep, and a foot apart."

General James S. Brisbin, U. S. A., writing from Omaha, to the Chicago Tribune, April 27th, 1874, says :

"The beautiful, green, graceful, white willow. Who does not love it ; and what ranchman does not hail it as his friend, and delight to sit in its cool shade ?

"It grows almost spontaneously ; shelters from heat or cold ; keeps off wind, rain or sleet, and is a green spot on which to rest the eye when all around is desolate, barren and a desert. It grows from a shoot without roots, and foresters always praise its rapid and graceful return for the slight labor they bestow upon it. A tree of this kind attains a height of 60 or 70 feet, and shows an immense trunk. For shade trees along the highways it is unsurpassed, repelling heat, wind and cold, and no drive can be finer than through an avenue of willows."

J. Plank, Eyota, Minn., March, 1874, writing to the Farmers' Union, says :

"I think white willow makes the best and cheapest fence. In six years (from planting) you can have a live fence, which will have cost you 25 cents a rod, and last a lifetime. I have about a hundred rods of it that will turn any kind of stock. I am going to put in some more this spring."

Jesse W. Fell, replying to an article in the *Prairie Farmer* derogatory to the white willow, says :

"If the writer of that article will call at our house at Normal, it will afford me much pleasure to show him a section of a moss-covered fence-rail that has lain in a fence more than forty years, and is yet perfectly sound ; and if he will go with me to my native county (Chester, Pa.), I will show him miles of fence made of the same material, and that has lasted the same length of time. That it makes good fuel—I will not say the best—is not doubted. I therefore enter my earnest protest against the remark that "this timber is of little value." The timber itself is of great value, especially in a country like this ; and when, in addition, you take into account how easily and surely it is propagated, simply by cuttings ; how rapidly it grows, how sound and healthy a tree it is, how vigorously it reproduces itself from the stump where cut down, and yet does not spread from the roots ; I say, when all these things are taken into the account, it is questionable whether, for the millions, it is not after all *the tree* for this country and climate. I did not intend to say so much, but could not well say less when one of my old friends had been so unjustly assailed. Whilst I am writing fierce winds are whistling around me, the force of which is unbroken for many miles by tree or shrub, except by those embryo forests in which this very plant cuts the most prominent figure, and I must raise my voice in its behalf."

Col. John Scott, of Story county, in Central Iowa, reported in 1876* that many miles of willow hedge were planted in that county, and that more than one hundred miles would be found a complete barrier against stock. Many miles had been set in a random, aimless way, and were worthless as a fence, although somewhat profitable as fuel and shelter.

*"Traité general des Conifères," p. 280.

He gives his method for successful planting as follows :

1. The row should be made mellow and deep, and the better the condition as to richness, freedom from weeds and good tilth the better. If in good condition for corn it will do for the willow.
2. The cuttings should be made before the buds swell in the spring; they should be packed in moist earth to keep them from drying out; they should be from the upright rather than the lateral growth, as being more thrifty; and may be from six inches to six feet in length, and from one-half to four inches in diameter.
3. It is best that they be assorted before planting, so that those of about the same size may be planted together.
4. They should be set in a straight line, and only one row planted, and should be ten or twelve inches apart. The cuttings are often set too closely. They should have room to spread themselves in.

ASH AND LARCH.

Failures have often been encountered in transplanting the larch, by overlooking the important principle that the top should bear a corresponding relation in its leaves to the root in its radicles. Many of the latter are necessarily torn off with the most careful transplanting, and it is a safe rule to shorten the branches in a corresponding degree. The larch should be planted early in the season.

THE ASH AND THE LARCH.

In an article by Mr. Arthur Bryant on the ash and the larch, he mentions the white ash as one of the most important timbers in the northern States, and concerning the difficulty of raising from seed, he says :

If the seed be sown soon after gathering from the tree, without drying, it will come up well in the spring; but if dried, a great part will often fail to vegetate the first year, even if kept through the winter in damp sand. Care must be taken not to cover too deeply. Probably forest trees, as well as others, often fail from this cause. When self-sown they have no other covering than leaves, or a little earth, when concealed by mice or squirrels. If sown in autumn, ash-seed should be covered with litter during winter, to prevent washing out by rains.

It seems very probable that the seed of the green ash is as often gathered and sown as that of the white. The green ash is common along streams in the west. It produces seed more frequently than the white ash, and upon small trees, and is, therefore, more easily collected. The seed vegetates with more certainty than that of the white ash, even if sown dry, and the young trees grow more rapidly for the first year or two. When in leaf it may easily be distinguished from the white ash. The timber is similar in quality, but it has the disadvantage of never becoming a large tree. The white ash is somewhat variable in its characteristics, and some of these variations have formerly been named and described by botanists as permanent varieties or even species. It belongs to northern latitudes, and only obtains its fullest development in colder climates than that of northern Illinois. The blue ash abounds in more southern latitudes than the white; it is, in every respect as valuable, and has the advantage of being more durable. The combination of strength, lightness and elasticity in ash timber, renders it superior to any other native wood for many purposes, and the demand for it must always be extensive.

Much has been said and written in praise of the European larch; but, nevertheless, little, if any, notice has been taken of its peculiar fitness for railroad ties. [The writer highly commends this timber for this use, citing English authorities. It grows rapidly, closely, and in fifteen years, becomes 50 feet high, and 8 to 12 inches in diameter. It should never be planted on wet land.] The American larch has been eulogized as fully equal to the European in durability. Michaux describes it as having the same properties. In the British Provinces, north of the Saint Lawrence, and in Newfoundland, where it is highly esteemed, it grows upon upland, forming large masses of forest. In the United States it is found only in swamps—never on upland; a fact which Michaux regards as evidence that the climate of the northern limits of the United States is too mild for its constitution. From all the testimony the writer has been able to collect from those who have used

it, it appears that when in swamps in the United States, it is by no means remarkably durable; whether this is owing to soil or climate is a matter of uncertainty. The European larch is found principally in the central and southern parts of Europe, and is, therefore, better suited to the climate of northern Illinois than the American species, which reaches perfection only in a much colder climate, and is, likewise, of slower growth.

LARCH PLANTATIONS OF THE DUKE OF ATHOL.

The plantations of larch by the Duke of Athol, have been often mentioned, and were begun in 1728. Between 1740 and 1750, James, then bearing this title, planted over 1,200 larch trees as an experiment; the tree being then new in Scotland. In 1759 he planted 700 more, mixed with other kinds, on a hillside very poor and stony, and with good results. His successor, John, first conceived the idea of planting the larch to the exclusion of other kinds, and covered four hundred acres of sterile hillsides with this timber. He died in 1774, and his son Duke John, continuing the practice, had, in 1783, planted 279,000 trees. Between 1786 and 1791 he planted six hundred and eighty acres with 500,000 larches. He continued the practice till 1826, when he and his predecessors had planted more than 14,000,000, covering more than ten thousand acres. It was estimated that the larch in seventy-two years gained its fullest value, and before reaching this age the trees should be thinned to 400 on an acre. Estimating the trees at fifty cubic feet, worth a shilling a foot, the product would be £1,000 per acre on the poorest land for agricultural purposes that could be found in the country.

The condition of the forests on this estate was described in 1873* as follows:

The woodlands extend to over ten thousand acres, divided into five districts, each under a separate forester. The woods were still mainly larch; but it had in many cases been planted in soil better suited for the Scotch fir. But one man-of-war frigate, the Athol, had ever been built from the larch, it having fallen into disrepute for ship building on account of the disease which had appeared within the last thirty or forty years, and the recent substitution of iron for wood, which had reduced the calculation of £1,000 per acre to £150 or £200. The disease appeared universal, and no remedy had been found short of cutting off and replanting. It appeared to be atmospheric, and appeared as a fungus like growth on the stem of the tree, generally near the axils of the branches, then developing itself as a blister, and finally a hole or wound, as if a branch had been rudely broken off. There was still a fine larch wood of three thousand acres, covering hills that rise sixteen hundred feet above the sea. The forester in charge approved the practice of removing the lower dead limbs of the larch, which could best be done in very dry, clear weather, whether warm or frosty, as the branches were then brittle. Plantations of Scotch fir and other conifers were being introduced, and the sycamore-maple was found to flourish extremely well. Larch trees planted by the Duke of Athol in 1743. were in 1795 nine feet three inches around at four feet from the ground, and one hundred feet high. In 1869 these trees measured more than sixteen feet around, and were one hundred and twenty feet high.

RATE OF GROWTH AND DURABILITY OF THE EUROPEAN LARCH.

The experience of European observers, is very generally united in assigning great durability to this timber, and these opinions have been often quoted in essays intended to encourage its growth in this country. Carriere, after describing eight species of the *Larix*, remarks that this tree was known to the ancients, and that it is cited by Pliny as most valuable on account of the fineness and elasticity of its wood. He highly commends it, as well for ornamental planting, as for its rapidity of growth,

*"Reports on Forest Management," by Capt. Campbell Walker, p. 115.

the large size that it attains, and the superior quality of its timber.* Laslet says:† “The wood is of a yellowish white color, tough, strong, and occasionally a little coarse; but it is generally straight and even in the grain. It works up tolerably well, and is considered to be very durable, but has the serious drawback of excessive shrinkage, with a tendency to warp in seasoning.” Grigor says,‡ that when favorably situated, no tree becomes so valuable in so short a time, and that it is particularly durable, as posts and palings, and in all structures that come in contact with the ground. It is constantly employed for railway sleepers, for mill axles, and in ship building. These opinions might, in fact, be extended almost indefinitely, and with but little to be said against it. It also possesses qualities which we scarcely have seen noticed in connection with its culture in this country, as the source of tanning material in its bark, and of Venice turpentine, in its resinous sap.

A section was exhibited by D. C. Scofield, of Elgin, Ill., in 1874, which had been imported as a small plant in 1858, and had grown to nearly a foot in diameter in thirteen years. He also exhibited a branch a fourth of an inch in diameter which had been seven years among decaying rubbish on the ground, and was still hard and sound. This test was claimed to demonstrate the remarkable durability of the European larch in the climate of Illinois, while the native species (*Larix Americana*) would not probably have lasted even half that time.

Its rapidity of growth, beauty of foliage, and general value as a screen and ornamental tree have been sufficiently proved in this timber as grown with us. But has its durability as a post, or when in contact with the ground, been proved? We apprehend that this durability depends upon the conversion of sap-wood into heart-wood; a change that has not very often been observed in the larch grown in this country, or at least in the West. The Conifers, as a class, are found stronger and of better quality in proportion as their growth has been slow.

In reference to the law which governs in the formation of wood, it is remarked by Bagneris§ that in the broad-leaved species, the vessels of the annual layers of growth are either distributed equally, as in the beech, hornbeam, poplars, willows, &c., or are congregated nearly together at the interior of the ring, and are wanting, or very small and scattered toward the exterior. This inner or porous layer is of spring growth, and about the same in width from year to year. The outer portion of the year's growth, formed later in the season, and generally called the autumnal layer, is composed of heavy, compact, woody tissue, and this varies in thickness from year to year, being sometimes thick, and at others thin. These woods are therefore heavier, denser, and for most uses better in proportion to the rapidity of their growth. To this class belongs the oak, ash, and other kinds which show their rings conspicuously in section. Their heartwood is generally different in color from the sap-wood, being stronger and more durable; while in the kinds that have their vessels scattered through the whole growth of the year, there is not much difference in color, density, or durability between the heart-wood and the sap-wood.

But the conifers have no ducts as in most other exogenous woods—their ligneous structure being made up of a peculiar kind of tissue, differing from common wood fiber, which may be known under the micro-

**Traité general des Conifères*, p. 230.

†*Timber, and Timber Trees*, p. 230.

‡*Arboriculture*, p. 232.

§“MANUAL OF SYLVACULTURE.” Translated by Fernandez and Smythies, pp. 31 and 59.

scope by the numerous thin circular spots in the walls of the wood cells. These are found in no other woods except the gymnosperms. The outer margin of the annual layer, is in this class made up of harder and denser tissues than the inner, and this harder part is generally of about uniform width from year to year. The difference in growth is expended upon the inner and softer portion, and varies in thickness according as the amount of growth has been greater or less. This harder portion on the outer margin of each year's growth gives the wood more strength and durability, at least until the more porous part has been filled by resinous deposits, as in heart wood. For this reason, conifers of slow growth, in which these hard tissues are more abundant, have their wood stronger and better for most uses than the fast growing kinds.

In visiting the plantation of Mr. C. D. Scofield, at Elgin, Ill., during the last summer, he remarked that his larch, set as posts, scarcely lasted three years. It by no means follows that durability would not be gained with age, and the formation of heart-wood, or that this quality might not be imparted by injecting the timber with mineral salts.

It is further probable, that the quality of wood may be found to vary with the soil, and that the larch, grown on the high gravelly land, would differ from that of the rich prairie mold. It is within the knowledge of all lumbermen that *sap-pine* has no durability in the ground. It is reasonable that *sap-larch* should exhibit the same properties. We know that the pine in our soil and climate acquires with age the most desirable qualities, and it is equally probable that the same may be true of the European larch. It is probable that the durability of this timber would be increased by stripping off the bark and allowing it to season for a time before cutting.

CALCULATIONS OF COST FOR ONE ACRE OF LARCH; BY M. L. DUNLAP, OF CHAMPAIGN, ILL.

Trench plowing.....	\$ 5	Cultivating.....	\$ 4
Harrowing and rolling.....	2	Hoeing the young trees.....	5
Three thousand plants.....	30	Cultivation five years.....	15
Freight.....	1		
Spade and setting.....	3	Total.....	\$65

The cost of land, interest for six years, taxes, and the above in five years amount to \$125, making the total cost at that time \$190. No further attention would be needed for the next six years, when, with interest and taxes, the cost would have amounted to \$320.

The crop at this time should consist of 2,500 trees, allowing 500 for loss. Of these, 100 may be taken out, leaving 1,500 standing. Those taken out would give 1,500 posts, worth \$350, less \$30 for cutting, and leaving \$320. Thus, in twelve years the partial crop will have paid for the land with interest, and we have 1,500 larch trees, large enough in twelve years more for railroad ties, and worth, at 50 cents apiece, giving \$800 for the land and trees, at the end of twenty-five years.*

SUGGESTIONS ON PLANTING—IOWA EXPERIENCE.

Mr. Suel Foster, of Muscatine, Iowa, in a prize essay on forest tree planting, offers the following suggestions as applicable in this State: †

*Cited in an address by Dr. John A. Warden, in January, 1873, before the Kansas State board of Agriculture. Report of that year, p. 262. See, also, "OHIO AGRICULTURAL REPORT," 1871, p. 55.

†"IOWA AGRICULTURAL REPORT," 1870, p. 328.

The larch is of tolerably rapid growth, growing half an inch or more in diameter each year for the first ten years, and the next ten years fully equal to one inch. This is in size equal to our black walnut, and it grows much better and straighter. The little trees should be bought of nurserymen, for it is a nice and particular thing to raise the larch or evergreen from seed. I would recommend to the farmers of Iowa to buy European Larch at two years old, at \$10 to \$15 per thousand. They should be set in the nursery rows, $4\frac{1}{2}$ feet apart, and one foot in the row, so that when one row is taken out it will make a wagon road through the grove. Larch must be moved very early in the spring, for they are among the very earliest trees to start to grow. The ground should be plowed very deep in the fall, then plowed in the spring as soon as possible, harrowed and pulverized very finely by turning the harrow bottom up the last time. Then stretch a line and set with a spade. Have a mud-hole to dabble the roots all in. While the man uses the spade a boy can handle plants. About 2,000 will be a day's work, and will cover about a quarter of an acre. They must be carefully plowed and hoed for two years, and if the weeds start too quick in May and June, the third or fourth years they should be plowed.

Cost.—8,000 plants for an acre, \$80 ; setting out, \$8 ; plowing and hoeing the first year, \$8 ; plowing and harrowing the land before setting, \$4 ; second year, \$4 ; two years after, \$4 ; interest on the land at \$50, eight years at eight per cent. = \$32. Total cost of any acre of European larch at eight years, \$140.

Credit.—By taking out 3,000 plants after two years' growth, to set in other ground, at \$20 per thousand, \$60. It is calculated that 1,000 in 8,000 will die, although those who are accustomed to handling and cultivating will not lose so many. Then half the plants are taken out, leaving them 2 by $4\frac{1}{2}$ feet. When they are eight years old they will be poles fit for fence, two or three inches through and fifteen or twenty feet high, and another thinning out must be done by taking out 2,000, leaving the grove 4 by $4\frac{1}{2}$ feet. These poles are worth 5 cents each, \$100. At eight years one acre has cost \$140, and has a credit of \$160. Those transplanted at two years from setting should be set 4 by $4\frac{1}{2}$, covering about an acre and a half, and will cost, in setting out and cultivating two years, something over \$100, including the plants at \$60.

PLANTING OF THE ASH.

Mr. J. L. Budd, now of Ames, Iowa, in a paper published in the Transactions of the Northern Illinois Horticultural Society (1867-'68, p. 72), advises keeping the seeds of the ash through the winter in kegs or boxes, mixed with clean moist sand, taking care that they become neither too wet nor too dry. Freezing will do no harm. The ground should be marked and prepared as for corn, and planted at the intersections, placing four to six seeds in a hill. They should be carefully cultivated, and the next spring thinned to one plant in each hill, the vacancies being supplied. By planting thus thickly, the young trees get a straight growth. At the end of six years every alternate row north and south should be thinned out, and at the end of ten years every alternate tree in each row. When twelve years old, on good soil and with proper culture the first four years, the grove would have 12,000 trees on ten acres, averaging eight inches in diameter. By cutting the stump close to the ground, and covering with a light furrow on each side, a second growth is obtained in eight or ten years, more valuable than the first.

Prof. of C. S. Sargent, in speaking of this timber, says :

To develop its best qualities, the white ash should be planted in a cool, deep, moist, but well drained soil, where it will make a rapid growth. That the plantation may be as early profitable as possible, the young trees should be inserted in rows three feet apart, the plants being two feet apart in the rows. This would give 7,260 plants to the acre, which should be gradually thinned until 108 trees are left

standing, twenty feet apart each way. The first thinning, which might be made at the end of ten years, would give 4,000 hoop-poles, which at present price would be worth \$400.

The remaining thinnings, made at different periods up to twenty-five or thirty years, would produce some three thousand trees more, worth at least three times as much as the first thinnings. Such cuttings would pay all the expenses of planting, the care of the plantation and the interest on the capital invested, and would leave the land covered with trees capable of being turned into money at a moment's notice, or whose value would increase for a hundred years, making no mean inheritance for the descendants of a Massachusetts' farmer. The planting of the white ash as a shade and roadside tree is especially recommended, and for that purpose it ranks, among our native trees, next to the sugar maple.

OAK.

To some Minnesota tree planters, a few words about the oak will perhaps be of interest. It has the reputation of being a slow grower, too slow for the planter to reasonably expect any benefit from his work. I am inclined to think this trait in its character has been somewhat exaggerated. Thousands of acres in Minnesota are now covered with groves of jack oak, the trees now large enough to make four good rails from the butt cuts, where only 20 to 25 years ago nothing could be seen but small, short, shrubby brush. Some of these new forests will yield nearly or quite as much fuel and fencing per acre as the average primeval forests.

Such being the fact, and one not easily rubbed out, may it not be as well to look into this thing from a practical standpoint? Taking a hint from nature, let us look into this grub prairie business a little. We find, usually, the jack oak grubs most numerous—next burr oak and white oak grubs. How they got there, or how long they have been there, are among the things no fellow can find out. With my spade and ax I have "grubbed out" many thousands of them—have dissected them, and examined them critically. I have found them in all periods of existence, from mere rootlings to masses of roots sufficient for a tree a hundred years old.

A very large area of Goodhue county, Minnesota, the banner wheat county of the whole world, was, when I first made tracks over it, covered with such grubs, and had they been left undisturbed by the breaking plow, spade, ax and grub hoe, and protected from fire and cattle, Goodhue county would to-day be one of the finest timbered counties in Minnesota.

Nearly all the great wheat counties of southeast Minnesota were, 25 years ago, largely covered with just such grubs. The annual prairie fires swept over them with great regularity and certainty, annually burning off the brushy tops, but leaving the roots generally uninjured. The roots, protected by the earth from much damage by fire, kept up their subterranean growth with great vigor, thus laying up the amount of vital force which has backed up these young forests to such speedy and wonderful development. And now, my christian friend, if you are so fortunate as to own a few acres of such grub prairies, guard it as the apple of your eye; suffer no evil to befall it, and in a few years you will count it among the choicest of your earthly possessions. I would thus "point the moral, and adorn the tale." But should you be compelled to commence, *de novo*, I will try to point out what I would do. After I had gotten my young forest well started; ground well subdued and in a high state of cultivation—the surface tolerably well shaded by other young trees, I would plant the acorns among them. Repeated attempts and repeated failures, have convinced me that the young oak seedlings demands considerable shade for a year or two; and won't tolerate too much hot blazing sunlight. I have

had no trouble in growing the young plants to a height of four to six inches most anywhere, but I have so far found it extremely difficult to get them much further along unless somewhat shaded. The same remarks are perhaps applicable to beech, birch and the coniferous tribe. The permanency, great durability and longevity of this tree justly entitles it to a very high rank in forestry. With the exception of the conifers, no tree is more generally useful to civilization, none more worthy of cultivation and perpetuity. I now proceed to again plunder that unfailing and inexhaustible fountain of forestry information (Hough's Report), for further items bearing on this subject.

The OAK (*Quercus sessilifolia* and *Q. pedunculata*) was relatively more important among forest trees a century or two ago than now. Extensive forests of this timber have since been cleared for cultivation, so that the noblest forests are now among the hills.

On account of diminishing supply and rising demand for oak timber, much has been done of late to promote its cultivation. Young trees shelter the soil from the sun, but as they advance they demand more light and room, so that many die unless seasonably thinned. In forests, the oak assumes greater dimensions when grown with other oaks alone, for it may be laid down as a rule that *it thrives best with the crown free, the stem sheltered and in shade, and the foot under covering*. The *Q. pedunculata* is disposed to develop many branches, but where this is not possible (as in forests of beech and oak), the stem is straight and free from branches to seventy or eighty feet, and the whole height one hundred to one hundred and thirty feet. The tap-root penetrates five or six feet in good soil, so that the subsoil is of great importance in its growth and quality. Moderately cleft and inclined limestones, and the milder clay slates, the richer sandstones and marls, granite, basalt, greenstone and clayey porphyry, and good peat are favorable subsoils for both kinds of oak, as they generally continue fresh, and are not apt to hold water. The timber of this kind is of fine texture, tough, hard, and heavy. It is the strongest and most durable timber grown in large quantities in Europe, and is indispensable in ship building, in the construction of mills, and structures in or near water, and when submerged is indestructible. The *Q. sessilifolia* does not grow so quickly but has a longer life, is more disposed to form branches, but may under favorable circumstances grow to equal size. The roots do not penetrate so deep, the wood is less tough and elastic, is more easily split, and therefore more prized by coopers. Being of coarser texture, it is not so well suited for carving and cabinet work, and being heavier, it forms better firewood, the proportion being as twelve to eleven. As a building timber it is little inferior to the *Q. pedunculata*. The latter prefers plains, warm sunny valleys, and outlying hills of mountain ranges, while the former is at home on the mountains themselves. They often grow together, but the *Q. sessilifolia* ascends the slopes to a greater height, although it does not grow so far north and prefers the south and west slopes.

The oak is not by nature intended to form extensive and unmixed forests, but requires the aid of a shade enduring and soil improving tree; for the growth of oak depends less on the kind of soil than on its quality, depth and freshness. No tree is better qualified to perform these functions than the beech. In coppice wood with standards or reserved trees, the oak enjoys the sunlight, and does not throw much shade on the coppice below—acquires moderate thickness, but at the expense of its branches, and comes to greatest maturity at 200 to 240 years, but when well exposed to the sun may be felled much sooner. In order to obtain

valuable timber in such cases, the trees must, ere they grow too old, be stripped of their lower branches, as far as practicable.

Oak reproduces itself from stools, and is suitable for coppices, the wood (generally at the period of sixteen years) being cut and peeled for tanner's use. The bark is most prized when grown on strong mineral soil on hill-sides, in sunny exposures, where the trees have not been too closely planted, and have room for development. It is best before it begins to split. In higher situations the *Q. sessilifolia* is said to yield bark in greater quantity and of better quality than the *Q. pedunculata*.

The growth of oak depends less on the kind of soil than on its quality, the amount of humus, and, above all, of moisture contained in it. The best growth occurs in a deep, somewhat loose loamy sand, or sandy loam, but it thrives well on loam or sand. Although it prefers moisture, it will not grow in marshes unless drained.

The oak thrives exceedingly well when mingled with beech, because its penetrating roots draw their support more from the subsoil, while the beech spreads its roots near the surface. This association does not prosper, however, in exposed situations or on shallow soils.

MODE OF PLANTING OAKS RECOMMENDED BY THE SOCIETY FOR THE PROMOTION OF AGRICULTURE, ARTS AND MANUFACTURES.

To this society, formed in New York as a State institution in 1791, may undoubtedly be ascribed the first direct recommendation of a society for the planting of forests for their timber in the United States.

In a circular issued at the beginning, they made particular inquiries concerning the propagation of the locust tree, the possibility of introducing the white mulberry, and the profit and propriety of raising in nurseries and transplanting hickory, chestnut, ash, beech, and other trees for fencing and fuel, and the planting of hedges.

About 1795, a committee appointed to consider the best mode of preserving and increasing the growth of wood and valuable timber, reported in favor of recommending this where the soil was not better adapted to other uses. One of the committee, twenty years before, had allowed land worth \$2.50 per acre to grow up to timber, then worth \$12 per acre, besides the land, which had been improved in the meantime. They insisted upon the importance of fencing out cattle; suggested the propriety of cutting off old woodlands entirely, so as to give the young trees an equal start; showed that the woods should not be thinned too much, as this would favor the growth of grass, to the injury of the trees; and pointed out a method of planting oaks that deserves notice:

Oaks are best propagated by leaving the acorns on the surface of the ground, covered with the grass; but in this way the acorns are exposed to be devoured by animals. To prevent this it is recommended to preserve them through the winter and plant them in the following manner: First, make a bed of loam about six inches deep; on this plant the acorns about two inches deep; over them lay another bed of six inches of earth, over that another layer of acorns, and so on as far as the occasion requires. The whole must be covered with earth, to preserve them from the frost. Early in the spring the bed is to be opened, when the acorns, which will have begun to shoot, are to be planted about a foot distance from each other.

Another method of planting them, is to dig a small hole with a pick-ax, and drop the acorn, covering it with earth. This is a very simple method, but care must be taken not to bury the seed too deep; two inches is found to be the best depth; the less covering the better, provided the acorn is secured from birds and other animals. Another practice is to pare the earth with a plow and plant the acorns in rows, covering them with the turf. This is not a great deal of labor, and will secure the acorns from animals. The distance of the rows may be at any man's pleasure, but

the thicker the trees the sooner will the ground be shaded and the turf destroyed. As the young trees advance the weaker ones will die, and the vigorous and thrifty ones only survive. * * *

We often see in a transplanted fruit tree the top die down and sprouts appear from the root, one of which, if spared, may become a vigorous tree. This is very liable to happen with the oak in bleak and exposed situations, and foresters sometimes anticipate this by cutting them over by the surface of the ground after they have been planted a year, so as to develop new shoots, one of which is saved.

In sheltered situations this becomes needless, and no time is lost in bringing forward the shoot as soon as possible.

The managers of government forests in England, where oak is being raised for the royal navy, rear the trees from the acorn, and the trees are found to grow for the first few years more rapidly than if transplanted.

Much difference of opinion has prevailed as to the distance at which young oaks should be planted; in fact, as many views have been expressed as there are differences of circumstance, and each in its place may be best. It is often of advantage to grow other timber with the oak, and for this the fir has been planted in Scotland with best results, and this in exposed situations becomes essential as a shelter till the oaks attain a size to take care of themselves. In such a case, a distance 10 to 12 feet apart for the oaks, and the same for the firs, making the distance between trees of alternate kinds $3\frac{1}{2}$ to 4 feet. The firs are cut out in a few years. It is thought that, besides the shelter thus gained, the oaks grow more rapidly with this mixture of young evergreens among them. (*Brown's Forester*, p. 364.)

With the oak, its value depends rather on the *quality* than the *length* of its wood, and for ship building (its principal use) a straight trunk is sometimes less prized than one of a proper curve. Now this wood cannot be grown of best quality unless free access of air is allowed, and hence dense plantings are not economical.

James Brown, a Scotch writer, mentions two lots of oak timber, one one hundred years old, with 200 trees to the acre, that sold for £360, and another ninety years old, with 109 trees, that brought £868. The latter had grown with free access of air, and had an abundance of bends fit for ship building. But such trees growing low, and with spreading branches, do not yield so much bark for tanning, and for this use a dense, tall coppice is best for *quantity*, although its *quality* is not equal to that of wood grown in open places.

Oak grown in free air weighs almost double that from a dense shade, and its bark contains more tannin.

OBLIQUE PLANTING.

Among the established rules of planting are the three following:

1. Set to the same depth as the plant stood in the nursery.
2. Spread with the hand the fibres of the root in their natural direction.
3. It is essential that the plant should stand upright.

A recent writer* has shown that these rules have their exceptions, and, describing the usual manipulation of planting, says:

The workman takes the plant in his left hand, holds it vertically in the middle of the hole to the proper depth, and with the right hand (not particularly caring for the direction of the roots), fill in the earth around the plant, crowding it down as it

*M. Regimbert, in the "*Revue des Eaux et Forêts*," 1875, p. 139. The above is but a condensed abstract of this article.

fills up, and press it down with the feet. The operation thus described would be called well done, if executed carefully and without slighting. But as we turn in and press down the earth, the radicles are crowded together in a vertical direction, like the rods of an umbrella when shut, instead of being in a natural position, and more or less plants will be lost.

My plan would be as follows:

Having thrown out the dirt, I would put about half of it back, so as to make a slope on one side, against which I would lay the plant, the roots being of the same depth as before being drawn. In this position it is easy with either hand to spread out the radicles, and finish by filling the hole and pressing in the earth, as commonly done. Plantations thus executed in 1859 appear now sensibly better than those in adjacent grounds, executed at the same time and in the common way. But in this case the plants were buried deeper than the rule prescribes, and to this may be due a part of the success.

In deciduous plantations it is a rule to trim the young plants more or less, so as to preserve a due balance between the roots, torn and lessened by the extraction, and the top. Resinous species should never be subjected to this operation, but they generally shed more or less of the lower leaves, which amounts to the same thing, and leave only a tuft of small branches and leaves at the top, exposed to the winds and the weight of snows, which are most liable to injury the first winter.

It therefore appears probable that a young plant would suffer less to have these lower leaves buried, than to lose them by drying in the air, and that planting a little deeper is beneficial—rules to the contrary.

On the other hand, if we plant young oaks in autumn, some vertically and others horizontally (it might not be the same in spring, and I give my own experiences), it does not appear to show any difference. It appears chiefly important that the plants be laid deep enough, while by the oblique method the roots are most easily placed somewhat in their first position.

As to expense in planting, the difference of time is from fifteen to twenty per cent. in favor of the method recommended, which has moreover a decided advantage of not being so liable to damage from the heaving of frost.

I do not hesitate to recommend the burying of more of the stem than was covered before, the proportion extending to two-thirds or more.

PLANTATION OF EVERGREENS—PROFESSOR AMOS EATON'S DIRECTIONS.

Prof. Amos Eaton, in his Geological and Agricultural Survey of Rensselaer County, New York (1822), alluding to the difficulty of transplanting evergreens, attaches importance to the most careful handling and to the keeping of the roots moist by retaining the soil upon them, or covering with wet moss, cloths, &c. They succeed best, according to his observation, when the roots were not bent or distorted in planting. They should be cut off at a distance of one or two feet from the stem, and taken up without force or without wounding the body or limbs. He laid down the rule of never cutting off a limb until at least a year after transplanting, and of never pruning evergreens at first close to the stem. He would leave four or five inches, which, after it had withered and died, might be cut loose without injury to the wounded part, which should be covered with some kind of adhesive paste.

In selecting evergreens from the woods, care should be taken to obtain only those that grew in open and exposed situations, and, as nearly as might be, from a soil in composition, texture and dryness as nearly as possible like that to which it is to be transferred.

Deciduous forest trees require less care, excepting oak, walnut and ash trees, which require the same treatment as evergreens.

EVERGREEN PLANTING IN ILLINOIS AND IOWA.

Mr. Samuel Edwards, formerly of Mendota, Ill., who has an extensive experience in planting evergreens, states his belief that the surface soils of Iowa and Illinois appear to be well adapted to this class of trees.* He remarks:

Extensive plantings of pines and junipers may be made with perfect safety on sandy soils, and those having a thin layer of porous surface soil. But on such soils I would not advise any one to put out plants of less size than one foot in height; two foot plants would do better. Excessively dry seasons are almost certainly fatal to small plants on such soils. Puddling the roots with clay mortar is always advisable when planting out evergreens, being sure to have the roots perfectly wet when placed in position for covering with dirt. In such soils, too, it is best to set deeper than the plants stood in the nursery. In moist localities arbor vitæ and spruces are perfectly at home.

In the discussion of this paper the opinion was expressed that the Norway spruce was the best ornamental evergreen for Eastern Iowa. The white pine has proved healthy, but the Scotch and Austrian pines had been badly infested with a kind of aphid, which injured the tree.

In dry soils, evergreens had suffered from drought, but on porous soils they had generally grown with success. The relatively dry air of the West, as compared with that of Europe, appeared to account for the great difference observed with respect to the locations and conditions under which evergreens will thrive. It was remarked by one who had seen planting operations in Europe that—

Wherever a larch, spruce, or pine can be started, (even with rock near to the surface,) the plants grow with a luxuriance we can *never attain* here under the most favorable conditions. The forester there goes to his work of planting coniferous seedlings with the plants wrapped up in a dry rag. He makes a hole with a tool provided for the purpose, sticks in the plant without regard to shape or position of the roots. The cavity is closed by a movement of the tool and a motion of the foot, and the work is done. Yet the plants rarely fail to grow, and that with a vigor wonderful to behold on such sterile soil.

EVERGREEN PLANTING—METHODS AND ADVICE OF MR. R. DOUGLAS.

Mr. Robert Douglas, of Waukegan, Ill., in a lecture before the Kansas State Horticultural Society, sums up the whole substance of success in transplanting evergreens in a few words: "Plant early in the spring; never allow the roots to become dry; and pack the ground tight, so that they cannot shake about or be moved by the winds." He would plant as soon as the frost is out of the ground, (first puddling the roots as soon as received,) and plant a little deeper than they had grown in the nursery. The center of the hole should be elevated to set the tree on, and the roots should be spread out and filled in compactly, and particularly under the tree, so that it will not sink.

In his own practice he sowed the seeds in the spring, until May, in beds four feet wide, broadcast, and raked in. The young plants must be shaded, the first year at least, by lath, cloth, or brush, and his former practice was to lay frames of lath, with spaces as wide as the strips, over the seed-beds. Another, and by some regarded as a better screen, is a frame-work of poles raised upon posts about six feet high, and covered with brush. He would

*"Transactions of the Iowa Horticultural Society," 1875, p. 124.

bed out the plants from three to six inches apart in the rows, and the rows twelve to eighteen inches apart, shading the first season, and working with the hoe. The earth should be drawn up to the plants at the last hoeing of the season, to prevent heaving out in winter. In two years from planting they will be nice stocky trees, averaging about one foot in height, and may then be planted in nursery rows, three or four feet apart, or in shelter belts and hedges. Three year old plants, six to nine inches high, may be planted immediately into three or four foot rows. His advice in the choice of kinds for different situations was as follows:

For hedges and screens, not intended to grow higher than eight feet, plant the American arbor vitæ; for higher hedges and screens, plant Norway spruce; for wind-breaks, sheltering orchards, &c., plant Scotch pine or Norway spruce.

For ornamental planting, use Norway spruce more freely than any other evergreen.

I would particularly call your attention to the European or Tyrolese larch, as undoubtedly the most valuable timber-tree for extensive planting, combining the durability of the red cedar with rapidity of growth, extreme hardiness, freedom from disease, and adaptability to almost every variety of soil.*

EVERGREEN SEEDLINGS—OBSERVATIONS OF H. M. THOMPSON, OF SAINT FRANCIS, WIS.

Losses have very often been experienced in transplanting evergreen seedlings, and these have often been attributed to the fact that they had been grown in the shade; but this result, Mr. Thompson thought, was not wholly due to the sudden transition from shade to sunlight, but to other causes, such as the pulling up of the plants, instead of digging with a spade, imperfect packing, and exposure of the roots to the air. It is well known that shade is one of the most essential requirements of a young evergreen plant, enabling it to retain an equable volume of moisture, and preventing evaporation from the soil. In order to ascertain what would be the result of exposure to full sunlight, in the spring of 1874 he had removed the screens from several beds of one-year-old Norway seedlings and Scotch pines, and from two-year-old Austrian pines and arbor vitæ. During May and a part of June, the moisture was sufficient for a fine growth, and favorable to the development of buds and ripening of the wood. But for five successive days in July, the heat was excessive, rising from 98 to 103 degrees: the surrounding objects tended to hinder a free circulation of air, and the heat and evaporation must have been excessive.

In autumn it was found that the loss of the Norway spruce was about fifteen per cent., arbor vitæ fifteen per cent., Scotch pine less than half of one per cent., Austrian pine no loss. The loss of the former of these was attributed to the fact that the lateral roots of these species of seedlings grow nearer the surface, and are, therefore, more liable to injury from heat and evaporation. In August of the same year he transplanted 10,000 Scotch pines from the beds that had been exposed, with a loss of less than half of one per cent. In June and July, 1873, he transplanted about 30,000 Norway spruce, two to six inches in height, without loss; these transplantings being at an unusual season of the year, but in a cool, damp atmosphere, and in a wet soil after a rain, the June and July transplanted seedlings being

*"Transactions of the Kansas State Horticultural Society," 1872, p. 182. In some localities the larch, grown rapidly, has come to the size of a fine-looking tree before its wood has hardened, and such timber by no means justifies the reputation for durability here given. Our experience with this tree has not yet been sufficiently long to enable us to determine how far this valuable property in the timber will be acquired by age.

sheltered by lath screens, the August planting of Scotch pine having no protection until nearly a month after the transplanting was completed. His practice had been for years to bed out all seedlings less than six inches in height, and protect them the first season with a cheap screen; larger sized seedlings either bedded out or planted in nursery rows and mulched; the loss from drought under this treatment being too trifling to mention. His deductions from these observations were—that nursery grown seedlings have an ample supply of roots, if properly handled, planted and cared for, and will survive and produce satisfactory results.*

ON THE PROPAGATION OF EVERGREENS—EXPERIENCE OF A SUCCESSFUL PLANTER.

Mr. Samuel Edwards, of Illinois, who has had eminent success in planting evergreens, at the University course of lectures and discussions, held at Rockford, Ill., in February, 1870, made the following statements concerning the handling of evergreens:

I have had a good many year's experience with evergreens. Growing them from seed in ordinary seasons on our prairies is rather difficult. A wet season like the last, is better, but as a rule, those who are inexperienced had better buy their trees.

To grow evergreens, soil that is about one-third sand, with some mold, should be used. The seeds should be covered once or twice their diameter. They should be sown early to prevent their "damping off." This arises from excess of moisture in hot weather. We sow on dry sand to check it. Sow the seeds in beds four feet wide; about two pounds of the seeds of the European larch, or of the pines, to the square rod. Cover the young plants with leaves the first winter. Leave the plants two years in the beds before transplanting. Birds are fond of the seeds and must be watched. In getting trees from the forests, plant them as quickly as possible, and put a shade of laths over them. Plant them closely in the bed; leave them in the bed generally two years, and then plant the rows two and a half feet apart; put the trees close together in the rows. We sowed our seeds last year at Green Bay. The atmosphere is not so dry there; the birds are the only trouble. I prefer to plant evergreens when in a state of rest, but they can be moved in a moist day until late in the season. In that case I would plant late in the evening, water heavily, and protect them the next day from the sun. Trees for belts I place ten feet apart in the row, and break the joints with the next row.

Red cedar has generally succeeded pretty well until three or four years ago. Hemlock is grown best in partial shade. The American yew is fine in the shade. It is similar in leaf to the European, and to the hemlock. It is propagated readily from cuttings in the shade late in May. The Norway spruce will bear shearing well, as also the arbor vitæ.

[In answer to queries.] When the branches are too thick, taking out the alternate branches often does very well. It will answer to move seedlings that have not been transplanted, if you are careful. I would just as soon have trees from the woods; but they must be carefully handled, and be small ones, not more than four to twelve inches in height. Red pine is difficult to handle. Austrian pine is attacked by a fungus. I find it here at Rockford. Siberian arbor vitæ does very well here. In the shade it roots readily from cuttings made with a part of the last year's wood left on.†

Mr. Edwards, in an article published in the Iowa Agricultural Report of 1871 (page 346), explains more fully some points of his method in propagating evergreens and larches:

The beds are made four feet wide for convenience of weeding. By sowing so early, the plants attain the woody fibre before hot weather, which is so fatal to the plants while young. The beds when sown may be covered with damp moss, rags, or something of the kind; this is to be closely watched, and removed when the plants begin to show themselves. Arbor vitæ, and many varieties of juniper, are readily grown from cuttings four to six inches long, taken off in May or the fore

*"Transactions of Wisconsin State Horticultural Society." 1875, p. 90.

†"Transactions Brit. Asso. Sci.," 1836, p. 104.

part of June, with an inch or two of last year's wood, and planted two-thirds of their length in the ground, the lower end in pure sand. Cuttings of this kind, and of small plants of evergreens, should be shaded in time of extended drought, and should receive a liberal watering every two or three weeks, followed, before the surface dries, with a mulching of dry forest leaves, sawdust or other litter. The idea formerly so prevalent that evergreens were more difficult to transplant successfully than deciduous trees, is not sustained by extended experience. It is now generally known that the roots of evergreens must never dry in the least while out of the ground. Transplanting can be done from opening of spring until time of bursting of the buds. Even after growth of an inch has taken place, they may be successfully planted if the roots are grouted as soon as they are taken from the ground, and well watered and mulched when planted. Shading the tops when late planted makes success still more certain. Early planting is always advisable. In time of severe drouth large specimens, at other times nearly certain to die, may be safely transplanted if the work is carefully done and the tops are watered each evening. From the time when the terminal buds are formed until the middle of September, transplanting may be done with safety. In an extreme instance, I had good success with a lot of thirty or forty from the forests of Colorado, planted at their arrival, just at the opening of winter, by covering with leaves so deep as almost if not entirely to exclude the frost. It has been generally supposed that late fall planting of evergreens, or taking up plants in the fall and preserving them for early spring planting or shipment, could not be done. Robert Douglas & Son, of Waukegan, Ill., however, have for two past winters kept millions of young plants in their frost-proof lighted greenery with the most perfect success. Their discovery or use of this mode is of great value, for those wanting trees sent south can thereby plant much earlier, and have them established and growing before the dry, hot weather comes on.

Immense quantities of evergreen plants will be in demand during the next few years in the prairie States. Our people, thus far, have only thought of planting them for ornamental trees on the lawn, or for screens. But timber culture in earnest is about to begin. European larch and the pine will doubtless be planted in immense numbers. From experience in planting larches four to six feet high in the fall, it is my opinion that we shall eventually adopt the plan of setting out our two-year and older larches at that season. If small mulch liberally. When set in spring, they ought to be put out very early, as they start the first thing in spring. They do not thrive unless planting is done before starting.

Many evergreens were injured by the unprecedented freeze of last October, in conjunction with the excessively wet season. This conclusion seems probable from the fact that evergreens in very dry situations were almost entirely exempt from injury. While tree planters regret losses from casualties of this kind—to the men whose hearts are in the business, such drawbacks act only as incentives to increased diligence in the good work. True manhood, it has been well said, is only developed in bravely meeting, and, under God, overcoming obstacles.

MANAGEMENT OF THE PINE TRIBE.*

At the sixth meeting of the British Association for the Advancement of Science (1836), a paper from John Nuttal, of Tittour, county of Wicklow, was read on this subject. Having noticed that almost all the plants of *Pinus sylvestris* and other species, when planted in a light clay slate soil, on exposed situations, grow too rapidly, or out of proportion to their rootings, and thereby become *wind-waved*, and that those which, by accident, had lost their leaders, took a strong hold on the ground, he commenced a series of experiments as follows: In the spring, when the buds were fully developed, he went over those that were suffering from the foregoing causes, and broke off all the buds except those on short branches. By this process their upward growth is checked for a year, the trunk increases in bulk, and the plant roots much more freely than if the shoots had been allowed to grow. New buds are formed during the summer, and in the following spring these plants present the most vigorous aspect.

*"Transactions Brit. Asso. Sci.," 1836, p. 104.

The larch he cuts down to a strong lateral branch, on the windward side, when possible. These soon begin to spread their roots, increase in size similarly, and ultimately become choice trees. In some instances he had cut them down a second time, when he found it necessary, and with equally good effect.

PLANTING OF WILD EVERGREENS IN IOWA, AS RECOMMENDED BY D. W. ADAMS.

The following suggestions upon the planting and care of evergreens, by D. W. Adams, Esq., of Waukon, Iowa, is founded upon experience, and is worthy of attention.*

I have practiced the following method of taming wild evergreens, with perfect success: At the proper season for transplanting, proceed to the grove where the young plants are abundant, well furnished with common boot or other convenient sized boxes, moss, pruning-knife, spades and buckets. Make a puddle of rich earth and water; as fast as the plants are raised, prune away the dead and deformed branches, dip the roots in the puddle, and pack upright in the boxes, with damp moss among the roots, and so continue until the box is crowded as full as possible. But one tier should be put in a box. Then nail a few slats on the top, but be sure and have plenty of ventilation, as there is great danger of their heating if the boxes are closed too tightly. As fast as the boxes are filled, place them in a cool, shady place till all are full; then load them on a wagon and lose no time in taking them to their destination, where, of course, they should be planted without delay, in accordance with the direction given for seedlings. If your plants are taken from a situation much shaded, which is not advisable, it will be well to give them a little shade during the first summer. When young evergreens are taken from the forests, it is seldom advisable to plant them at once in their permanent location. Usually they are poor, weak, straggling things, not at all ornamental. They should be taken from the wood to the nursery, where, after receiving from two to four years' careful culture, as described for seedlings, they will become of a rich, dark green color, the foliage will become dense, and the form symmetrical. Then they are prepared to come out and display their charms upon the lawn, or show their usefulness and beauty in the grove or screen.

SELECTION OF VARIETIES IN PLANTING EVERGREENS IN IOWA.

The varieties of evergreens adapted to the climate of our State (Iowa) are not very numerous, but most of them have more or less good qualities to recommend them. Of course, before selecting his varieties, the planter will decide upon the object to be attained by the planting. If his object be shelter, he will choose strong, rapid-growing varieties, that are cheaply procured and easily transplanted. If he is growing a grove for timber, wood, or fencing, he will, of course, keep in view the particular object for which they are intended, and select accordingly; while for ornament alone, he would make a very different selection. Perhaps a word or two descriptive of some of the more valuable kinds would not be out of the way.

First on the list for general usefulness, I place the Norway spruce. It is easily transplanted, of rapid growth, fine form, and grows to a large size. It makes a very ornamental hedge or screen, is a fine single tree on the lawn, or a shelter belt impenetrable to the wind. Scotch pine is easily transplanted, grows rapidly while young, and makes a strong, spreading tree, that always gives satisfaction to planters. I know of no evergreen that will make a shelter so quickly, and the young trees are very ornamental. Austrian or black pine is every way a much finer tree than the Scotch, except that while young it is a slower grower, and is more impatient of removal. A large Austrian pine, clothed in its garb of rich, dark green, standing up unscathed against our fiercest and coldest wintry blasts, looks the very impersonation of sturdy vigor and health. White pine has many friends, and is the most valuable of all the pines as a lumber tree. It is of rapid growth, has beautiful light green soft foliage, but is rather difficult to transplant. Red cedar is a tree of moderate growth, easily transplanted, valuable for screens, and invaluable for posts, as the

*"Iowa Horticultural Reports," 1867, p. 16.

wood is very durable. White cedar or arbor vitæ, is also useful for ornament and screens, but will not be largely planted. The native spruces, when they can be procured cheaply, are of much value, and may be extensively used in groves or otherwise. Balsam fir is probably the least valuable of all I have mentioned. While young, it is quite ornamental, and is easily transplanted, but it soon becomes shabby, is comparatively short-lived, and the wood is of very little value for any purpose whatever.

TRANSPLANTING OF LARGE EVERGREENS AND OTHER LARGE TREES,
AS RECOMMENDED BY MR. D. C. SCOFIELD, OF
ELGIN, ILL.*

Large nursery-grown, oft-transplanted trees, may be removed with as much certainty for their living as small ones. The hardy evergreens, such as Norway spruce, Scotch Weymouth (or white), and black Austrian pines, may be removed from the height of twelve to eighteen feet as safely as from two to four feet. The method of removing is the same as of small trees, and they have no more need of a large ball of earth to secure their growth than a plant of twelve inches. True, they must be taken up with great care to preserve the roots from breaking on being moved, or from exposure to a dry atmosphere, and when set, especial care must be taken to keep the roots in their natural position, thoroughly packing the earth among all the roots with the fingers, so as to exclude the air and retain moisture. This should be done by suspending the tree in the hole, which should be made sufficiently large not only to receive the roots of the tree, but also the planter to readily get to his task. The earth must be in as fine tilth as for planting corn, and must never be wet or muddy, and when thus planted the earth around should be pressed thoroughly with the feet, and when well planted, a quantity of coarse mulching of rotten straw, leaves, or better, spent tan-bark, should be put around the tree and cover the surface from two to four feet on all sides, and from three to six inches in depth; but do not pack too closely against the trunk of the tree. Three strong stakes six feet high should be set four or five feet from the tree at equal distances from each other. A collar or band should be fixed around the tree five or six feet from the ground, to which strong hay bands should be fastened, and then to each stake a piece of fence-wire, which will not shrink or expand.

In the transit, the roots should be secured with moist, fine straw, hay or moss, so that they shall not at all lose their native condition. When the tree is thus set, a few pailfulls of water may be poured upon the ground so as to settle it, as if a great rain had done the work. When dry spade up often, and mellow the soil to give the air circulating and condensing room in hot weather. Then replace the mulching about the tree. The less of earth retained in which the tree formerly stood the better, as from it the substance or nutriment necessary to feed the tree is entirely exhausted, and the myriads of feeding roots running off in every direction have been left in the ground. To retain the entire ball as when removed in the forest, would be to not only stop the growth of the tree, but to starve it to death before the fibrous roots could extend far enough to procure necessary food. I have had large evergreen trees stand thus, scarcely living for three or four years, and only from freely feeding the ball with liquid manure were they kept alive; for in our ignorance we supposed we must remove as much earth as possible to make an evergreen live. We now send our large trees off by the car load, that are several days on the transit, and yet all are reported to live.

The difference between the forest-grown evergreen and the nursery-grown is, the former has but few roots, the latter has them in great abundance, and numerous in proportion to the number of times it has been transplanted, by which a great mass of central roots hold in their custody, with what may be called "a death grasp," a quantity of earth, while the former will retain none. The tree also makes a more compact shade and more beautiful for oft transplanting. Perhaps no tree in the whole forest family is more tenacious of life when rightly handled, and in the right season, than the evergreen, and no tree is more sure to die from improper exposure. The sap of the evergreen is resinous, and coagulates in the sun's heat as soon as the bark of the root becomes warm in a dry atmosphere, and cannot be dissolved by any application whatever; the flow of life is obstructed and consequently the tree dies. But let the roots be kept moist, the great supply of resin in every de-

*"Report of Iowa State Horticultural Society," 1857, p. 22.

partment of the tree more active and abundant from its ever-living foliage, every leaf of which, forming a part of the active life-giving influence, becomes more tenacious of life than any other tree. Pine trees were taken from my ground last spring, each one of which filled a lumber wagon box, and only one could be carried in the load, and yet grew apparently as well as if left standing in their native bed, though not as much. There have been many hundreds of large trees taken annually from my grounds, and yet only in the case of bad treatment have any perished.

To the above the secretary adds a remark, that it is highly important before setting trees that have had their roots puddled, to dip them in water to dissolve or soften the soil that has dried upon them. If received late in the fall, he advises that they be heeled in in a sloping position just before the ground freezes, the soil being finely mingled with the roots and between the tops, and thus cover them completely. If planted in the fall they will usually dry out, especially in a snowless winter, and all living circulation, except in the roots alone, will be thereby forever stopped. He adds as his experience, that the white pine is one of the easiest and safest of all evergreens to plant.

MISTAKES IN PLANTING FOR ORNAMENT.*

In planting for ornament, a want of taste is often exhibited in arranging the specimens. A little careful thinking before commencing operations will often avoid after regrets over our mistakes. It is a mistake to plant trees too close to our dwellings. It is a mistake to plant all trees in parallel lines, as they look stiff and repulsive to the eye. Still, one row running parallel to the public road is admissible; but in this case do not plant them too near together, so as to obstruct a view of the road when they attain size and age. We may also suggest that obstruction of desirable points of view should be considered in all our planting of trees. Plant the inside rows in graceful curved lines, with here and there a group of from eight to ten acres. Plant only one variety of trees in each group; but do not plant all the trees in curves and groups. Single specimens, properly distributed, are objects of interest to the eye, and where the size of grounds permits, eight or ten trees in a circle present a fine appearance. Do not mix deciduous trees with evergreens in groups, rows or circles. It gives a mixed, broken expression to the lawn in winter. While we may imitate nature in our groupings, yet it is a part of the art of prairie and city lawn making to modify, and even improve on nature's capricious modes of planting and arranging.

The preceding pages concerning evergreens afford much valuable information to the tree-planter; and this branch of the subject would now be allowed to drop had we not something in the way of a Minnesotian's experience in this branch of forestry.

The following paper, entitled a "Plea for the Evergreen," was prepared expressly for this work, at my urgent solicitation. Having personally known the author, Mr. Kepner, for many years, as an unusually successful tree-planter, as a practical, conscientious man, and as one of the most successful horticulturists in Minnesota, I regard this Minnesota experience, as given by Mr. Kepner, of great practical value, and very appropriately entitled to a place among these pages.

A PLEA FOR THE EVERGREEN.

Of the delightful prospects to be seen on our prairies, in the summer, no Minnesotian need be told; the older settlements, dotted as far as the eye can reach, with beautiful groves of young timber, ranging, in size, from the clump of a few specimens, to the tract of twenty acres, or more. These

*From a report by Samuel Bowers, with discussions that followed. "Iowa Hort. Report," 1875, page 97.

groves have nearly all grown up, within the memory of the older settlers, and have transformed, what was then a monotonous landscape, into a country so beautiful that it seemed a blessed privilege even to live in it.

Now let us look at this same picture in the winter. We drive along over the same country; but how everything is changed! This is the same road; here are the same farm houses; here are the same groves; but they are leafless,—and there is no color to brighten up the view; and there is scarcely anything to obstruct the fury of the fierce winds! We are disappointed! We thought these farmers had wind-breaks—about their habitations. So they had in the summer, when the necessity for them was not apparent. And we drive over many weary miles of this kind of country; but we must acknowledge that it is very cold; and notwithstanding the many fine buildings which we see on every hand, the country has not that home-like aspect which has lingered in our memory since our summer visit.

But here, at last, we find a different scene. The atmosphere has changed,—it appears to us by contrast,—to that of Indian summer. We hear the wind howling in the air overhead, but we do not feel it as we did; but, now, what is the matter?

Here are some hundreds of evergreen trees, disposed in groups and belts, about a farm-house, which we find, on inquiry, to have been transplanted from the forest a dozen years ago, by the proprietors own hands, at no appreciable expense, save the few days work *then*, with additions of other trees since, from time to time, an occasional day of loving care and attention afterwards. Here we have a green landscape, a bit of summer in the middle of winter.

Nothing very fine yet, it is true, but promising much in the future; but still enough to add much to the attractions of the home; enough to reduce the cost of winter's fuel quite noticeably; enough to shelter every living thing about the place in the coldest storms, of the coldest winters; and, enough to repay the planter many times its cost in beauty alone, for "a thing of beauty is a joy forever," and is worth striving for, even on a farm.

And it is to the eye,—to the love of the beautiful, to which we must largely appeal to make farm-life more attractive, and this keeps the boys and girls on the homestead, instead of going to town; for we must acknowledge that in home adornment, our city friends are far ahead of us.

The foregoing is no fancy picture, and the object of this paper will be to induce the farmers of Minnesota to assist, and to try to *show* them how they may assist in greatly multiplying the bright side of this picture. Or, in other words, that in planting about the home, many evergreens should be used for the groundwork; and a few deciduous ones for variety, instead of many cottonwoods, &c., &c., and a few evergreens as now; that is to reverse, in a measure, the usual order of planting about the house and grounds, in this our cold and bracing climate, and thus have shelter and beauty in the winter, when both will be more appreciated than they are in the summer.

When it is taken into consideration how easily the different kinds of native varieties are transplanted, and how very fast some of them grow, in almost any kind of soil, we are greatly astonished in traversing the country, to see how very few people have availed themselves of the bountiful supplies which nature has furnished in many parts of our State, and which can be had merely for the trouble of digging. And when these are not available, we can have recourse to those of nurserymen, who make a specialty of evergreens; or to those persons who advertise in our agricultural and horticultural journals, to furnish forest seedlings, in any desired quantity, either of which parties will furnish enough to shelter a home for a very few dollars.

VARIETIES.

That sort which is found to succeed best in your locality, is the sort most largely to plant. For instance: In this part of the State, (in east Olmstead county,) there is nothing like the white pine. We have planted a hundred fold more of this than of any other variety. One on the lawn, twelve inches high when planted, thirteen (13) years ago, measures to-day, with tape-line, eight inches from the ground, forty-one (41) inches in circumference, and twenty-one (21) good long paces around the lower tier of branches. The pines,—Austrian, Scotch and black, are all good. So is red cedar and arbor vitae. So, also, is balsam fir. But it is not desirable to enumerate, as each one will be obliged to content himself with such as will be best adapted to his needs. The important business is to plant, and to do the work with care, when in nearly all cases there will be success. The per centage of loss with me is no larger in evergreens than in cottonwoods, or any other variety of deciduous trees.

PREPARATION OF SOIL, PLANTING, &C.

Any soil that will grow a good crop of wheat, will be suitable for evergreens. It must be well prepared,—deeply plowed, and finely pulverized. It may be last season's breaking, or the oldest land on the farm; there is very little difference, but in either case it ought to be mellow and in good heart. A good plan is to prepare a strip, where there is to be a permanent wind-break, on the north or west side of the lot, which it is desirable to improve; and for two rows of trees, of large growing kinds, as the pines or spruces, about twelve (12) feet wide; for smaller growing sorts, ten feet will do. In this strip mark out two rows, or draw two lines five (5) feet apart for the large, or four (4) for the smaller growing kinds.

Now we are ready for the trees, and if they are to come from the forest, we choose a rainy, or at least a cloudy day in the spring, (never in the fall,) just about the beginning of seeding; or, if time is no object with you, wait till the buds swell, (don't wait till they have grown,) the time of which will vary nearly a month, in the different varieties. This is the *very best time* to move all sorts of evergreens, although we know that an expert can transplant them successfully at almost any season of the year. Take your wagon, a few wet horse-blankets, to cover the trees as fast as dug, and go to the place previously selected, and carefully dig and cover such trees as you wish, always remembering,—and *I wish to impress this fact upon the mind of every one who undertakes this business*:—THAT THE ROOTS MUST NOT BE ALLOWED TO DRY IN THE LEAST, or be exposed to the sun or wind for a moment; if you wish first-rate success, and if the roots should once become nearly dry, throw them away at once, as it will only be labor lost to take them home and plant them. And also, if you wish to make fine trees in the future, you must be content to select small ones now, from two (2) to eighteen (18) inches high; the smaller the better. Nursery grown trees may safely be somewhat larger; but even in this case small ones will be best, and they will certainly cost less. If you are obliged to use nursery grown trees, select to order your trees early; *don't be put off till June*. Two or three year-old seedlings, which will be from two (2) to eight (8) inches high, will be most profitable, but if it suits your case, get them larger:

PROPAGATION BY SEEDS.

Raising evergreen seedlings is a very simple and easy process to one who understands how to go about it; but to the novice it is very slow and unsatisfactory; and believing that the time gained by the former, in planting trees already grown, will more than compensate for the difference in first cost, even if he should succeed and grow first rate seedlings, I would not advise planters generally to raise their own trees, but will here give, for the benefit of those who *wish* to do so, a method which has succeeded well with me:

Send your order to a reliable seedsman early enough to have your seeds on hand by the time the ground will be fit to work in the spring. Make long, narrow beds, east and west if possible, not more than two (2) feet wide, with eighteen (18) inch alleys between. Sow seed broadcast twice as thickly as you would sow oats, (five or six bushels to the acre,) and cover nearly one (1) inch deep by sifting over them good, mellow soil with a coarse sieve.

It will be a good plan, if you have time, to prepare your beds in the fall previous, so that the seeds can go in early in spring, as it is quite important that the young plants should have a good start before hot weather sets in. Having the seed in the ground, the next thing will be to stick brush (evergreen will be best but others will do) along the south side of the bed, to partially shade them, so that the sun will not shine long at a time upon any one place; as, without this shading, the young plants will be scorched nearly as fast as they come up. If the weather is dry, the ground must be well soaked once a week. But if the weather should be wet, it must not be kept too moist or too much shaded after the plants are up or they will rot. If they appear likely to do this, a little dry road dust sprinkled on them, if you have it on hand, will be a good prevention. We must now keep our beds clear of weeds, and the wisdom of having them narrow will be apparent, as we can weed them from one side without disturbing the brush. Here our seedlings must remain till two (2) years old; when, if they have done well they will usually be from two (2) to eight (8) inches high, and ready for transplanting to the nursery.

In the first fall, with one summer's growth, most varieties will be very small, having really only well made their appearance above ground; and to prevent the frost in the following spring from heaving them out, they must be covered with brush or straw, or mats; but take care that you do not make a harbor for mice. And to avoid this it would be better not to cover till nearly spring. In the first fall after the little seedlings have been transplanted to the nursery rows, the earth should be drawn about them, (early in the spring will do) so that the alternate freezing and thawing shall not heave them out. In the second summer they will not need shading, only keep them clean, and if the weather is dry, water as in the first season. (Propagating evergreens by any other method than seeds is impracticable for general use.)

Now, having our ground prepared and the trees on hand, we proceed to plant them about a foot apart in the rows, as carefully as we could so many cabbage plants—putting them in the ground as deeply as their size will permit, and if the ground is at all dry, watering them thus: After planting and *half filling* the holes of a dozen or more with fine dirt, go back and pour water enough into each hole to completely soak the ground about the roots; then, when the water all soaks away, fill up with dry, fine earth, and thus continue to do till all are planted.

Never water on the surface, as this bakes the ground. Having now plant-

ed all our trees, we have nothing more to do but to keep them clean with hoe and cultivator, as we should keep so many rows of corn, till harvest time, when they may be let alone till fall, when they should be weeded again. We never mulch small trees when we have them in rows so that they can be cultivated, without the soil is very sandy, and then only in an excessively dry time.

We have now established a nursery from which to draw, from year to year, as we may need them to set about the house and barn, or to sell to our neighbors—remembering that we must leave enough for our wind-break, and that for this purpose they should be all of one variety; that is, that each wind-break should be of one kind of trees, as two or more kinds do not look well, even if they should grow as well, which they will not. They should be about five feet apart in the rows for the larger growing kinds and four for the smaller, and stand thus: zigzag like a worm fence. In transplanting larger specimens to the lawn or grounds greater care must be taken to preserve as many roots as may be, and if possible, to take up a good ball of earth with each one; and also, if the roots seem to be few, shortening the branches as we would those of any other trees, except in the case of those trees—like the pines—which grow only from the ends of the branches. Here we must not cut the top tier of branches, nor the main leader. Large trees should have large holes, and be well watered—the same as our small trees—and well mulched with rotten stable manure; as in *this* case mulching will be much better than cultivation. If the position is exposed to the wind, a good plan is to stay the tree with three small wires, one end of each fastened to the body of it with a leather strap, or some other soft material which will not injure the bark, and fasten the other ends to the ground with pegs for a year or two till the roots have firmly taken hold.

Trees of almost any size can be successfully transplanted if the necessary time and care be taken, but such trees are very costly, and would be entirely unavailable.

For the general planter, and, where fine specimens are to be the result, the small ones will be far the best, *every time*, even if there is no difference in the cost.

For a forest, the trees can be as large as you desire to handle, as the object here is to grow a straight, tall trunk and not side branches, as is the case in our ornamental trees and wind-breaks, and they should be set in check-rows, about four feet apart each way, so that they can be cultivated with horse power, like corn, and when they grow to such size that it is no longer possible to cultivate them, we can remove every other tree, leaving them quincunx, and when they again become too thick take out the center one of each five, when they will be eight feet apart each way, and will be about right for our permanent forest.

Political economists now assure us that the limit of the wooden age will have been reached in about fifty years, if there is not something done to arrest the rapid destruction of our forests generally, and more especially of our pine forests, whose products enter so largely into the construction of almost everything in the country—in fact, affect almost all industries directly or indirectly. We cannot see any plan by which this necessary destruction can be stopped, nor would it be desirable so long as on this very destruction depends the welfare of so many of our population. Of the *unnecessary waste* of these products, it is not in our province now to speak; but we would urge upon congress to take some effective measures to forestall the consequences of this waste and destruction, by offering a premium, if need be, to

every land-owner in the Union whose soil and climate will be suitable for growing pine timber, not only in the new, but in the older States as well, and thus, if not put off till the end shall have really come, the supplies can be kept up, *ad infinitum*. Some of the older people of the world have thus kept up their supplies, and why not us? If the government can not see this, let every individual who has the welfare of his country at heart, do what in him lies to promote this good cause; and as there is nothing in the world that succeeds like success, every pine tree seen flourishing on our prairies will be a sure incentive to some one to go and plant another; and thus, as the perfectly simple conditions of success begins to be understood there will be no trouble to induce people to plant evergreens.

Let no one be deterred from planting an evergreen forest by the fear that they will grow too slow. The native pine here has grown forty feet in twenty-five years, and with good cultivation, the same variety has grown much faster even than this; so that if the first settlers had planted pine forests, they could now be cutting all the smaller timbers for the large barns which they are building at this time, and for which the timber comes long distances by river and rail.

AFTER CARE.

Having brought our trees through the first season all right, we are apt to congratulate ourselves that our work is done. On the contrary, here is just where many planters suffer shipwreck. Now is just the time to make or mar the beauty of our trees, if we wish them to be what evergreens ought to be, with branches sweeping the ground, in all the luxuriance of full foliage. In order to attain to this perfection of form and foliage it is necessary to keep down every vestige of weeds and grass while the tree is making its new growth, as the young shoots are then very tender, and those in contact with the grass will be smothered. This can best be attained by thorough cultivation where we have them in rows. After a tree has attained its annual growth, say about the fourth of July, it will be able to take care of itself; yet, if time can be had, it will be well to keep all grass and weeds away from it always. For trees on the lawn which are not yet large, a good plan is to invert the sod with the spade to the depth of three or four inches each spring, say in May, six inches to a foot outside the lower limbs. This keeps the ground mellow, and also, for a time, kills the grass; but this plan will only be allowable in good, rich soil, and will not do at all in sand. Here we must mulch with good rotten stable manure, and to get the full benefit of it, the operation should be performed every fall, and if too much material should accumulate, scrape away the old before applying the new. And this mulching is not understood as it should be. We must not pile up little conical heaps of stuff about the stem, but spread it out beyond the lower branches six inches or a foot, quite thickly on the outside, and growing thinner as it approaches the center, where it is not necessary to have anything, as the foliage itself will keep that part of the earth moist; and thus we have a kind of reservoir, in the middle of which is the tree, and which will retain the moisture which falls on the branches. In this way we keep the soil rich and loose for the small rootlets, which will always be found to extend further out from the trunk than the branches, and, of course, these must be fed if we wish the tree to prosper.

After lawn trees, in good soil, have grown to large size, say twenty feet and upwards, it is only necessary to attend very carefully to keeping down

the grass, mowing once in ten days till the tree has attained its annual growth, which will be as before stated, about the fourth of July. If the soil is poor and the tree does not seem to do well, a good plan is to mulch *heavily* with good rich manure in the fall, and remove again in the spring, after the rains shall have washed the substance of it into the ground. Neglecting to attend to these things will assuredly, in time, cause the lower branches of most varieties to die out, and thus give us a poor, scrubby looking specimen, only fit for the woodpile.

Having attended to the foregoing suggestions, which are not mere theories, but have been deduced from actual experiments, no one need fail. Only have faith enough in your work, and in yourself, to go about it as you would any other thing in which you desired to succeed, and you will not fail; and at the return of spring you will rejoice to see your beautiful trees put forth their delicate young foliage, and continue to do so year by year, until they shall have attained to such magnificent proportions that you will have more pride and gratification in leaving these as a heritage to your children than you will in all the broad and fertile acres which you may have acquired in a long and successful life.

Not only will their graceful foliage gladden your eyes and cheer your heart in the spring time, when all nature re-awakes to a renewed activity, but they will cheer you in the autumn, when all else is in the sear and yellow leaf; and they will be with you in their shining green all the cold and sombre winter long, to keep away the howling storm and brighten up your now beautiful prairie home, as nothing else in inanimate nature can; and all the year through their resinous juices will fill the air about you with health-giving odors, so that, when at length, in the fullness of time, you shall pass away from earth and your children shall succeed you, and *their* children, in turn, shall come upon the scene, generation after generation shall rise up and call you blessed for having given them such a beautiful heritage.

JOHN R. KEPNER.

Little Valley, Minn., March 1, 1878.

The following unusually instructive and every way valuable paper, from Mr. J. H. Brown, of Lac Qui Parle, Minn., prepared expressly for the Minnesota State Forestry Association, presents so many important features in tree planting as to commend it to all who have any interest in "conquering the prairies." Mr. Brown was one of the early settlers of Northern Illinois—then, again, an early settler of Olmstead county, Minn., and again, one of the pioneers of civilization on our western borders; a good type of the class of men who cause the wilderness "to blossom as the rose;" and now in his old age is successfully battling against, and gradually overcoming all the privations and hardships incident to the settlement of a new country—building up a beautiful and attractive home—rearing to himself an arboreal monument, more enduring than marble, and setting an example all may profitably emulate. His young plantation so successfully prosecuted, is already the most noticeable feature of the Upper Minnesota Valley, and is the admiration of every passing traveler. His views in regard to close forest planting are commended to the consideration of the "carping critics." "The proof of the pudding is in the chewing of the bag-strings."

LAC QUI PARLE, Dec. 25, 1878.

Mr. L. B. HODGES, Dear Sir :—

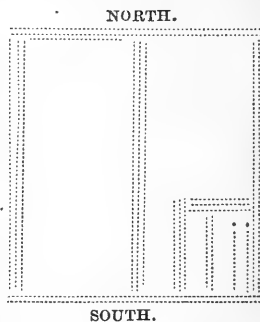
You wrote me that you wished me to write up my experience on forest tree growing. You said that you wanted it to read at the meeting of the State Forestry Association. I feel thankful to you for the kind invitation. I am fearful, however, that you will be disappointed in consequence of expecting more from me than I can give to your association ; for you doubtless have men in your association who are far more competent to instruct in your deliberations than I am. But since you wish it, I will try to give a few thoughts on the planting and growing of forest trees on these treeless prairies. In order to make a success in growing trees, we must be thorough in the preparing of the land before the trees are planted, and after they are planted, they need to be well cultivated until they are large enough to take care of themselves, and unless this is done, it is of but little use to think of growing a forest. The land should be prepared and cultivated in the same manner that a thorough farmer prepares and cultivates his land for corn. I have had very good success with trees planted the next spring after the land was broken, but it requires much more labor. It is better to sow the wheat one year, the sod then will be quite well rotted and the trees will grow faster.

It is quite useless, however, to dwell long on the preparing and cultivating the land. If a man generally does his farm work well, he will be quite likely to treat his trees the same way, and the result will be a grand success ; but, on the other hand, if the man is in the habit of doing his work slovenly, he will treat his trees in the same way, and the result will be a miserable failure. As regards to the best kinds of timber to plant on these prairies, I think cottonwood the most preferable. It grows more rapidly than any other tree ; next to that is the soft maple. After having planted a liberal amount of these two kinds, I should plant the white ash, which, when grown, is the most valuable of any variety of timber we have here, and I regard these three varieties the only kinds we have here that is worthy of forest culture. But for early wind-break, or shelter from the wind and early fuel timber, the cottonwood should have the first attention. Its timber makes very good fuel, especially when dry. The white willow as a single row, if we wish to grow a live fence, is the only tree plant we have here, as yet that will answer that purpose, but I hope to see something better introduced for that purpose. I have, however, planted nearly two miles of it on my farm, and had not the hoppers kept eating it off for the three years, it would have made a satisfactory growth, but they kept it back very much ; they likewise clipped the outer limbs of the cottonwood, but not as much as the willow. I have used mostly cottonwood in planting my groves, and for the most part I have planted seedlings of one and two years' growth ; some seasons they are quite plenty here, and some seasons there are but f-w, which was the case last fall. The seeds fall from the trees from the first of June to July. They fall on the water of the rivers and other places of water, they catch on the shores and sandbars, and grow up the same season four to twelve inches. I have used such plants for the most of my tree planting. But some seasons that class of little trees are quite scarce here, and in that case we resort to cuttings. I have sometimes had very good success with them, and at other times they have been almost a total failure with me. I have heard many men speak of like results, that is when they are prepared and stuck in the earth the usual way of doing. I have found by experimenting that cuttings may be prepared and planted in such manner that they will be almost sure to grow and do well, at least they have proved

a perfect success with me so far as I have tried them, I take the limbs from the tree and cut them about six inches in length, leaving one small side limb as nearly as may be in the middle of this cutting, cut this back to the length of five or six inches. Plant this cutting flat in the ground, say about three inches deep, leaving the end of the side limb two or three inches above ground.

In planting, a small trench should be made as deep as you wish to plant the cutting. Place the cutting in it, draw over it an inch or more of earth, then press firmly with the foot, after which, fill the trench level with mellow earth, and you have a cutting planted that will most surely grow rapidly.

It is a matter of no small importance to us to know how to best arrange our forest trees, so as to have them both ornamental and useful. I have here drawn a small plat of a farm, of one hundred and sixty acres. I thought, when I planted the trees, that they were quite well arranged. But, perhaps, some of you can suggest a better plan. If so, please send us a specimen, and we will be glad to see it. This sketch represents a farm as it now is, and I think anyone who carefully looks at this drawing would, if they should chance to pass by this farm, see at once that it is a fair specimen of the real appearance. You will perceive that these several belts of trees are in the aggregate nearly three miles in length. There are not less than fourteen acres of land in them. The outside row of all the lines of trees is thickly set with willows. These are intended for line fence. On the south and east side, there are only two rows of shade trees planted, as the dots indicate. The southeast corner represents house and barn grounds. The open ground a little to the west contains four acres of land. I have planted nearly all kind of trees on those grounds. There are public highways on all sides of this farm, save on the north. We think it quite a nice drive around this farm; the trees standing, for the most part, about sixteen feet high. The forest-belts are planted in rows four feet apart, and from two to four feet in the rows. This may seem to some to be quite too close; but by so doing they will grow tall and straight with but few side branches, and in a few years after planting they will admit of being thinned one-half, and those left will be worth more than if planted farther apart at first, and the thinnings will make a large amount of fuel to the acre. If we would grow tall, straight forest trees, we must have them quite near together when small. If too far apart, then they will take the form of shade trees, having short trunks and wide-spreading tops, which are not desirable for a valuable forest of timber. Trees planted twelve feet apart, as some are doing, will never make a valuable forest. And when would we begin to thin it, in consequence of its becoming too close on the ground? I should not look for that time to come in my day; for, when we cut one tree we have a space of twenty-four feet. If we plant closely, we will have an annual return for our labor a number of years before we would think of cutting a tree, if we had planted twelve feet apart, and the trees still left will be of far more value. They will not be mere shade trees, having short trunks. They will be tall, straight trees, useful for any purpose. There is another benefit derived from close planting, for if well cultivated, in two years they will take care of themselves. But, if planted twelve feet, we may keep on cultivating at least five years, and then we have but little value. To grow white ash, I find, by my



experience, that it should stand very close while young, if we make a success in growing it on the prairie ; and it is best to plant the seeds where you wish them to remain. I think eight inches is far enough apart in the rows. That will cause them to grow tall and slender, with but few side-branches. If left too far apart, they grow quite scraggy. I have ash eight feet tall four years after planting seeds. It is better to plant in the fall. Some men in this locality are planting ash-leaved maple in their groves. It grows quite fast, but is rather short lived, and does not grow to a large size; but, when planted alone, it makes a beautiful shade tree. I have used them quite liberally for that purpose. It is the first tree that looks green in the spring, and is a very ornamental tree. I have none in my forest planting, regarding it of less value for that purpose, than most other varieties. We have been very much annoyed in this locality by the hoppers. They bite nearly everything they light on; they have entirely destroyed very many small trees. I planted a nursery of about ten thousand small cottonwood seedling trees, intending them for transplanting. They looked very promising until late in June, when the hoppers took possession of the ground, destroying all but about fourteen hundred. They also injured the larger trees very much for the last three years. Therefore, their annual growth has been much less than it would have been. But yet the growth has been quite satisfactory. I think the cottonwood has made an annual growth of four feet. The maples, two to three feet, and the ash still less. We had, also, a beetle or June bug here last season, which worked on the ash, nearly destroying the entire growth for the season. The young twigs were eaten off and started again three successive times. The bugs leaving about the last of June, they sprouted again, but it was so late that the growth was but little. I have seen the same bug before, but never in such great numbers, and never so destructive. The maple, likewise, has nearly all been cut off when quite small, several years in this locality. Some years they are not touched. Five years ago I planted quite a large number of seeds for a nursery of trees. They came up very nicely, and had about eighty thousand of them. When they were nicely above ground, they began to disappear, and in the fall I had only five or six thousand; I called the destroyer a cut-worm. We all well know that we are liable to meet with disappointments in any enterprise we may engage in; and forestry growing is not an exception to the general rule. Notwithstanding these disappointments, I have continued to plant a few trees, and the result is quite satisfactory. The theory that forest trees could not be grown on the open prairie is now proven to be false; and that of itself is a long stride towards the treeing of treeless lands.

I well remember that only six years ago this winter, when the wind would be blowing with all its violence, bringing the loose snow from twenty miles west and northward of us, piling it up in huge drifts around like buildings, and at times making it unsafe to step out of doors, I then, at times, being seated around a well heated stove, talked about planting trees, under the protection of which we could build our houses and barns, and be protected from the wind. Some of my boarders would, at times, jokingly remark that around this warm stove in a cold, wintry day, was a very good time and place to grow such nice forests; they not believing that it could be done in our day. Since then, I heard the same persons express their fullest belief of the sure and early protection from wind and snow, by planting trees. And such is the case with thousands of men all over the Western States. And now that men have faith in tree growing, we may look for forests to spring up all over this treeless west. I have observed that some persons make a fatal

mistake in planting a grove around their buildings; they plant a few trees quite near their buildings, and think they have done a very good thing. Well, they have, so far as it goes. But if they go no farther, they will some day see that it is not so good after all. This small grove will break the wind and stop the snow; but the snow will be stopped and piled up just where they don't want it. Their door yards and barn yards will become filled with snow; or, in other words, they will have no yards visible, and will be quite likely to find themselves wishing that they had not planted any trees. Below, you will see a sketch of ten acres of land, on which is designed to represent ten acres on my homestead-claim in the southwest part of the county. When I planned and arranged the ten acres, as before shown on my farm at Lac qui Parle, I find that I made in that one mistake, at least. You will observe, that on the north and west sides of this sketch, I have planted three rows of trees, one of willow and two of cottonwood.

This narrow belt will cause the snow to pile up on the south of the north belt, and on the east of the west belt, the snow always being blown from the northwest in our severe storms. I have then left within these outer south lines several rods in width of unplanted land. This open space I call the snow line, and within this snow line, I have planted the main grove, designed to protect my building grounds. The southeast part not closely planted, is designed for house, barn, barn-lot, garden and fruit grounds. A plantation arranged after this plan will avoid the main grove being piled full of, and broken down by the snow. This ten-acre plat may be located on any part of the farm you please to choose. This plat of land is on my homestead claim, which is located about twenty miles from Lac qui Parle, and nine miles northeast of Canby. There are a large number of groves planted in the county. I noticed when passing over some parts of this county last September, one place where I saw at least ten of these artificial groves at one view, showing their dark green lines above the rolling prairie.

I hear many talking about planting trees next spring; and many more will yearly be induced to plant groves when they see their neighbors' trees grow so nicely. And at no distant day, this so-called treeless country will become the pleasant abode of intelligent and civilized man.

I wish here to take the liberty to correct a mistake, made by some one in regard to the amount of natural forest-timber in the country. I have seen it stated in the reports pertaining to timbered lands in the western part of our State, that the county of Lac qui Parle has only two hundred acres. This is quite far from being correct. Those who best know how much there is, say there are at least twenty-two hundred acres. Please correct this report when opportunities present.

We shall expect you will use your utmost endeavor to induce Congress to amend the tree-claim act, bringing down to where the man of small means may avail himself of its benefits, and causing him to grow a closely-set and useful forest, with complete success, instead of an attempt to grow forty acres of shade trees, (for it will be nothing more for a long time,) and make a sad failure, losing his claim, labor and all. For no poor man can support a family, open up his farm, and grow forty acres of timber at the same time. This class of men are the only men who will undertake



to do it; the wealthy are not apt to bind themselves to hold a piece of land eight years, before they can procure title. The premium acts of seventy-one and seventy-three, passed by our State Legislature, were very good to encourage growing forest-trees. But the life of these two acts was five years in which to plant groves to obtain the premiums. We here think that those acts ought to be re-enacted; and if you think so, we cordially invite you to use your co-operative influence to induce our legislature to renew those acts this winter, and have them run indefinitely as to time, when they may be repealed, when they become in-operative. I would suggest, however, that no premiums be awarded for trees planted in the future, unless they are planted so closely together that they will insure a dense forest.

We can afford to be taxed for the growing of properly planted and well cultivated forests. But a forest tree planted sixteen feet apart, as the other State acts indicated, is too far apart,—“*too thin*,”—to be worthy of the imposing of taxes on the people of the State for their support. Perhaps I have not been so particular in my remarks about close planting as I might have been. I will say a few words more about that part of the work. It is of much importance in planting closely, to have the trees of uniform size and strength of growth, else the stronger will kill the weaker, before they become large enough to be of value for fuel or other uses. If we plant a large tree, and then a small, and again a large one, as we are quite likely to do, if we don't know any better, the larger trees will soon spread their branches over the tops of the smaller trees, which will entirely stop the growing any farther of the smaller trees, and they might about as well be left out. So long as a tree can keep its head up in the sun, it will continue to reach up still higher. Therefore, it is better that we assort the trees before planting. When we get a large amount of trees ready for planting, they will usually be made up of various sizes. We should assort them in three parts, putting the largest by themselves, and again, the next largest, and lastly, the smallest by themselves. Plant these three divisions as much as may be by themselves; you will then have planted them so as to cause a uniform growth. If we observe these rules in our forestry-planting, we may plant quite closely and every tree will grow large enough to be of value before they will require thinning. I should be happy to meet with you in your deliberations for the encouraging of forest-tree growing. I have noticed with much pleasure, the success attending your most worthy efforts for the promotion of a cause, which, if properly carried forward, will greatly help to encourage tree-planting in all the treeless portion of our State. And, as it must be apparent to all, that the entire State will receive more or less benefit by your efforts. It is highly gratifying to witness what a great change has taken place in the minds of the masses in a few years.

Six years ago, I one day went to the timber and got a back-load of sprouts and brought them up to the house. A little time after I went in the store, and one of my neighbors asked me what I intended doing with those brush he saw me carrying. I told him that I was going to cut them in pieces and stick them in the ground, and grow me a forest of timber for fuel and other purposes. He, not believing that these brush would grow to trees of value and usefulness in our day, in quite a solemn manner remarked that some of us would need a wooden jacket before we could grow trees large enough to do us any good. Neither him nor I have yet needed a wooden jacket. I have some splendid trees from the

brush, but he has not commenced planting yet. He told me last week that if he could have believed that the trees could be made to grow as mine had, he would have had a grove likewise. This man was not alone in his unbelief. To-day, men do not believe that forests can be grown, and thousands will act according to their faith in the good work. The time is not far in the future when I believe this country will be all dotted over with groves of forest trees.

Before I close, I again invite you to use your utmost influence in behalf of the tree claim act, the State premium acts, and any and everything you can for the benefit of the treeless portion. We are woefully poor, financially. The grasshoppers for three years past have used us without mercy, and we greatly need the almighty dollar. But I must close, hoping this will do you no harm, if it should do you no good. This is from an obscure and humble frontiersman.

J. H. BROWN.

THE BEECH—*Fagus Sylvatica*.

In all my rambles over Minnesota I have never yet encountered a regular old fashioned beech tree—such as are common east of Lake Michigan. The water beech is indigenous and common along the river bottoms of Minnesota, but of too little value to talk much about. There is a tradition of a large beech tree standing, or formerly standing, somewhere near the banks of the Mississippi between Hastings and Red Wing, that the Indians held in great reverence, and performed many a sacred “pow-wow” under its umbrageous shade.

Whoever succeeds in growing a beech forest in Minnesota will have, certainly, the poor consolation of knowing that his life has not been altogether a failure. It is more than probable that his name would be honorably enrolled high up in the annals of forestry. I would not view the attempt to grow a beech forest in Minnesota as Utopian in any sense. Our climate and soil are both good enough, and I do not see any insurmountable obstacles to overcome.

It is true that the attempts in this direction so far are not encouraging, “but if at first you don’t succeed, try, try again.” Try it on after your young forests have so far developed as to afford a good shade to the young plant. Plant the beech nuts soon after they have dropped, and while yet perfectly fresh and sweet, and cover lightly.

There is no use in planting eastern grown beech trees on the open prairie; I do not say they will all die within six months, but I do say the blazing sun and drying winds make it mighty tough for them. They need the protection of a partially developed forest would naturally give, and with such protection success is possible.

Bryant says: “The beech is one of the loftiest trees of the American forests, sometimes reaching the height of one hundred feet. It occupies a wide range of latitude, being found from Canada to the Gulf of Mexico. It is a stranger to the prairies of Illinois and Iowa. It grows to the greatest size in deep, moist soils. * * * The roots of the beech run near the surface of the soil, and often appear above it. If the trees are felled in winter, they send up a great number of sprouts, so that a beech forest is easily renewed. * * * The beech cannot be recommended as one of the most profitable trees for forest culture;

nevertheless, it is worthy the attention of those who plant on a large scale.

From Hough's report, page 72, we find the following, which I deem useful in this connection :

The BEECH (*Fagus sylvatica*) is the only hardwood by nature admirably suited for growth in unmixed forests. Its leaves, rich in potash, decay easily, and form an excellent humus. In high-timber forests, it finds its proper place, growing best where the foliage forms an almost unbroken roof, which hinders the sun from drying the soil. Its period is usually 100 to 120 years, being longer on poor soils. It is not suited for coppice, because its power of sending up shoots from the stool is not great, and their growth is slow ; but in lime soils this power is greater. It occurs as coppice under standards where the latter throw much shade on the under-wood, or where, as in the case of oak standards, the ground should be well shaded from the sun. On lime, and the milder clay soils, it thrives as standards, but it then overshadows more than any other tree. Its wood is usually worth less than other hardwoods in the market. The beech requires a strong mineral soil, fresh and rich in humus. It is often found with the oak on sandy, loamy deposits, if not too dry or too moist ; but on poorer and lighter soils, or in exposed places, it grows slowly, and the soil becomes impoverished. The true home of the beech is on lime, basalt, and greenstone, if the soil is not too thin. This partiality for lime is shown in the smoothness of bark, the straightness of trunks, and their freedom from branches ; the annual growth is great, and reproduction by natural means easy. In fresh, sheltered places on lime, the beech bears seeds early, (beginning about the seventeenth or nineteenth year), and continues to do so at intervals of three to five years, and in abundance.

THE CHESTNUT, (*Castanea*.)

I do not propose to recommend this tree for the prairie. More than twenty years of unsuccessful experimenting have proved its unfitness. During a succession of unusually mild winters it has escaped severe injury, but when we get 40° below zero, goodbye to him ! I am inclined to think the soil of our prairies is not just the thing for the chestnut, for 40° below zero among the mountains of northern New York, don't hurt it. I am informed that among the timbered bluffs, ravines and gulches of Allemaque Co., Iowa, and Houston Co., Minnesota, it has proved a success. In such localities I would try it on a small scale, but never out on the open prairie.

SOFT MAPLE, (*Acer dasycarpum*).

Not a bad tree for the prairie ; nor as good as many of its friends claim. Closely planted in groves, it is well worth cultivating. It is a rapid grower, generally healthy and hardy. Found in its native state on nearly all the river bottoms. Well cultivated, it produces a large amount of very good fuel in a very few years. It pays well to manure this tree.

For isolated shade trees, although very beautiful, they are not to be depended on, as they are pretty sure to split down from the pressure of strong winds about the time you begin to think you have something to be proud of. Notwithstanding this serious objection, lots of fellows will keep right on, all the same, transplanting them from the river bottoms to their door-yards. To all such let me say, *don't cut the tops off*. If necessary to trim up to bare poles, do so, but always leave the leader as nature made it. By so doing your tree is not half so liable to split down. The young nursery trees should be kept well trimmed, the lateral branches never to be allowed to get any start.

The seed ripens in Minnesota last of May or first of June. Should be picked from the tree as soon as the seeds begin to fall, and should be sown

as soon thereafter as possible. The sooner the better. On clean, new ground I have seen them do remarkably well, sown broadcast and very thick.

They are usually planted in drills and covered about one inch deep; should the ground be dry, roll it or tramp it down. The seed will sprout and the plants will appear about as quick as corn. When the young plants first show themselves, shade thoroughly, or the sun will be pretty sure to burn them off. Then cultivate frequently till harvest time, and they will grow from 8 to 18 inches the first season, and are suitable for transplanting the next spring.

BOX ELDER, ASH-LEAVED MAPLE, (*Acer negunda*).

A good tree for the prairie; "in favorable situations, becomes a stately tree, reaching the height of 50 or 60 feet." It is very hardy, growing as far north as 54°. The finest specimens of this tree I have yet seen, are to be found in the valley of the Red River of the North. In rich, moist soil, its growth is surprisingly rapid, discounting the soft maple two to one. In very dry soil it is short lived; it yields a wonderful flow of sap, from which sugar can be made. The quality of the wood is similar to the soft maple.

As an ornamental tree, its dense, beautiful green foliage, (and if it has room to spread itself) its round, symmetrical top renders it an object of admiration. The seed ripens in the fall and should be sown soon after. I have carried them over till the next spring and then sown, but have always had better results from fall sowing; cover the seed lightly, and with frequent and clean culture you soon get lots of good trees.

I believe I have now briefly touched upon all, or nearly all, the desirable forest trees for our Minnesota prairies. It is not the object, nor is it within the scope of this little work to treat upon all the forest trees of America. To such persons as may be disappointed in not finding in this work a greater range of information, I would respectfully recommend to their perusal the works of Bryant, Gray, Warder, Fuller, Michaux, Evelyn, Berenger, Burgsdorf, Brown, and other eminent authorities. I shall now proceed to gather and arrange such items of practical value and interest, as may seem calculated to promote forestry in Minnesota.

Prof. William H. Brewer, of Yale College, in an article published in Walker's Statistical Atlas, estimates the number of species of woody plants in the United States at 800. Of these, upward of 300 indigenous species attain the height of 30 feet, of which 251 are abundant somewhere, or at least, not rare. In this he excluded all smaller trees that never attain a height of 50 feet, and the tropical species found on the extreme southern border. Of large trees somewhat abundant, he estimates 120 species, of which 20 grow 100 feet; twelve, 200, and perhaps five or six 300 feet in height, or upward. Of these 120, about fifty belong to the coniferæ. Only a very few species occur across the whole country, from the Atlantic to the Pacific. Of these, the aspen (*Populus tremuloides*) and some of the cottonwoods are mentioned; but as a rule, there is a marked contrast between the forest regions east and west of the treeless belt, the timber of the Rocky Mountains belonging to the western rather than the eastern type. New England, originally all wooded, has 80 to 85 species, of which about 60 grow to a height of 50 feet. The Middle States, also originally wooded, have 100 to 105 species, of which 65 to 67 sometimes reach a height of 50 feet. The southeastern part, also entirely wooded, has over 130 species, 75 of which grow 50 feet or more, and perhaps a dozen, 100 feet. The southwestern region was characterized by dense forests and open plains, and numbers 112 to 118 species, of which 60 to 75 grew to 50 feet. The northwestern region is diversified by prairies, "openings," forests, (some of great extent and density,) and timber belts along the rivers and streams. It contains 105 to 110 species, about 68 to 70 of which grow to 50 feet.

Professor Newberry, in his Geological Survey of Ohio (i. 529,) notices several instances of this relation between rock formations and timber growth. The Cuyahoga shales, rich in potash, bear a growth of large elms, scattered over this plateau as far as the eye can reach; beech and maples, with thick groves of chestnut where the broken rock comes near the surface, mark the horizon of the conglomerate, and above this a belt of forests, in which the predominate timber is oak, defines with great accuracy the limits of the coal-measures in the northern part of Ohio. The redwood of California is limited to a peculiar sandstone formation, and the noble red cedars of Tennessee to the Glade Limestone, a subdivision of the Trenton Group, which extends superficially as a very irregular ring across the central part of the State. On subsequent pages we shall have frequent occasion to notice this dependence of forest growth upon the underlying geographical formations, including, of course, the soils resulting from their decomposition. These peculiarities, when understood, afford valuable indications that may be followed with profit in attempting the cultivation of timber trees.

SOWING AND PLANTING.

BY DR. HOUGH.

We shall endeavor to present in the following pages, such practical statement of methods and results of experience as appeared best calculated to afford subjects of thought and suggestions for experiment in tree planting. The results obtained in one country may be different from those in another, but due allowance being made for circumstances, the principles of vegetable growth are everywhere alike, and a careful result of experience and observation acquire a permanent value.

SHOULD WE SOW OR PLANT?—EXPERIENCE OF EUROPEAN FORESTERS.*

Most foresters nowadays resort to *planting* in preference to *sowing* in beginning new forests. Is this a fashion and mere caprice, or is it the fruit of experience and observation? This question we will proceed to examine. Let us go back a hundred years or more. In 1756, the most distinguished German forester of that period, Johann Gottlieb Beckmann, published a work entitled *Experiments and Experiences upon the necessity of sowing Forest Trees*. In this work he specified the method of *sowing* as alone capable of yielding good results, and as the proper means for regenerating a ruined forest. "What shall be said of the method of *planting*?" he asks; and to this the reply is short and decisive, "It is not a good way, and as to resinous species, it is impracticable."†

Had foresters been satisfied with this positive declaration, there would have been no question as to planting within the last hundred years, but this has not happened, and they have been compelled to have recourse to planting oftener than they wished, perhaps, as they regarded it, to complete and replace their sowing. They were led to observe that the ancient process of planting left much to be desired, and that it was susceptible of great improvement, while on the other hand, they found many soils to be covered in which sowing afforded but slender chance of success. Little by little they gave more attention to the system of planting, and had oftener recourse to this method, so that fifty years after the publication of Beckmann's book, to-wit: 1805, Burgsdorf thus expressed himself in his *Treatise upon Forests*, in the chapter upon forest plantations:

*Translated from an article by the Baron Manteuffel, grand master of Forests in Saxony. "*Revue Des Eaux et Forêts*," 1, 147.

† "Chapter iv, § 13."

"Besides the kinds above mentioned that may be planted on a large scale, it is a principle that others may be planted, but only on a small scale ; in all cases depending upon success only where the conditions are favorable." He seems to have understood these "certain rules," and "favorable conditions," and explained them; but in this it was a sad thing for sylvaculture; they tainted the precepts of the master.

It would require much time to do full justice to the system of plantation, and in proof of this the elder Cotta, some twenty-five years ago, remarked: "As the establishment of forest growths on a large scale is easier to do by sowing than by planting, &c., * * * we deem it convenient to give preference to the former of these methods." An examination of the modifications wrought both in theory and in practice since these principles were laid down would lead us much too far, and in our day, progress is more rapid, and science travels further in twenty years than formerly in a century. We will only remark that the old rule which prescribed *that we should plant only where there is no chance of success by sowing*, has now in many countries, and especially in Saxony, given place to this, *never to sow except where it is impossible to plant.** In other words, planting is now the rule—sowing the exception; just the reverse of what it formerly was. Experience has, in fact, demonstrated to the present generation of sylviculturists that generally a forest growth can be established *sooner, more surely, and in better condition*, by planting; sooner, because it starts at least two years earlier than one that is sown, and furthermore, four or five years often elapse before it is positively known whether a sowing is to be repaired or completed, while in plantations the very next year will show every plant that is unable to survive, and these can be at once replaced;—more surely and in better condition, because plantations are exposed to fewer casualties than seedling growths. The success of the latter depends in the first instance, upon the quality of the seeds. Now, as we are seldom so situated that we can harvest them ourselves, we must take them as offered in the market, at which are too often sold seeds gathered before they are ripe, or that are withered, or badly kept, or heated, or too old. But assuming the most favorable conditions, let us suppose that all the seeds we get are good, we still have cause to fear that the soil is not well prepared, the sowing not even, that theseeds are covered too little or too much, or that too violent showers or persistent drought, too burning a sun, or a late frost, may happen to destroy all our hopes; but we will further suppose that the season has been as favorable for the coming up of the seeds as we could desire, and that the birds and the mice have scrupulously respected the tender plants, we shall be very much deceived if we suppose that everything is now secure; but in fact, if the conditions have been propitious for the growth of forest seeds, they have been equally so for the growth of the pernicious weeds; so much so indeed, that we can scarcely find the little germs in the midst of the grass and herbage by which they are covered and stifled. We may sometimes pull up these weeds, but at the risk of drawing up the young plants; but this does not always happen, and in this case the mice often find among the dried weeds under the snow a refuge, the more attractive because it offers a shelter from the cold, and young plants at hand for food. When the spring comes to melt the snow, there is more sowing to be done, for

*Messrs. Lorentz & Parade remark: "Sowing is considered by many foresters as principally applicable to large operations, because its processes are more natural and simple, as well as cheaper than those of planting. But practice tends every day to establish the superiority of the latter." (*Cours Elementaire de Culture des Bois*, 4th ed., p. 509)

everything is eaten up. If we succeed in keeping a sowing clean of weeds the first year, we have every reason to apprehend that in the next spring following we shall find the ground spread over with young plants that have been thrown out by the frost. Many other dangers await the seedling forest during the following years, but it would be needless to enumerate them. We have said enough to show that success in sowing is uncertain.

Plantations are likewise liable to late frosts, the teeth of mice, and of various other accidents, but their existence is not endangered. In most cases these troubles do not occur after two or three, or at most, four years. The only real enemies to plantations are insects and their larvæ, and it is not surprising that foresters now give preference to this system.

Plantations become cheaper than seeding. Experienced foresters do not need facts to convince them upon this point. They know, in fact, that if the cost of first establishment is a little less in sowing than in planting, especially if seeds are cheap, the expenses occasioned in caring for the work and of re-planting gaps and vacant places is much greater for seeding, so that taking everything into account, the advantage is altogether on the side of planting. Be it far from us, however, to think that we should never have recourse to direct seeding. In sylviculture there are no absolute and universal rules. Thus, for example, we would never advise planting timber on the light sands of La Manche or Basse Lusace, as we would always blame sowing on the strong-sodded but thin soils of Saxony. All we have to say as to this is, that as a general rule, and except in certain well-defined cases, such as those above mentioned, *planting should be the rule; sowing the exception.*

THE CONDITIONS MOST FAVORABLE FOR GROWING OF FOREST SEEDS.

That seeds may germinate, they must have a certain amount of contact with the air, and a proper degree of warmth and moisture. In the natural process of seeding but a very small number of the seeds so bountifully produced ever find these due proportions of congenial influences, so as to take root and grow. It is only here and there that a seed gets lodged among the dead leaves and the mosses, or gets covered by the detritus, so as to secure the needed protection and a successful growth. If seeds are left too lightly covered they may be eaten by the birds, or washed out by rains. If too deep, the young shoot will be entirely smothered, or will come slowly to the surface in too feeble condition for vigorous growth.

With the view of determining fixed rules from careful trial, a series of observations were made by Dr. Baur, director of the experimental station for forestal researches at Hohenheim, in Wurtemberg, in 1873, 1874 and 1875, the principal results of which are given in the *Revue des Eaux et Forêts* for June, 1876. The soil selected for these experiments was of average density. We can only state the general results :

Beech. Seeds should be but slightly covered. The best results were found when the covering was from 0.39 to 1.57 inches, and the best depth 0.79. This agrees quite nearly with the rule laid down by Burckhard, Heyer, and Lorentz and Parade.

Quercus pedunculata.—The acorns should be planted shallow, but a little deeper than beech-nuts. The depth should be more in light soils. Heyer recommends 1 to 2 inches, and advises that they be sometimes covered by a plow.

Acer campestre (English Maple).—The seeds should be but slightly covered, but little deeper than with beech. From 0.39 to 0.78 is unquestionably best, and beyond 2.75 inches they will not grow. The observer noticed the following appear-

ances in the germination of the maple: They issue with very long cotyledons, and if deeply covered, or if the surface of the soil is too hard, these cannot easily break through the obstacle, yet continue to grow, and at length break, and thus the germ is lost. We may thus see why many vacant places often occur in seed-beds of the maple.

Acacia.—The results here observed were quite interesting, and agreed perfectly in the two years observed. When Stumpf (*Waldbau*, 2d ed. p. 276) laid down the general rule that "large and heavy seeds should be more deeply covered," he should have excepted this kind. The results tend to show that depth has but very little influence, but that these seeds, however light, should be planted at least as deep as acorns. The result appears to lead to the conclusion that the acacia might be used with advantage in planting arid soils and southern slopes, where seeds thinly covered would scarcely grow from want of moisture.

Black Alder.—This should be but very slightly covered, a third of an inch being enough. Burckhard advises that it should be very slightly covered, or even simply strewn upon the surface, and Heyer remarks that it should be mingled with the most superficial parts of the soil. The experiments of Dr. Baur gave the best results at 0.39 inch. From 0.59 to 0.98 the shoots were but few, and from greater depth but one seed came up.

Common Pine.—The results of two years showed that a covering of 0.39 to 0.59 inch is the most advantageous. At greater depths the plants were scattered, and none grew from a depth of over 1.18 inches.

Fir.—With this, as with the pine, the deeper seeds were slower in coming to the surface, and the general average for best results was the same.

Silver Fir.—The best depth ranges between 0.39 and 0.77 inch, or a little more than in the case of the pine and fir. None appeared which had been covered 1.18 or more inches.

ATTENTION TO THE QUALITIES OF SEEDS—GATHERING OF SEEDS.

It is a universal law in nature that certain qualities of excellence or defect tend to transmission from parent to offspring. By virtue of this, the various choice breeds of domestic animals have been originated and improved. Our plants cultivated for culinary use and ornamental planting, have thus been multiplied in variety without number, and in quality so greatly improved upon the native original as scarcely to be recognized as of the same species.

May we not, from an analogy, hope an equally good result in the growth and quality of timber, and of the fruits and other products of forest trees? Herein, although we have the disadvantage of a slow growth, and of a life that often outlives a man's, we have the decided advantage of being able to hold and keep what we get, by the process of budding and grafting; as we constantly see in our nurseries of ornamental trees, where striking peculiarities, often originating in nature, or from some accidental circumstance, are perpetuated and multiplied without limit.

But starting with the seed, it is obviously of first importance that it be of the best quality—not the first that falls, because, as in fruits, it may have ripened prematurely from injuries done by insects—not from stunted and dwarfish trees, which sometimes bear and seed in morbid excess, nor from trees enfeebled by extreme age or other debilitating causes.

It is laid down as a rule worthy of close observance, that the trees from which the best seed are to be expected should be middle aged, that grow isolated, or at least a little separate from others, so as to have the full benefit of the air and light—that the tree have a full head, and a perfectly healthy and vigorous condition.

Wood that is aged and decaying, as well as that which is young and tender, is apt to yield seed that will not grow, or at least that will produce dwarfish and worthless shoots.

Scrubby and malformed trees are said, on high authority, to tend to the production of degenerate varieties, from which they will not recover to the primitive type, until they have been cultivated under better conditions, and through several generations.

Seeds should be gathered when the weather is dry, and such as are heavy when they fall to the ground, as when beaten or shaken from the trees they sometimes fall before fully ripe. When gathered they should be spread in thin layers in a dry airy place, at least until the dampness is evaporated. The mode of preservation differs greatly with the species and the tendency to sprout, to rot, to heat, to perish by dissication, or to mold, is to be counteracted according to circumstances. In some cases it is important to keep seeds from fluctuations of temperature by burying in dry sand, or covering them with litter or straw. In others it is advisable to keep them cool and slightly damp, as by placing them in a cellar.

The soft maples (*Acer dasycarpum*, or silver maple, *A. rubum* or red maple) mature their fruit in June, and their seeds should be planted at once. The sugar, Norway, sycamore, and some other maples, ripen their seeds in the fall, and they may besown then, or be kept in a box, mixed with sand, until the following spring.

Acorns, walnuts, chestnuts, &c., should be planted as soon as they fall to insure success; but as they are liable to destruction by squirrels and other small animals, it may be often convenient to keep them in boxes covered with sand in a cool place to prevent too much drying through the winter, and then plant in the spring.

METHODS OF PRESERVING AND OF PLANTING SEEDS.

Elm seeds ripen in June, and if they find congenial soil and conditions, will make good growth the first season.

Red cedar berries should be bruised early in March, and mixed with an equal or greater bulk of wet wood ashes. In three weeks the alkali will have cut the resinous gum, when the seeds can be washed clean from the pulp. In preparing the seed beds, dig the ground a foot or more in depth, mix for three or four inches at the surface a liberal dressing of well-rotted leaf-mold (or wood-soil) and sharp sand. Lay off the beds four feet wide, and sow, screen and cultivate as elsewhere described for other evergreens. They may be watered occasionally in the evening in case of drought. The shading should be removed and a mulching of leaves two inches deep put along the rows. They may be transplanted to nursery rows the second spring, and three years after the alternate rows should be taken out.*

ECONOMICAL MODE OF PRESERVING ACORNS IN LARGE QUANTITIES THROUGH THE WINTER.

METHOD PRACTICED IN FRANCE.

Acorns when kept over winter in large quantities, are liable to various

*S. Edwards, of Lamolille, Ill., "in Transactions of Wisconsin Agricultural Society," 1858-1859, p. 506. In this article, preference is given to the red cedar in Illinois before any other evergreen for ordinary screens of moderate height. For screens to orchards, buildings and stock-yards, the Norway spruce would do better. Mr. Edwards has tried and rejected, as not hardy, the cedar of Lebanon, Deodar cedar, Mount Atlas cedar, Douglas spruce, Menzies spruce, Araucarian pine, English and Irish yews, Chinese arbor vita and golden-leaved yew. The sea pine and European silver fir were not sufficiently hardy unless protected in winter.

accidents that injure or destroy their germinating power. They may become too dry; in large heaps they will heat and mold; or if too wet they will sprout sooner than is desired. To obviate these dangers, the following cheap mode of keeping them in large quantities has been mentioned as practiced in France, which might be equally adapted to the middle latitudes of our own country, with such modifications due to greater dryness of climate as experience would suggest:

A place is selected in a forest where the soil is sandy and dry, the surface level, or slightly inclined to the south, and the shelter of large trees low and abundant. It should be fenced in, and if liable to drainage of water from adjacent grounds, a small ditch may be dug around it. The acorns are spread on the ground as gathered, but nowhere more than four or five inches deep, the leaves and litter being first removed. From the beginning, they should be raked an hour or two daily, with great regularity, during the first month, and after that a raking once in two or three days will be sufficient. By the end of December their tendency to heat will be over, and during very cold weather they should be lightly covered with leaves or ferns; but these should be taken off early to prevent sprouting. In temperate climates, no covering is needed but the shelter of the trees. In very rainy winters, the raking may be renewed from time to time, and continued till time for planting.

TREE-SEEDS—METHODS OF PLANTING.

In a report of a committee upon forestry, made to the Iowa State Horticultural Society in 1875 (p. 298), by Prof. Henry H. McAfee, the following practical statements are made upon this subject:

Seeds may be classified for purposes of treatment into three sorts, viz: nuts, hard seeds, and soft seeds. The nuts should always be planted where they are to remain permanently, as the nut-trees do not usually transplant without considerable injury, and the nuts must be kept damp from the time when they are ripe till planted; at least the kernel must not be allowed to become dry, or they will surely fail to grow. Thin soft-shelled nuts, like the chestnut, will, if exposed to sun and air, dry in a few hours enough to prevent growth. So nuts must be kept in earth, or on the earth under mulch, or in something that will prevent drying till used. Peat, moss, old straw, dust, etc., will do. A very good way is to spread them in a thin layer upon the ground, or in a trench so located that water cannot stand among them, and cover them thoroughly with mulch, planting them at corn-planting time, and about as deep as corn is planted.

The hard seeds are generally somewhat slow to germinate, and need to be in soak a long time, to be frozen wet, or to be scalded before planting, or to be treated with some substance to hasten germination. This class embraces honey-locust, which, if kept dry and planted in the spring, will seldom ever grow the first year, and sometimes will not sprout till the third season; also the stones of cherries and plums, and even the seeds of apples and pears. If mixed with sand (two parts of sand to one of seed by bulk) and dampened fully, and subjected to moderate freezing through the winter, all this class except honey-locust, coffee-nut, the hawthorns, and red cedar are likely to grow the season planted. For these exceptionally hard cases, water heated to boiling is poured over them, standing upon them an hour or two, some may swell and can then be picked out and planted, and the more incorrigible treated to another scald, and thus till they all swell, or they are planted in fall and left to grow when they will; or in case of the haws, they may be mixed into bran-mash and fed to sheep or cattle, and the droppings planted, when the seeds, softened by digestion, are likely to grow.

The soft seeds, comprising all not named in the two other classes, may be still further divided into spring, fall and winter seeds, each of which requires or permits different treatment. The spring seeds are those which ripen in spring or early summer, as silver and red maples, and red and white elm, all ripening from May 15 to June 5,* and the rock elm a little later than the others. These seeds will not keep well, and should be gathered from the trees before they fall, except where

they are so situated that they may fall into still water, when, being light and floating, they may sometimes be scooped up in large quantities. As soon as possible after gathering they should be planted, not covered deeply, say one-half inch, in good mellow soil, and if a fine mulch, like damp chaff, can be obtained, it should be lightly spread over the ground to protect from too rapid drying of the ground, which sometimes takes place in June.

The winter soft seeds are ash-leaved maple, green and black ash, sycamore, basswood &c., or those seeds which have a tendency to hang all winter in sheltered localities. These seeds may be gathered sometimes as late as planting time and immediately planted; but if gathered earlier, had better be spread thinly upon the ground and covered until planting time. All others of the soft or winged seeds, not classed as spring or winter, are the soft fall seeds, and they should all be stored as directed for nuts. Hackberry and cherry, though properly classed with the hard seeds, should be freed from their pulp in fall and stored in earth to freeze, and planted in spring without scalding. All seeds, but nuts which are large enough to pick up readily, and such as may be gathered floating on still water, as noted above, are best gathered from the trees, and stored so as not to dry too much. They must not be kept in too large masses, as so dealt with, they may heat and spoil. * *

If ground is not very weedy, it may be economy to plant all the seeds in permanent plantations; but in old or weedy ground it is generally best to grow them in seed-bed or nursery-rows. If put in the permanent plantation, allowance should be made for poor seeds, and more planted than you want of trees. The question of check-row or drill-planting is to be decided by the planter, and the same reasons which determine the manner of planting corn have weight in forestry; though generally speaking, forestry is more satisfactory in drills than is an annual crop like corn. If check-rows are used, several seeds per hill are desirable; and if drills, generally twice or three times as many seeds as you need trees should go in. It is not worth while to put tree seeds into any but mellow, moist soil, and to secure good results with them, thorough culture the first year is necessary. A rule of depth sometimes given is to cover with soil as deep as the seed is thick, and that is of course very thin for small seeds. But seeds of trees often get covered too deep, and any seeds but the nuts ought to grow with half an inch of fine earth lightly packed above the seed. Nuts may be planted a little deeper, but not very much.

Seed-beds and nursery rows are, all in all, to be advised, and they are generally used for seedling trees. Seed-beds are usually four feet wide and of any convenient length, and four inches above the surrounding level. For evergreen and larch seeds, which, by the way, ought not to be attempted by any one not trained in the nursery business, shades are used in the form of lath hurdles, with openings of less width than the strips, and generally in addition to the hurdles, wind screens around the beds, while some nurserymen build arbors over their seed-beds, and such seed is generally put in broadcast, covering by sifting on sandy earth. But for any of our native tree-seeds, shading will hardly be necessary.

* * * * *

Drills across the beds one foot apart may be planted, or drills twenty to twenty-eight inches apart may be made of any length, and on the general level, and the seeds planted at the rate of twenty to forty to the foot. Culture while plants are young should be by hand, running a hand wheel-hoe and hand-weeding in the drill, if necessary; but when the trees have attained some growth, a steady horse may be used, and if the nursery is made of long rows, of course horse labor is better employed than if it is in short rows. Most of the native trees will be fit at one year old to remove to permanent plantation, and if to be so used, should be dug in the fall, and stored by burying, or in cellar, ready for early planting the next spring.

The writer mentions two systems of planting—the furrow and spade—giving preference to the latter in any but a very damp spring. For this a heading spade (a sort with a long blade ending in an obtuse angle) is used to best advantage. The spade is pushed half way down, the handle borne a foot back, and then it is pushed down the whole length, when it is again brought upright. This makes a hole proper for receiving the roots of the tree, and when set the earth is pressed down.

As for distance apart, 4 by 4 feet is generally preferable, which requires 2,722

*These dates, and in fact the whole article, will be considered as applying to Iowa and adjacent parts in the Western prairie country.

trees per acre. Spaces 3 by 3 are as near as can be cultivated by horse power, giving 4,840 trees per acre. The writer prefers $3\frac{1}{2}$ by $3\frac{1}{2}$, and has found that yellow cottonwood at this will cover the ground the first year.

In planting trees the earth should not be wet so as to make a mortar; neither should they be set while there is standing water in the hole. In such cases the soil in contact with the roots tends to become hard in drying, to the great injury of the growth. The clay that may adhere and dry on, where the roots have been puddled in transplanting, should be rinsed off before the trees are set. The necessity of pressing the earth firmly around the roots appears to be greater in the fine prairie soil of the west than where it is of a coarser texture. At least, it appears to be the concurrent testimony of planters on the prairies that the soil should be strongly compressed, leaving, however, the surface loose, so as to readily absorb the rains. A clay soil would be apt to bake if pressed. This tendency to bake is greater when planting is done in a wet time.

SHELTER TO YOUNG SHOOTS IN NURSERIES.

When the young tree begins life in its native conditions it is sheltered by the parent boughs. When we seek to produce the same kinds, in nurseries, it is in reason that we should not expose them to the direct rays of a hot sun. The careful forester will protect the tender shoots by branches of trees lightly spread over the ground, and for this the deciduous kinds are better than evergreens, because the latter afford less shade and sooner shed their leaves.

When this shelter is removed, it should be done little by little, to accustom the plants gradually to the open air.

NUMBER OF TREES TO THE ACRE.

Systematic treatises upon planting give tables showing the number of trees of different species that should be allowed to remain on the ground at different ages of growth. But so many circumstances of soil, aspect, and climate affect these, that the experience of one locality can scarcely be allowed to establish rules for another. In fact, this must be left to the skill and intelligence of the planter, who should carefully observe the wants of the case and afford the relief from overcrowding that the case demands.

It has been stated as a general rule, that full half of the trees first planted at 4 feet apart should be removed before the growth is 20 feet high; the number should not exceed 800 to the acre when 30 feet high; and when 40 feet, not over 300 to 350 to the acre, the soil and exposure being the most favorable that are found. Others reckon the space between at one-fifth of the height.

Some idea of the capacity of soil for tree growth, under the best management in Europe, may be found from the statement that an acre of ash, elm, or sycamore 40 years old will contain 2,000 or 3,000 cubic feet of timber, and when 60 years old double this amount. This is, besides the successive thinnings, which become, when near a market, an important source of income, and when the growth becomes large, may be more in value than the cost of management and interest of investment. These thinnings should be continued as long as necessary, and in full-grown forests may sometimes be required in forests 80 years old. As a general rule, larch, spruce, and other conifers, require less space than broad-leaved, deciduous trees. Larch is supposed to do well in good soil, with 9 feet space around it.

It is also observed that certain trees bear the shade of other species better than that of their own, and that, therefore, a mixture, as for instance, of oak and beech, will grow nearer together than either species would if alone.

The following table shows the number of trees upon an acre, at the distance specified, and the number that might be left at different ages, with the proportional value of the thinning, taken at these several periods :

Age (years).	Distance apart.		Trees to the acre.	Trees taken out.	Proportional value of each trimming to total thinning.
	Ft.	In.			Per cent.
10.....	3	9	3,097	358	3.4
15.....	4	0	2,792	375	5.2
20.....	4	3	2,411	311	6.5
27.....	4	7	2,073	338	10.5
35.....	5	6	1,440	833	23.6
43.....	6	6	1,031	409	23.7
51.....	8	0	680	291	27.5

The amount of timber grown on a given area, in some of the governmental forests of Europe that have been planted and managed according to the rules of forestal science, is very much greater than the same soil would grow in wood if left to itself. So striking is the difference, that Dr. Berenger, who is at the head of the Italian school at Vallombrosa, remarks, in the Journal of Forestal Economy (*Giornale di Economia Forestale*) 1871-72 :

That while an uncultivated woodland taken for a long period, and counting interest and taxes, would yield almost nothing to the capital invested, it is well established that the same land, managed according to modern science would, in the long run, yield a revenue both conspicuous and constant.

PLANTATION OF DIFFERENT SPECIES.

Without attempting to discuss the artistic effects which become a study in landscape gardening and the laying out of parks, we will concisely state some suggestions that have been made as worthy of attention by those who wish to apply them.

By placing a plat of white pine in the centre, and surrounding it by successive belts of Norway spruce, Scotch pine, Austrian pine, white cedar, and red cedar, the group planted on level ground, when fully grown, would appear highest in the middle, as if standing upon a mound. A belt of cottonwood around the margin would afford shelter while needed, and should be cut away when fully established.

Orchard belts of Scotch pine, white pine, Norway spruce, and larch, have been recommended, and the use of screens on the north and west sides have been mentioned as desirable. But from observation and inquiry in the prairie States of the west, we are convinced that the most injury to fruit trees has resulted from hot, drying winds from the southwest, and that a screen against these is quite necessary.

For a mound of deciduous trees on level ground, a central plat of Euro-

pean larch, surrounded by belts of the American larch, soft maple, honey locust, black oak, wild cherry, hickory, ironwood, crab apple and wild plum, has been suggested. But these combinations are too variable for a general rule, and in each locality the planter, with a knowledge of the habits of growth of the trees at his command, will be able to vary them to suit his purposes.

RELATIVE VALUE OF GROWTH AT DIFFERENT AGES.

It is very often found that the layers of annual growth are thicker when young, and that they progressively diminish in width as they increase in size. The conifers of the Rocky Mountains, and elsewhere, often show this fact in a conspicuous manner.

In other kinds, as the elm, the wood is more profitable when cut young, because the timber deteriorates in quality with age. The inner wood of a large elm tree is comparatively spongy and weak. But in other woods, as the oak, the value increases in a gaining progression with age, and large timbers are worth more per cubic foot than small ones, because they can be applied to more important uses when of larger size. The annual revenue from the growth of an oak tree, of the species commonly used in ship building, has been very carefully determined from the mean of a great number of records in France, and is stated as follows :

							Fr. c.
Tree 50 years old,	-	-	-	-	-	-	0 10 per annum.
Tree 100 years old,	-	-	-	-	-	-	0 80 per annum.
Tree 150 years old,	-	-	-	-	-	-	2 00 per annum.
Tree 200 years old,	-	-	-	-	-	-	4 00 per annum.

The value per cubic foot, therefore, increases with the size of the tree, and (for straight hewn timber) the length of clean trunk below the branches.

GROWTH OF WOOD IN DIFFERENT YEARS.

Every one who has closely examined the layers of wood growth on a transverse section, must have noticed that considerable difference occurs between the growth of different years. We have here, in fact, a record of the combined influences of climate upon wood growth. Soil, aspect and other circumstances of a permanent kind may largely influence different trees of the same species, but in a given tree, one year with another, they change so little that we may scarcely be able to appreciate their effect; and in comparing the thickness and quality of the layers formed in different years, we may regard them as an indication of the effects of temperature, moisture, winds and other variable elements of the climate.

ADVICE OF MR. GREELEY WITH REFERENCE TO TREE-PLANTING.

The founder of the New York Tribune took frequent occasion to urge, with voice and pen, the practical importance of tree planting, not only for the direct, but also the indirect profits to be derived from this source. In a little manual, well known, and full of sound advice in matters relating to the general interests of husbandry, this writer gives the following suggestions as to the advantages and best methods of forest culture :

I have said that I believe in cutting trees as well as in planting them. I have not said, and do not mean to say, that I believe in cutting everything clean as you go. That was once proper; * * * it is still advisable in forest-covered regions, where the sun must be let in before crops can be grown; but in nine cases out of ten timber should be thinned or culled out rather than cut off; and for every tree taken away at least two should be planted or set out. * * * Why do not farmers infer readily and generally, that growing indifferent timber, where the best and most valued would grow as rapidly, is a stupid, costly blunder? It seems to me that whoever has attained the conviction that apple trees should be grafted, ought to know that it is wasteful to grow red oak, beech, white maple and alder where white oak, hickory, locusts, and white pine might be grown with equal facility, in equal luxuriance, provided the right seeds were planted, and a little pains taken to keep down, for a year or two, the shoots spontaneously sent up by the wrong ones.

North of the Potomac and east of the Ohio, and I presume, in limited districts elsewhere, rocky, sterile woodlands, costing \$2 to \$50 per acre, according to location, etc., are to-day the cheapest property to be bought in the United States, even though nothing were done with them, but keep out fire and cattle and let the young trees grow as they will. Money can be more profitably and safely invested in lands covered by young timber than anything else. The parent who would invest a few thousands for the benefit of his children or grandchildren, still young, may buy woodlands which will be worth twenty times their present cost within the next twenty years. But better even than this would it be to buy up rocky, craggy, naked hillsides and eminences which have been pastured to death, and shutting out cattle inflexibly, scratch these over with plow, mattock, hoe or pick, as circumstances shall dictate, plant them thickly with chestnut, walnut, hickory, white oak, and the seeds of locust and white pine. I say locust, though not yet certain that this tree must not be started in garden or nursery beds and transplanted when two or three years old, so puny and feeble is it at the outset, and so likely to be smothered under leaves or killed out by its more favored neighbors. I have experiments in progress, not yet matured, which may shed light on this point before I finish these essays.

Plant thickly, and of diverse kinds, so as to cover the ground promptly and choke out weeds and shrubs, with full purpose to thin and prune as circumstances shall dictate.

Many farmers are averse to planting timber, because they think nothing can be realized therefrom for the next twenty or thirty years, which is as long as they expect to live. But this is a grave miscalculation. Let us suppose a rocky, hilly pasture lot of ten or twenty acres, rudely scratched over as I have suggested, and thickly seeded with hickory nuts and white oak acorns only. Within five years it will yield abundantly of hoop-poles, though the better, more promising half be left to nature, as they should be; two years later another and larger crop of hoop-poles may be cut, still sparing the best; and thenceforth a valuable crop of timber may be taken from that land; for if cut at the proper season, at least two thrifty sprouts will start from every stump; and so that wood will yield a clear income each year, while its best trees are steadily growing and maturing. I do not advise restriction to those two species of timber; but I insist that a young plantation of forest trees may and should yield a clear income in every year after its fourth.

As to the far west—the plains, the parks, and the Great Basin—there is more money to be made by dotting them with groves of choice timber than by working the richest veins of the adjacent mountains. Whoever will promptly start, near a present or prospective railroad, forty acres of choice trees—hickory, white oak, locust, chestnut and white pine—within a circuit of three hundred miles from Denver, on land which he has made or is making provision to irrigate, may begin to sell trees therefrom two years hence, and persist in selling annually henceforth for a century, at first transplanting—very soon for a variety of uses in addition to that.

EVELYN'S MAXIM FOR THE PREPARATION FOR PLANTING.

The keeping of soil around the roots of a tree when taken up for planting is no new notion, for Evelyn, in writing two centuries and more ago, reminds us that—

Theophrastus, in his third book, *De Causis*, (cap. vii), gives us great caution in planting to preserve the roots, and especially the earth adhering to the smallest

fibrils, which should, by no means, be shaken off, as most of our gardeners do, to trim and quicken them, as they pretend, which is to cut them shorter; * * * and, therefore, Cato advises us to take care that we bind the mold about them, or transfer the roots in baskets, to preserve it from forsaking them, as now our nurserymen frequently do, by which they of late are able to furnish our grounds, avenues and gardens in a moment with trees and other plants, which would else require many years to appear in such perfection.*

Evelyn also notices the importance of preparing the holes some time beforehand, so that they be left some time open to macerating, rains, frosts and sun—

So that they resolve the compacted salt, (as some will have it,) render the earth friable, mix and qualify it for aliment, and to be more easily drawn in and digested by the roots and analogous stomach of tree. This, to some degree, may be artificially done by burning of straw in the newly-opened pits, and drenching the mold with water, especially in over dry seasons, and by meliorating barren ground with sweet and comminuted lactations. Let, therefore, this be received as a maxim: Never to plant a fruit or forest tree where there has lately been an old decayed one taken up till the pit be well ventilated and furnished with fresh mold.

This practice of exposing the soil taken from excavations made from tree-planting to the action of frost and other atmospheric influences, is sanctioned by the best experience. It is most serviceable in strong clay soils, and is chiefly limited to ornamental planting.

A PRACTICAL VIEW OF THE TIMBER QUESTION.

We shall have elsewhere repeated occasion to mention the eminent success with which the Hon. C. E. Whiting, of Monona county, in western Iowa, has commenced plantations of timber; and the profits already derived from this source. He has been not less diligent in precept than commendable in practice, and his experience is worthy of careful notice everywhere, and especially in the prairie States of the Northwest, to which it more particularly applies. In an essay presented at a meeting of the State Horticultural Society, in 1876, after mentioning the rapid waste and consumption of timber throughout the United States, he says:

The rapid cutting away of what forest we have, and the feeding off and plowing under of so large a portion of our prairie grass, are already beginning to tell with disastrous effect on all our inland streams, large and small. The question will here arise: What shall we do? To my mind, in the light of my experience, the answer is plain, and the solution easy. Let us use the timber nature has furnished us for all the purposes that our wants really require—just as we would use a crop of wheat, corn, cattle or hogs; but, as with the latter crops, let us consider the question of keeping up our stock. In the place of every tree we cut, enough should be planted to make the loss at least doubly good.

The title-deeds which we hold to the broad acres of this good old mother earth of ours, gives us no moral right to render them unfit for habitation for those who are to follow us. Nature has formed all things well, if man would only profit by her lesson, even when she made these vast prairies. One-tenth part of our surface covered with timber—planted in belts—would furnish an abundant supply for every conceivable purpose for which timber is needed. The remaining nine-tenths will furnish more of all the necessities of life, and that with far more uniform certainty, than the whole would without the protection of the one-tenth in timber-belts. For the last twelve years, for every native tree that I have appropriated to my own use, I have planted at least one hundred, and it is proving to be, and is likely to continue, one of the best paying investments ever made in Iowa. Let us now consider a few reasons why every man on a prairie farm should plant timber:

1. To those of us who have chosen our homes in this prairie State, it is a binding duty that we owe to ourselves, to our State and our children.

* *Sylva: or a Discourse of Forest Trees, and the Propagation of Timber in His Majesty's Dominions*, &c. By John Evelyn (1669). Hunter's third edition, i. p. 67.

2. Timber-growing is no longer an experiment, but, with care, a certain and complete success.

3. The State has wisely offered to, and actually does pay, in exemption from taxation, an amount equal to the entire expense of cultivating the timber.

4. If planted in belts around the farm, the protection is worth more than the rent of the ground on which the timber stands. All the timber which I have planted, or will plant under the present law, will stand, when ten years old, without having cost me a cent.

5. It renders a farm so much more beautiful and attractive as a home, and so much more valuable if we ever wish to sell.

6. One can hardly look on those beautiful groves, with their cool shade in summer, and protection in winter, without a feeling of self-conscious satisfaction that he has done one good thing for himself, for his State and for his posterity.

With these facts before us, have we not every inducement to go forward in the work? Our State, as a part of the great confederacy, is taking noble lead in the work. Our State Horticultural Society is giving, and giving most earnestly, all the benefit of her great experience. The State Agricultural Society has also offered large premiums for timber-planting; but its strongest and most earnest advocates are to be found among those who, to-day, are in house, barn and field surrounded by the protecting influence of groves and belts, and know their full value, both in summer and winter. A high state of civilization, and an abundance of timber, must ever go hand in hand; and it is a hopeful sign of the times that the whole civilized world is beginning to move in this direction. Iowa, as a State, must move with the current if she maintains her present proud position. As fine groves of young cottonwood, white willows and box-elders as I ever saw growing, I have seen in the extreme north-west counties of our State, as Clay, O'Brien and Osceola. In the years 1873 and 1874, the St. Paul and N. P. R. R. Company planted, successfully, four millions of trees west of the timber region of Minnesota, toward the Red River of the North. * * *

A few words more to one class of our citizens, and I have done. To our young men who are just starting life for themselves and feel as though they needed every dollar of money and every hour of time for other purposes, let me say, get a few cuttings of white willow, or cottonwood, from an older neighbor, or pull up a few seedlings from the nearest river bottom, or, in the proper season, gather a few seeds of ash, box-elder, soft maple, or elm; plant, set or stick, as the case may be, in well prepared ground, north and west of house and field lots; plant close together, take good care for two or three years in the way of good culture, and you will, almost from the beginning, have an abundance of cuttings from your own cottonwood and willows to continue your plantation around your fields, and in a very short time you will have any quantity of seeds from your box-elder, maple and ash for further plantations. If the quick-growing trees be planted 2 by 5 feet in the rows, an upright growth will be secured, and the needed thinning out, as the poles attain size, will very soon furnish all the fire-wood needed. Set all the trees on the outside line in straight rows, and equal distances apart, and they will, in a very few years, support either boards or wires for a fence.

TREE-PLANTING IN EASTERN MASSACHUSETTS.

OBSERVATIONS OF MR. GEORGE B. EMERSON, AS TO PLANTING, CULTIVATION, KINDS OF TIMBER BEST ADAPTED TO THE CLIMATE, ETC.

Mr. George B. Emerson, of Boston, in a letter commending the subject of planting in eastern Massachusetts,* remarks:

In our hard and barren soil, the land on which the seed is sown, or the young trees are planted, must for many years be cultivated while the plants are growing, in order that they may make any show at all, even in twenty years. They will, doubtless, grow without cultivation—but very slowly. If an open pasture or newly cleared land should be taken, the process must be very different in the two cases.

In an old, open uncultivated pasture, the soil and subsoil are usually very hard, presenting great obstacles to the penetration of the roots. In this case, the ground must be plowed, that it may be opened and loosened to the depth of two feet. After

*Transactions of the Agricultural Societies of Massachusetts, 1874, p. 42.

the acorns are sowed, or the trees planted, the plow can go only between the rows, leaving the subsoil between the rows unmoved. This shows the necessity of getting the ground in proper condition before the operation of sowing or planting begins.

The best kinds of oak, are those of the white-oak group, viz: the common white oak, the swamp white oak, both of them common, in Essex county, Massachusetts, the over-cup oak and the mossy-cup, the latter to be found in Berkshire, the stem-fruited and the sessile fruited, which grow readily in our climate, and the chestnut oak, found north and south of us, and the Rocky Mountain oak, found in rocky hills, in several parts of the State. The wood of all these eight is of great value as fuel and for timber uses. The next group is the red oak group, containing the black or yellow-barked oak, the scarlet oak, the pin oak, and the two varieties of the red, called the red and gray. The black and the scarlet, are common in Essex county, and are valuable and very beautiful. The pin oak is found farther south, but would, I think, grow readily here. The red oak is a rapid grower, and a beautiful tree, but the least valuable of the oaks for fuel or timber. There is one species of the live oak group—I mean the willow oak—which grows so luxuriantly in the State but little south of this, that I have no doubt will grow here.

The time for sowing the acorns is in the autumn, immediately after they have fallen from the tree. It is very difficult to keep the acorns through the winter, and it is necessary only when they are to be transplanted to a distance. They should be placed just below the surface. The plants must for some years be kept free from weeds. I suppose the most profitable way of doing this is that practiced in the peach orchards in New Jersey, which are for some years covered with crops of beans, potatoes, or something else suitable to the soil.

The first acre sowed or planted as a nursery, will bear plants enough for many acres of forests. As they grow larger they may be thinned out and transplanted; and when too large for that, may be gradually thinned for poles or for fuel. I suppose that, either for ornament or for timber-forest, it would be a great advantage to continue to cultivate between the trees, until they cast so deep a shade that nothing would profitably grow.

If recently cleared forest land is to be restored to forest, plowing may be necessary, but probably not subsoil plowing, as the roots will keep the ground open and porous by their own penetration. The thing to be principally regarded is the character of the previous growth. Land ought not to be chosen which has already been covered with oaks, unless the cultivator is willing to go to the expense of trenching to the depth of two or three feet to bring to the surface unused virgin soil.

It would be well to cultivate all the different species, as different species are adapted to different situations; the swamp-oak and mossy-cup to moist land, the rock chestnut to dry, rocky hills, the red to sandy, the white to clayey, the black and the scarlet to hard and hungry soils.

Perhaps it would be well to interpret "oaks" as including the oak family, and thus taking the beech and chestnut; the former for its beauty as a tree near dwelling houses, the latter for its great rapidity of growth, and for its value as fencing and building stuff.

. PROFITS OF PLANTING.

STATEMENT OF MR. O. B. GALUSHA, OF ILLINOIS.

In a lecture at the Industrial University of Illinois, in 1869, the following instances of forest growth and profits of timber culture were mentioned by Mr. O. B. Galusha :*

A few miles from my residence are a few acres of ground which were cleared of timber sixteen or seventeen years since. There was then left upon the ground a growth of underbrush only, consisting of several varieties of oak, hickory, ash, and some other sorts. I have watched the growth of timber there from year to year, until the present time, and am myself surprised at the result. The land was worth when cleared, perhaps \$12 per acre, not more. There have been taken from it, during the last seven years, poles equal in value probably to \$10 per acre, and \$150 per acre would hardly buy the trees now standing upon it. So that, if we estimate the value of the land (at the time mentioned) at \$12 per acre, and compute the interest upon this for sixteen years at six per cent. compound interest, adding the amount

*"Second Annual Report of Board of Trustees of Illinois Industrial University," p. 352.

of taxes accruing during the time, with interest upon this at the same rates, we have \$100 per acre as the net profit of the timber crop; while, of course, the land itself has partaken of the generally enhanced value of surrounding real estate, and would now probably sell for \$50 per acre, were the timber removed.

* * * Let us estimate the expense of raising a growth of ten acres, planted with white ash and black walnut, five acres of each. These varieties grow at about the same rate, and are about equally valuable for lumber. The seeds of the ash, like all seeds of this class which ripen in the autumn, should be gathered when ripe, and kept in the cellar through winter. The walnuts, as other nuts, should be spread evenly upon the ground, where surface water will not stand, not more than two nuts in depth, and covered with two or three inches of mellow soil, that they may freeze during the winter; to be planted as soon in spring as they show signs of sprouting. The land should be deeply plowed, late in the fall if practicable, and finely pulverized in early spring, and marked both ways as for corn, three feet eight inches apart. The tree seeds and nuts should be planted eleven feet apart, which will admit of two rows of corn or potatoes between each two rows of trees. By putting two or three seeds in a place, to be thinned out to one if both or all germinate, an even stand can be secured. A better way is to plant in rows, eleven feet apart, running north and south, and three feet eight inches,—(in the marks for corn). This will secure straight trees, being closer, and they may be thinned out to eleven feet each way, when large enough to use for grape stakes, bean or hop poles. This will give 300 trees per acre, or 3,000 trees in all, allowing for some vacancies, though in all cases of tree planting, whether in groves or screens, a supply of good plants, grown elsewhere, should always be in readiness to use in filling vacancies, which should be done at the end of the first year.

The preparation of ten acres, at \$5 per acre, would be \$50. Average cost of seed, 50 cents per acre, \$5. Planting, \$25. The cultivation, during the first five years, will be paid for in the crops grown between the rows. For cultivation from fifth to ninth years, four years, with horses only, \$30 per year, \$120. After this time no cultivation or care will be needed. This makes the entire cost, in seed and labor, of the ten acres of trees, \$200. These trees will, at twenty-five years of age, average sixteen inches in diameter at the ground, and about ten inches at the height of sixteen feet. This will give, deducting waste in sawing, 120 feet of lumber per tree. Allowing one-sixth for damage by the elements and loss from other causes, we have, in round numbers, 360,000 feet of lumber, which, at \$50 per M., would amount to \$18,000. The value of the tree tops for fuel would be equal to the cost of preparing the logs for the mill, and the expense in sawing would not exceed \$5 per M. This, added to the cost of producing the trees, and the amount deducted from the value of the lumber, leaves \$16,000 for the use of ten acres of land for twenty-five years, and the interest upon the amount expended in planting and cultivating the trees! This statement may be deemed incredible, perhaps, by those who have not previously turned their attention to the subject; but after much study and many years' observation and measurements of growths of different varieties of trees, I am convinced that in all well-conducted experiments in growing artificial groves upon our large prairies, the profits will not fall far, if at all, short of the rates above stated. It must be borne in mind that trees standing at regular and proper distances upon rich prairie soil, and receiving good cultivation, will grow much faster than the same varieties found growing in natural groves. For a list of varieties suitable for planting in artificial groves, I would refer all interested to the lists recommended by our State Horticultural Society, with the remark that the planter can hardly be in error in planting any tree which is indigenous in a soil and climate similar to his own; while many trees, whose native homes are found in latitude north or south, have thus far proved valuable, as the osage orange and catalpa from the south and the red pine and white spruce and some others from the north. Some foreign varieties are equal or superior to any of our natives, among which are European or Scotch larch (best of all foreign deciduous trees), Austrian and Scotch pines, Norway spruce, and white willow.

RULES OF E. FERRAND ON EVERGREEN CULTURE (NEBRASKA.)

Suggested by ten years experience as an evergreen tree raiser, and ten years as evergreen forest planter:

1st. Never plant your evergreens in the fall of the year, but do it in the spring as early as you can obtain the trees.

2d. Do not set your trees in the ground deeper by an inch than they stood in the nursery. Use no manure of any kind in planting evergreen or larch, but let the soil be mellow and friable, without lumps in contact with the roots.

3d. Do not plant trees under two years old even for stocking a nursery, and for the garden and lawn give the preference to trees one to three feet high.

4th. Never dig deep among the roots of your trees, but keep the soil mellow and moist at the surface by a light mulching of bruised straw or hay, that will prevent the weeds from growing.

5th. Last, but not least, get your trees direct from a nursery, carefully avoiding trees that are heeled in by peddlers in the fall, because such are always killed at the root, notwithstanding their green appearance. And here allow me a little digression. Give your preference to home nurseries. You have men here engaged in the business who have spent their lifetime judging what varieties of trees you could better plant for your profit and success.—(*Fourth Annual Report of Nebraska State Board of Agriculture*, 1873, p. 443.)

METHOD OF CULTIVATION BY THE WINNER OF A PRIZE.

A statement made by Hiram O. Minick, Nemaha county, Nebraska, to whom a premium was awarded for the cultivation of a grove of not less than 1,000 trees, gives the following account of his method of cultivation :

The ground was plowed in the spring, the same as for a crop of corn, and crossed out at distances of five feet by seven. The cottonwood yearling trees were procured on a sand bar in the Missouri river, in the fall previous, and heeled in during winter. By selecting a spot on the sand bar where the surface of the sand is but little above the water in the river, the yearling trees can be pulled out with great rapidity, probably at the rate of a thousand in twenty minutes, the operation being similar to pulling flax, and the trees can thus be taken up preserving their rootlets entire, thus securing them in the best possible condition for transplanting ; and taken at this age they receive but little check in their growth by the operation. Part of my grove was planted with the spade, the operation being the same as for a hedge. Another part of the grove was planted by drawing a deep furrow with the plow, and dropping the trees at the crossings of the furrows, the roots in the furrow and the tops projecting out, and then cover by throwing another furrow slice upon the roots and base of the stock with a plow. This left the trees leaning at an angle say of forty-five degrees, and fearing this position would be injurious to the trees, I took the pains to place some of them carefully erect ; but upon an examination of the trees after one year's growth no difference was perceptible in those left leaning and those straightened up, as they invariably start their growth from a bud near the base of the stock and grow erect. The portion of my grove composed of cottonwood contains about 3,000 trees, and was the work of two men, a boy and team, one day planting. The ground was cultivated similar to corn for two years after planting. This required one hand and horse two days each year to five acres of ground. The maple portion of my grove was planted by preparing the ground the same as above, and dropping the seed (which have been procured from trees on the Nemaha river) in the furrow and covering with the harrow, and cultivating as above. The seed ripens about the middle of May, and is generally very abundant. The following may be considered as a fair estimate of the cost of the grove :

Hand and team one day procuring trees,	- - - - -	\$3 00
Two men, boy and team employed in planting,	- - - - -	5 00
Plowing ground,	- - - - -	5 00
Two years' cultivation of trees,	- - - - -	9 00
Total,	- - - - -	\$22 00

TIMBER-GROWING IN NEBRASKA.*

* * * The best method of stocking our prairies with timber is to prepare the soil precisely as you would if you were going to raise a large crop of corn. The quickest way to raise a grove is with cuttings of cottonwood or willow. I plow, drag and mark the same as for corn, four feet each way, which will contain 2,722 hills to the acre. I should plant one-half to trees, four feet one way and eight the other, making 1,361 trees, and the other in corn for two years, to pay for cultivation, and that is all the cultivation needed. I should adopt the same plan in planting acorns, hickory nuts, white and black walnuts, soft maple, elm and ash, where the sprouts are one year old. White pine, arbor vitæ, red cedar, European and American larch, when large enough to transplant, require more cultivation. I estimate the cost of preparing an acre and getting the seedlings of soft maple or ash (they can be had by the thousand along our streams) at \$3 per acre. A man can plant two and a half acres per day. This is all the cost for ten years, except interest and taxes on land. I have 1,361 trees per acre; seven years from planting I will cut one-fourth, or 340 trees, equal to 15 cords of wood; the eighth year 15 cords more; the ninth the same; the tenth year you see my profits. I should cut what is left, 456 trees.* Allow four trees to the cord, so as not to over estimate it. I have several trees only ten years old which are 14 inches in diameter and 50 feet high; four, I think, would make a cord. Allowing six trees to the cord, we have 76 cords, and with 45 cords cut before, 121 cords. At \$3 per cord, allowing \$1 for cutting, I have \$242. I contend that five acres planted to cottonwood, after a growth of seven years, will furnish one family with fuel for one stove a lifetime, and sell enough to pay for the use of the land besides. I claim, after fifteen years experience in tree planting on this plan, which I adopted last spring on Arbor day, on my new farm in Otoe county, Nebraska, that the white willow (*Salix alba*) is equal to soft maple for wind-breaks and fuel, and superior to all trees for rapidity of growth, as well as good for timber. Chestnut, too, is super-excellent. The climate influence of timber is discernible in the regular attraction of rain and tempering the chilly winds of the winter.

PLANTING IN NEBRASKA.†

* * * What shall we plant in Nebraska that will most quickly and fully meet our requirements? Shelter and shade are our immediate and imperative necessity. To provide these we unhesitatingly recommend, first of all our native trees, in the following order: Soft maple, willow, cottonwood, buckeye, ash. The maple is raised from seed as easily as corn; makes a good shelter when thickly planted in rows, and a grateful shade where room is given to its lateral branches. It furnishes a fuel which, though it does not consume as slowly as oak and hickory, makes a quick, hot fire. The willow, objected to by many as a harbor for insects, yet offers a complete break to the keen winds, grows rapidly to a good size, and some varieties, as the white and weeping willow, furnish good timber for fuel and manufacturing purposes. The common osier, planted upon wet spots, will pay as well as any other crop on the farm. Cuttings of all varieties are easily and cheaply secured.

As a source of profit, the raising of trees in Nebraska ranks next to the raising of stock. A quarter section planted with chestnut, spruce, larch,

*From an article by J. W. Davidson, in the Fourth Report of the State Board of Agriculture, p. 444.

†From an article by James Morris, in the Fourth Report of the State Board of Agriculture, p. 454.

maple, mammoth aspen, or even inferior trees, would, in ten years, yield a satisfactory return for the investment.

CLOSE PLANTING OF COTTONWOOD.

Judge Whiting, of Monona county, Iowa, remarked, in 1869, that he had at first planted cottonwood eight feet apart each way, giving each tree 64 square feet of ground. They grew well, but too many branches in proportion to the amount of body wood. He had adopted the rule of planting three feet each way, giving nine square feet to a tree, and in this order they grew tall and straight, soon shaded the ground, and in three years needed no further cultivation than thinning as became necessary, by removing alternate rows and drawing out the poles with one horse and a chain.

THINNING OF PLANTATIONS.

In a young growth of natural seedlings, the plants are often densely crowded; but as they become larger the feeble ones die, and others lose their lower branches; and so, from year to year, the numbers diminish in the struggle for life, until but a small part of the first number comes to full maturity. The careful forester seeks to imitate this process of nature by securing a sufficient growth for shading the ground from an early period, and by reducing the numbers as the trees increase in size. These labors include the clearing out of the worthless bushes and brambles that never come to useful size, but is chiefly secured by giving the greatest opportunity possible to the most valuable kinds. No rules can be given for the execution of this work, without knowing the conditions, further than the general statement, that it should be done wherever required, and as often as may be necessary.

With respect to the removal of a part of the trees of the valuable kinds, where crowded, great prudence is to be exercised, because the whole growth, if standing dense, if too much exposed at once, would be liable to suffer from the winds, or from the weight of snows. The precept laid down by Lorentz and Parade for the first thinning, is as follows:*

The principal rule to be observed in a thinning of this kind, is to keep the trees conveniently close, and in a word, *never interrupt the continuity*. In a young wood, which has hitherto grown very dense, the stems are very thin and slender, and have the greatest need of support. An imprudent clearing would expose them to storms; they would be injured by the weight of snow and ice, or even bent down by the weight of their own tops. In such a growth, it is to some extent necessary to save some of the poorer kind as protectors, and allow them to stand till the next thinning. We should also remember that the young trees must obtain the greatest height possible, and this can only be done by keeping them close. At an older stage of growth, the inconvenience of too much thinning would be less injurious. Moreover, if opened too much, the grass and the weeds will get in and absorb a part of the aliment of the soil; or, if it be a seed year, a new crop of tree seedlings will cover the ground, which is to be, if possible, avoided.

The age at which the first thinning is needed cannot be fixed by any rule, as it depends upon the rate of growth and the various influences to which it is exposed. It should begin as soon as the lower branches begin to die and drop off, and should be repeated more thoroughly when the trees get to be three or four inches in diameter at the ground, and afterward, from time to time as may be necessary, till the forest gains its full maturity. These operations may be repeated every five years at first, and afterward at longer intervals. In the state forests of France, where the most valuable timber is the object, and time of less consequence, the interval is some fifteen or twenty years. Although in these operations no particular number

*"Culture des Bois," 2d ed., p. 174.

of trees can be fixed as a rule, it may serve as some guide to give the following as approximately the proper number to be left :

At 30 to 40 years—1,300 to 1,620 to the acre.*

At 50 to 60 years—490 to 608 to the acre.

At 70 to 80 years—305 to 410 to the acre.

At 90 to 100 years—200 to 360 to the acre.

The selection of trees to be removed in thinning out forests so as to allow the reserves the better chance for development, can best be done in summer, when the foliage is the densest, and the effect of shade the most apparent. An experienced eye can at such a time more readily judge as to what trees are most promising and what can best be taken out.

A recent writer upon practical forestry,† in speaking of the proper time for thinning a plantation, recommends that it be done early, and assigns as a reason that the remaining trees will then have seasonable opportunity for developing their lower side branches. He remarks :

It is those branches situated upon the lower part of the stem of the tree that supply food and nourishment to the roots, and unless they are preserved vital at this critical period of the tree's existence, it very soon ceases to develop itself and make wood. In fact it ceases to grow to anything like satisfaction at that very early period when it should be making wood faster than any other. To the preservation of the lower branches of the celebrated larch forests of the Duke of Athol, more than anything else, may be attributed their successful growth. The larch there were planted 6 feet apart, and that distance, admitting that all the trees grew, allowed all the lower branches to grow 3 feet in length all around. But as many of them would no doubt decay, and from accident and other causes perish, many of the trees would thereby produce their lower branches twice that length, hence the unparalleled results of the growth of the larch in these forests.

Having witnessed so much injury inflicted upon young plantations, and some entirely ruined by the lower branches being interfered with at a stage of growth too early, I would recommend, in the strongest possible terms, the special attention of all who have the management of plantations, to this particular aspect of the subject. It is often asked what rule can be given, and how it may be known when either individual trees or plantations have the exact and proper quantity of branches upon them. The rule for this is, as far as any rule can be given, to maintain a due proportion of girth to the height of the tree, and these proportions are, girth in inches to feet in height. For example, a tree twelve feet high should have a girth a little above the swell of the root of twelve inches, and so of larger sizes. When trees attain the height of 30 or 35 feet thinning should be entirely discontinued, and frequently it should not be prolonged after the trees are 20 to 25 feet in height, but allow the plantation to grow undisturbed (except by cutting down dead or decaying trees) till it is ripe for cutting down and clearing the ground. There is a danger of old trees having too many as well as too few branches ; but there is no danger of *young trees* having too many, and if the rule given should be observed there will be no superfluity of branches at any time, for if the proportional girth is too great it can soon (if there are sufficient trees upon the ground) be reduced.

The form of the tree up to the period when the thinning should be discontinued, should be conical or tapering, both in the stem and general form of the tree. After thinning is discontinued the shape of the tree alters, both in the stem and branches ; the latter wither and fall off till only the top is covered, and the form gradually changes from a cone to a cylinder. The cause of this is the increase of woody deposits near the live branches, and the decrease of it where the branches have fallen off.

This writer points out various reasons that should prevent late thinning of evergreen plantations, among which are the insufficiency of roots in trees

*"In France, Duhamel and Varenne de Fenille advised a much greater reduction, allowing, in fact, almost as much land for an oak as an apple tree in an orchard. The object in view was the thickness of the trees, rather than the height, and such broad spreading trunks as ten or eleven metres between the trees would produce, could not fail of yielding an abundance of the crooked pieces so much prized in ship building."

†"On Thinning Plantations, as applicable in Practical Forestry," by Christopher Young Michie, of Cullen House, Cullen. "*Transac. of Highland and Ag. Soc.*," 1876, p. 199.

closely planted, and which are not able to support them when exposed to the winds, the injury that the sun may cause upon the trunks and branches that have been accustomed to the shade, and the effect upon the roots when the ground is too much exposed; although all of these parts may in time become accustomed to these different conditions. He regards the thinning of such forests a delicate and dangerous operation, except when practiced while young, and mentions some forests in splendid condition, which had scarcely been trimmed at all. In one the trees stood nine feet apart on an average, some as far as fifteen feet, and others as close as two feet. The market value of such a forest, if the trees were all sound, would be at least £300 per acre. The ground was a light, sandy gravel and very poor. He advises that all thinning should be begun before the side branches touch each other, and that it be continued till they are eight feet apart, after which he would leave them to nature to complete their growth.

As to the larch, our author remarks, "It gains the most by thinning and suffers least from it. It is very impatient of confinement, and enjoys freedom although it comes late. On the bare, pole like trees that are left, lateral branches will form beyond anything witnessed in other forest trees. Unless the trees are sound and healthy, however, no lateral growth will take place by thinning." He mentions some stumps of this tree that had remained alive more than twenty years after cutting, without being able to account for the phenomenon. He regards the two greatest errors of foresters as "being too late in commencing to thin, and continuing the operation too long. It does much good if done early, and equally much harm if done late."

MEANS FOR DESTRUCTION OF INSECTS INFESTING TREES.

Among the methods practiced with success for the destruction of insects upon forest trees, and applicable to forest trees, may be mentioned the following:

Building fires in the evening, to attract millars and other insects; which fall into the flames and perish.

Jarring the trees by striking them with a heavy piece of scantling, padded at the end to prevent injury to the bark. Cloths should be spread under the trees to catch whatever falls. Some caterpillars that spin down on a silk fiber, may be swept down with a broom and destroyed.

Smearing the bark with tar, molasses or printers' ink, or other viscid substance, or what is better, wrapping paper or cloths around the trunk, and applying the tar to these instead of the bark. The substance should be renewed as it becomes dry.

Surrounding the trunks with leaden troughs filled with oil, coal tar, or other liquids. Applying discs of tin, that, sloping downwards, prevent insects from passing. Binding locks of cotton wool around the trunks, &c.

Washing the trunks and large branches with soft soap, or strong soap suds or lye, or whitewashing with lime.

A wash composed of one pound of flour of sulphur and a peck of quicklime, mixed in a close vessel with a sufficient quantity of hot water to make it of the consistence of common whitewash, has been used with advantage as a remedy against insects and mildew in forest and fruit trees. It should be applied when freshly made, in April, using a whitewash brush.

Dusting the leaves of trees with lime, or with powdered hellebore, when the dew was on, has been mentioned as a remedy against leaf-eating insects.

Another mode of protecting trees from insects that crawl up the bark, con-

sists in fastening a rope around the tree and nailing a strip of tin, four inches wide, around the rope so as to project above and below. The females of the insect whose larvæ is the cankerworm (*Anisopteryx vernata*) will lay her eggs under the rope, where they may be killed by applying kerosene.

Digging around the trees to kill or expose the larvæ to frost has been tried with success. Others scatter corn around the roots, and allow hogs to root among it, thus turning up the soil, and doubtless destroying many of the puppæ. Late plowing, by exposure to frosts and to birds, will assist in destroying insects on their nests.

Hand-picking, the seeking of cocoons and nests of insects, especially in winter. Sweeping or burning down the nests of insects, and seeking and destroying them in their burrows, have been practiced with success.

The vapor of kerosene has been proposed as a remedy against insects infesting wood work.

The injection of mineral salts and of creosote, &c., is a preventive against insect damages to timber. The sap-wood of white hickory, so liable to injury from boring insects, even after worked into spokes or made into carriages, is sometimes protected by these chemical processes.

The apple-leaf crumpler sometimes contains the eggs of parasitic insects which would hatch, and by multiplying diminish the injuries done by this insect. It is therefore recommended to gather the affected leaves, and instead of burning them throw them on the ground in a bare place. The parasitic insects would hatch and be saved, while such of the noxious kind as hatched would perish before reaching a feeding place.

But many of the methods above enumerated are applicable only in a small way to trees in nurseries or favorite shade trees, and in forest culture we must seek relief from other sources, or, as sometimes happens, stand helpless and witness the great injuries done without hope of relief.*

Immense damages are also committed in fields and gardens upon grains and fruits, and here, as in the forest, there is often evidence that an increase is often caused by killing off the birds.

SHELTER BELTS, WIND BREAKS, &c.

A wind screen, if close, affords some protection on the windward side, by the calm which it produces. It is noticed that sheep and cattle will sometimes find shelter on the front side of a screen.

A writer in the *New England Farmer* (vi, 350), in noticing shelter, and its effect upon farm stock, says:

It is indeed astonishing how much better cattle thrive in fields, even when moderately sheltered, than they do in an open, exposed country. In the breeding of cattle, a sheltered farm, or a sheltered corner of a farm, is a thing much prized; and in instances where fields are taken by the season for the purpose of fattening cattle, those most sheltered never fail to bring the highest rents.

In the grazing regions of Texas, cattle seek the timber on the approach of a storm, and stay there while it continues, and on the western plains they will retreat before a storm a long distance to gain shelter.

The freshness of pastures interspersed with trees, is well known in the

*In speaking of insects, we must distinguish between friends and foes, and not regard our allies as enemies, however disagreeable they at times become. The ant is treated by the German forester as his friend, knowing as he does the services which these little insects render. Besides furnishing in its eggs a dainty food to many kinds of song birds, it pursues the larvæ of leaf-eating insects with great avidity, mounting to the highest branches in pursuit of its prey, and destroying these destructive parasites of trees in great abundance. A nest of ants introduced in the midst of a plantation of cabbages has been known to protect the plants from the worms that were destroying them.—*Revue des Eaux et Forêts*, xiii, 303.

dairy regions of the north, and is doubtless partly due to the shelter that trees afford to the winter snows.

The prevalence of dry southwesterly winds in the Western States, has suggested a practice, quite advantageous in fruit trees, of leaning the trees toward that point, so as better to resist the wind, as well as to shade the trunk from the sun. It is also found a good practice to allow the tops of fruit trees to grow low, so as better to resist the drying effects of the wind and sun. The same reasons would lead to a like practice with the outside rows of forest trees, especially on the sides of a grove most exposed. It would be unnecessary in the interior, as if properly set, the trees would shade one another sufficiently for all purposes, after they had got well started.

Dr. John A. Warder, in a paper read before the Northern Illinois Horticultural Society,* in speaking of shelter for fruit trees, says:

Evergreens may be planted here and there through the orchard with very great advantage. For this purpose the most robust varieties should be selected, such as the Scotch and Austrian pines, and the beautiful Norway spruce, from Europe, or our own native, the noble silver pine, the red or Norway pine, the *Banksiana*, the white spruce, the common red cedar and arbor vitæ. All are robust and hardy, rapid growers, and valuable for shelter and for timber, but *screens* are what we need. A single row of such trees outside, will afford a great deal of protection from the winds after a few years, indeed, from the first; but a closely planted belt of two or three rows will be much more effective. These should not be set too near the orchard trees; two rods may be allowed, or, if closer, the outer rows of the apples can be cut out in a few years to make room for these nurses when they may require more space. The evergreens may be set in double or triple rows, and alternately, so that every three shall be opposite the space in the next row. In planting a triple row, it is well to set the *Pinus strobus* in the middle, with Norway or white spruce, or red cedar, on either side, planting these from eight to ten feet apart. * * * The hedges should not be set too closely to those shelter belts, especially where they are allowed to grow high for screens. At one rod they will soon interfere with the trees, so that a space of two rods may be better—outside the belt. In large plantations it may be well to set rows of evergreens across the orchard, dividing it into two or more sections. For this purpose, a single row of Norway spruces will produce a very fine effect, or the American arbor vitæ can be used as an evergreen hedge, and kept to a height of ten or twelve feet if desirable.

Both these plants are eminently well adapted for close shelters, and will bear the shears, which help to make them a perfect screen and wind break. Deciduous trees are also very desirable as shelter belts, and for the sake of immediate effect the quick-growing kinds are preferred, such as the soft maple, or even the white willow, but more especially the European larch. * * * These should be planted pretty thickly, say five or six feet apart, and in strips of three or four rods wide, to produce their best effects, both as shelters and for timber, for which they are highly recommended. Do not be misled by the swampy habits of the native tamarack, nor induced to set the larch in the sloughs, which should be planted with willows.

PROTECTION TO NURSERIES.

FRENCH EXPERIENCE.

Screens or wind breaks (says Carrière†) are indispensable to a nursery, as well to shield the plants from the hot sun, as to shelter other kinds from cold in winter. Their direction will vary according to the contour of the ground, but they should almost always run east and west. Wind breaks, according to local circumstances, may be oblique, either to the north or south, and it may be necessary to have them in a line between these points, for the climatic conditions under which the nursery is placed, and surrounding objects, such as a mountain, a grove, a river or a lake, or large buildings, may deter-

*"Transactions," fourth meeting, p. 63.

†*Peptinieres*, pp. 38-41.

mine the course of prevailing winds, and observation alone can decide as to which are the most prejudicial. Having settled upon the direction of the lines, the next thing to determine is the species with which they should be planted. Some kinds are preferable to others, and they vary with the soil and climate. We always prefer evergreen trees; but these are for the most part of slow growth, and when the intention is only to shelter the nursery in summer against the ardor of solar heat, the choice is left among the deciduous kinds of rapid growth, which do not shed their branches too near the ground, and of which the foliage and aspect is sufficiently ornamental. There is another consideration that is not less important. We should not select trees with long, tracing roots, which, by spreading, so to speak, "*eat up the soil*," by robbing the plants even when growing in pots. In these respects we have two species of the *Tamarix* that unite almost all the good qualities required, the *T. tetrandra* and *T. Indica*. These trees are very accommodating as to soil, have a hardiness well tried, and a very rapid growth—endure prolonged drought without injury, and appear indifferent to excess of moisture. Their roots are small, close, and but little spreading; they bear trimming, and their elegant foliage of light, feathery spray form plumes of most pleasing effect, while their blossoms of rose, flesh colored, or almost white tint, in spikes or branching panicles, present a most agreeable aspect. The first of these blooms in April and May, and the other toward the end of summer and in autumn. The tamarisk grows easily from slips, which may be set from November to February, and will form the first season shoots from one to two meters high. They should be set about eight inches apart, and may be cut back when twenty inches high to make them thicken up. Sometimes a trellis of grape vines will answer every purpose of a screen for young fruit trees.

But, as we remarked at first, the evergreen species are generally employed as a screen, and of the conifers the *Biota orientalis* is particularly suitable when the soil is light, warm, and but little calcareous. In places where the soil is more moist and more clayey, and the climate more severe, the *Thuja occidentalis* is much more hardy. The common yew (*Taxus baccata*) is also very precious as a wind break. Its foliage is very dense, and of a green so deep that it borders closely upon black, and the perfect docility with which it bears clipping renders it a most valuable tree for a shelter hedge. We sometimes employ the common pitch tree (*Picea excelsa*), but this tends to grow to a large tree, and readily sheds its lower branches. The red cedar (*Juniperus Virginiana*) is also sometimes used as a wind break, and in proper soils produces a fine effect. In many districts of southern France the pyramidal cypress (*Cupressus fastigiata*) is used to advantage.

Of the evergreen shrubs other than conifers, we have the box (*Buxus sempervirens*), evergreen oak (*Puercus ilex*), the holly, the *Bupleurum fruticosum*, the *Rhamnus oleifolius*, the *Aucuba japonica*, and the Japanese spindle tree (*Evonymus japonica*). The latter may be used when we need shelter of limited extent, for they are generally of low growth. In some places we may plant the *Lauro-cerasus vulgaris*, *colchica*, and *lusitanica*; and in other cases may employ shrubs with semi-persistent leaves, as the *Rhamnus hybridus*, *Ligustrum japonicum*, *ovalifolium*, and *vulgare*. In some privileged localities of southwestern France, we may plant the *Rhamnus alaternus*, *Arbutus uredo*, *Viburnum tinus*, and a host of other species.

The breadth of space to be reserved between the lines of shelter varies somewhat according to the use, but it should be never less than two metres between, because the paths for service would be always of about this width. If there be no necessity of using the ground sparingly, it would be better to

give them greater width, so that the plants sheltered may be a little away from the screen, and it would be still better if a path could be allowed on both sides.

TIMBER-BELTS FOR FARM PROTECTION IN KANSAS.

Mr. W. Marlatt, of Manhattan, Kansas, in a paper read before the State Horticultural Society, in 1875, after alluding to the frequent and severe losses of fruit and forest trees in Kansas, and condemning altogether any attempt at planting until the soil was as thoroughly prepared as for corn, he says:

With my present experience as to the peculiarities of the soil and climate of Kansas, I would plant timber only in the form of shelter belts for the protection of farm crops, the orchard, the stock range, and the home and its surroundings, being especially careful to shelter the latter from the north, northwest and northeast winds, leaving the south and east, particularly, open to the sunshine and south winds, which are *nearly* always warm in winter and cool in summer. By planting the shelter belts on the higher and more exposed ground, where practicable, the value of the farm may be greatly enhanced at a comparatively small outlay, æsthetically as well as practically. From experience and observation, I am of the firm belief that if 40 acres in every quarter section were thus occupied by judiciously located timber belts, the remaining three-fourths would produce more than all of it would without the protection thus afforded. I have seen the soil in exposed situations blown away to the depth of six inches, or as deep as the land has been plowed, in a single season. An effective shelter belt would not only remedy this evil, but would serve largely as a preventive of drought; first, by measurably warding off the dry, hot winds that sometimes sweep over the country as a blighting, withering curse; and, secondly, as a shelter for the snow, that is otherwise blown away into the ravines and hollows, where it is not needed; and, again, in breaking the force of the fierce storms that almost every season do more or less injury to the growing corn and other farm crops.

I recommend the cottonwood for timber belts, rather than some other more valuable species of wood, from the fact that it takes kindly to our prairie soil, grows rapidly and tall, and is yet able to withstand the force of the winds; and, on the whole, seems to fill the bill more nearly than any other at hand just now. To render this shelter mere effectual. I would plant out a single row of box-elder, or some other spreading or low-heading tree, on either side of the cottonwood belt. I recommend the box-elder for this purpose, from the fact that it is never stripped of its leaves in summer, not even by the omnivorous hopper. As this belt attains to age and size it must be systematically thinned out by removing, from year to year, a certain number of the less likely or less thrifty trees, else, in the course of time, you will find them dying out *en masse* for want of sufficient nourishment to keep up the vital force necessary for their continuous growth and well-being. As they are removed thus gradually, other varieties of forest trees may, with success and profit, be made to take the place thus vacated, and for this purpose, where they can be had easily, I would especially recommend red cedar. At all events, in planting a grove, stick to our *native* forest trees, rather than any of foreign growth, however highly they may be extolled by parties interested in their sale, or without an experimental knowledge as to their adaptability to our peculiar soil and climate.

A few words as to the best mode of planting such a belt must suffice for this phase of the subject. Supposing the ground to be in proper condition, and the trees ready to hand, with team and plow strike a straight furrow through the centre of the piece to be planted, and back-furrow three rounds, going 8 to 10 inches deep. Then, with an armful of small trees pass along in the furrow, and at every four feet stoop down and place a tree in the loose soil thrown up at the last round, letting the top lean toward the ridge. Then turn on a furrow, and so on at every fourth furrow, until a dozen or more rows have been thus put in their place. Then passing along each row, straighten up each tree with the hand, and at the same time press the earth firmly about it with the feet. In this way, with one man to run the team, and two others to put the trees in place and straighten them up, two acres may be planted with 5,000 trees in a day, at a cost, aside from procuring the trees, of not more than \$5. In this manner the farm, when comparatively level, may be surrounded and intersected, where necessary, with shelter belts

at a comparatively small cost, and the value of the place may be doubled in five years?

In orchard and small fruit culture. I consider protection of some sort as absolutely essential to success. I have found most kinds of small fruits doing best when partially sheltered from the hot sun; while the sad effects of the burning southwest winds two summers ago is but too apparent in nearly all the orchards of Kansas to-day. In my own, I have found, generally speaking, the least damage done where most effectually sheltered on the south and west.*

In asserting the value of wind breaks to growing crops, or as a shelter for stock, it is impossible to appraise the benefit pecuniarily with anything like the exactness with which we measure and sell the actual products of the forest. We may, however, sometimes arrive at a close approximation by comparing the differences shown where the protection is present or absent. In illustrating this point, Mr. O. B. Galusha, of Illinois, has presented some instructive examples:†

In the year 1862, at the time when spring wheat and oats, in the northern portion of the State, were just past their bloom, and a portion of the grain in the milky state, we were visited by a storm from the northwest, which swept over this portion of the State, prostrating nearly all the grain not sheltered by timber. * * * In one locality a single line of broad and tall willows, closely planted, proved a sufficient check to the wind, so that a field of wheat adjoining it on the east, stood erect and was harvested with a machine, while in exposed situations the shrunken grain, if saved at all, was often gathered by the slow and tedious process of hooking it up with scythes. Many thousand acres were left to dry, and were burned upon the ground which two or three weeks before had promised abundant crops. The extra expense of gathering the grain of that harvest could not have been less than 50 cents per acre on the whole amount harvested. I traveled quite extensively over this portion of the State before and soon after the harvest of that year, and am convinced that one half the value of the wheat and oats in the territory passed over by that storm was destroyed by it. There were sown in that year, as per census reports, in the thirty counties lying north of the Burlington, Peoria and Logansport railroad, about 1,200,000 acres of wheat, and at least one-fourth as many of oats. Allowing one-tenth of these crops to have been protected by timber, we find the loss to have been equal to 540,000 acres of wheat, and 130,000 acres of oats. Computing the wheat at 15 bushels per acre, and the value at 50 cents per bushel, the oats, at 30 bushels per acre and price 20 cents per bushel, we have the sum of \$4,860,000 as the cash value of property in these two crops alone, which was destroyed in a single storm in an area of little more than one-third of our State. Allowing 150,000 acres to have been burned, or not harvested, and adding to the amount of loss per acre the remainder of the nine-tenths (lodged grain), equal to \$600,000, it swells the amount to the enormous sum of \$5,460,000. Let us see how much it would cost to plant and cultivate screens to prevent such losses. A double row of white or golden willows, with trees in the second row set opposite the spaces in the first, planted on the west side of every 80-acre lot, would doubtless prove sufficient, as they would, at the age of twelve years, form a dense wall of foliage about forty feet high, and would, of course, increase in size for many years thereafter. These would cost per mile of screen, about as follows: Average value of two acres of land, at \$40 per acre, \$80; preparation of the soil and planting with strong cuttings, \$10; cultivating the first two years, \$20; making a total cost, with purchase money of the land, \$110. After two years no care will be needed, save a mulch of refuse straw, to be renewed once in two or three years, the cost of which will be more than repaid in the partial protection which the trees will render previous to the twelfth year.

There are in the thirty counties referred to about 16,625 sections of prairie land. This will require 66,500 miles of screen if planted as above proposed, making the entire cost \$7,315,000. Thus, we see that without estimating the immense damage done to fruit and other crops, the wheat and oats destroyed in that storm would, if saved, have paid about three-fourths the entire expense of growing timber belts throughout that entire territory.

*"Transactions of the Kansas State Historical Society," for 1875, p. 113.

†"Lecture at the Illinois Industrial University in 1869, published in the second Report of its trustees," p. 356.

I think it may be safely estimated, that an average of one-twelfth part of all our crops of grain and large fruits are destroyed by violent winds, which such a system of protection, or its equivalent in groves, would so far check as to prevent the destruction. If this is true, such protection would save to the husbandman and orchardist its entire cost every two, or at most, three years. Such protection, too, would, by causing the snow to remain spread evenly over the surface; as before hinted, enable the farmer to raise winter wheat in localities where it is impossible now to do so. If we add to the benefits of the culture already considered those far-reaching and incalculably valuable climatic influences which would flow therefrom, we must all admit the necessity of commencing this great enterprise at once, and prosecuting it with vigor.

I do not introduce this plan of planting straight belts of trees, a quarter of a mile apart, because it is the most desirable plan which can be adopted, for no man of taste would regard it as such. The eye would soon tire of such stiffness and monotony in the landscape. Tree-planting may be so planned and conducted as to give beauty to the landscape, and at the same time secure nearly all the combined benefits of protection to crops, timber for uses in the mechanic arts, and those climatic influences which we all regard as so important. Of course no rules can be given for such tree-planting. Generally where the surface is somewhat undulating (for we have no hills), the planting should be done mainly upon the higher portions of the farms, and along the water courses. Where the surface is level, belts may be planted upon the north and west of the farms, with groves upon the least valuable portions. These last would intercept the straight lines and give diversity. But if each prairie farmer were to follow his own tastes, or adapt his planting to secure his greatest profit in timber or protection to his own farm, planting about one-tenth of his land with trees, it is probable that all the desirable ends which we have been considering will be gained, and the landscape sufficiently diversified to be pleasing to the eye.

Here then * * * we have two pictures presented us. In the one we look into the future, and see wide spread desolation, an extended treeless country, visited by destructive storms, by severe drouths, with its streams dried up, and food for man and beast in such scarcity that the poor can scarcely obtain a supply. In the other, we see a charming landscape, a rich fertile country, a population enjoying all the blessings which flow from peace and plenty.

The following suggestions concerning shelter-belts are offered by Messrs. H. M. Thompson and son, of Milwaukee, Wis. :

It has been found that belts from seven to eight rods in width are, all things taken together, the best. These belts should be planted on the outside with some evergreen whose roots strike deep into the ground and do not spread near the surface, and whose leaves and branches will afford protection from the winter winds. In the center can be placed the deciduous trees. If, however, the farmer wishes first to experiment, and should think belts of this width entail too much cost and labor, belts of two or three rows will be found to make remunerative returns, and even one row planted, say not more than six feet apart, will give rich returns in increase of crops, and add very much to the attractions of the estate. The trees for planting should be those best adapted to the soil and situation, and will vary much with different localities. There are, however, certain trees, such as the larch, Scotch and pitch pine, that are so well adapted to dry soils, rich or poor, and the Norway spruce, Scotch, Austrian and white pines, American arbor vitæ and ash, which are best for moist, rich soils, and which so fully meet the wants of the farmer, that they should always form a large portion of his planting. Belts composed of Scotch pines, Norway spruce, white ash, and European larch, planted from the outside of the belt, in the order named, have been found to meet, in almost every particular, the need for which they are planted, and to afford to the farmer every protection in the way of timber that he can want. The value of such a timber-belt is felt very early, and cuttings for stakes, hoop-poles, bean-poles, fuel, &c., begin much earlier than may be thought; while the after-products of hop-poles, telegraph-poles, railroad-ties, and lumber for general use, follow year by year, and are a constant annual source of profit.

Prof. H. H. McAfee, formerly of the Iowa Agricultural College, a close observer in forest culture, in an article on shelter-belts,* remarks that prai-

*"Iowa Horticultural Report," 1875, p. 292.

rie farms need shelter most on the west, next on the north, next on the south, while their usefulness on the east is not so great, though sufficient to call for planting. A good combination for an evergreen belt is two or three rows of white pine for center, two rows of Scotch or Austrian pine on each side, and two rows of red cedar or arbor vitæ outside of these, making ten or eleven rows, and giving, by different rates of growth, a belt with a conical cross-section, and limbs from the ground up. Another good evergreen combination would be Norway spruce for center, white spruce next, and black spruce and red cedar or arbor vitæ outside. These kinds were hardy in Iowa, except in too great drought. A shelter-belt of cheap soft wood may be made of two rows of gray or white willow, flanked by one row of Lombardy poplar on each side, rows eight feet apart. Willow alone is apt to spread too much, and this poplar alone is apt to lose its side branches, but thus combined, the poplar, which is always erect, holds the willow up and the willow grows twigs enough to make a fair barrier. But any kind of tree, except perhaps such thinly-foliaged trees as the walnut and coffee-nut, will make fair shelter belts, if enough width is given them. At least ten rows of any of the maples, birches, poplars, or other common woods should be put in the belts, or eight rows of white or scarlet oak, which holds leaves in winter. Where road-side planting is done to obviate snow-drifting in winter or to furnish shade and shelter in summer, less rows are needed.

Judge C. E. Whiting, of Monona county, Iowa, in reporting to the State Horticultural Society in 1876 (p. 156), mentions that he had on his farm of 1,800 acres about forty acres of timber in belts around his fields, varying from single rows to twenty rows, and of different ages from eighteen years down to one; but mostly from five to twelve years. In regard to the influence of these belts on the growth of crops, he says :

As my groves increase in height, I still find that the visible influence of this protection—with almost mathematical precision—amounts to one rod on the ground to one foot height of the tree. Whether from cause or from accident, I will not pretend to say, but leave it for the entomologist to decide—I record, that during the great grasshopper visitations of 1873 and 1876, all my fields surrounded by timber escaped almost wholly uninjured. The same was true of the farms opened on our Missouri bottom timber. Will Professor Bessey please inform us if a Colorado locust, with an eye to beauty and utility, respects a field surrounded by green growing trees? We know from long experience that the summer storms, the early frosts and the fierce, unrelenting winter blizzards do pass these fields by uninjured and unscathed, and why should not a locust as well? I would make no material change in my order of planting; on our treeless prairies, where timber is wanted quick for fuel, shelter, and other purposes, the cottonwood, in my estimation, still stands *king* among all our native trees. I am now using my round cottonwood posts cut from my young thrifty-growing trees, peeled, seasoned, and the posts set in the ground, boiled a few minutes each in coal-tar, at an expense of about one cent each, that bid fair to outlast oak not so treated. Maple, willow, ash and walnut should follow in the order named, the latter to be planted on the deepest soils.

NEED OF WIND-BREAKS FOR THE PROTECTION OF HUMAN LIVES.

A winter seldom passes without deaths from storms on the prairies of the Northwest. Mr. James T. Mott, in an article on timber culture in the Iowa Horticultural Report of 1872 (p. 109), after seventeen years' residence in Iowa, says:

I have many times wondered how it could be that people were so easily lost in these storms; why it was that a man in good health, strong in limb, and well clothed, could not go a few rods from his house to the barn, to care for his stock, without danger of death; why whole sleigh-loads of people were frozen to death

within a hundred rods of dwellings, and this in the same location where I was living. But lately it has been my fortune (or I thought at the time misfortune) to be caught in one of these storms in Minnesota; and it took only a short time for me to see through the whole thing. I felt the wind first blowing softly from the south; in thirty minutes it changed to a fierce gale from the west, bringing with it a bank of snow that would compare to the rush of water as the flood gates are opened in a mill-race, and with a force that no man or team could travel against it a mile, as steady as in a bellows run by machinery, being filled with snow as fine as the finest dust, and so thick one could not see ten feet, filling the eyes and nostrils of man and beast. The storm lasted three days, * * * and the news is of hundreds dead; people frozen in stage coaches, whole sleigh-loads returning home from town, men standing dead with hand on the stable door latch, others had saved themselves by burrowing in snow banks—little children lost going home from school, passengers in railroad cars two days without food, &c. * * * More people have been frozen within the last year, in Northwest Iowa and West Minnesota, than were ever murdered by the Indians in those counties since their settlement. * * The people are now petitioning their legislatures for some kind of protection from these storms, asking that wire fences and storm houses be built along the traveled roads—asking them to do something for their safety. I see none that would do but timber planting. It alone would stop these terrible winds, modify the climate, and furnish land marks for the traveler.

SCREENS OF WOODLAND AS A BARRIER AGAINST THE PROGRESS OF INSECTS.

The Hon. J. G. Knapp, of Madison, Wis., in a lecture delivered at the University course at Rockford, Ill., in February, 1870, notices the influence of forests in intercepting the progress of insects and the spread of contagious and destructive fungi. He says:

The chinch-bug of the prairies was lately as much dreaded by those who knew their ravages * * *, but these can never traverse a belt of thick woods seven or eight rods in width to devastate an adjoining field. The cool, damp soil of such a belt presents an impassible barrier to their march, the same as to the grasshopper.

Citing from I. T. Thomas, he continues:

Another important advantage 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 kind 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 woodland, it was least injured. An extensive farmer in 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 believes, would have been saved, had his land been protected by timber belts.

INSTRUCTION IN FOREST CULTURE.

RECOMMENDED AT THE STATE AGRICULTURAL COLLEGE, AT AMHURST.

The executive committee of the Massachusetts Agricultural College, (Amhurst), in a report made in February, 1876, included the following recommendation, which, being fully discussed, was adopted:

It is also recommended, that some instruction be given in forestry, both theoretically and practically, and that special attention be paid to the raising of forest trees from seed, their care and treatment in nursery, their permanent planting in various portions of the farm, and the subsequent care of the plantations. The time

is not far distant, when every farmer in the country will, in his own interest, be obliged to give some attention to the subject of tree-planting, and such a course as is here recommended, will be of advantage to the students, and to the State at large. Similar considerations apply to the raising of fruit-trees. A nursery of reliable standard fruit-trees, adapted to one section, ought to be a source of some income to the institution.

BRISTOL COUNTY.—Mr. Morrill Allen, of Pembroke, Mass., in a letter relating to tree planting, written December, 1874, says :

A man in Bristol county, about fifty years ago, planted a field, somewhat exhausted, with acorns ; when the young trees were two or three inches high, he plowed and hoed, as in a field of Indian corn ; the trees grew, to the astonishment of the whole neighborhood, and in less than forty years, were ripe for the ax. About a century since, there was an experiment in this town in planting the white oak for ship timber, the success of which ought to have encouraged frequent repetition. The grove was in cutting for timber thirty years since, and a man between seventy and eighty years old told me that in his boyhood he assisted in planting these trees. It is not to the existing generation so hopeless an undertaking as some would represent it, to plant forest trees, even those of slow growth. I recollect measuring the circumference of an oak tree, in West Newbury, the acorn of which was planted by Benjamin Poore, who is yet comparatively a young man, and I think it measured twenty-seven inches. It is a well proportioned, handsome tree. Had he planted at the same time fifteen acres of similar soil, it would have become before now an inexhaustible wood lot for the use of one family.

The general elevation of this district above sea level, is about 80 feet ; highest point, 210 ; prevailing winds southwest, and rainfall 46 inches. The native timber consisted of several species of oak, the walnut, maple, pine and hemlock, used for lumber. A variety of trees for fuel and cabinet work are found in the forests. There has been but little clearing within the last century ; the woods have simply been cut off and allowed to grow again. In a few cases, forest planting has been done on a small scale, but so recently that no result has been reached, though the plantings are usually in a healthy condition. Fires set by locomotives, or by careless persons, sometimes do a great deal of damage.—*Elisha Shade*, Somerset, Bristol county, Mass.

Having been, for thirty years past, more or less engaged in buying woodland and cutting it off, I wish to state that I know, from careful observation, that an acre of good land, where there is a mixture of the several kinds of oak and walnut (hickory), cut off while young and thrifty, will produce, during the first 20 or 25 years, a cord of wood yearly. I believe that most kinds of hard wood are worth 20 or 30 per cent. more for fuel at the age of 25 years than at 75.—(*A. M. Ide*, of South Attleborough, to George B. Emerson : *Trees of Massachusetts*, p. 26.)

The Massachusetts Society for Promotion of Agriculture, in April, 1876, offered premiums of \$1,000, \$600 and \$400 for first, second and third best plantations of not less than five acres, to be made of European larch, except in Barnstable, Dukes and Nantucket counties, in which the Scotch pine or the Corsican fir, or both the latter, must be used. The plantations must originally consist of at least 2,700 trees to the acre, and the land must be poor, worn out, or unfit for agricultural use.

They also offered \$600 and \$400 for first and second best plantations of five acres or more of American white ash, at first having 5,000 trees to the acre.

The plantation must be made in the spring of 1877, and the prizes are to be awarded in the summer of 1887. The directions for planting were as follows :

LARCH AND PINE.

• When the nature of the soil will permit, shallow furrows, 4 feet apart, should be run one way across the field to be planted. This is best done during the autumn previous to planting. Then by planting in the furrows, and inserting the plants 4 feet apart in the rows, the whole land will be covered with plants standing 4 feet apart each way. Planted at this distance, 2,720 plants will be required to the acre. On hilly, rocky land, which is especially recommended for the cultivation of the European larch, and where it is impossible to run furrows, it will be only necessary to open with a spade holes large enough to admit the roots of the plants, care being taken to set them as near four feet each way as the nature of the ground will admit. In very exposed situations on the sea coast, it is recommended to plant as many as 5,000 trees to the acre, the plants being inserted more thickly on the outside of the plantations, in order that the young trees may furnish shelter to each other.

It is imperative to plant the larch as early in the season as the ground can be worked. No other tree begins to grow so early, and if the operation of transplanting it is delayed until the new shoots have pushed, it is generally followed by the destruction of the plant.

The Scotch and Corsican pines can be planted up to the first of May.

ASH.

Land in condition to grow corn or an average hay crop, is suited to produce a profitable crop of white ash. Deep, moist land, rather than that which is light and gravelly, should be selected for this tree. The land should be plowed, harrowed and made as mellow as possible during the autumn previous, that the trees may be planted as soon as the ground can be worked in the spring.

As soon as the frost is out, mark out the field with furrows 4 feet apart, and insert the trees 2 feet apart in the rows. This will give 5,445 plants to the acre, which, at the end of ten years, must be thinned one half. These thinnings are valuable for barrel hoops, etc.

It is recommended to cultivate between the rows for two or three years to keep down the weeds and prevent the soil from baking. At the end of that time the ground will probably be entirely shaded by the trees, and further cultivation will not be necessary.

GENERAL DIRECTIONS FOR TREE PLANTING.

Be careful not to expose the roots of trees to the wind and sun more than is necessary during the operation of transplanting. More failures in tree planting arise from carelessness in this particular than from any other cause.

To prevent this, carry the trees to the field to be planted in bundles covered with mats; lay them down, and cover the roots with *wet* loam, and only remove them from the bundles as they are actually required for planting.

In planting, the roots should be carefully spread out and the soil worked among them with the hand.

When the roots are covered press the earth firmly about the plant with the foot.

Insert the plant to the depth at which it stood before being transplanted.

Select, if possible, for tree planting a cloudy or a rainy day. It is better to plant after the middle of the day than before it.

All young plantations *must be protected* from cattle and other browsing animals—the greatest enemies, next to man, to young trees and the spread of forest growth.

EXPERIMENTS OF D. C. SCOFIELD IN TREE PLANTING, AT
ELGIN, ILL.*

This plantation was begun in 1858, with imported and American seedlings and seeds; and is on a rich, dry, undulating prairie, with black loam passing into clay at a depth of 4 to 6 feet, where it is underlaid by coarse gravel. It consisted at first of about 12,000 trees; 8,000 set from 1858 to 1862, and 4,000 in 1866. The plants were usually from 8 to 12 inches long, were transplanted in nursery rows, and in two years to their permanent places. The ground had been cultivated three years from prairie sod, and was well pulverized. The planting was done in furrows of proper depth, level places of proper depth being prepared by the spade, and care being taken to prevent drying of the roots. The larch (forming the greater part) were 2 to 4 feet high when transplanted, and the evergreens $1\frac{1}{2}$ to 3 feet. Having been transplanted once or twice in the nursery, they were well stocked with roots. They were cultivated three to six years, and beans planted in the wider spaces; and from this time, excepting the black walnuts and elms, they protected themselves. These and the white ash needed longer cultivation on account of later leafing.

The varieties planted were the Scotch, black Austrian, and white pines, Norway and white spruces, American and Siberian arbor vitæ, hemlock, and European and American silver fir; and of deciduous trees, the black walnut, silver-leaf, sugar, and red maples, box-elder, English red, and white American elms, chestnut, horse-chestnut, European mountain ash, white ash, redbud (of Southern Illinois), European and American larch, and cypress.

European Larch.—This is now twenty-eight to thirty-two feet high, with diameters varying according to density, the most being fourteen inches at one foot from the ground. Nearly every tree grew; average annual growth the first nine years, $2\frac{1}{2}$ feet. On the nineteenth of October, 1869, a severe frost, coming before the tops had hardened, checked them, and the gain was not over two inches a year, or a foot in six seasons, till 1876, when they grew eighteen inches. No bird or insect has attacked them.

Black Walnuts grew so long as cultivated, but when exposed, from the dying out of a row of soft maples, and by the encroachment of sod, they became stunted in growth, except a few that grew in a depression, equally dry with the rest, but of richer soil, where the trees were now twenty to thirty feet high and twelve to sixteen inches in diameter. A block of black walnuts, three by sixteen rods, in rows four feet apart and two feet between the rows, was cultivated eight years and then left. Some of these, in a basin of vegetable mold, are now four to six inches in thickness and twenty to twenty-five feet high. The rest are two to four inches in diameter and fifteen to twenty feet high, the average amount of wood growth being one-fifth of those in the basin. A neighbor had planted walnuts, in 1844, that had been transplanted twice. They were twenty feet apart; had been in cultivated ground twenty-five years. They are now seventeen inches thick at two feet from the ground, and one that had been cultivated till now on one side was twenty-three inches, with a height of forty feet. These trees have a spreading top, the branches beginning at seven to eight feet up, and bear fruit abundantly.

These facts lead to the conclusion that black walnut will succeed on dry, rich soil, if cultivation is continued till the trees are able to shade out the grass, and that when planted alone, and without shading nurses, they will die. Mr. S. prefers the European larch as a nurse. The sugar maple is found to agree well, and might be used for this purpose. These other trees secure a clean, upright stem to the walnut, an important object with this timber. It must have deep, rich soil.

Silver-leaf Maple.—This promised well everywhere ten or twelve years, and some trees had a diameter of eighteen inches at the collar in fifteen years. They are liable

*Communicated to the Horticultural Society of Northern Illinois, and published with the "Transac. of Ill. Hort. Soc., 1876, p. 284.

to break from winds in summer and from ice in winter, and many show signs of early maturity and decay. They are particularly liable to injury from grass. It grows best in wet soils.

White Ash.—Trees set in 1856, one inch in thickness and seven feet high, two rods apart, are now thirty feet high, eight to fourteen inches thick, and the spread of the limbs twenty to twenty-five feet. They have a strong tendency to sprout from the stump of the parent tree. Trees from seed, planted in 1858, and set in forest rows, with European larch and black walnut, are straight and smooth twenty-five to thirty feet high and three to four inches in diameter.

Sugar Maples, planted twenty feet apart, seven feet high, in 1856, are now twenty-five feet high and six to eight inches thick, spreading from twelve to seventeen feet.

Trees from seed planted in 1858, have a height of twenty feet and thickness of three to six inches. It grows very slow in prairie soil for fifteen to twenty years, after which it makes satisfactory growth. Trees an inch in diameter when set, thirty-three years ago, are now over three feet in circumference at a foot from the ground, thirty feet high, and twenty-five feet spread. A wild cherry tree, set in the same ground, twenty-six years from seed, is now five feet round.

Box Elder grows rapidly, gaining a diameter of six inches in seven years from planting, and forms a fine head, sixteen feet across. It is not liable to break from winds and ice, like the soft maple.

Butternut grows well under cultivation, being five to seven inches through, and a well proportioned head. It bears nuts.

Redbud, good only for ornamental planting; slow grower.

American Larch grows nearly as well as the European, but with less regular form; branches, wild and straggling; height twenty-five feet, diameter four to six inches.

Red Elm grows rapidly, some trees being six to eight or ten inches thick; but at this age many have an unhealthy appearance. It is not worthy of cultivation on dry land.

White Elm.—In regard to growth, variety of soil needed, and habit of late leafing, it resembles the walnut, requiring the same treatment, and leading to the same results. Valueless on common prairie without cultivation until able to protect itself. There is this difference between these two trees, however, that while the walnut requires a deep, rich, dry soil, the white elm will flourish in a wet soil, less deep and rich, with annual cultivation for twenty years. These two trees make about the same growth on common dry prairies as they do in the "sinks," with a cultivation of four or five years.

English Elm makes a more vigorous growth and a more beautiful foliage than either of the American varieties, and will do well with less cultivation.

Chestnut.—A total failure on prairie soil. Only one tree remained on the ground, and this is the only one known in the county. It stands twenty feet high, six inches in diameter, and is kept in slightly growing condition from the forest protection around it. It grows satisfactorily on the lighter soil of the Mississippi bluffs.

Lombardy Poplar grows rapidly and beautiful a few years, but is unhealthy and valueless in ten or fifteen years, especially so on rich soils. Trees of ten years' growth are eight to ten inches thick, and twenty-five to thirty feet high.

Horse Chestnut.—Hardy, but an exceedingly slow grower on prairie, yet grows well on gravelly or sandy soil.

EVERGREENS.

White Pines are thirty to forty feet high in forests six to eight feet apart, with a diameter of ten to fourteen inches. When close they are equal height but slender, and denuded of side branches. The white pines of this plantation are from trees from seedlings gathered from American forests in 1866, planted twelve feet apart. They were six to ten feet high in 1876. They are filled with Scotch pine for nurses, with trees grown from seed gathered from trees imported and planted in 1858. They were cultivated till able to protect themselves.

Scotch Pine, in close plantations, four to six feet apart, have a height of twenty to twenty-five feet, and a diameter of six to seven inches. When standing separate, they have twice this diameter, and form a beautiful tree, valuable as a wind-break, and growing surely and rapidly on nearly every variety of soil. They are very hardy.

Black Austrian Pine grows equally well with the Scotch, and mainly valuable for ornament and wind-breaks.

Norway Spruce, when planted alone, spreads nearly as wide as it grows in height, forming a beautiful pyramid. The greatest diameter of the trunk of these trees is fifteen inches, from trees planted in 1857 one foot in height.

American White Spruce.—This is a beautiful tree, equally, if not excelling the Norway, and with the same habits.

American Arbor-vitae. (white cedar).—This forms a beautiful tree when young, and standing alone, and it may be successfully sheared to any desirable form. It grows slowly, and when planted closely in rows, six feet apart, and only one foot in the row, has a diameter of two to four inches, and sixteen feet in height.

Siberian Arbor-vitae, is equally hardy with the American, and grows more compact and beautiful.

Hemlock, when planted on prairie soil, makes a slow and dwarfish growth, till twelve or fifteen years old. It is better on hard soil.

American Silver Fir (Balsam).—A rapid, beautiful grower, its main value being as an ornamental tree; is less hardy in the extremes of cold following exceedingly severe droughts, as in 1864-'65; as in case of the great droughts which then visited this western country, when a great many of the finest of the balsam trees, many of them forty feet in height, died.

European Silver Fir.—This is too tender for this climate, and has only flourished in protected situations. It has a height of thirty feet, and a diameter of six to seven inches, and should be used only as an ornamental tree. Yet this tree shows early old age, and is less beautiful in twenty or thirty years.

EXPERIENCE OF TREE CULTURE, IN ILLINOIS.

Mr. Samuel Edwards, of Mendota, Ill., reporting from a committee of the State Horticultural Society, in 1876,* speaks of the condition and prospects of tree planting, and of the success and failure that has attended the experiments hitherto tried:

For several years the locust used to be the timber tree, and was quite extensively planted; and when the beautiful groves, on which so many had placed their dependence for future fencing, were destroyed by the borer, a general depression came over the minds of tree-planters. For a time their energies for work in this direction were paralyzed, and it is only recently, from observation of the growth and value of a few other varieties of trees as yet successfully cultivated here, confidence in timber-growing is being restored. Many have made small beginnings, a few are planting extensively of black walnut, European larch, ash, of different varieties, white and Scotch pines, white willow, silver maple, and ash-leaved maple, all of which give satisfaction, except the silver maple, which is in some cases troubled with a borer, and limbs are broken in severe storms.

Some have advocated extensive planting of the chestnut, and for over twenty years they were thrifty on a prairie mound, clay soil, with good natural under-drainage in my grounds. A severe winter succeeding a drought fatally injured one of the two trees set in 1851, and on my new grounds, at Mendota, only some four feet to a stiff clay, they are very unsatisfactory; many trees four to six feet high, were killed in the winter of 1874-'75. The tulip tree, for twenty-five years from first planting, grew finely. Quite a number on the grounds of Arthur Bryant and Tracy Reeve, at Princeton, and at "The Evergreens," Lamoille, failed under the same circumstances as the chestnut. The English walnuts, grown at La Porte, Ind., were brought to one of the meetings of this society a few years since, by W.

*Transactions of Illinois Horticultural Society, 1876, p. 115.

H. Ragan, with the report that it proved hardy and had borne fruit there several years. I tried a second hundred from an eastern nursery, and they have all winter killed. Doubtless, all of these varieties planted on timber soil, in the southern and central parts of the State, will succeed. It is evident, from past experience, that it will require several years to test varieties of trees before planting extensively on the prairies of our section of country.

A good beginning is being made in planting trees along the public highways, for which white elm, ash and silver maple are generally used. It is to be regretted that some continue to plant the Lombardy poplar, which is very short-lived, and timber of so little value. Centennial trees were very generally set by our people who plant at all.

Several cemeteries, a number of farms in this vicinity, and the Blackstone Public School grounds, in Mendota, have been improved the present year, by planting extensive evergreen screens.

How anyone can reside on our bleak prairies during the passage of one of our polar waves, like that of December 9, with the mercury at -23° , and not decide to provide timber-shelter for his family and animals, is past my comprehension. Yet, how many men, with good sense in every other respect, and with ample means, continue to live without this merciful provision! It really does seem certain that, at no distant day, a general awakening, to this work of necessity must break out all over the prairies of the northwest.

Of ornamental deciduous trees, as yet planted only to a limited extent, I would place first on the list our lovely sugar maple. If there is a finer avenue of deciduous trees in our State than the one of sugar maple, planted by Arthur Bryant, some forty years since, it has not been my good fortune to see it. Norway maple is one of the most valuable, on account of retaining its foliage late; cut-leaved weeping birch, very fine; weeping mountain ash; horse chestnut, slow grower, desirable; Japan ginko, unique; American linden, if foreign, would be called for; magnolia acuminata, unsurpassed. The following do not endure severe winters: European ash, and several weeping varieties of it; European weeping linden; weeping thorn, several varieties; rosemary-leaved weeping willow. Kilmarnock weeping willow, though harder than the foregoing, is frequently injured enough to render it undesirable.

COMPARATIVE VALUE OF WOODS FOR FUEL.

EXPERIMENTS BY MARCUS BULL.

A paper read before the American Philosophical Society, April 7, 1826, by Marcus Bull, of Philadelphia,* gives the results of careful experiments upon qualities and relative values of American woods, that have been regarded as trustworthy and valuable. In conducting these experiments, Mr. Bull constructed a room within a room,† so that the walls of the inner one could be kept uniform in temperature, and combustion was made in a stove with an abundance of pipe. The time and effects were carefully noted, and all circumstances affecting draught of air, size, and condition of fuel, &c., were made as uniform as possible.

*"Experiments to determine the Comparative Value of the principal Varieties of Fuel used in the United States, and also in Europe, and on the Ordinary Apparatus used in their combustion." By Marcus Bull, Philadelphia, 1827, 8 vo., p. 103.

†The outer room was 11x14 feet and about 14 feet high; the inner one was cubic, 8 feet on a side, and containing 512 cubic feet.

Common and Botanical Names.†

	Specific gravity of wood.	Avirdupois pounds of dry wood in one cord.	Product of charcoal from 100 parts of dry wood, by weight.	Specific gravities of dry coal.	Pounds of dry coal in one bushel.	Pounds of charcoal from one cord of dry wood.	Bushels of charcoal from one cord of dry wood.	Time 10° of heat were maintained in the room by the combustion of one pound of each article.	Value of specified quantities of each article, compared with shell-bark hickory as the standard.
White ash— <i>Fraxinus americana</i>.....	.772	3450	25.74	.547	28.78	888	31	h m	77
Apple tree— <i>Pyrus malus</i>.....	.697	3115	25.	.543	23.41	779	33	6 40	70
White beech— <i>Fagus sylvestris</i>.....	.724	3236	19.62	.518	27.26	635	23	6 40	65
Black birch— <i>Betula lenta</i>.....	.697	3115	19.40	.628	22.52	604	27	6 40	63
White birch— <i>Betula populifolia</i>.....	.530	2369	19.	.364	19.15	450	24	6 40	48
Butter-nut— <i>Juglans cathartica</i>.....	.667	2534	20.79	.237	12.47	527	42	6 40	51
Red cedar— <i>Juniperus virginiana</i>.....	.565	2525	24.72	.238	12.52	621	50	6 40	56
American chestnut— <i>Castanea vesca</i>.....	.522	2333	25.29	.379	19.94	590	30	6 40	52
Wild cherry— <i>Cerasus virginiana</i>.....	.597	2668	21.70	.411	21.63	579	27	6 10	55
Dogwood— <i>Cornus florida</i>.....	.815	2643	21.	.550	28.94	765	26	8 10	75
White elm— <i>Ulmus americana</i>.....	.580	2592	24.85	.357	18.79	644	34	6 40	58
Sour gum— <i>Nyssa sylvatica</i>.....	.703	3142	22.16	.400	21.05	696	33	6 20	67
Sweet gum— <i>Liquidambar styraciflua</i>.....	.634	2834	19.69	.413	21.72	558	26	6 40	57
Shell-bark hickory— <i>Juglans squamosa</i>	1.000	4469	26.22	.625	32.89	1172	36	6 40	100
Pig-nut hickory— <i>Juglans porcina</i>.....	.949	4241	25.22	.637	33.52	1070	32	6 40	95
Red-heart hickory— <i>Juglans laciniata</i>.....	.829	3705	22.90	.509	26.78	848	32	6 30	81
Witch-hazel— <i>Hamamelis virginica</i>.....	.784	3505	21.40	.368	19.36	750	39	6 10	72
American holly— <i>Ilex opaca</i>.....	.602	2691	22.77	.374	19.63	613	31	6 20	57
American hornbeam— <i>Carpinus americana</i>.....	.720	3218	19.	.455	23.94	611	25	6 40	65
Mountain laurel— <i>Kalmia latifolia</i>.....	.663	2963	24.02	.457	24.05	712	30	6 40	66
Hard maple— <i>Acer saccharinum</i>.....	.644	2878	21.43	.431	22.68	617	27	6 10	60
Soft maple— <i>Acer rubrum</i>.....	.597	2668	20.64	.370	19.47	551	28	6 40	54
Large magnolia— <i>Magnolia grandiflora</i>.....	.605	2704	21.59	.406	21.36	584	27	6 10	56
Chestnut white oak— <i>Quercus prinus palustris</i>.....	.885	3955	22.76	.481	25.31	900	36	6 30	86
White oak— <i>Quercus alba</i>.....	.855	3821	21.62	.401	21.10	826	39	6 20	81
Shell-bark white oak— <i>Quercus obtusiloba</i>.....	.775	3464	21.50	.437	22.99	745	32	6 20	74
Barren scrub oak— <i>Quercus catesbeii</i>.....	.747	3339	23.17	.492	20.63	774	38	6 30	73
Pin oak— <i>Quercus palustris</i>.....	.747	3339	22.22	.436	22.94	742	32	6 20	71
Scrub black oak— <i>Quercus banisteri</i>.....	.728	3254	23.80	.337	29.36	774	38	6 30	71
Red oak— <i>Quercus rubra</i>.....	.728	3254	22.43	.400	21.05	635	30	6 20	69
Barren oak— <i>Quercus ferruginea</i>.....	.694	3102	22.37	.447	23.52	694	29	6 20	66
Rock chestnut oak— <i>Quercus prinus monticola</i>.....	.678	3030	20.86	.436	22.94	632	28	6 40	61
Yellow oak— <i>Quercus prinus acuminata</i>.....	.653	2919	21.60	.295	15.52	631	41	6 10	60
Spanish oak— <i>Quercus falcata</i>.....	.548	2449	22.95	.362	19.05	562	30	6 20	52
Persimmon— <i>Diospyros virginiana</i>.....	.711	3178	23.44	.469	24.68	745	30	6 30	69
Yellow pine (soft)— <i>Pinus mitis</i>.....	.551	2463	23.75	.333	17.52	555	33	6 30	54
Jersey pine— <i>Pinus inops</i>.....	.473	2137	24.88	.335	20.26	532	26	6 40	48
Pitch pine— <i>Pinus rigida</i>.....	.426	1904	26.76	.298	15.68	510	33	6 40	43
White pine— <i>Pinus strobus</i>.....	.418	1868	24.35	.293	15.42	455	30	6 40	42
Yellow poplar— <i>Lyrodendron tulipifera</i>.....	.563	2516	21.81	.383	20.15	549	27	5 10	52
Lombardy poplar— <i>Populus dilatata</i>.....	.397	1774	25.	.245	12.89	444	34	6 40	40
Sassafras— <i>Laurus sassafras</i>.....	.618	2762	22.58	.427	22.47	624	28	6 20	59
Wild service— <i>Aronia arborea</i>.....	.857	3964	22.62	.594	31.26	897	29	6 20	84
Sycamore— <i>Acer pseudo-platanus</i>.....	.535	2391	23.60	.374	19.68	564	29	6 30	52
Black Walnut— <i>Juglans nigra</i>.....	.681	3044	22.56	.418	22.	687	31	5 20	65
Swamp Whortleberry— <i>Vaccinium corymbosum</i>.....	.752	3361	23.30	.505	26.57	783	29	6 30	73

EXPERIMENTS IN TREE PLANTING BY MR. JOSEPH S. FAY,
AT WOOD'S HOLL, BARNSTABLE COUNTY, MASS.

At the close of the season of 1875, the plantation of Mr. Fay included something over 125 acres, of which about 100 were sown broadcast, chiefly in the spring, and about 25 were set with imported trees. The seed sown were chiefly those of the native pitch-pine, with some white pine, the Austrian, Scotch and Corsican pine, the Norway spruce, and the European larch. The imported trees number about 35,000, consisting of the Austrian, Scotch

†These names are generally according to Michaux, and in some cases are different from those now generally adopted.

and Corsican pines, Norway spruce, Norway maple, English sycamore (*Acer pseudo-platanus*), English oak, alder, Scotch birch and larch, wych elm and Huntington and red German willows. There were also set several thousand native pines from the eastern part of Falmouth.

This plantation is between Buzzard's Bay on the west and north and Martha's Vineyard Sound on the east and south, the highest elevation being about 150 feet above the sea. The surface is uneven and made up of abrupt hills and deep hollows, sprinkled over with bowlders of granite, and the soil a drift formation of clay and gravel with a yellow or sandy loam. It was, before seeding, an old pasture ground, with no tree except an oak that springs out of the huckleberry bushes here and there, but hardly rising above them on account of the wind, and from being kept down by browsing. The annual rainfall in this section is about 45 inches, and the prevailing winds in summer are southerly, and in winter northerly.

The native pines of Mr. Fay's plantation were set in 1853-1856, and imported trees were set in 1852, 1853, 1855, 1871, and 1882. Native pine seeds were sown in 1858, 1861, 1864, and 1868. The foreign seeds were sown in 1861, 1862, 1868. The results are stated as follows :*

The Scotch pine from the seed have proved on the whole, including prompt germination, the best grower and very hardy ; but the weevil affects the symmetry of many trees. The Norway Spruce and English oak have done well, and the white pine ; but all three suffer when much exposed, as on the outside of a plantation, to the strong salt winds. The Austrian pine does well, but is slow and irregular in germinating, and makes a later start from the seed. The larch has not come well from the seed ; from the nursery, or as imported, it does remarkably well ; so with the Scotch birch and alder. The Scotch pine does finely from the seed or the nursery, and from the latter the English sycamore does well. All have done better than the native pitch pine.

One kind of pine, though not fully tested by me, promises better than the rest, namely, the Corsican (*Pinus laricio*). In my first importation I ordered five hundred, but when transplanted in my absence, they were mixed with the Austrian, and I lost sight of them for ten years. I was then so struck with their great vigor, beauty and fine promise, that in 1868 I imported some seed and commenced sowing them, mixed with other kinds, upon vacant lands, and have since kept it up. Some of those that came up are very strong and healthy, while others are affected by some insect or a kind of blight. They are very hardy and beautiful when not so affected. I think that some of the nurserymen have imported and sell them under the name of Austrian. Of those sown in 1868 some are (in 1875) over eight feet high, of which nearly or quite five feet grew in the last three years. At an early day I tried some seed of the French maritime pine (*Pinus pinaster maritima*) which were so successfully planted on the west coast of France under the first Napoleon ; but after germinating and growing thriftily to the height of six feet, they were winter killed. This was the experience on Nantucket and Martha's Vineyard Islands, where they were tried extensively.

Some of the Scotch and Austrian pines, Norway spruces, and Scotch larches which I obtained from my brother, Mr. Richard S. Fay, of Lynn, in 1853, probably imported by him in 1850, are about 40 feet high, and from 10 to 14 inches in diameter one foot from the ground. Some native white pines set out about the same time have done as well. Of those imported in 1853, many are about 35 feet high, and 8 to 12 inches in diameter one foot from the ground. Of the Scotch pines, from seed sown in 1861, some favorably situated—that is, not crowded, and in fair soil and shelter—are 30 feet high and 10 inches through the butt a foot from the ground. Most of them which were not too thickly sown in 1862 and 1863, are upwards of 20 feet high and 6 inches in diameter one foot from the ground.

All the pines have done well from the seed, on the whole, except the native pitch pines, which became sickly, and which, after a good growth to a certain point, I am cutting out for fuel, as not worth keeping. Some, however, that I transplanted in 1853, 1854 and 1855, are very strong and healthy, being at least 30 feet high and 10 to 12 inches in diameter. I am told that the seedling native trees, of which

*"Massachusetts Ploughman," February 26, 1876, in answer to enquiries by Prof. C. S. Sargent.

many acres have been planted in Nantucket, are proving worthless, and are being cut down.

My first importations of trees were in 1871 and 1872, and consisted of English alder, Scotch birch, Scotch larch, English sycamore, Norway spruce, and Austrian, Scotch, and Corsican pines. The alder I have found to be a very rapid grower, very hardy and ornamental, well adapted for a screen or a shelter to other trees. Some which were set out at $1\frac{1}{2}$ to 2 feet high in 1871, are now 8 and 10 feet high. The birches have done well, and so with the pines; the sycamore and Norway spruce not as well, needing, perhaps, two years on the nursery or a better soil. The Scotch larches were heated on the voyage, and the summer following being very dry, many died. Those that survived have recovered, and being now finely started, are making a vigorous growth.

My first purchases of foreign trees were planted about my house, in the openings of a thirty acre lot of oak and beech woods near by, and on the bare, gravelly hills overlooking the Sound, and raked by strong winds. The trees I imported in 1853, after two years in the nursery, I planted out, some in clumps of a quarter and half an acre each, on an old pasture which I did not "seed down," and which had not a tree upon it. I surrounded them with fences of wire drawn through cedar posts to keep off the cattle, who find in them a grateful shade, now the trees are too large to be injured by them. Others I placed along the walls of my cultivated field, and some on the margin of my old deciduous woods, so as to afford a shelter and a variety of foliage. My importations of 1871 and 1872 were planted as soon as received, on an old and poor pasture land, where I intended they should remain. My method was to run, with oxen, deep single furrows 7 feet apart, and then set the trees in them 7 feet from each other. The land is rough and of the average soil of a worn out pasture. These have done well, except those larches which died, as before stated, in consequence of being heated on the voyage, taking into the account the saving of labor and the use of more valuable land, by not putting them into a nursery, though if placed there at the first start they may have seemed to do better.

The trees were introduced as a matter of taste, and as an experiment, without the calculation of any immediate advantage. Still I think if it had been near a market, or one had been sought, there would have been a profit in the sale of the surplus young trees, and now already in the sales of wood, if only the thinnings. The land has been, no doubt, improved by the deposit of thousands of loads of leaves upon it, and by the shade afforded it, while it has been lightened and lifted by the permeation of the roots of the trees. Much of the labor has been done at intervals of farm work, and chiefly without professional supervision.

When I bought my place in the fall of 1850, except a few stunted red cedars on Parker's Point, and some white cedars in the swamps, there was not an evergreen tree within three miles of my house, and hardly any tree of any kind in sight of it. The woods (oak, beech and hickory), were in the dells and valleys behind the hills fronting the sea, and it was maintained that trees would not grow, and could not be made to do so, in the face of the salt-laden winds from the south and southwest. The exposure was certainly great and the soil poor, and trees planted singly or sparsely, perhaps, could not have resisted it, but close planting made a shelter, and those not specially from an inland habitat (like the white maple) have done well, and seem to the manor born.

In answer to the question, "If you were to do the work over again, could you improve on the methods employed by you?" Mr. Fay replied:

I think I should recommend, where the ground was not too stony and rough, instead of sowing seed broadcast, to run parallel furrows, not deep, running east and west (so the mid-day sun will not strike across them) seven feet apart, and drop the seeds in them, merely pressing them into the ground, and not covering them more than this, if at all. This, in the first place, especially on the hill side, where the furrows should be run at right angles with the slope, and not vertically, will prevent the seed from washing down to the low places; in the second place, the seed will be likely to come up more at the same time, and would be more uniformly distributed than can be done broadcast, unless sowed when there is snow upon the ground, and also less seed would be required and less would be wasted; in the third place, the side of the furrow would tend to shade the young germ, which, on the open sward, in a dry time, is apt to be withered and destroyed by the heat. In my plantings, where the trees have come up too thickly, I have transplanted them to spots where the seed has failed or was not sown; but this makes extra labor. If sowed in furrows, the seed might be dropped at intervals of four or five feet, and even then,

in a few years, if all were to come up they would require thinning. In this case the surplus could be sold or planted elsewhere. They would make good nursery plants.

As to imported trees, when it is considered that the average cost, landed at the farm, of English grown plants one or two feet high, is less than one cent each, it would be a saving of time to procure them and set them out in the place where they are to grow. There is a little uncertainty in their condition, but, as a rule, they come in good order. This requires two plantings. My last I placed, as I have stated, in the field where they were to grow, in parallel furrows. I think it would be better to plow cross furrows the same distance apart, or say 10 feet each way, and plant the trees at the intersection. Unless the land is very much exposed to the wind, 10 feet is near enough, as even then, in about seven years, a man could hardly walk between the rows. If there are bleak hills to be planted, then the trees should be nearer together, say 6 or 7 feet, so as to shelter each other more; but, when they get up and are doing well, they ought to be thinned. But for this need of shelter in exposed places, they would do better in view of a twenty-five years' growth to be 20 feet apart each way. Up to a certain point they help each other by proximity, but it takes great courage to cut down strong and thrifty trees to make room. Yet, on a farm the thinnings may be useful, and when near large towns would be saleable for cheap rustic fences and inclosures, and certainly for kindling stuff. It is also to be considered that if planted too far apart, the growth would be more lateral than vertical in proportion, and the trees would be more spreading, and tend less to taper form and slenderness.

In planting out at once on rough land instead of first in a nursery, though the tree may take a year or two to get a start, for the roots to find their way into the closer soil of an old field, there is a great saving of labor and not *much* loss of time, as each transplanting checks a tree in its growth. One thousand trees will cover an acre well, if planted 6 or 7 feet apart, and five hundred if 9 or 10 feet from each other; and after the furrows are made, two active, handy men could plant one to two acres a day. Care should be taken not to plant too near other older trees, lest they overshadow and kill out the new planting, or the overhanging limbs chafe and keep down the leading shoots. I have wasted a great many trees by planting them in the old woods where the spaces seemed large and open, by their being overgrown and shaded out. If I were again to set out young trees among the old woods, I should cut the latter all down clean, and let them start again from the stumps with the new planting. If this is not done, and it is desirable to keep the old trees, they must then be carefully watched and trimmed and lopped, as the young ones grow up under and about them. And I have lost many trees by their being planted or sowed too near each other. When trees are two or three feet high, it seems quite safe to plant them five feet apart, but soon they are too close, and the most vigorous crowd out and destroy the weakest. In my seeded plantations in many spots, they have come up at the rate of 40,000 trees to the acre; hence my advice to mark off the fields in furrows and sow in them rather than broadcast. It would be a great saving every way, except in a little labor at the start. Nor in sowing should I now mix the seeds of different pines, as I have done, but sow each kind by itself distinctly. For a Scotch, for instance, comes up promptly, it is likely to get the start of the Austrian, the seed of which sometimes lies dormant two or three years, and so overshadows and crowds it out. If the latter were sowed by itself, though it would be slower in germinating, all would be likely to start together, and when fairly rooted make up for lost time. It would not be amiss to plant here and there some desirable kinds of acorns or nuts, for while the pines would grow faster and keep them down, if for any reason the pines were cut off, the oaks and hickory would come forward very rapidly when open to the sun. A few chestnuts that I have planted under the lee of other trees have made an extraordinary growth, and in the interior, their habitat, they must be a very profitable tree to plant.

You will bear in mind that I have given you my experience as a planter of trees, much as an incident of farming and not as a business. Were it taken up as a thing of itself, then it might be advisable to start seed beds and raise one's own trees, and nurse them, instead of importing them. I have endeavored to raise a forest about me at the least possible cost of labor, and not looking much to the hurrying of the result, or to count up an early profit. The land was denuded and exhausted, and moss grown, and I took this method to cover it with verdure and restore it, believing that the wood would compensate me or my heirs sooner or later. * * * In closing my discursive remarks, I would say that, considering the position of my place, exposed on the northwest to the violent winds of winter sweeping across Buzzard's Bay, and in summer to the strong breezes from the southwest, bringing

salt spray from Vineyard Sound, the vigorous growth and promising appearance of my forest plantations is very encouraging to those more favorably placed. Not only may the destruction of our forests be partially remedied at a cheap cost, but the waste and sterility of our land by long cultivating and pasturing, be removed and replaced with fertility by the simple process of nature. It is much, also, to restore shade in summer and shelter in winter by the renewal of our forests.

A committee of the Northern Illinois Horticultural Society, at a session held in December, 1867, recommended the following list of evergreens as suitable for cultivation in that region :

For timber belts : White pine, Norway pine and spruce, Scotch pine, Austrian pine, and American arbor vitæ.

For high screens : Norway spruce and American arbor vitæ.

For screens of moderate height : Siberian arbor vitæ, Norway spruce, American arbor vitæ, hemlock and red cedar.

Ornamental specimen trees : All the foregoing, and the white, black, and red spruce, *Picea pichta*, Cimbrian pine, *Pinus mitis*, Irish and Swedish junipers.

Shrubs : American yew, tamarix-leaved and Waukegan trailing juniper, savin, *Pinus magnus*, *Pinus pumilis*, and *Andromeda floribunda*.

An experimental station, begun at the Illinois Industrial University, reported, February 29, 1872, seven acres as planted with 36,749 trees, at a cost of \$433.48 for trees, \$106.72 for planting, and \$42.83 for cultivation; total, \$583.03. The kinds planted were the white and green ash, catalpa, chestnut, white elm, European larch, white maple, Osage orange, Austrian and Scotch pines, white walnut and white willow. The land planted with each kind was generally a quarter of an acre, but more with white ash and larch. Distance apart 2 by 4 inches, except the pines, which were 4 by 4. The catalpas and white elms were all living, and but 2 per cent. of the green ash, white maple, Osage orange and white willow died. But 1 per cent. of white walnuts, and 5 per cent. of white ash were lost. Half the chestnut and three-fourths of the larch perished, and but 2 per cent. of the pines lived. The white grub (the larva of the May beetle) did great injury, especially to the larch and white ash, girdling the roots below the surface. The loss of the pines was attributed to dry weather.

In 1872, 10,083 trees were planted; the larches and pines from R. Douglas & Sons, Waukegan, Ill., and the others grown on the premises, at Campaign. The per centage living from both years' planting, at the end of 1872, were as follows : Catalpa and white elm, 196; white walnut, 99; green ash, white maple, white willow, Osage orange, and Norway spruce, 98; white ash, 93; European larch, Austrian pine, and white pine, 30; Scotch pine, 20; chestnut, 4. The white grub had again done much injury, especially to the larch. It was found to be less affected on high land. The chestnuts mostly winter killed. The Osage orange was promising to become one of the most valuable trees for that latitude, and both this and the catalpa, when cut close to the ground in order to get a good, straight growth, had succeeded well.

A prominent cause of failure in evergreen planting, is the exposure of the roots to the sun and air. "We have seen hay-racks loaded with evergreens going from the nursery to the packing-house, that were dead before shipping, proving worse than a total loss of money to the purchasers." The pear grafted on quince stock has also led to great disappointment.

In making plantations in exposed situations, it will be found advantageous to have them of as large an area as possible, for trees will, in many

cases, thrive in large masses which would actually starve in small clumps or belts. The soil should be well trenched or drained, and great care should be taken in selecting the hardy varieties that are suited to the soil in which they are planted. The plants should be small when transplanted, and those that are known to stand severe winds should form the margin, while the more valuable kinds are planted in the interior. In many cases it will be found judicious to plant thickly with the view of shelter, and thin early, so as to bring up the trees in a healthy and hardy state, taking girth with their height.

In respect to the success that may, under good management, be expected to result from tree planting in eastern Nebraska, the following extract from an address delivered before the State Board of Agriculture, by the Hon. J. Sterling Morton, January 26, 1876, lays down his rules and mentions his results as follows :

First, the original sod should be broken and turned over in thin, evenly-laid strips. When completed, a good breaking will appear like a vast floor of well laid two inch plank painted with lampblack. Then plant and cultivate, not to see *how much* you can manage, but *how well*. Then come trees : walnuts, cottonwoods, willows, mulberries and elms will make the home seem civilized. Tree planting is an avocation which barbarians never follow. Indians never adorn their wigwams with orchards, nor indulge in floriculture. There is no record of an aboriginal horticulturist in any book I have read or heard of anywhere. It may seem a long time to raise a saw log from the walnut which lies in the palm of your hand, but the rain and frost of winter and the sunshine of summer, together with the fertile and forcing soil of Nebraska, crowd a walnut into the dimensions of a respectable saw log in less than twenty-five years. Upon a farm where I have lived, in Otoe county, for more than twenty years, one may see black walnut trees, which will make good railroad ties, and some which will do to saw up, which I planted with my own hands. * * * And, again, there may be found cottonwood saw logs growing there which are more than six feet in girth, and when I first saw them they were only wandering germs, floating in the air like down from a bird's breast. But they are adult saw logs in 1876. These remarks, somewhat egotistical though they may be, are made for the purpose merely of impressing you, and through you the farming people, with the tree possibilities of this State, and I only preach in this regard what I have faithfully put in practice, and the witnesses of the truth of my theories stand majestically verifying me all over the farm whence this is written to you, in the form of beautiful, thrifty, and valuable fruit and forest trees. Come down and see them in the hot summer days, while you rest in their shade, even their foliage will tell you in whispering with the wind, how pleasant and profitable a thing it is to plant the prairie with trees.

MINNESOTA STATE FORESTRY ASSOCIATION.

This, the first, and hitherto the only State forestry association within the United States, was formed at St. Paul, January 12, 1876, in pursuance of a call signed by many leading citizens of the State, who realized the importance of taking effectual measures for protecting the existing timber resources of the State, and of making provision against future wants. At the first meeting, held January 11, a committee consisting of Gen. George L. Becker, ex-Gov. William R. Marshall, Leonard B. Hodges, Prof. Charles Y. Lacy, Wyman Elliott, L. M. Ford, and Prof. William W. Fowell, was appointed to draft a constitution, which was adopted the next day at an adjourned session, as follows :

CONSTITUTION OF THE MINNESOTA STATE FORESTRY ASSOCIATION.

ARTICLE I. This Society shall be known as the Minnesota State Forestry Association.

ART. II. The object of this association shall be the encouragement and promotion of forest culture by the collection and diffusion of practical information on that subject, and by the discussion of all questions pertaining thereto; to secure the general observance of Arbor Day throughout the State, and to promote the ultimate redemption of the treeless regions of Minnesota.

ART. III. The officers of this association shall consist of a president, one vice-president for each Congressional district, a treasurer, and an executive committee consisting of the president, secretary, and five elective members.

ART. IV. The president shall preside over all meetings of the Society, and deliver an annual address on the subject of forest culture in Minnesota.

ART. V. In the absence of the president, his duties shall devolve upon the vice-presidents in their regular order.

ART. VI. The secretary shall record all transactions of the Society; shall collate, edit, and prepare all work for the press; shall receive and answer all communications addressed to the Society; shall establish and maintain correspondence with similar associations, and secure by exchange their transactions, as far as possible. He shall give full and general notice of all meetings of this Society, through the public press of the State. He shall report and submit to the annual meeting of the Society all matters that have come into his possession, which, with its approval, shall become a part of the transactions of the Society. He shall receive and pay over all moneys received from members, or otherwise, to the treasurer, from whom he shall take a receipt therefor.

ART. VII. The treasurer shall collect and be held responsible for all funds of the Society, and shall disburse the same only on the order of the executive committee.

ART. VIII. The officers of this Society shall be elected annually by ballot, and shall hold their offices until their successors shall be elected.

ART. IX. Every member shall be entitled to copies of the transactions of the Society, as often as the same shall be published, and it shall be the duty of the secretary to forward the same to each member, by mail, express or otherwise, immediately after publication.

ART. X. The executive committee may call a meeting of the Society at any time and place they may deem advisable by a notice of at least ten days in the public press.

ART. XI. The Society shall hold annual sessions on the second Tuesday in January of each year, at such place as the executive committee shall determine.

ART. XII. Any person may become a member of this Society by the payment of one dollar to the secretary.

ART. XIII. It shall be the duty of the executive committee to prepare a programme of exercises for each annual meeting, assigning to each division of arboriculture an essay or paper to be furnished by some member specially qualified for this service.

ART. XIV. The president and secretary shall have power to appoint delegates to meetings of kindred associations.

ART. XV. This constitution may be amended by a vote of two-thirds of the members present at any annual meeting.

Under this organization, the officers first elected were E. F. Drake, of St. Paul, *President*; A. A. Soule, of Cottonwood county (first district), Ignatius Donnelly, of Dakota county (second district), and John H. Stevens, of Hennepin county (third district), *Vice Presidents*; Leonard B. Hodges, of St. Paul, *Secretary*; Pennock Pusey, of St. Paul, *Treasurer*; and Prof. C. Y. Lacy, of the State University, G. W. Fuller, of Litchfield, C. F. Dunbar, of Faribault county, John P. Schoenbeck, of Nicollet county, J. W. Blake, of Lyon county, with the *ex-officio* officers above named, as *Executive Committee*.

The State Legislature, by an act passed March 2, 1876, appropriated \$2,500 to promote the objects of the association, and in order to perfect the organization and remove all doubts as to legality, it was deemed

proper to reorganize under the general laws of the State, which was done in due form on the 23d day of November, 1876.

The means provided by State grant, and dues from members, enabled the society to offer a series of premiums, which, although not large in amount, were sufficiently numerous to stimulate competition, and the objects and plan of the society were widely published in time for the planting season of 1876. The first Tuesday of May was fixed upon as Arbor Day, and every citizen owning land was invited to devote this day especially to tree planting.

Dr. Hough says: Mr. L. B. Hodges, of St. Paul, the Secretary of the Association, in a letter dated November 29, 1877, gives the latest returns of operations for that year,

The spring planting reported by the several township assessors amounted to 5,268,939 trees, of which 502,568 were planted on Arbor Day. The returns of fall planting are coming in by every mail, and will come in till January. The total amount for the year 1877 cannot fall short of 7,000,000, and will probably reach 10,000,000 forest trees planted in Minnesota during the entire planting season.

The returns of assessors are regarded by Mr. Hodges as very incomplete, as it is an extra service for which no pay is allowed, and many appear to take no pains to get full returns. As to the proportion of these ten millions of trees that have been planted under the stimulus of premiums offered by the State, there are no means of knowing. We know that some would have planted without special inducement beyond self-interest.

Unlike the experience of the more humid regions of the Atlantic States, timber culture west of the Mississippi has difficulties to encounter which require energy and patience to overcome. During the past summer, in some ten or twelve counties of Minnesota, the grasshoppers proved very destructive to young trees, especially to seedlings. The correspondent just quoted mentions the following as within his experience:

In October and November, 1875, I planted sixteen acres very thickly with cottonwood and willow cuttings, ash seed and box-elder seed, with a few thousands of cottonwood yearlings. Nearly all from seeds and cuttings came up well, and on the first of June last that patch of sixteen acres of young forest trees on the broad prairie was a beautiful sight. But during the month of June and July they were nearly all devoured by the "hoppers." I have this fall replanted the same ground, and more too. May not grasshoppers, as well as fire, be one of the chief causes of the treeless region.

The State commissioner of statistics, in reporting for 1876, says that estimates based upon the returns received, show that a million and a half of trees were planted on Arbor Day in 1876, and ten millions during the season. Of these about 70 per cent. were alive and in healthy, growing condition October 15th. In noticing the results he says:

Indeed, from the sworn statements of parties competing for premiums, we ascertain that in a large majority of instances, when work was properly and intelligently performed, when the ground was properly fitted up, and the necessary *cultivation* given at the proper periods during the growing season, that the percentage of loss is surprisingly small—in many instances less than ten per cent. In analyzing the returns, we find a very large proportion of the tree-planting has been done where there is the most pressing necessity for this kind of work, viz: in the treeless region and the counties bordering thereon. For example, Faribault county, with an area of 460,800 acres, had, at the time of the United States' survey, 20,300 acres of timber, being about $6\frac{1}{2}$ acres to each quarter section, if proportionately distributed; enough to entice settlers into it, but not enough to last them forever. This county

realizing her necessities in this regard, has distinguished herself by planting, as reported by assessors, on Arbor Day, 195,278 forest trees and cuttings, and during the entire season the enormous number of 1,804,777, clearly entitled her to the appellation of the "Banner County," as awarded by the State Forestry Association.

Nobles county, with an area of 460,000 acres, had at the survey but 40 acres of timber. The assessors report in this county 121,052 trees planted on Arbor Day, and 693,343 during the season. In the southwestern group of counties, intersected by or tributary to the Southern Minnesota Railroad, the St. Paul and Sioux City Railroad, and the Winona & Saint Peter Railroad, in all fifteen counties, lying south of the Minnesota river, and having together an area of 6,216,680 acres, and an average native supply of only $1\frac{1}{3}$ acre to each quarter section, there were planted on Arbor Day 799,348 trees, and during the season 5,084,828 forest trees and cuttings, or more than half the whole amount in the State. In another group of counties, equally destitute of timber, on or near the St. Paul & Pacific Railroad, and the Hastings & Dakota Railroad, lying north of the Minnesota river, comprising ten counties and 4,753,400 acres, there were planted on Arbor Day, 279,825 forest trees and cuttings, and during the season 898,431.

The assessors report over 400 miles of windbreak and hedges as planted during the season of 1876 on farms bordering upon highways.

Mr. John H. Stevens, of Minneapolis, in writing to the Department of Agriculture upon tree planting in Minnesota, mentions the white, green, and black ash, aspen, long-toothed poplar, linden, yellow and white birch, black walnut, butternut, box-elder, cottonwood, red and black cherry, elms of several kinds, hackberry, shagbark and bitter-nut hickories, red mulberry, several of the maples and oaks, and willows, tamarac, and many smaller trees and shrubs, as adapted to cultivation in that State. As a rule, the evergreens had not done well, and the list of those that might be planted with much chance of success were the pine, balsam fir, swamp spruce, red and white cedar, and juniper.

Mr. Stevens insists upon the thorough breaking up of the sod before planting, and advises that a hoed crop should be first cultivated so that the native sod shall be thoroughly pulverized and rotten. After the crop is removed the ground should be plowed deep and then harrowed. He would set the cuttings deep and cultivate so as to destroy all weeds and grass. He commends the white willow and Lombardy poplar for windbreaks, and the buffalo berry (*Shepardea argentea*) as a hedge plant. In starting the oak he would plant the acorn where the tree is wanted, as it is not easily transplanted. In some instances he had known a cottonwood of fifteen years' growth make a cord of wood. The black walnut and butternut are well worthy of cultivation, especially the former, which grows rapidly and is quite valuable. The locust had very often failed, but it was hoped that it might yet succeed. He is confident that tree planting may be successfully undertaken throughout Minnesota and Dakota, and that prairie farms may be easily kept supplied with all the wood needed for farm uses and for fuel, by proper care and management.

TREE PLANTING IN KANSAS.

SUGGESTIONS BY MR. KELSEY.

Mr. Kelsey, in an essay read before the Kansas State Horticultural Society, December 15, 1868, from an experience of twenty years in planting, of which six had been spent in Kansas, gave the results of his observa-

tion, especially with the black walnut, cottonwood and silver maple, which he preferred as best adapted for this region. In planting black walnuts, he desired they be gathered soon after they drop, and to be spread and covered two or three inches deep with moist earth, or, better, with saw dust, to keep them moist through the winter. They should be planted two inches deep, early in spring, and with fair soil and good cultivation, they will grow so as to be of some use as fuel in five or six years, and in ten years, would make good fence posts or railroad ties, and begin to bear nuts. In fifteen years they would make a fine forest, and, if judiciously managed, would go on increasing in value for a century, returning fair profits annually, and without expense. It should not be transplanted, but the seed should be placed where the tree is to stand.

Cottonwood might be started from shoots of last years' growth, cut in the fall and packed in moist saw dust, or buried in the earth till spring. They should be a foot long, and might be set with a narrow spade, leaving an inch or two out, and pressing the soil firmly about them at setting. Small plants with roots might be easily got; they would begin to be of service as wind-breaks and shelter for stock in four years, and the wood makes a fair fire-wood. He suggested planting cottonwood alternately with black walnut, to make the latter grow taller than if grown alone.

Silver Maple should be started from seed, which ripens from the 15th to the 18th of May, and should be sown immediately in drills, and covered with an inch of good, mellow soil. It will come up in six to ten days, and by fall of the first year, will be two feet and a half high. The next spring it should be set in forest rows, two inches deeper than it stood in the seed-bed, the earth being pressed firmly about the roots. In ten years it will be twenty-five to thirty feet high, and ten to twelve inches in diameter. It forms a beautiful tree while young, and its wood is more valuable than cottonwood, being useful for cabinet wares. Its sap will make sugar of good quality, but less in quantity than sugar maple. It has the fault of forking, so as to make two or more stems, and, except in favorable circumstances, is not likely, if left to itself, to make a large, straight tree. It is also split down too easily by the wind and by sleet.

THE CONGRESSIONAL TIMBER CULTURE ACT.

As this act of Congress more directly concerns and affects our western prairies, and the people living thereon, than is yet generally realized, I deem it proper and useful to give in this place the act as amended, and under whose provisions we are now working. I am led to this from the fact that so many people are constantly enquiring as to its provisions, many of whom seem, by their inquiries, to be considerably confused as to their duties and requirements under the act.

Answers made to individual enquiries, seem to be generally forgotten nearly as soon as answered, and I now propose to furnish such information as to save myself, as well as the U. S. Land officers, a large amount of labor that can just as well be avoided in the future. With this information generally in the hands of the people, many errors can be avoided, and much valuable time saved.

THE AMENDED ACT OF JUNE 14, 1878.

AN ACT to amend an act entitled "An Act to Encourage the Growth of Timber on the Western Prairies."

Be it enacted by the Senate and House of Representatives of the United

States of America in Congress assembled, That an act entitled "An Act to amend the act entitled 'An Act to encourage the growth of timber on the Western Prairies,'" approved March thirteenth, eighteen hundred and seventy-four, be and the same is hereby amended so as to read as follows: That any person who is the head of a family, or who has arrived at the age of twenty-one years, and is a citizen of the United States, or who shall have filed his declaration of intention to become such, as required by the naturalization laws of the United States, who shall plant, protect, and keep in a healthy growing condition for eight years, ten acres of timber on any quarter section of any of the public lands of the United States, or five acres on any legal subdivision of eighty acres, or two and one-half acres on any legal subdivision of forty acres or less, shall be entitled to a patent for the whole of said quarter section, or of such legal subdivision of eighty or forty acres, or fractional subdivision of less than forty acres, as the case may be, at the expiration of said eight years, on making proof of such fact by not less than two credible witnesses, and a full compliance of the further conditions as provided in section two: *Provided further*, That not more than one quarter of any section shall be thus granted, and that no person shall make more than one entry under the provisions of this act.

SEC. 2. That the person applying for the benefits of this act shall, upon application to the register of the land district in which he or she is about to make such entry, make affidavit, before the register or the receiver, or the clerk of some court of record, or officer authorized to administer oaths in the district where the land is situated; which affidavit shall be as follows, to-wit: I, ———, having filed my application, number ———, for an entry under the provisions of an act entitled "An Act to amend an act entitled 'An Act to encourage the growth of timber on the Western Prairies,'" approved ———, 187—, do solemnly swear (or affirm) that I am the head of a family (or over twenty-one years of age), and a citizen of the United States (or have declared my intention to become such); that the section of land specified in my said application is composed exclusively of prairie lands, or other lands devoid of timber; that this filing and entry is made for the cultivation of timber, and for my own exclusive use and benefit; that I have made the application in good faith, and not for the purpose of speculation, or directly or indirectly for the use or benefit of any other person whomsoever; that I intend to hold and cultivate the land, and to fully comply with the provisions of this act; and that I have not heretofore made an entry under this act, or the acts of which this is amendatory. And upon filing said affidavit with said register and said receiver, and on payment of ten dollars if the tract applied for is more than eighty acres, and five dollars if it is eighty acres or less, he or she shall thereupon be permitted to enter the quantity of land specified; and the party making an entry of a quarter section under the provisions of this act shall be required to break or plow five acres covered thereby the first year, five acres the second year, and to cultivate to crop or otherwise the first five acres broken or plowed the first year; the third year he or she shall cultivate to crop or otherwise the five acres broken the second year, and to plant in timber, seeds or cuttings the five first broken or plowed, and to cultivate and put in crop or otherwise the remaining five acres, and the fourth year to plant in timber, seeds or cuttings, the remaining five acres. All entries of less quantity than one quarter section shall be plowed, planted, cultivated and planted to trees, tree-seeds, or cuttings, in the same manner and in the same proportion as hereinbefore provided for a quarter section. *Provided, however*, That in case such trees, seeds or cuttings, shall be destroyed by grasshoppers, or by extreme or unusual drouth, for any year or term of

years, the time for planting such trees, seeds or cuttings, shall be extended one year for every such year that they are so destroyed: *Provided further*, That the person making such entry shall, before he or she shall be entitled to such extension of time, file with the register and the receiver of the proper land office an affidavit, corroborated by two witnesses, setting forth the destruction of such trees, and that, in consequence of such destruction, he or she is compelled to ask an extension of time, in accordance with the provisions of this act: *And provided, further*, That no final certificate shall be given, or patent issued, for the land so entered until the expiration of eight years from the date of such entry; and if, at the expiration of such time, or at any time within five years thereafter, the person making such entry, or, if he or she be dead, his or her heirs or legal representatives, shall prove by two credible witnesses that he or she or they have planted, and for not less than eight years, have cultivated and protected such quantity and character of trees as aforesaid; that not less than twenty-seven hundred trees were planted on each acre, and that at the time of making such proof that there shall be then growing at least six hundred and seventy-five living and thrifty trees to each acre, they shall receive a patent for such tract of land.

SEC. 3. That if at any time after the filing of said affidavit, and prior to the issuing of the patent for said land, if the claimant shall fail to comply with any of the requirements of this act, then and in that event such land shall be subject to entry under the homestead laws, or by some other person under the provisions of this act: *Provided*, That the party making claim to said land, either as a homestead settler, or under this act, shall give, at the time of filing his application, such notice to the original claimant as shall be prescribed by the rules established by the Commissioner of the General Land Office; and the rights of the parties shall be determined as in other contested cases.

SEC. 4. That no land acquired under the provisions of this act shall in any event become liable to the satisfaction of any debt or debts contracted prior to the issuing of the final certificate thereof.

SEC. 5. That the Commissioner of the General Land Office is hereby required to prepare and issue such rules and regulations, consistent with this act, as shall be necessary and proper to carry its provisions into effect; and that the registers and receivers of the several land offices shall each be entitled to receive two dollars at the time of entry, and the like sum when the claim is finally established and the final certificate issued.

SEC. 6. That the fifth section of the act entitled "An Act in addition to an act to punish crimes against the United States, and for other purposes," approved March third, eighteen hundred and fifty-seven, shall extend to all oaths, affirmations, and affidavits required or authorized by this act.

SEC. 7. That parties who have already made entries under the acts approved March third, eighteen hundred and seventy-three, and March thirteenth, eighteen hundred and seventy-four, of which this is amendatory, shall be permitted to complete the same upon full compliance with the provisions of this act, that is, they shall, at the time of making their final proof, have had under cultivation, as required by this act, an amount of timber sufficient to make the number of acres required by this act.

SEC. 8. All acts and parts of acts in conflict with this act are hereby repealed.

Approved June 14, 1878.

And now, by connecting with the amendatory law the following explanations of the changes made, together with the regulations issued by the Department of the Interior, General Land Office, Washington, D. C., Oct. 1st, 1878, we have all the information necessary for any one to enable him to fully understand the duties, obligations, and rights, under the congressional timber culture act. Please study the law, the official explanations and regulations, and you will then know for yourselves more than you can possibly learn by writing to any one for information on the subject.

LAWS TO PROMOTE TIMBER CULTURE.

The timber culture act of March 3, 1873, having been amended by the act of March 13, 1874, the latter has been further amended by the act of June 14, 1878.

I.—Certain provisions of the act of March 13, 1874, are repealed by the act of June 14, 1878.

1. The act of March 13, 1874, at the close of its first section, contains the following: "*Provided*, That no more than one quarter of any section shall be thus granted, and that no person shall make more than one entry under the provisions of this act, unless fractional subdivisions of less than forty acres are entered, which, in the aggregate, shall not exceed one quarter section." In the act of June 14, 1878, the concluding words, "unless fractional subdivisions of less than forty acres are entered, which, in the aggregate, shall not exceed one quarter section," are omitted. Hence, the rule forbidding more than one entry is made universal, and will govern in all future cases.

2. The provisions of the act of March 13, 1874, requiring that the trees shall be not "more than twelve feet apart each way," is omitted from act of June 14, 1878. The latter requires, however, that the final proof shall show "that not less than twenty-seven hundred trees were planted on each acre, and that at the time of making such proof there shall be growing at least six hundred and seventy-five living and thrifty trees to each acre."

3. The closing sentence of the second section of the act of March 13, 1874, provides that "in case of the death of a person who has complied with the provisions of this act for the period of three years, his heirs or legal representatives shall have the option to comply with the provisions of this act, and receive, at the expiration of eight years, a patent for one hundred and sixty acres, or receive, without delay, a patent for forty acres, relinquishing all claim to the remainder." This provision is not contained in the act of June 14, 1878.

4. The following section of the act of March 13, 1874, relating to homestead entries on which timber is cultivated, is omitted from the act of June 14, 1878.

SEC. 4. That each and every person who, under the provisions of the act entitled "An Act to secure homesteads to actual settlers on the public domain," approved May twentieth, eighteen hundred and sixty-two, or any amendments thereto, having a homestead on said public domain, who, at any time after the end of the third year of his or her residence thereon, shall, in addition to the settlement and improvements now required by law, have had under cultivation, for two years, one acre of timber, the trees thereon not being more than twelve feet apart each way, and in good thrifty condition; for each and every sixteen acres of said homestead, shall, upon due proof of such fact by two credible witnesses, receive his or her patent for said homestead.

The rights of claimants under entries actually made according to the act of March 13, 1874, before the 14th of June, 1878, when the amendatory act took effect, are not affected by the repeal of the provisions referred to. The parties interested, if they so elect, may consummate their entries according to the provisions of the act under which they were initiated. And homestead entries made before the 14th June, 1878, will be patented according to the fourth section above quoted, where the facts are such as to bring the cases within its provisions and the interested parties so desire. But entries made since that time must be adjusted according to the principles of the law as modified by the amendatory act.

II.—The principal points to be observed in proceedings thereunder, may be stated as follows :

1. The privilege of entry under the act of June 14, 1878, is confined to persons who are heads of families, or over twenty-one years of age, and who are citizens of the United States, or have declared their intention to become such; according to the naturalization laws.

2. The affidavit required for initiating an entry under the act of June 14, 1878, may be made before the register or receiver of the district office for the land district embracing the desired tract, before the clerk of some court of record, or before any officer authorized to administer oaths in that district.

3. Not more than one hundred and sixty acres in any one section can be entered under this act, and no person can make more than one entry thereunder.

4. The ratio of area required to be broken, planted, etc., in all entries under the act of June 14, 1878, is *one-sixteenth* of the land embraced in the entry, except where the entered tract is less than forty acres, in which case it is one-sixteenth of that quantity. The party making an entry of a quarter section, or one hundred and sixty acres, is required to break or plow five acres covered thereby during the first year, and five acres in addition during the second year. The five acres broken or plowed during the first year, he is required to cultivate by raising a crop, or otherwise, during the second year, and to plant in timber, seeds, or cuttings, during the third year. The five acres broken or plowed during the second year, he is required to cultivate, by raising a crop, or otherwise, during the third year, and to plant in timber, seeds, or cuttings, during the fourth year. The tracts embraced in entries of a less quantity than one quarter section are required to be broken or plowed, cultivated, and planted in trees, tree-seeds, or cuttings, during the same periods, and to the same extent, in proportion to their total areas, as are provided for in entries of a quarter section. Provision is made in the act for an extension of time in case the trees, seeds, or cuttings planted should be destroyed by grasshoppers or by extreme and unusual drought.

5. If, at the expiration of eight years from the date of entry, or at any time within five years thereafter, the person making the entry, or, if he be dead, his heirs or legal representatives, shall prove, by two credible witnesses, the planting, cultivating, and protecting of the timber for not less than eight years, according to the provisions of the act of June 14, 1878, he, or they, will be entitled to a patent for the land embraced in the entry.

6. If, at any time after one year from the date of entry, and prior to the issue of a patent therefor, the claimant shall fail to comply with any of the requirements of that act, then, and in that event, such entry will become liable to a contest in the manner provided in homestead cases, and upon due

proof of such failure, the entry will be cancelled, and the land become again subject to entry under the homestead laws, or by some other person under the act of June 14, 1878.

7. No land required under the provisions of the act of June 14, 1878, will in any event become liable to the satisfaction of any debt or debts contracted prior to the issuing of the final certificate therefor.

8. The fees for entries under the act of June 14, 1878, are ten dollars, if the tract applied for is more than eighty acres; and five dollars, if it is eighty acres or less; and the commissions of registers and receivers on all entries (irrespective of area) are four dollars (two dollars to each) at the date of entry, and a like sum at the date of final proof.

9. No distinction is made, as to area or the amount of fee and commissions, between minimum and double-minimum lands. A party may enter one hundred and sixty acres of either, on payment of the prescribed fee and commissions.

10. The fifth section of the act, approved March 3, 1857, entitled, "An Act in addition to an act to punish crimes against the United States, and for other purposes," is extended to all oaths, affirmations, and affidavits required or authorized by the act of June 14, 1878.

11. Parties who have already made entries under the timber culture acts of March 3, 1873, and March 13, 1874, of which the act of June 14, 1878, is amendatory, may complete the same by compliance with the requirements of the latter act; that is, they may do so by showing, at the time of making their final proof, that they have had under cultivation, as required by the act of June 14, 1878, an amount of timber sufficient to make the number of acres required thereby, being one-fourth the number required by the former acts.

III.—The following regulations are prescribed pursuant to the fifth section of the act of June 14, 1878, viz :

1. The register and receiver will not restrict entries under this act to one quarter section only in each section, as was formerly done under the acts to which this is amendatory, but may allow entries to be made of subdivisions of different quarter sections; provided that each entry shall form a compact body, not exceeding one hundred and sixty acres, and that no more than that quantity shall be entered in any one section. Before allowing any entry applied for, they will, by a careful examination of the plat and tract-books, with reference to any previous entry or entries, within the limits of the same section, satisfy themselves that the desired entry is admissible under this rule.

2. When they shall have satisfied themselves that the land applied for is properly subject to such entry; they will require the party to make the prescribed affidavit, and to pay the fee and that part of the commissions payable at the date of entry, and the receiver will issue his receipt therefor, in duplicate, giving the party a duplicate receipt. They will number the entry in its order, in a separate series of numbers, unless they have already a series under the acts to which this act is amendatory, in which case they will number the entry as one of that series; they will note the entry on their records and report it in their monthly returns, sending up all the papers therein, with an abstract of the entries allowed during the month under this act. If the affidavit is made before a justice of the peace, which the act admits of, his official character and the genuineness of his signature must be certified under seal.

3. When a contest is instituted, as contemplated in the third section of the act of June 14, 1878, the contestant will be allowed to make application to enter the land. The register will thereupon indorse on the application the date of its presentation, and will make the application, and the contestant's affidavit setting forth the grounds of contest, the basis for further proceedings, these papers to accompany the report submitting the case to the General Land Office. Should the contest result in the cancellation of the contested entry, the contestant may then perfect his own, but no preference right will be allowed unless application is made by him at date of instituting contest.

4. The fees and commissions in this class of entries the receiver will account for in the usual manner, indicating the same as fees and commissions on timber culture entries, which will be charged against the maximum of \$3,000 now allowed by law.

5. In all cases under this act, it will be required that trees shall be cultivated which shall be of the class included in the term "timber," the cultivation of shrubbery and fruit trees not being sufficient.

6. The applications, affidavits, and receipts in entries allowed under the act of June 14, 1878, will be made out according to the forms hereto attached, Nos. 38, 39 and 40.

PRUNING AND THINNING.

On tree pruning, a great difference of opinion exists. You don't want to prune your trees late in the winter, nor when the sap is flowing freely. As to the exact time when to prune, I do not attach much importance; so do your pruning as soon as the tree needs it. When you grow a young forest, you can almost do your pruning with your thumb and finger, by pinching off the young shoots soon after they start. But, when you have neglected this, and the limbs have been allowed to have their own way any length of time, then the pruning knife or saw must be brought into requisition. In my own experience, I have found any time after the leaves are full grown, until late in the fall, is a good time enough to prune in Minnesota. I doubt if any rules can be properly given on this subject. Your own judgment and common sense must direct you largely in this matter. For wind-breaks, very little, if any, pruning is necessary. For a shade tree, you so prune as to form a wide spreading top; but, for a young forest, in which the growing of timber is the main object, you so prune as to get a long, straight body as free from branches as possible; and if your young forest has been as thickly planted as it should be, nature will do most of the pruning, nearly, or quite as well as need be. First, know what you want of your tree, and then prune accordingly. You can so prune and direct its growth as to give it almost any shape you choose. Bryant says:

"In pruning young trees designed for timber, the symmetry of their form is the first consideration. When taken from the seed bed, all side branches should be cut off; only one leading shoot should be allowed, which must not be permitted to fork. All side branches which approach in size and vigor to the leading shoot, should be shortened or cut off entirely. Suckers from the base of the tree should be cut away."

Bryant also says:

"The best time to prune is, in my opinion, the autumn after the trees have ceased their growth. The worst time to prune is the latter part of the winter, and

in the spring, just before or during the first flow of sap. * * * * * Nevertheless, when trees are transplanted in spring, they may be pruned, as they do not bleed when recently taken up. When the young trees become large enough to crowd, or materially check each other in growth, they must be thinned to one foot apart in the rows. Care should be taken to leave the straightest and most vigorous trees. The thinning may be continued gradually, as the trees grow larger, and those cut out used for purposes to which their size and quality are adapted."

Fuller says :

"If the trees are properly pruned when young, there will be no necessity for taking off large branches when they become old. Too many branches must not be taken off at one time, as leaves are indispensable to growth; but young trees may produce more leaves than is necessary for a healthy growth, and a reduction in number may increase rather than decrease strength. * * * Pruning should not be practiced to such an extent that the tree may be eventually weakened or checked in growth. * * * Trees, when standing alone, should have at least two-thirds of their height occupied with branches. But, when grown in thickets, and for the purpose of producing timber, this rule may be reversed, and the branches occupy only one-third, varying the rule according to the natural habit of the tree." * * *

Fuller also says, further :

"There is no better time (to prune) than in summer, after the leaves have become fully formed, and the tree has commenced to make a new growth. * * * Pruning may also be done any time in summer, fall, or early winter. * * * Midsummer is the best time to prune all resinous trees."

In pruning, use a sharp knife, and make a clean, smooth, upward cut. Should the branches be too large for a knife, use a fine tooth saw, smoothing off the wound with a sharp knife. Where large wounds are made, an application of common grafting-wax, or cow-manure when warm, will exclude the air until there will be little danger of decay.

MOUNTAIN FORESTS AND THE WATER SUPPLY OF THE CONTINENT.

An Open Letter to the Hon. Carl Schurz, Secretary of the Interior, from Dr. John A. Warder, President of the American Forestry Association.

NORTH BEND, OHIO, January 8th, 1879.

Hon. Carl Schurz, Secretary of the Interior :

MY DEAR SIR.—Observations made on a previous visit to Colorado, and again during the past season, in a journey on the Medicine Bow Range, in Wyoming, with my friend, Governor J. W. Hoyt, have filled me with apprehensions as to the future water supply of our Western rivers.

The destruction of the forests by fire is a most fearful and melancholy subject to contemplate. An inspection of portions of the public domain by one who has studied the subject, and who has either read of or witnessed the disastrous effects of the spoliation of the forests in elevated mountain heights, can not fail to fill the mind with the most serious apprehensions.

Your efforts, my dear Secretary, on behalf of the forests are highly appreciated

by those of us who have made the influence of the woods upon the water supply of our country a matter of study.

The mountains (up a certain elevation, close to the limit of perpetual congelation) were designed for the forests, nor should they ever be stripped of their arboreal covering; for, as you have well said in your report of last year, if the forests in such regions be once destroyed they will never be restored.

It were a work of supererogation, my dear sir, to attempt an explanation or rationale of the action of the forests as receivers, reservoirs and fountains of waters, to one who is evidently so well informed in regard to forest science as yourself, whom I have been induced to suspect of having been a pupil of Ebermayer, of Bernhardt, of Judeich, of Burckhardt, or some others of the magnates in Foerstwirthschaf of the Vaterland.

But to return to Wyoming, and what was seen while traversing a broad plateau of the range, and passing through a glorious forest primeval—a very Uhrwald. This is composed chiefly of pines, and among them, in the lower and damper spots, the most lovely furs and spruces reared their tall shafts, clothed with a mystic drapery of depending boughs, bearing silvery green foliage of the Menzies, Douglas and Englemann spruces, and the Grandis firs. While contemplating these noble trees, we suddenly came upon a scene of *appalling desolation*. Upon a tract of many square miles in extent, as far as the eye could reach in every direction, over many thousands of acres, there was not a living tree to be seen! All, all were standing bare, stark and stiff in death, their tall, dead trunks blackened by fire, except where time had come to their relief and stripped off the bark, leaving the bare poles that stood beside the way like shivering ghosts in purgatory, waiting until the storms of years should come to their relief and prostrate them to the earth that bore them, when they would at length gradually crumble into mold to renovate the soil, which had been deprived of all its humus by the fierce flames.

The forest is destroyed, the noble trees are dead and gone, too often, never in our time, to return and be a kindly covering and befitting garniture to these sad wastes, nor to clothe these mountain sides with verdure. *Continued* and *continuous* desolation is their doom!

Practically speaking, this is and must be so; whence can come the seed-germs for the future aforesting of such extensive tracts? Man, the improvident destructive, will not do it; the kindly winds can transport the winged seeds but a short distance from the parent trees; the cunning and provident squirrel has a still more limited range within which to carry the seeds he may gather, and, with wise instinct, store up for his liberal repast, from which a few might escape to germinate and form nuclei, producing at length seeds for further transportation in the future.

Agas must be required to restore these forests in the course of nature, and meanwhile the degrading agencies of every storm will be carrying away the soil and scarring the mountain sides with frightful gullies, occupied at times with violent torrents, for there is no longer any herbage, no moss nor brush, nor any debris to cover the surface, and, sponge-like, to absorb and retain the precipitated moisture.

Yes, my good Secretary, you are perfectly right in your assertion that in these bared mountains the forests will never be restored, when thus ruthlessly destroyed, in certain situations, and over such vast areas, practically speaking in reference to any period of time that it is worth our while to calculate upon, any time that we or our progeny for many generations need take any account of, this is true.

PREVENTION.

But, it may be asked, cannot these terribly destructive fires be prevented? Can not the calamitous results that must follow be avoided? Yes! Yes! They may, and they must be prevented, and that at once, lest our fair continent become a desert, unfitted for the many millions it is capable of happily sustaining upon the broad territory of her fruitful bosom.

That is, indeed, a great question, requiring the exercise of a high order of statesmanship. It is truly a difficult question, but the interests at stake are enormous, and are of infinitely greater importance to this Nation, than deciding who of all the great army of office-seekers shall be gratified by an appointment to this or that petty place under the government. Oh, that we could be blessed with a race of statesmen capable of grasping such problems as this!

Yes, the interests at stake are really enormous; they involve the welfare of the country, since they concern the very existence and permanence of our rivers. If neglected, will not the future explorer of the vast Sahara that may be spread from the eastern slope of these mountains, find, amid the shifting sands of that wide desert, only depressions of the surface, marking the ancient beds of our great rivers and their numerous tributaries, in that American Sahara, as Champollion observed them in the wastes of Northern Africa; of which he said: "And so, the astonishing truth dawns upon us, that this desert may once have been a region of groves and fountains, and the abode of happy millions. Is there any crime against nature which draws down a more terrible curse than that of stripping mother earth of her sylvan covering? The hand of man has produced this desert, and, I verily believe, every other desert upon the surface of this earth. Earth was Eden once, and our misery is the punishment of our sins against the world of plants. The burning sun of the desert is the angel with the flaming sword who stands between us and Paradise."

But how shall this great work be accomplished? How shall we preserve these treasure houses of the snow and rain, that they shall steadily distil the streams that are to feed our rivers?

By wise legislation, after we shall have enlightened the public upon the subject of an advanced forest science, and educated them up to a proper appreciation of the importance, and of the special functions of the forests on these mountain heights as *conservers of moisture*, as *receivers* and as *reservoirs* of the water supplies of a large portion of the continent.

When so educated, and fully informed upon these important truths by an enlightened public sentiment, the people will become more careful in the use of this dangerous agent; they will be more watchful of their camp fires, and will compel others to be more careful, and they will stamp out the first beginnings of a conflagration.

In addition to this enlightened sentiment, and complementary to it legislation will be needed to operate upon those who may wickedly or ignorantly transgress.

Some of your excellent suggestions, Mr. Secretary, as they were incorporated in the bill of Senator Plumb, of Kansas, (Sen. No. 609,) would prove valuable as preventive measures, if enacted; especially the appointment of Forest Guards, (*Forest Wærter*;) in the third section, and prescribing their duties.

Section 13 of this proposed law is one of great importance, being intended to furnish protection against fires on the public domain, whether prairies or timber. This is a much needed provision, which has never before existed in

the case of government lands, though provided for by some of the States. The losses by fires are enormous, and should be prevented.

We all know by sad and painful experience, how difficult a task it is for the philanthropist who presents a simple proposition for the public good, how great soever its importance, to arrest the attention of the public. We have also learned how almost impossible it is to reach the ear of the law-making powers, and to excite in their minds an active interest in such questions as are here presented; in a word, how herculean an undertaking is presented when we attempt to educate the people, and those who represent them in the halls of Congress, up to a proper and full appreciation of such a subject as this of forestry, which so deeply concerns the public weal.

More especially unpromising does such an effort appear when an attempt is made to impress upon their minds the absolute necessity of keeping these extensive ranges of mountain heights in a condition best adapted to attract and condense the atmospheric humidity, to receive the precipitation, to retain it for a time, and then gradually and quickly to give off, through perennial springs, the fluid to supply the fertilizing streams, that shall fill the rivers, which are so happily and so extensively distributed over our great continent.

And now, Mr. Secretary, hoping that you will excuse the prolixity which must unavoidably attend the briefest exposition of the subject, be pleased to accept the thanks of your countrymen for the noble stand you have taken in defense of our forests on the public domain; and allow an humble student of the great leaders and teachers of forest science, on behalf of his associates in the upbuilding of an *American Forestry*, to beg your continuance in these efforts in behalf of the protection, preservation and extension of our heritage of woodlands.

Very respectfully yours,

JNO. A. WARDER, M. D.,
President A. F. A.

From the Pioneer Press of January 15, 1879.

TIMBER CULTURE.

Annual Meeting of the Minnesota Forestry Association.

An annual meeting of the State Forestry Association was held at the capitol last evening, Mr. Ignatius Donnelly in the chair, and Mr. L. B. Hodges at the secretary's desk.

MR. DONNELLY'S ANNUAL ADDRESS.

About the first business in order was the delivery of the annual address of the president, which was listened to with great interest by the audience. After an interesting review of forest culture in Europe, Mr. Donnelly said:

One of our unsolved problems is the origin of these prairies. Some have claimed that they are due to a peculiarity of the constitution of the soil, which renders them unfit for the production of trees, but this theory seems to be disproved by the fact that trees can be readily produced upon them; and

that a spontaneous growth of forest soon follows the exclusion of the fires. Neither can we ascribe their first existence to these fires, for this vast region must have existed long before the Indians could have been developed to apply the fire to the autumnal grass. As soon as this portion of the continent emerged from the condition of great lakes or lagoons and became marshes, trees must have sprung up and covered the land, and long before man appeared on the scene, with any knowledge of the use of fire, the country must have assumed the character of a densely wooded region, which no conflagration could destroy. If the soil was once denuded of its forest it would, indeed, be easy for the prairie fires, kindled by savages, to keep down the growth of young trees, and produce the state of things which the white settlers found here; but what agency could, in the first place, have destroyed the ancient forest growth, as heavy and dank as that of the everglades of the South or the pine woods of Canada? It must be remembered that the true prairie region, apart from the painless plains, is confined to certain prescribed limits, viz: "The western part of Ohio, nearly the whole of Indiana, Illinois and Iowa, the southern part of Michigan, the northern part of Missouri, and portions of Wisconsin, Minnesota, Kansas and Nebraska."

It would seem that either man must have existed, with a knowledge of the uses of fires, at the time the swamps of this inter-continental region were drained off sufficiently by the accretion of the soil or the rising of the continent, to produce trees; and this would be, indeed, a violent presumption; or else it would appear probable that some human agency must have swept away the forest through all this region, precisely as it was destroyed by white men, in the interest of agriculture, in Europe. * * * * *

It would seem not improbable that on this continent was worked out, under the directing intelligence of the divine Architect, the great scheme of development. The explorations of Prof. O. C. Marsh, of Yale College, in the Bad Lands at the base of the Rocky Mountains, demonstrate that in that region, where originated the elephant, the rhinoceros, the tapir, the horse, the lion, the hyena, the monkey, the hog, and the camel. And it is not improbable that on this continent human civilization began. Here alone, as shown in a recent lecture of Dr. David Day, traditions are preserved by existing races of the rise of man from a brutish condition, the invention of the bow and arrow, and the first working in metal. The iron age was preceded by the bronze age. Bronze is an amalgam of copper and tin, and must have followed, probably, at a vast interval, the use of copper itself; and only in America do we find traces of an age when copper was used alone; and only on Lake Superior do we find copper in so pure a state as to be capable of being worked into implements without smelting; and there, too, we find vast remains of ancient mining, evidently carried on for ages by some extinct race; and in the Chippewa legends we have the traditions of the manufacture of the first copper implements. In Mexico the Aztecs had learned the art of hardening the edges of their cutting tools with tin, thus producing a veritable bronze. Here then we have in unbroken succession the genesis of metallurgy, stretching from the shores of Lake Superior to Assyri, India and Egypt. * * * * *

It is a strange, but not altogether improbable suggestion, that all the prairie region was once occupied by the fields and gardens of a vast, populous, peaceful, agricultural, religious people; as numerous as the inhabitants of Egypt, in the days of the Rameses. It is well known that their monuments do not extend east of Ohio; neither do prairies. It can be supposed that thousands of years ago they were driven southward to Mexico and Yucatan, by savage tribes, and then began a struggle, which has lasted to our day,

between the prairie-fires and the advancing forest, the latter crowding in from north, south, east and west, and sheltering itself behind every lake and river from the tongues of flames kindled annually by the Indians. * *

The problem to which our people must address themselves, is how to make these mighty plains pleasant homes for human beings; how to stop the sweep of the great winds which pour down on them from Mackenzie's river and the Rocky Mountains; for homes, to be pleasant, should be built like bird's nests, amid the trees. If man has swept away the forests from whole continents to procure fields, surely he has genius and power enough to re-create lines of forest to protect the fields which nature, or the labors of another race, has given him. It must certainly be a harder task to lay bare of trees a thousand acres than to fence it with groves. But construction needs a higher genius than destruction. "He who plants a tree labors for posterity," says the proverb; and some are inclined to ask, in the words of Sir Boyle Roche: "What has posterity done for me?" Hence, only the highest representatives of the highest races are equal to the task of planting a crop that will not ripen for ten or twenty years.

I need not speak to you of the effects of forest-growth upon the climate of a country; with all that you are familiar. It would appear as if the movements of storms were determined by the laws of electricity. The tendency of showers to follow wooded hills and river courses has often been observed.

W. W. Johnson, one of the Smithsonian reporters, writes from the valleys of Montana: "The showers of summer are of much more frequent occurrence along the mountain sides, and are always of longer duration among the timbered peaks and foot-hills, than in the lower and treeless portions of the country."

I have every reason to believe that the presence of groves, dotting the whole extent of our prairies, would tend to equalize the fall of rain, and prevent the excessive droughts which we suffer from at certain periods, and the deluging storms which afflict us at other times. In fact, we are now in the midst of a very curious experiment, viz: the effect upon climate of the breaking up of the soil and the construction of railroads and telegraph lines.

R. S. Elliott, industrial agent of the Kansas Pacific Railroad company, writes to Prof. Henry, in 1870: "Facts such as these, seem to sustain the popular persuasion in Kansas, that a climatic change is taking place, promoted by the spread of settlements westwardly, breaking up portions of the prairie soil, covering the earth with plants that shade the ground more than the short grasses, thus checking or modifying the reflection of heat from the earth's surface. The fact is also noted, that even where the prairie soil is not disturbed, the short buffalo-grass disappears as the frontier extends westward, and its place is taken by grasses and other herbage of taller growth. The civil engineers of this railway believe that the rains and humidity of the plains have increased during the extension of the railroads and telegraphs across them. What effect, if any, the digging and grading, the iron rails, the tension of steam in locomotives, the friction of metallic surfaces, the poles and wires, the action of batteries, etc., could possibly have on the electrical conditions, as connected with the phenomena of precipitation, I do not, of course, undertake to say. It may be that wet seasons have merely happened to coincide with railroads and telegraphy."

A recent writer from Bismarck, D. T., speaking of an old settler in Montana, says: "Clendenning is agent of all the transportation companies that have occasion to unload freight at Carroll. He has noticed that the water is increasing in consequence of the additional rains. He observes that cooleys,

formerly dry in the fall, are now full of water. The irrigation was unnecessary this year, and the Indians observe the change. Civilization is turning Montana into a wet country."

It would appear probable, that when four broad, double bands of iron and numerous telegraph wires extend across the continent from Texas, from Omaha, from Duluth, and from Winnipeg, united at their eastern and western extremities by rivers, mountain chains, forests, and a grid-iron of other railroads and telegraphs, that climatic changes may result of the most surprising character. The prosperity or the poverty of great sections may depend upon causes now but little understood. If it be true, as alleged, that earthquakes have ceased in California since the construction of the Union Pacific railroad; and if it be also true, as claimed by others, that earthquakes are electrical—the thunder-storms of the earth—what strange results may not follow when man's enterprise ribs all the continent with conductors of electricity hundreds of thousands of miles in length?

If I was required to furnish a motto for our society, it would be the one word, "Perseverance." Only those who have passed through it can understand the long, hard, dark, continuous struggle which awaits the settler in a new country; the battle with nature: her cruelties and uncertainties, on the one hand; and the conflict with his fellow-man, his greed, his cunning and his rapacity, on the other. The pioneer-farmer seems sometimes to stand alone with everything in air and on earth making war on him, with nothing left to him but his indomitable soul. For such a man, so struggling neck-deep in distress, to plant groves, construct hedges, rear orchards and plant for posterity, requires a breadth of mind that is the highest statesmanship. And yet, I would say to all such, "Perseverance!"

"The columns of our stately fortunes
Are sculptured with the chisel, not the axe."

Even the gigantic tides of the St. Lawrence have their ebb, and misfortunes at last grow weary of submerging their victims and draw sullenly off. And then how sweet the home, snatched like a brand from the burning, won from innumerable battlings and sheltered amid arboreal beauty that shall ever increase as the days roll on. There can be no true home where there are no trees. And so I conclude with that one word for the great army of tree-planters—"Perseverance."

TREE CULTURE.

*Another Interesting Meeting of the Minnesota State Forestry Association—
Address of Prof. C. Y. Lacy, of the State University.*

An adjourned meeting of the State Forestry association was held at the capitol last evening, with a good attendance of persons interested in the scheme for covering our prairies with forest trees. Lieutenant Governor Wakefield presided, and Mr. L. B. Hodges acted as secretary. Prof. Lacy, of the State University, then read the following paper :

ADDRESS OF PROF. LACY.

A little more than a year ago a meeting was held in this hall for the purpose of organizing a Forestry Association. On the following evening another meeting was held, a constitution adopted and officers elected in accordance with it. Soon the association numbered more than one hundred members. Before the adjournment of the legislature, the association was entrusted with \$2,500 to be awarded in premiums for tree planting. The executive committee of the association met and constructed a list of premiums to be competed for. This premium list was printed and distributed throughout the State at the expense of the association. The premiums have been competed for and many of them awarded.

Why this conceded, extended and continued action towards one end by men engaged in the widely different pursuits of transportation, law, medicine, agriculture, legislation and administration? Was it to gratify the whims of a few half-crazy enthusiasts? Was it because it was easier to comply with the wishes of such in cases of doubtful utility than to resist their arguments and entreaties? No. The association includes such men as Geo. L. Becker, E. F. Drake, Herman Trott, Wm. W. Folwell, L. B. Hodges, J. W. McClung, H. H. Sibley, and J. S. Pillsbury—men who have not been suspected of insanity in other affairs—men who have not time to treat individual cases outside of the insane asylum—men who have the sagacity to read the true nature of facts correctly, and the force of character to say no when their judgment demands it. The Minnesota State Forestry Association was organized to meet and deal with the stern realities of facts. It was organized to meet the fact that over more than one-third the great State of Minnesota the winds rush with a howling fang and with a bitter cold that neither beast nor fruit can resist nor withstand, and for miles not a single forest tree rears its head in protest. It was organized to meet the fact that in a climate which affords six months of winter, much of it fearfully severe, there are thousands of farms on which there does not grow one particle of fuel, and on which it cannot be obtained without the expenditure of both money and labor by a people often destitute of means. It was organized to meet the fact that for miles and miles there is not a single landmark to guide the benumbed and benighted traveler. It was organized to meet the fact that to induce human beings to make their homes on such farms, is downright inhumanity. It was organized to meet the fact that people cannot and will not submit to these conditions, but when undeceived will abandon their new homes and seek elsewhere. This association was organized to deal with the fact that forests break the force and fury of winds, yield fuel and material for fencing and building, and furnish landmarks for the traveler. It was organized to deal with the fact that forests can be grown. Gentlemen, these are not mere figures of rhetoric. They are solemn statements of facts, which the most thorough investigation will only confirm. The force of the wind on our western prairies cannot be conceived of by you who have always lived within the area of forests. They are simply terrible to endure and appalling to contemplate. They carry death alike to the unprotected beast and the more tender forms of arboreal life. Fuel must not only be purchased at a fair price, but must be transported by rail, and often in addition, it must be hauled a distance which requires a journey of one or even two days. When unexpectedly overtaken on these broad prairies by darkness or blinding snow, the traveler has no guide, and is liable to be overcome by cold and discouragement when within a mile of his own home. It is cruel and inhuman to place human beings in the midst of such conditions. And it is not uncommon for our frontier settlers to abandon their inhospitable homes and to follow the flowing waters of the Mississippi to more genial climates. To show that belts and blocks of forests on every quarter section would completely change all these conditions needs no argument. That forests can be grown, the millions of trees that have been planted in this State, and in Kansas, Iowa and Nebraska, and are now growing, show conclusively.

Thus far I have indulged in no speculation, no theory, no fancy. What I have claimed for forests no man of good judgment will attempt to question or contradict. But those who have given the subject most attention are firmly convinced that forests will do more than arrest the wind, modify the cold, produce fuel, yield lumber and fencing material, guide the traveler, invite the emigrant and retain the pioneer settler. I am convinced that forests will modify climate in other respects than its temperature. They will affect the rainfall. The experience of Egypt and of one of the West India Islands indicates this, if it does not prove it. In the former case rain fell after several million trees were planted in a district where it was never known to fall before. In the latter instance, where the forests were de-

stroyed, the rains ceased to fall and streams dried up. The island was allowed to grow up to forest and the rainfall returned. Again the island was denuded, with the same result as before.

Forests will preserve our springs and streams. They prevent the rain from flowing off from the surface as fast as it falls, thus producing destructive freshets, and cause it to sink gradually in the soil, thence to feed constantly flowing springs or the waste of evaporation.

Forests will distribute the fall of rain more equally throughout the year. It is believed in the Eastern States that droughts are more protracted and severe than in former years when forests were more extensive.

Forests will make the atmosphere more moist, more humid. With a brisk wind blowing, the air is blown away as fast as it becomes moist by contact with the earth. When the wind is arrested by forests, the moist air remains.

Through their influence on temperature, winds and moisture, forests will help to solve the problem of successful fruit culture. The forest tree must precede the fruit tree. Plant the former and the latter will follow with comparative ease.

May not fruits prove the ultimate solution of our most perplexing problem, the grasshopper? Insects are the chief food of many birds, and birds are doubtless the instruments of Providence for keeping the insect world within proper limits. Forests harbor and protect myriads of birds that find no suitable home upon the open prairie. The great difference in the kind and abundance of feathered life on coming into the vicinity of a grove is very marked. At first thought it would seem to need birds in greater numbers than can possibly be obtained to make any headway. But their capacity must not be undervalued. Each small bird can consume the young grasshoppers almost by hundreds daily, and the eggs by tens of hundreds, and living upon them year after year, the birds would much hasten the decline and exhaustion of each migration. Besides, it is very probable that forests may impede the migrations of the grasshopper. I do not consider it at all unlikely that if Dakota and Nebraska had been forest instead of prairie region, the grasshoppers would never have reached Minnesota and Iowa.

But the pressing need of forests in Minnesota is to break the force of the wind, modify the temperature, and furnish fuel and lumber, and landmarks. For these purposes we must have forests. These wants they can supply without a shadow of doubt or question. We must grow these forests where they do not already exist, and in our State they must be grown over a large area.

Different authorities differ in their estimates of the proper proportion between forest and cultivated areas. The estimates run from 20 to 33 per cent., varying somewhat according to the distance of the country from the ocean, or other large bodies of water. Taking distance as a basis, the higher estimate would be none too high for Minnesota, Dakota, Kansas, Nebraska and Iowa; but let us take the lower estimate and see how Minnesota stands, and what she requires. Taken as a whole, and compared with some other States, she does not appear to be very badly off. The census of 1876 showed 20 per cent. of the farm area in wood land in Minnesota, while Iowa has but 16, Kansas 11, Nebraska 10 and California 4. Of the total area, 17 per cent. is estimated to be in wood land in Minnesota, while in Iowa it is only 14, in Kansas $5\frac{1}{2}$, Nebraska 5, and California 8 per cent. But it is not sufficient that there should be within the limits of the State a fair proportion of wood land. Every farm must have its protecting belt and its supply of fuel and fencing. And when we come to examine the different parts of the State we do not find the results so encouraging. We find the wood land very unequally distributed. Some counties are composed almost entirely of it. In others the government survey does not show any, and in several others the wood land is less than 500 acres, often lying in one piece along some stream. In one piece in the southwestern part of the State, containing 23 counties, and more than ten millions of acres, the government survey reported only 80,144 acres of wood land.

This is thought to be double the true amount of timber at the present time; but if we allow that it is sufficient to supply the people of those counties with fuel for the next five years, we need not further take it into account. To put 20 per cent. of this area in forest will require the planting of two millions of acres. As to the distance at which trees should stand authorities differ, but we will take such a maximum as shall raise no dispute. We will assume that they should stand, at the end of ten years, one rod apart each way, or 160 to the acre. They should be planted then in rows not more than eight feet apart and four feet in the row, or 1,380 on each acre. After the lapse of four or five years, the necessary thinning would supply fuel and fencing. This gives us, at the least calculation, a grand total of 2,760 millions of trees that should be planted next summer, in order to give these twenty-

three counties a proper proportion of forest ten years hence. If we were to allow for probable failures, we should increase these figures by at least 25 per cent., and if we were to allow for the requirements of other parts of the State, we should increase this result by at least 50 per cent. The numbers already given are sufficient, however, to show the magnitude of the work before us.

Humanity requires us to do this work, for to invite the emigrant to our treeless prairies is cruel inhumanity. Public policy requires us to do this work, for without it the treeless regions will remain uninhabited, or else their inhabitants will continually require the bounty of the State. Humanity, public policy and the magnitude of the work all demand that we each and every one of us give it our best encouragement and our best assistance.

What encouragement have we? In the first place we are assured that the planting of trees will accomplish what we seek to accomplish—they will protect from winds, modify the temperature, yield fuel and lumber.

In the second place we have good reason to believe that numerous other good effects will follow, that the rainfall will be better distributed, our springs and streams preserved, the air rendered more humid, fruit culture facilitated and destructive insects checked.

In the third place we know that trees will grow on our prairies if properly planted and protected. It was formerly believed, because nature had not permitted them to grow, that trees would not grow on our prairies. This the numerous artificial groves scattered all over the States of Kansas, Nebraska and Iowa, as well as our own experience here at home, sufficiently refute.

In the fourth place we are not pioneers in this business of forestry. Foreign governments long ago, and very generally, took measures for the preservation of their forests. France, Germany, Russia, Egypt and other countries have planted forests by the thousands of acres. Their government actually does the work. Here government is only asked to encourage what is so manifestly for the advantage of the people. The people of Iowa, Kansas and Nebraska have led the way, and now have groves of trees ten inches in diameter and forty to fifty feet high. Minnesota has already begun the work and planted so many trees that, were it not for the vast necessities, it would seem that enough had been done. The assessors' returns of last summer show, in the twenty-three counties above named, more than thirty-two millions of trees planted and growing. This number might be greatly increased, perhaps doubled, without exceeding the truth. In either case the number is large, but how small compared with the 2,760 millions that *need* to be growing. The number is large enough to show that side by side with the most wonderful torpidity and unbelief, some people are alive and wide awake to the necessities and the possibilities of this great region. The number is large enough to show that we have only to keep the ball in motion to produce grand results—to show that our encouragement and assistance will not be tendered in vain.

In the fifth place the growth of these trees on our prairie soils is rapid, and even small plantations produced material results in a very few years. It used to be taught that he who planted trees planted for posterity. But the skillful modern cultivator plants trees for himself as well as for posterity. Fruit trees yield fruit in two or three years from planting. Forest trees rear their heads from 25 to 40 feet in the course of five to ten years. The few trees planted around a dwelling for shade and ornament soon make the winds seem not to blow as they did before the trees were planted. Ten acres properly planted to forest trees will, in five years, more than furnish the fuel and fencing necessary to furnish a large farm.

In the sixth place, while the planting of trees is a long investment compared with the sowing of wheat and other like crops, there is no danger of its being a losing one. Properly planted on good prairie soil the trees are almost certain to grow rapidly. There is no serious danger to be apprehended from insects. The demand for wood is in no danger of being cut off or even seriously diminished. Many claim that large profits will accrue, and while I do not doubt the fairness of their statements, I am content to claim that there can be no loss.

In the seventh place, we know that to plant a few trees is not so vast an undertaking as is generally supposed. The experience of the past year bears directly upon this point. We have the statements, supported by the affidavits of several men who planted on last Arbor Day more than 2,500 rooted trees, and of two at least who planted 5,000 or over. We have the statements, similarly verified, of more than a dozen men who planted last Arbor Day upwards of 7,000 cuttings, four of whom planted more than 10,000 each, and one of whom planted 15,411 cuttings, of which more than 13,000 were living trees in October. We have the verified statement of a boy only 14 years old who planted on Arbor Day 7,500 cuttings.

But what, it may be asked, have we to do with this matter? We don't live in the treeless regions. We don't suffer from violent winds, bitter cold or trackless wastes. We can get plenty of fuel and of lumber at reasonable prices. Why should we trouble ourselves to consider this matter? I answer, that we are a part of this great commonwealth. So are these treeless regions and their inhabitants. Our happiness, our reputation, and our continued prosperity do not depend alone upon our little home circle, but they depend upon the condition and prosperity of the entire State. We cannot be happy while our fellow citizens are enduring the pangs of cold and hunger. We cannot enjoy a good reputation while any part of our State bears a stigma. We cannot continue prosperous when the tide of productive labor is turned toward more genial climates, or toward those States which show more concern for the happiness and welfare of their people. Thus it is our duty as well as our privilege to encourage this thing by showing the faith that is in us, to assist it by imparting information to those who seek it and will use it; to encourage and assist by such other means as may lie within our power. Many of you are legislators. It is your duty to keep a watchful guard over the interests of your own district, but still more your duty to study carefully the interest of the entire State. It is for your judgment to determine how much you shall encourage this great interest of tree planting by official act. Monarchical governments actually perform work of this kind. It is the duty of republican governments to encourage the people to do it. Many States have already taken measures to this end. In Massachusetts, with but two counties having less than 15 per cent. of woodland, a premium of \$1,000 has been paid for the best grove of forest trees ten years old. In New York, with but three counties having less than 12 per cent. of woodland, bounties are paid to encourage this object. Missouri, Iowa, Kansas, Nebraska and California are also encouraging tree planting by the payment of premiums. The legislature of Minnesota at its last session appropriated \$2,500 for the encouragement of tree planting, and does not the planting of ten millions of trees last season justify the act? It is the policy of good government everywhere to do or to encourage that which is for the good of its people. The people and the State of Minnesota can do nothing that will be fraught with greater or more lasting good than the planting of trees. In the prairie counties it is the prelude to increased production and to successful fruit culture. It is the prelude or accompaniment to successful settlement. Nor will all the advantages of tree planting be confined to the prairie counties. But few agricultural counties in the State have over 20 per cent. of woodland. It is almost certain that the productive capacity would be greatly increased by raising the proportion to 20 or 25 per cent. Dr. John A. Warder, of Ohio, President of the American Forestry Association, advises the farmers of that State to plant 25 per cent. of their farms in forest, believing that the remainder will produce more than if the entire area were cultivated. A nurseryman of New Jersey says that within the shelter of evergreen belts that had been allowed to grow up to a height of 25 to 30 feet in his nursery, farm crops and crops of nursery trees averaged 50 per cent. better than when not so protected. Other examples of the same kind might be named, showing that while the prairie counties need tree planting the most, they are not the only ones to profit from it. The fact is that the natural forests are vanishing so fast under the increasing demands of a fast increasing population, that the whole nation must sooner or later turn its attention to tree planting.

But the planting of trees is not the only measure by which the treeless region is to be redeemed. Stop the prairie fires, and groves of trees of greater or less extent will spring up and grow of themselves. Probably fire has done more than any other agent to preserve the prairie, and when fire and cattle are restrained trees are not long in making their appearance. Require the owners of stock to take care of it, and you relieve these natural groves from another enemy. You relieve our present forests from a great drain made upon them for fencing material, and you facilitate the act of planting, because you permit the settler to do it at once, instead of incurring first the labor and expense of fencing his tract.

FOREST CULTURE IN MINNESOTA.

Extracts from an Essay Read at the Annual Meeting of the State Agricultural Society at the State University, in Minneapolis, February 5th, 1875.

By Leonard B. Hodges, Superintendent of Tree Planting, First Division St. Paul & Pacific Railroad Company.

* * * * *

A large volume concisely written would fail to do justice to the subject, and I crave your charitable consideration while presenting a few of the most prominent points suggested in its practical bearings upon our material interests.

While the northern and northeastern portions of Minnesota are emphatically timbered regions, the southwest and western portions of our State are very destitute of timber. While Minnesota as a State is more abundantly supplied with timber than either Illinois, Iowa, Kansas, Nebraska, Nevada, Dakota or California, yet the stubborn fact exists that nearly or quite one-third of the finest agricultural lands of Minnesota are absolutely too destitute of timber to admit of settlement and cultivation. Hence the propriety of the State Agricultural Society taking hold of this subject, and rendering such aid as the magnitude of this interest demands. In the proper presentation of this subject, it becomes necessary to introduce facts bearing upon timber consumption as well as timber culture, that the general knowledge of our present necessities may enable us to make suitable provisions against approaching want. Many of us have been permitted to witness, within the last twenty-five years, an increase of population from about 5,000 in 1850, to about 600,000 in 1875.

Estimating five persons to a family, Minnesota now contains 120,000 families. To provide one family a comfortable degree of warmth throughout the year, requires twelve cords of wood. This one item of fuel for the household demands an annual consumption of 1,440,000 cords of wood.

We have in Minnesota, in round numbers, say two thousand miles of railroad, with 230 or 240 locomotive engines, consuming annually, with the necessary supply to railroad stations, not less than two hundred and twenty thousand cords. The 5,000,000 ties entering into the original construction of our 2,000 miles of railroad, used up not less than 240,000 cords, and as they have to be renewed as often as once in seven years, here is another annual consumption of nearly 35,000 cords. When we also take into account the bridge timbers used in the construction and maintenance of our railroads, and the timber required for the construction and maintenance of the necessary station houses, warehouses, fences, &c., we can add another annual item of not less than 15,000 cords. When we take into account the consumption of timber in building our cities, towns and villages, and the amount consumed in fencing the sixty thousand farms in Minnesota, we are just beginning to get fairly into the merits of the question.

Let us recapitulate a moment.

	Cords.
For household fuel,	1,144,000
For locomotives, &c.	220,000
For repairing railroads, &c.,	50,000
Total,	1,710,000

Estimating our timbered lands to yield an average of 23 cords per acre, which I consider a liberal estimate, we find that about 75,000 acres of the forests of Minnesota are being stripped annually for our households and railroads alone. For fencing our farms, bridges for public highways, manufacturing purposes, the operation of our lumbermen who furnish the material for building our towns and cities, not only for Minnesota, but to a large extent for Iowa, Nebraska, Dakota and Manitoba, no one will quarrel with me, if at a rough guess I place this consumption equivalent to the annual stripping of another 75,000 acres. Hence I have some reason from the above approximations, to infer that the annual consumption of timber of this State is equivalent to the destruction of one hundred and fifty thousand acres of the primeval forests of Minnesota every year. The geographies in use in the public schools of Minnesota, say its area is 83,531 square miles. Our Commissioner of Statistics estimates our forests to cover one-sixth of our area. From these data you can figure how long our wood pile will hold out with our *present* population.

Twenty-five years hence, with a million or more of population, our pineries exhausted, the Big Woods pretty well thinned out, the Mississippi drying up, St. Paul and Minneapolis three or four hundred miles above the head of steamboat navigation, mercury 40° below zero, and the wind blowing a hurricane, is not the idle reverie of a dreamer.

Destroying one hundred and fifty thousand acres of forest annually, and planting to supply this loss—how much? Can this society answer? Can the State of Minnesota? If you can, the answers are in order now, for even now the grasshopper has become a burden, and the mourners go about the street; the frontier settlers of our treeless regions are twisting up prairie grass for fuel, burning prairie sods, and grubbing out old stumps and roots, doing their best to extract sufficient warmth therefrom to prevent their wives and little ones from freezing, alas! not always succeeding. The honest farmers, with loads of our great staple, on their way to the nearest market, overtaken with the pitiless storm and frozen to death, without a tree or bush or shrub in sight; our public highways and railroads blockaded, travel suspended, the mails stopped, commercial and other great interests embarrassed.

Through the kindness of our worthy Secretary, I am enabled from official data in the United States Surveyor General's office, to lay before you some statistics which are both "interesting and instructive."

Estimates of timber in the following counties, from plats on file in the United States Surveyor General's office, St. Paul, Minn.:

Counties.	Acres timber.
Rock	700
Nobles,	40
Martin,	2,200
Faribault,	20,300
Pipe Stone	00

Murray,.....	850
Cottonwood,.....	50
Watsonwan.....	2,800
Brown.....	22,400
*Lyon.....	2,800
Red Wood.....	2,000
Yellow Medicine.....	1,500
Renville.....	4,000
Lac qui Parle.....	2,200
Chippewa.....	3,520
Big Stone.....	495
Swift.....	1,470
Traverse.....	00
Pope.....	13,500
Stevens.....	686
Grant.....	373
Wilkin.....	260
Olmstead.....	170,000

I have placed Olmstead county in this list for the purpose of illustration and comparison. This county, named for my highly esteemed and lamented friend, Hon. David Olmstead, one of the founders of Minnesota, was settled in 1854, and organized in 1855. Its total area is about 422,400 acres. Its timber area, at the time of its government survey in 1853 and 1854, was estimated by the government surveyors at 170,000 acres, being about 64.4 acres of timber to each quarter section. Like the State, this county is abundantly supplied with timber, but it was not conveniently distributed, the northwestern and southeastern portions being heavily timbered on the Zumbro and Root rivers, with all the deciduous varieties, while the river bluffs were in many places heavily timbered with white pine and red cedar.

The intervening area was mainly prairie, with occasionally a small grove, and patches of hazel, wild plum, cherry, crab-apple, jack oak and aspen brush.

The old Dubuque and St. Paul stage road scarcely encountered a stick of timber from intersection of the northern boundary of the county until it struck the Root river timber near its southern boundary, with scarcely any timber in sight. It was a common remark of the stage passengers that this portion of Minnesota would never be settled, and in answer to this remark made in the winter of 1854 and 1855, by a well known, wealthy and influential gentleman, then and yet a resident of St. Paul, that we would have 10,000 people in there within ten years, I got the sneering reply that we would have 10,000 fools if we did. To-day 20,000 people occupy that region; the largest, most expensive and magnificent school house in Minnesota—if not in the United States—stands within a few hundred yards of what was then the most desolate and lonely point on this portion of the old stage road, and is occupied by more than one thousand children who reside within rifle shot of this school house, and the fools are not all dead yet! Olmstead county has probably the largest proportion of cultivated land to its area of any county in Minnesota, and yet a large proportion of her heaviest farmers haul every stick of their fire wood, fencing and building material from ten to twenty miles. With

*This probably includes both Lyon and Lincoln counties.

good roads they make a trip a day. On the eastern borders of the treeless region it takes the farmer two days to get a load of fire wood; while a hundred miles from any timber to amount to anything, the farmer can purchase fire wood, seasoned hard maple, of some of the railroad companies, cheaper than the same quality of wood could be had in St. Paul, Rochester or Stillwater.

Wilkin county has a larger area than Olmstead county, and with a reasonable supply of timber, would in a few years be as densely settled and contribute as much revenue to the State. Yet should the present population of Olmstead county be suddenly transferred to Wilkin county, they would burn up every stick of fire wood in that county in less than thirty days of such weather as Minnesota has experienced within the last month. If they were transferred to Nobles county, they would consume the timber of that county in less than a week; or, if transferred to Pipe Stone or Traverse, they would consume the last stick of wood in those counties in cooking their first meal of victuals.

Olmstead county, with an annual production of about two million bushels of wheat, and other agricultural products in proportion, has not yet reached more than half way to her maximum product, but a trifle over one-third of her total area having yet been placed under cultivation. Twenty-five years hence, when fully developed, she will support a population of 40,000.

Olmstead county pays into the State treasury over \$20,000 per annum. West of Olmstead county, on the same line of railway, out in the treeless region, we strike Lyon county. Just as good soil, capable of producing as much wealth, yet with less than half an acre of timber to a quarter section of prairie, has nearly reached her limit of population and wealth. Lyon county contributed in 1873, \$628.91 as her quota to the State treasury. The same instructive comparison could be made with 23 other treeless counties.

It would take all the timber in Lyon county to run Olmstead county eighteen months.

Does the State desire to see those treeless counties able to contribute \$20 to the State treasury where they now contribute one?

The State extracts about \$20,000 revenue per annum in State taxes from those most destitute counties of the treeless region; returns it all as soon as collected to keep the inhabitants from freezing to death every winter, besides contributing twice as much in provisions and seed wheat to keep them from starving, and yet, so far, refuse through their legislature to appropriate a dollar to the only project which will ever redeem those treeless counties from virtual pauperism, and place them in a condition which will enable them to subsist upon the fruit of their own labors, and also pay their just quota to the revenues of the State.

A member of the legislature should remember that he is not only the representative of his own local district, but equally so of the State at large, and while vigilantly guarding and promoting the interests of his own immediate locality, should employ the same energy and vigilance in promoting such interests as contribute to the general welfare of the State.

The State has also a direct interest in the improvement and consequent development of this treeless region, for she owns in fee simple not less than seven hundred thousand acres of choice agricultural lands, in a region so destitute of timber as to render them practically worthless. As Minneso-

tians we are indignant, and justly condemn the selfish policy of non-resident landholders, who, doing nothing themselves to enhance their value, yet reap a profit on such investments, through the toil and privations of our hardy pioneers. As a great landed proprietor, the State owes it to herself to mark out, pursue and develop a system of forest tree culture which will, in a few years, render those lands valuable, and consequently saleable. Every dollar judiciously, intelligently and honestly expended on such a system would come back to the State treasury in a few years with increase "an hundred fold," like the seed we read of "sown on good ground," for it is emphatically good ground to plant trees on.

The ready sale of lands thereby accruing would, in a comparatively short time, double our school fund, liquidate our State railroad bonds, and bridge our streams. The State revenues would indirectly be so augmented as to reduce our State tax to less than one mill on a dollar, returning to the tax payers of the timbered districts tenfold for their temporary advances.

Agriculture, pre-eminently the great interest of Minnesota, the foundation and support of all other interests, would thereby be enabled to so spread itself that this treeless region, now dependent on the bounty of the State for "seed wheat," would in a short period be enabled not only to return it "with usury," but would also be able to add more than a hundred millions bushels of wheat to our exports annually, with a proportionate increase of horses and cattle, butter and cheese.

Every consideration of sound policy, enlightened statesmanship, common sense and practical humanity, urges the State to the prompt inauguration and rapid execution of such a comprehensive system of forest tree culture as will render such results possible.

That the State partially recognizes the importance of forest tree culture is apparent, when we refer to the legislation already had in this behalf. But it is only a step in the right direction. Such additional legislation should at once be had as to render operative the acts already enacted. The State should at once organize a tree planting department, and appropriate such a sum of money for its operations as to enable it to accomplish such results as could be reasonably expected under a faithful, practical, intelligent and honest administration of its affairs.

This society should awaken to a full sense of its duties in this behalf. In the exercise of its appropriate and legitimate functions, the general public expect it to lead off in the promotion of agricultural interest. Any plan having for its immediate object the promotion of such interests, is entitled to its hearty co-operation and continued aid, or at least a fair trial.

* * * * *

The peculiar weakness of human nature to be in haste to become rich, continually acts as a drawback to the sure, but gradual accumulation of wealth. The young man of enterprise, industry and ambition, is generally in too big a hurry for *permanent* success. The profits on a quarter section of wheat, with its speedy returns in ready money within a year or two from the commencement of his work, is more alluring than the slow accumulations through stock growing and tree planting, and their consequent *permanent* values. The too common, but mistaken idea, that it takes too long to wait to get any good from tree planting must be corrected.

Right here I propose to challenge the present prevailing sentiments and opinions about tree planting by a few assertions, which, if false, can be readily disproved, and if true, will be of permanent value to this State.

1st. I assert that the farmer on the bleakest portions of our treeless regions can, with less ready money than it would cost to buy a breaking plow, surround his stock yard and buildings with a windbreak within five years, that will protect him as effectually as though he was in the middle of the Big Woods.

2d. That a crop of trees can be grown as surely, and in proportion to its value, with far less expense than a crop of corn.

3rd. That ten acres, properly planted to timber, and properly cultivated, will in five years supply fuel for a family in great abundance, and also fencing for the farm of 160 acres.

4th. That the most worthless lands of our treeless regions can, through the intervention of the tree planter, be sold for one hundred dollars per acre within twenty years.

5th. That the net profits on a quarter section of prairie, properly prepared, planted and cultivated with forest trees, will within ten years exceed the net profits of ten quarter sections of wheat.

6th. That a single cottonwood seed, although smaller than a "grain of mustard," can by intelligent cultivation be developed into a cord of fire-wood within twenty years.

7th. That any young man of muscular development and good "horse sense," can surely accomplish these results; providing always that he is not in too great haste to get rich; and

8th. That the genuine white willow, properly handled, will increase faster than money at interest at four per cent. per month, and that the First Division of the St. Paul & Pacific Railroad Company is now prepared to furnish it to settlers on their lines, delivered at any station on the prairie, free of transportation, at a cost of from one to two dollars per thousand trees. These may to some sound like bold, reckless, and perhaps, ignorant assertions, but they are hereby made, and I propose to stand by them.

We will now consider a few facts about the

GROWTH OF FOREST TREES.

I bring forward only Minnesota growths as specimens of what has already been done. We have no occasion to draw from other States for facts for the encouragement of forest culture. From many hundreds of similar facts, I select the following as sufficient:

Cottonwoods, in Olmstead county, seventeen years old, are from 50 to 60 feet high, and from 60 to 81 inches in circumference. Cottonwood in Dakota county, seventeen years old, are over sixty feet high, from 81 to 90 inches in circumference, and will yield a cord of fire-wood per tree, and are now standing on the farm of A. E. Messenger, Esq.

Basswood are now standing on timber land cleared by the writer in 1857, in the town of Oronoco, Olmstead county, 30 feet high, 25 inches in circumference. Ash, on same ground, 13 to 21 inches in circumference, 25 feet high, 10 to 12 years old. Butternut, 15 inches in circumference, 25 feet high, 14 years old. Pignut hickory, 15 inches in circumference, 25 feet high, 10 to 14 years old. This is on ground cleared from 10 to 18 years ago, and left to the care of nature ever since.

On "grub prairie," in the village of Oronoco, where the grubs did not average two feet high, and nothing but oak to be seen twenty years ago, now

stands a grove from which I select jack-oak trees 20 to 26 inches in circumference, and 25 to 30 feet high; white-oak trees, 21 to 23 inches in circumference, and 20 to 30 feet high; butternut, 27 inches in circumference, and 25 to 30 feet high.

All this without any cultivation, no protection from cattle, but pretty well protected from fire.

In the door yard of John K. Kepner, Little Valley, Olmstead county, black walnut in bearing, 7 years old, from seed, 3 to 5 inches in diameter, 18 to 20 feet high; elm trees, 6 years from seed, 2 to 4 inches in diameter; scarlet maple still larger; box elder, larger yet, and cottonwoods twice as large as the box elder; honey locust rather slow grower, but hardy, only one in fifty having killed during the hard winter of 1872-3; white pine 20 feet high, 6 to 8 inches in diameter, transplanted from the forest, seven or eight years ago, when only a few inches high; balsam fir, $23\frac{1}{2}$ feet high, 38 inches in circumference, one foot above the ground, 12 years old, the branches covering a circle of more than fifty feet." On the farm of Hon. Dwight Rathburn, Fillmore county, black ash, seven or eight years old from seed, 18 to 21 inches in circumference, 18 feet high, with beautifully shaped tops 15 to 18 feet across. In the door yard of Gen. Gorman, St. Paul, tamaracks transplanted from the swamp eighteen years ago, 30 to 35 feet high, and 24 to 34 inches in circumference—large enough for railroad ties. Sugar maple, on Dayton avenue, St. Paul, 23 to 26 inches in circumference. On the farm of Harrison Waldron, of Byron, Olmstead county, white willow, 41 inches in circumference one foot above the ground, and 40 feet high, eight years from the cutting. Mr. G. N. Waldron, in the same vicinity, has white willows of still larger growth. At Winona, bass wood, planted in 1859, 20 inches in circumference; hard maple, same age, 16 inches in circumference; soft maple, planted five or six years later, 28 inches in circumference; elm, planted in 1859 or '60, 54 inches in circumference; cottonwood, planted in the same row at the same time, 78 inches in circumference. These results, gratifying as they are, might have been materially increased by better cultivation, some of the trees having received no cultivation, and many of them but little.

Besides the destruction of the forests of Minnesota caused by the constant demand for fuel, fencing and building material, the destruction caused by the ravages of fire, and the depredations of horses, cattle and sheep, is scarcely less. This loss is almost wholly unnecessary, and as the result of sheer negligence our annual losses, without any equivalent gain, are immense. I am indebted to the courtesy of Col. Griggs of St. Paul, for the following item of fuel consumption in St. Paul, which can be relied upon as a very close approximation, based upon purchases and sales of the wood and coal dealers in St. Paul for 1874:

Wood.....	40,000 cords.
Coal.....	20,000 tons.

Reducing coal to wood—one ton of coal equivalent to one and a half cords of wood—gives 70,000 cords of wood as the actual consumption of St. Paul for 1874. As this is nearly all the best quality of wood, chiefly sugar maple, to reduce it to the average grade of our forests would swell the measurement to about 96,000 cords. Population, say 40,000; number of families, say 8,000, equals twelve cords to each family, thus verifying my original estimate of twelve cords per annum to an average family, of average wood. It may be objected by some that my estimates are erroneous, because I do not wholly embrace the amount of coal annually consumed in Minnesota. This is a point worth raising. If Minnesota is already too destitute of timber to be unable

to compete with Iowa, Illinois, Ohio and Pennsylvania in the matter of supplying her own people with cheap fuel, she had better go to growing forests at once, stop the sending of money to other States for fuel, and keep it among ourselves. In the timber estimates from the Surveyor General's office, it is proper to remark that these estimates are not absolutely correct, the timber not being meandered, its intersection by township and section lines and bearings noted. Although a close approximation, my personal observation of the timber in many of those counties causes me to think those estimates were originally high enough, while the consumption and destruction since occurring by the settlers, by fire and cattle, will far exceed the growth.

I might enlarge this paper, perhaps profitably, with a chapter on the untimely effects sure to ensue from the destruction of our forests—the drying up of our creeks and navigable streams, shortening of crops by drought, destruction of property by floods, diminished and uncertain rainfalls, &c. I might also show some of the blessings resulting from extensive forest culture, in the favorable climatic changes sure to follow better sanitary conditions, and the virtual promotion of all the material interests of the State; but I am admonished to be “short and concise,” and will close by saying there is a rich mine of undeveloped wealth in our treeless regions, which can only be developed by a comprehensive broad gauge system of tree planting.

THE TEACHINGS OF MANY YEARS' EXPERIENCE IN FOREST CULTURE.

Agricultural Editor of the Pioneer Press :

Many years' experience in timber culture on the farm in central Iowa, has taught me that one hundred cords of wood can be successfully raised on one acre of land in ten years' time, by planting in belts on the border of the farm.

That the white willow (*Salix alba*) is the best border tree for the northwest. That the yellow cottonwood of the Missouri valley, when planted where it has room to develop itself, has no equal save the yellow poplar (tulip tree) of the Middle States. That the catalpa is making a good growth as far north as the 42d parallel north latitude, is a fine ornamental tree, and is said to be valuable timber for posts and railroad ties. That the seeds of the black walnut should be planted in the fall as soon as gathered, either in the seed-bed or where it should stand in the grove; should be taken from the seed-bed at one year old and transplanted in the grove of young trees that will not overshadow it while young, and when it is twenty-five or thirty feet high the nurse trees should be taken out, that it may develop into worth. That the white walnut is easily transplanted, and is worthy of the attention of the tree-planting public. That the white or green ash is a tree of great value for farm purposes, easily transplanted, and should be found growing on every farm. That the sugar tree, sometimes called “hard maple,” is one of our finest ornamental trees, stands transplanting well, and is not easily broken by the storm, has few equals on the street or lawn. That the soft maple is a valuable forest tree, and should be set in a thick grove, transplants well at one and two years old, is one of the poorest for the border, as the storms break it worse than almost any other tree. That the box-elder is one of the valuable hardy trees for the border, street or lawn; can be cut in any shape, and will stand more abuse than almost any other tree; makes a valuable shade for the pasture. That the honey locust is a valuable timber tree, of thrifty growth, and transplants well, and were it not for its thorn producing propensity, would have few equals; the thorny ones, if managed right, make a good hedge for those who like it. That the buckthorn and berberry are hedge plants of value in the northwest; though slow of growth, will make impenetrable barriers with proper care in time. That the osage orange is a failure in 42 north latitude.

That tree culture in Linn and Benton counties, Iowa, has proved the best investment made by those who have done the most of it, as acknowledged to me by themselves.

W. L. BROCKMAN.

CARROLL CITY, IOWA, January 15th, 1879.

FOREST CULTURE IN MINNESOTA.

A Paper Read before the State Forestry Association, at the Capitol, Saturday Evening, Feb. 12th, 1876, by Leonard B. Hodges.

MR. PRESIDENT :

In endeavoring to comply with the invitation of the State Forestry Association to address them this evening on the important subject of forest culture in Minnesota, I am painfully conscious of my inability to do justice to a subject, the proper discussion of which might well occupy the best minds of the State. I crave your indulgence and that of the company present, while endeavoring to lay before you some of the reasons which I trust may be of service in awakening a new interest in a matter of vital importance to Minnesota; and in doing so, may perhaps bring forward facts and items not wholly new; yet of such practical importance as to bear repeating. With line upon line, precept upon precept, here a little and there a little, all important truths are inculcated.

Until within a few years, the emigrant to Minnesota has been able to obtain good farming land, with plenty of good timber adjoining, or within convenient distance.

Thousands of the earlier settlers were fortunate in obtaining prairie, timber and running water on the same farm. Others coming in later, have obtained choice prairie farms with good timber within three to five miles. And as emigration has gradually over-run the most desirable agricultural portions of the State, the intervening distance between large bodies of choice wheat land and groves of timber, has gradually widened out, until now we find the great body of our most productive agricultural lands so remote from timber as to seriously interfere with their settlement.

The emigrant who now comes to Minnesota to obtain a farm under the provisions of the Homestead or Pre-emption Law, is compelled to make his choice either in the heavy timber or in the treeless region. The question for him to determine at the outset is this : Shall I settle in the heavy timber and spend a lifetime in hewing out a farm, or shall I go out in the treeless region and reverse the process—plant, cultivate and prune, instead of cut and slash, burn and grub. Hence the importance and necessity of a correct solution of a question which is of interest not only to the poor emigrant and the well-to-do farmer hunting a new location where he can obtain a thousand or five thousand acres of cheap, rich land, where he can settle his half dozen sturdy lads around him, but also to the entire State, and more especially to the towns and cities of the State, whose continued growth and prosperity can only be secured and permanently maintained by the gradual and complete agricultural development of what is known as the treeless region of Minnesota. This region stretching away from the "Big Woods" on the east, to Dakota on the west—from Iowa on the south to Manitoba on the north—covering an area of more than twenty thousand square miles—almost an empire in extent—really the fairest portion of Minnesota—capable, when fully developed, of adding a hundred million bushels of wheat to the exports of the State, with a corresponding amount of cattle and dairy products—crossed and re-crossed by seven different lines of land-grant railroads, rendering it easily accessible from all quarters; presented to the emigrant the largest, most fertile and most accessible body of government land now remaining in the United States, needs only the intervention of the tree-planter to transform this desert solitude into what nature intended it for, one of the granaries of the world. On this broad expanse of fertile prairies, with natural meadows, lovely

lakes and running streams, forty thousand families can find free homesteads and a healthy climate within hearing of the whistle of the locomotive.

The redemption of this treeless solitude; the conversion of its desert wastes into fruitful fields, is an object of great importance, not alone to this particular region, but also to the entire State. The pioneer work to be done in effecting this change is the patient, persistent, untiring labor of the tree-planter.

THE TREELESS REGION.

To illustrate the necessity and magnitude of the work, let us take a glance at what is known as the "Treeless Region."

Fortunately for Minnesota, she embraces within her borders but a fraction of that great waste which covers the greater portion of the interior section of the North American continent.

The map which I have placed in view, compiled by Prof. Brewer, of Yale College, shows at a glance the treeless region. Our own portion is so small compared with the whole, as at first glance to seem too insignificant to make such ado over. Yet we must take into account, small as it appears on the map, it is capable when fully developed of sustaining five times the present population of the State.

There is, in addition to the increased productive area to be developed by an extended system of forest culture, the climatic changes and consequent benefits resulting therefrom, to be considered.

The great objection, and really the only one that is urged against Minnesota by rival interests, is the climate. We point with pride to the progress of our State during the past twenty-five years. Its transformation from a howling wilderness to a sovereign State, with its common schools, its colleges, its churches, its commercial and manufacturing interests, its 2,000 miles of railroad, and its annual crop of 30,000,000 bushels of wheat.

We challenge the world to produce a finer brand of flour than is made every day in Minnesota from Minnesota wheat; we challenge the world to produce an entire community of 600,000 people as well fed, as well clothed, as well educated, as well supplied with the comforts of life, and as well paid for their labor, as are the 600,000 inhabitants of Minnesota. And those of us who have been here from the early days, whose labors, privations, foresight and energy have contributed so largely to such magnificent results,—while we may individually regret lost opportunities, each of us can with more than Roman exultation exclaim, "I am a Minnesotian."

Yet knowing beyond the possibility of any mistake, that we can offer to the emigrant better inducements than any other equal area on God's footstool; we are failing to get our share. The treeless arid plains of Kansas, Nebraska and Texas, with their protracted droughts, their grasshopper experiences and their malarial fevers, are more than successfully competing with Minnesota for emigration.

And why? Simply on account of the grossly exaggerated stories of our winters. That in Minnesota men freeze to death going after a load of wood; farmers freeze to death while hauling their wheat to their nearest market; and that there are weeks at a time when it is impossible for a man to go from his house to his barn without one end of a rope fastened around him and the other end in the house, in his wife's hands, so she could haul him in, hand over hand, before he perishes; and that even in St. Paul, the principal occupation of the street commissioners and their force in winter is in sweeping and shoveling up bushels and wagon loads of fragments of frozen ears and noses which encumber the sidewalks and pavements.

The great electrical storm of January 7th, 8th and 9th, 1873, which swept over Manitoba, Dakota, Nebraska, Kansas, Minnesota, Wisconsin, Illinois, and other extensive areas, carrying suffering and death into each of those States and Territories, is all located by rival interests in Minnesota.

The story of that storm and its attendant horrors is more firmly established and more vividly remembered among people seeking new homes in the west, than even the Sioux outbreak in 1862, and is more lasting in its effects.

Now, what are we going to do about it? While we laugh at the absurdity of such stories, we realize their disastrous effects. There is no use in denying them, for the grain of truth we are willing to admit, carries conviction as to the truth of the whole.

I see no way but "to take the bull by the horns" and "face the music." Save the breath now spent in denying these absurdities for hard work. Instead of a clothes-line running from the house to the barn, surround that house and barn with a live wind-break of willow, cottonwood, larch, pine and spruce; surround your

farms with belts of forest timber; line your public highways with rows of elm, sugar maple, butternut, black walnut, basswood and ash; plant plentifully of acorns in the shaded places of your wind-breaks and hedge rows; plant the seed of the ash, elm, box elder, cottonwood, basswood, and hackberry on every frontier farm in the State. Take care of them, cultivate them and protect them from fires and from cattle; extend this system over our entire treeless region, and in a very few years our winters will be robbed of their terrors, blizzards will be unknown, the grasshoppers will cease to be a burden, the devastating hail storms of midsummer will fail to appear, protracted droughts and devastating floods will be of rare occurrence. Snow blockades, with their attendant embarrassments and loss of time and money, will be unknown, the average yield of our cereal crops will be increased, cattle and horses will do better, the difficulties attendant upon fruit growing will vanish, our treeless region will be densely settled, the revenue of the State quadrupled, individual taxation lightened, and Minnesota triumphantly vindicated.

WORK TO BE DONE.

In looking over this last paragraph, I see there is a good deal of *work* laid out. *This work has got to be done.* As a State, we are in a similar predicament to the boy after the wood-chuck. *We must have the wood-chuck.* How to dig him out the quickest and cheapest, is the question always in order. We have all got to dig. This Minnesota State Forestry Association has got to make the dirt fly. We propose to do a heap of digging next Arbor Day, (first Tuesday of May,) and to plant so many trees in Minnesota on that day, that for the next hundred years people will talk of that day's work, and point to the results with gratitude and pride.

And right here I come to a tender spot; the members of this association expect I'll say something to the legislature in this behalf. Now, I have been a member of the legislature myself, and so have most of the members of the State Forestry Association.

We know what it is to be buzzed, button-holed, bored, and bamboozled generally. We think we know ourselves better than to fool away our time; besides, we have too much to do. As a society, we are giving the State our experience and our services gratis, we work hard and board ourselves; we ask no pay for those services, virtue is its own reward. But we do ask the legislature to appropriate a small sum of money to encourage forest culture in Minnesota.

How do you propose to use it?

First, to expend a portion of the appropriation in the publication and distribution of a small pamphlet for gratuitous circulation among the people; this pamphlet to be clearly and tersely written, eminently practical, embodying the experience of practical men, pointing out the proper methods of preparing the ground, how to plant, what to plant, how and when to cultivate, cost of planting, how to propagate successfully from seeds and cuttings; in short, to give such information on forest culture, that the work may be done *successfully*, and that time and money be not wasted; it should also contain the laws of Minnesota relating to forestry, the congressional timber culture act, the pre-emption act, and the homestead act. It would come so near being an emigration document, that a few chapters on the resources of Minnesota might be profitably appropriately added without much extra cost. Then we propose to devote a large portion of the appropriation in premiums, to be distributed among the people for the general observance of Arbor Day.

The very encouraging results obtained from the very inadequate premiums offered by *The Pioneer Press Company*, and the First Division of St. Paul & Pacific Railroad Company, to parties planting the most trees or cuttings on Arbor Day last spring, shows clearly what may be accomplished by a premium list commensurate with the magnitude of the work.

A MILLION OF TREES PLANTED.

From the best information I can obtain, I feel safe in saying, that more than a million forest trees were planted last Arbor Day in Minnesota, under the stimulus of less than \$400, and none of that in money.

Those premiums were so offered that but one in each county could, by any possibility win. They were offered so late that not half of the people heard of the offer until the day was past.

This association propose to arrange a premium list so comprehensive and so wide in its range, and to throw it before the public so early, that every man, woman, boy

or girl in Minnesota can have a fair chance of winning a prize. We do not rely solely on the legislature for help to carry on this work; we are trying to help ourselves.

A month has not yet passed since the organization of the Minnesota Forestry Association; from initiation fees and from donations, we can already offer \$700 for premiums next Arbor Day.

We can surely raise this amount to \$1000 within a week.

THE PRACTICABILITY OF THE WORK.

This is a question to be considered in this connection. Practical men who have made forest culture a study and a business, have no doubts on this subject.

Impracticable men, educated fools, and those whose skulls are so thick as to require a pile-driver to assist them in getting a new idea, denounce it as impracticable.

I apprehend the great diversity of opinion on this subject is, in part, to be accounted for in the wide range of territory the treeless region of the North American continent covers.

I apprehend, and indeed my own experience has suggested and confirmed the idea, that the difficulty increases in almost exact proportion to the distance from large bodies of timber.

In my own work for three successive years, I have been obliged to observe that the expense and difficulty of forest culture increases in very exact proportion to the distance west of the Big Woods. As far west as Wilmar no difficulty has yet been experienced. West of that point, we very soon observe a perceptible decrease of rainfall. We are gradually approaching the arid, treeless region of Dakota and the plains country.

As we gradually approach this arid region, greater care is found to be necessary in preparing the soil. Greater care is necessary in handling and planting the young trees and cuttings. More cultivation is necessary. Excessive aridity is to be overcome, not by the water-pot, but by the cultivator.

Heavy mulching will be found useful.

Greater skill, greater care, more and better cultivation, greater experience and more hard, horse sense, will be needed the further you go west. Our own portion of the treeless region can be redeemed by forest culture without any great difficulty or expense. We are, as it were, only on its borders. But when you get out among the sand hills of the Coteaus, and among the breeding places of the migratory grasshopper and Colorado beetle, you've struck a horse of another color. A big one, and not easily curried.

I apprehend that the final redemption of the great treeless region of the continent will be, by the gradual approaches of the tree planter from Minnesota, and other regions where rainfalls are sufficiently abundant to insure a reasonable degree of success.

My own impression is, that as these artificial plantations are increased and pushed gradually out into the treeless region, that the earth and the air will gradually become somewhat ameliorated; that the excessive aridity will gradually yield to increasing moisture, and that rainfalls, if not more abundant, will be more durable in effect. Hence, the work we accomplish in redeeming our own portion of the treeless region sheds its beneficial influences over Dakota, and as we incidentally help Dakota, Dakota will more than repay us in the groves and windbreaks she will be enabled to erect between us and Old Boreas.

Now, about the cost of this work, enough has been said to show that the cost varies with the locality in which the work is to be done.

I suppose that portion of the treeless region of Minnesota which is intersected by the Main Line of the First Division St. Paul & Pacific Railroad is a fair average of the treeless region of Minnesota—no better and no worse. Now; my experience in this work on that range of country, enables me to say with considerable confidence, that I can figure as closely on the cost of growing 40 acres of forest timber out there, as any farmer can on the cost of growing 40 acres of wheat, or of corn; I might truly say with more certainty, for there is less risk in raising a crop of forest trees; if the corn fails to mature in season, no atonement is possible; not so with the trees, if they get a backset one year, they can make it all up the next. No crop grown for profit in Minnesota is more certain to afford satisfactory results.

GROWING TIMBER FOR PROFIT.

In growing forest timber for profit, I should plant much closer than 12 feet apart each way. I would advise planting first so as to be sure of complying fully with the requirements of the law; and then, instead of planting corn or some other hoed crop, I would plant the intervening spaces with forest tree seeds, so as to have an average stand of four feet apart each way.

The object of thick planting is to compel the young trees to a correct habit of growth, and to sooner shade the ground, thereby shortening up the time of cultivation, and consequently diminishing the cost of cultivation.

After two or three years of good cultivation, the annual shedding of the foliage of all the quick-growing varieties would so mulch the ground as to render further cultivation unnecessary.

Ground properly broken in June, re-plowed in October following, can be planted at once. If you break too early or too late, I would not undertake to say when you could plant it.

I can, however, say, without any mental reservation, that the men who commence breaking before the grass is good enough for their oxen to work on, or who continue to run their breaking plows after the prairie grass stops growing, are not only fooling away their time and labor, but laying the foundation for disappointment and failure. Every new comer is pretty sure to fall into this error unless warned, and even then, bitter experience is too often the result of knowing too much.

PROTECTION AND PRESERVATION OF OUR FORESTS.

Closely allied to forest culture is the preservation of our native forests. The rapidity of their destruction and the inevitable calamities resulting therefrom, ought to awaken us to a lively sense of our duty in this regard. This rapid destruction of our native forests is increasing in exact ratio to the development of the country. Drafts upon them, which would have seemed incredible twenty-five years ago, are now made and honored with scarcely a thought of the future.

DEMANDS OF CIVILIZATION ON OUR NATIVE FORESTS.

In my address before the State Agricultural Society, one year ago, I estimated the annual consumption of wood in Minnesota, to call for an amount equivalent to the annual destruction of 150,000 acres of the native forests of Minnesota. Subsequent investigations confirm the truth of that estimate. We have probably 9,000,000 acres of fair average forest in Minnesota. If our present condition remains unchanged, our supply is good for about 60 years, but if we as a State keep step with the advance of civilization, there are persons now in this room who will live to see our present supply completely exhausted, unless the supply is renewed by artificial planting.

If 600,000 people require 150,000 acres annually, 1,200,000 will require 300,000 acres annually, which would exhaust the present supply within the probable lifetime of the young man just striking out for himself.

Wisconsin is destroying her forests at an equally rapid rate.

50,000 acres of Wisconsin forests are cut annually to supply the Kansas and Nebraska trade alone.

10,000 acres of forests goes into the stoves and furnaces of Chicago every year. Many additional thousands of acres are annually required to supply that city with the enormous conflagrations she has a habit of indulging in.

The Lumberman's Directory for 1874-5 says the Chicago lumber trade handles annually 1,350,000,000 feet of lumber, shingles and lath.

This aggregate, enormous as it seems, is but one-tenth of the annual consumption of the country.

The Chicago capital used in the lumber trade is \$33,000,000.

Within the last ten years 12,000,000 acres have been burned over, simply to clear the land.

It is calculated that 8,000,000 acres are cleared every year, and only 10,000 acres planted.

THE TARIFF AND TRANSPORTATION.

Two causes peculiar to this country increase the consumption of our own wood beyond its natural limits.

The first is the tariff, which, by taxing foreign competition almost out of the market, concentrates our demand upon our vanishing forests.

The second is, that prices do not advance, and so check demand.

The reason for this is, that transportation is the chief element of cost in the wood delivered at our doors, and this increases so rapidly as to counteract the otherwise inevitable increase in price. I can buy cordwood for one dollar per cord on line of railroad within 110 miles of St. Paul, but transportation will make it cost me \$3 per cord by the time it reaches this city. Gen. Brisbane of the U. S. army, produces figures in support of the assertion that "at the present rate of consumption, in ten, or at most in twenty years, the forests of Michigan, Wisconsin and Minnesota will be swept away." There is now left untouched, he says, in the whole territory of the United States, but one really fine belt of timber—that growing on about one-half of Washington Territory and one-third of Oregon; and this, when the Northern Pacific Railroad is built, will soon be destroyed. Then the last great American Forest will have disappeared; and by the way, I am credibly informed that the material for the construction of a common lumber wagon does not exist in that great forest, or, indeed, west of the great plains.

It should be borne in mind that to this time our great forests have met the demands and destruction of a gradually increasing population, from 3 to 40,000,000 people. We have now gone through and surrounded our great timber reserves, and we enter on the margin of the great treeless waste, with our original store three-quarters consumed, the demand accelerated and the consumers to rise rapidly from 40,000,000 to 50,000,000 within the last quarter of the present century. A little common arithmetic will satisfy any thinking man of the consequences, and of the proportion which the demand and supply will bear to each other at the close, as compared with the commencement of this century. Extend the time another decade, with the added population, and it will be fortunate if our people get boards three inches wide, as in China at the present time.

THE DEMANDS OF CIVILIZATION.

The increasing wants of civilization are running way ahead of the supply accumulated by the growth of past centuries. Forests, those vast aggregations of nature's forces, accumulated by an allwise power for the good of mankind, are melting away before the demands of the present, like frost before the morning sun.

Civilization is dependent on the forests, and when they fail, civilization goes up the spout.

In addition to the ever increasing demands of civilization, another element, fire, is annually making such ravages in our forests, that the ravages of the grasshopper and potato bug dwindle into insignificance in comparison.

Between the demands of civilization and ravages from fire, our native forests are getting badly squeezed. Civilization and fire will in time rob us of the Mississippi river, unless this thing is checked and regulated pretty soon.

When our northern forests and the big woods west of us have disappeared, as they assuredly will, unless the State takes more interest in this question than it has hitherto been inclined to, who will care to live in Minnesota?

Gentlemen of the legislature, if you have any regard for the best interests of Minnesota, make it manifest by a liberal appropriation for the immediate encouragement of forest culture. Guard it as carefully as you please, but make it at once available. Don't stop there; make arbor day a legal holiday. Organize a State Land Department; and appoint a commission of the best men in the State to look into the condition of our northern forests. Encourage the people in every practical way to plant trees by the wholesale. *Do this now*, and the blessings of posterity will follow you.

GOVERNMENT ON FORESTRY.

I am not of those who are continually holding up the example of foreign countries and governments as models for our own affairs. I do not believe in purchasing new red flannel shirts for the amelioration of the unfortunate infants of "Barrioboola Gha," while our own urchins are in want of shirts. I cannot say that I can fully appreciate that high toned, fashionable civilization which crowds the Opera House of this city, to listen to the dulcet strains of the Hutchinsons, or the ponderous eloquence of the companion of John Stuart Mill, Bradlaugh, or Queen Victoria, in picturing the beauties of country life in England; while such men as Delano, Donnelly, Bishop, Marshall, Dunbar, Becker, Webb, Drake, McClung and others

have great difficulty in calling together a corporal's guard to take part in the discussion of home questions, upon the proper discussion of which the existence of civilization depends. But I do believe in applying the beneficial results of the experience of foreign nations in the correct solution of great national problems like the one now under discussion.

When the Khedive of Egypt, by a sensible expenditure of government funds in tree planting, demonstrates to the world the possibility of redeeming even the deserts of Africa, and rendering them subservient to the wants of civilization; when the government of France redeems entire provinces from ruin, from drifting sands, which gradually rise upon crops as if they were inundated with water, and the herbage and even the tops of trees which appear quite green and healthy, even to the moment of their being overwhelmed with sand—arresting and effectually staying the progress of this desolation, by planting over 100,000 acres with the maritime pine, (*pinus pinaster*) which now produces immense amounts of tar, resin, lamp-black and timber; when in the north of Germany immense tracts of loose, drifting sands have in like manner been covered with pine forests; when even Russia has successfully employed the tree planter in fixing the surfaces of the sandy wastes in her southern provinces; when the bared mountain tops of Germany and Austria, of Sweden and Norway, are by government authority being reclothed by the planting of new forests: when at this time most of the governments of Europe have, through the lessons of dear bought experience, been compelled to recognize the importance of forestry, and encourage it by all the fostering influences at their command;—may not we, profiting by their experience, take timely warning, and by timely economy provide against approaching desolation?

CIVILIZATION DEPENDENT ON FORESTS.

The eminent scholar, G. P. Marsh, in his great work, entitled "Man and Nature," says: "If we compare the present physical condition of the countries of which I am speaking (the Roman Empire) with the descriptions that ancient historians and geographers have given of their fertility and general capability of administering to human uses, we shall find that more than one-half of their whole extent, including the provinces the most celebrated for their profusion and variety of their spontaneous and their cultivated products, and for the wealth and social advancement of their inhabitants, is either deserted by civilized man, and surrendered to hopeless desolation, or at least, greatly reduced, both in productiveness and population. Vast forests have disappeared from mountain spurs and ridges; the vegetable earth accumulated beneath the trees by the decay of leaves and fallen trunks; the soil of the alpine pastures, which skirted and indented the woods, and the mold of the upland fields are washed away; meadows once productive, fertilized by irrigation, are waste and unproductive, because the springs that fed them are dried up; rivers, famous in history and song, have shrunk to humble brooklets; the willows that ornamented and protected their banks are gone, and the rivulets have ceased to exist as perennial currents, because the little water that finds its way into their old channels is evaporated by the droughts of summer, or absorbed by the parched earth before it reaches the low-lands; the beds of the brooks have widened into broad expanses of sand and gravel, over which, though in the hot season passed dry shod, in winter sea-like torrents thunder; the entrances of navigable streams are obstructed by sand-bars; and harbors, once marts of an extensive commerce, are shoaled by the deposits of the rivers, at whose mouths they lie."

All this might have been prevented if the Roman grangers had passed a few bills for the encouragement of tree planting. But they didn't do it, and you now see what a fix they have got into, by not attending to tree planting in season.

The forests of Lebanon, once the supply of neighboring countries, have long since disappeared; the mountain ranges of Syria, and the once powerful kingdom of Persia, are now dry, barren ridges of naked rock, absolutely incapable of re-producing the woods which once covered them.

Large tracts in the interior of Asia Minor, and even portions of Italy, are now a horrible desert, seamed with ravines and gullies, or piled with ridges of sand and gravel, and utterly irreclaimable to the use of man.

Blanque, a French writer, quoted by Marsh, speaking of the destruction of the forest in certain mountainous parts of France, says, that he found not a living soul in districts where he had enjoyed hospitality thirty years before, the last inhabitant having been compelled to "get out of that" when the last tree fell.

Gentlemen, your duty is plain. Ignore this plain duty, and the historian of the future will write of Minnesota, as an eminent writer now writes of another region, using these words: "Many countries have, by the destruction of the forests, been deprived of rain, moisture, springs, and water courses, which are necessary to 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 this point I could enlarge indefinitely. Evidence of this character, from the most eminent scientists of both hemispheres, can be piled up mountain high, illustrating the absolute dependence of civilization upon forests. It is a question of not merely local, but of national importance. You are too well informed to need further argument. I trust I have not exceeded the bounds of propriety in merely calling your attention, in plain and unmistakable language, to the prompt performance of an urgent duty.

I could not do *my* duty by doing less.

FENCING.

I had fortified myself with a large amount of statistics on the destruction of forests, and the inevitable results. But time is passing, and it takes a better man than I am to entertain an intelligent audience over thirty minutes. I had also gathered some considerable information on the subject of fencing; although somewhat foreign, it is so intimately connected with forest culture as to really and fairly come within the scope of this discussion. I merely say that restraining cattle and horses from running at large would be a great encouragement to forest culture in Minnesota, and an immense relief to the agriculturist.

The cost of fencing against cattle and horses is the heaviest burden the Minnesota farmer carries.

It costs the farmers of Minnesota more than two millions of dollars per annum to fence against horses and cattle; enough to wipe out the old State railroad bonded indebtedness in short order, and leave something for tree planting. It occurs to me that the legislature should take such action as to relieve the farming community of this Herculean burden. The common law is clear on this point; that owners of live stock must take care of them, or be held responsible for the damage they commit.

An act of the legislature plainly interpreting the common law, and so spreading it on our statute books as to clearly define the rights, duties and responsibilities of all parties concerned, is loudly called for.

It is also a well established principle of common law, that private interests must give way to public interests. On this principle are based the laws of eminent domain. Under those laws the public can run a highway through the middle of your farm, and you can't help yourself.

A railroad corporation can run its lines through your private estate, condemn and appropriate to their own use such portions as their wants demand. They can even, and sometimes do, tear down your houses and barns, and you are powerless to prevent it. You are in the way of the public, you must get out of the way, for the public have the right of way over all intervening obstacles. I am no lawyer, but have not lived over fifty years without finding out that "common law" is simply common sense boiled down.

Let us apply this principle of common law, or common sense, to the question involved. Common sense revolts at the idea of the "tail wagging the dog." Yet, under the absurd statute laws of Minnesota, the tail of the dog swings the entire animal.

Let us examine into facts bearing upon this question. Referring to the report of the Auditor of State for the fiscal year ending November 30, 1875, we find the total value of all the cattle, horses, mules and asses in Minnesota, to be \$17,492,980.

Referring to the latest statistics on crops, we find that they represent of crops that have to be fenced in from cattle and horses, not less than \$10,000,000 annually in Minnesota, besides 20,000,000 young forest trees.

Here we may place the fences necessary to protect the growing crop of \$40,000,000, at a valuation of \$20,000,000.

We thus observe that we invest \$20,000,000 in fence, to protect \$40,000,000 worth of crops from \$17,492,980 worth of cattle and horses, or, in other words, we exhibit the ludicrous spectacle of a \$17,000,000 tail wagging a \$60,000,000 dog.

But there is a moral principle involved in this question which enters too largely into all its phases to be ignored. Under the laws of eminent domain, you split my well fenced, cultivated farm, into two unequal sized, irregular shaped pieces. The arbitrary award of damages rarely, if ever, makes me whole, but I am further outraged by being compelled to erect a lawful fence each side of this public highway to protect my growing crops, my young orchard and my grove of young forest and ornamental trees from destruction from cattle and horses permitted by the statutes of Minnesota to run at large in this christian country, in this enlightened century, up to this centennial year.

Those cattle and horses are simply trespassers. I am their victim. Their owners have neither the right to allow them to run at large, or to compel me to build that legal fiction, known as a lawful fence.

When I was a youngster, I followed surveying for a livelihood, and I well remember the remark of an old Quaker, who gave me one of my first jobs, in running and establishing his boundary lines; it was this: "Good line fences are the foundation of true religion." There is much truth in that remark, but a long experience compels me to believe that a general, sweeping herd law would promote true religion more effectually than the labors of half the men who make the promotion of that cause a specialty.

I feel safe in saying that by far the greatest amount of difficulty and bad feeling in every agricultural community is caused and kept in full force by keeping in force that relic of barbarism compelling the fencing in of crops.

Any man who wants a new home will give those counties the preference who have had the good sense to adopt the herd law. Pass a general herd law, applicable to every section of the State, and you wipe out a relic of barbarism, promote christianity, encourage tree planting, encourage emigration, and increase and promote the general welfare.

PLANTS OR TREES PER ACRE.

Number of plants or trees on an acre, at various distances apart;

6 inches apart each way.....	154,240
1 foot " " " ".....	43,560
1½ feet " " " ".....	19,360
2 feet by 1 foot.....	21,780
2 feet apart each way.....	10,890
3 feet by 2 feet.....	7,260
3 feet apart each way.....	4,840
4 feet " " " ".....	2,730
5 " " " ".....	1,750
6 " " " ".....	1,200
8 " " " ".....	690
10 " " " ".....	430
12 " " " ".....	300
15 " " " ".....	200
18 " " " ".....	135
20 " " " ".....	110
22 " " " ".....	90
30 " " " ".....	50

Rows six feet apart, and trees one foot apart in the row, 7,315 trees per acre.

Rows 8 feet apart, and one foot apart in the row, 5,434 trees per acre.

Rows 10 feet apart, and one foot apart in the row, 4,389 per acre.

One mile of wind breaks or shelter belt, requires 5,280 trees or cuttings for a single row, one foot apart in the row.

The white willow cuttings can be bought for \$1.50 per 1000.

Cottonwood cuttings, for \$2 50 per 1000.

Well rooted yearling or seedling cottonwood trees, ash, box-elder and soft maple for \$3.00 to \$5.00 per 1000.

Scotch pine, 6 to 9 inches, \$15.00 to \$18.00 per 1000.

European larch, 8 to 10 inches, \$10.00 per 1000.

Robert Douglass & Son, Waukegan, Illinois, grow larch and evergreens more extensively, perhaps, than any other party in America. Send for their catalogue.

ADDRESS OF PROF. C. Y. LACY BEFORE THE STATE FORESTRY ASSOCIATION, ON RELATIONS OF FORESTS TO WATER SUPPLY.

Mr. Chairman and Gentlemen:

"Plant trees" is the injunction we hear from almost every quarter of the civilized world. The Massachusetts Society for Promoting Agriculture now offers prizes for planting trees in a State in which the wanton destruction of forests has proceeded almost for centuries.

The people of the United States, having thinned the forests of the Appalachian slopes, find beyond them a vast territory destitute of forests, and offer to give it to those who will plant one-quarter of it to trees.

The State of Iowa gives a certain exemption from taxation for the planting of trees, and her Horticultural Society offers premiums for the encouragement of the same work.

The State of California offers premiums for the same purpose, and Nebraska has its "Arbor Day." Minnesota has laws encouraging the same work in a similar manner, and a Forestry Association is devoting its energies toward the same end.

Editors and writers in agricultural papers, teachers and fruit growers, are constant in their appeals to plant forests and protect from waste those we now have.

Our friend Hodges for years has pressed upon our attention the necessity of planting trees in Minnesota.

Met on every side by these appeals, we ask, "What is the use of planting trees?" Have forests anything to do with the moral, physical or pecuniary interests of men? Do they mitigate or correct any evils? Do they confer any benefits or exert any beneficial influence?

We may approach these questions by ascertaining the objections urged against certain sections of country, by noting the unfavorable reports and the appeals that reach our ears from different parts of the inhabited world.

Talk to the immigrant about settling in the prairie counties west of the Big Woods, and if he knows anything of that treeless region he will probably object:

- (1) That the winds are too violent.
- (2) That there is no wood for fuel, and no material for fencing.
- (3) That the landscape is too dreary and monotonous—there are no trees to give it a home-like appearance; it is too lonesome.
- (4) That it is too cold out there.
- (5) That you cannot raise fruit there.

Talk to him of some places, and he will object:

- (6) That they are unhealthy.

Reports come to us:

- (7) That the forests that now supply us with lumber for building and manufacturing purposes are fast melting away before the woodman's axe.
- (8) The reports of destructive insect invasions have not yet ceased to vibrate in our ears.

Every year we hear:

- (9) Of hail storms doing extensive injuries.

(10) Of floods and freshets carrying away bridges and dwellings, and destroying growing crops and human life.

(11) Of the injurious effects of long continued drought.

(12) Of the substitution of improved water wheels for those that formerly gave sufficient power; and finally, the complete substitution of steam for water power in mills and manufactories.

Every year we listen to :

(13) Appeals for the improvement of commercial water routes.

All these objections, reports and appeals indicate imperfections that are commonly supposed to be without natural remedy ; but it is claimed for forests, and with good reason, too, that they are the natural remedy for some of these imperfections, and the natural means of relief in the case of others. It is claimed for forests that they—

(1) Break the force and meet the fury of the winds, and thus afford shelter and protection to man and beast.

(2) That they supply fuel and material for fencing.

(3) That they give a home like character to the prairie that is otherwise dreary and monotonous.

(4) That they mitigate the cold of winter and the heat of summer.

(5) That they improve the conditions for fruit growing.

(6) That they improve the sanitary character of some localities.

(7) That they supply lumber for building and manufacturing purposes.

(8) That they diminish insect injuries, and,

(9) The injuries of hail storms.

It is claimed that forests affect favorably the water supply of a region :

(10) Diminish the destructive effects of freshets.

(11) Diminish the injurious effects of drought.

(12) Increase the flow of springs.

(13) Equalize the quantity of water in our mill and navigable streams, and

(14) Distribute the rainfall throughout the year.

It has been abundantly shown, in this and other States, that trees can be grown, in large numbers or in small, on any soil that will produce ordinary farm crops. This is all that is required to establish several of the above claims. Every one has observed the capacity of trees :

(1) To break the force of winds.

(2) To supply fuel and material for fencing.

(3) All who have traveled over the prairies know how welcome is the sight of a belt or group of trees, and how much more habitable and home like is a house surrounded with trees than one standing alone.

(4) If forests break the force of winds, we are prepared to understand how they mitigate the cold, for we all know how much colder it seems in windy than in calm weather. Some of you have noticed the difference in passing from forest to open country. Firemen on railway trains observe that additional fuel is required to keep up steam on passing from wooded into prairie regions.

(5) If forests break the force of winds and modify the cold of winter, they certainly improve the conditions for the growth of fruit. Horticulturists are pretty well agreed upon the value of a protecting forest, either natural or artificial.

(6) In a paper read before the American Public Health Association last

fall, Dr. Geo. L. Andrew reached, among other conclusions, the following: that "forests and tree belts are of undoubted value in preventing the dissemination of malaria;" that "trees are of positive sanitary value in affording shelter from the excessive heat of the sun, from the violence of winds, and in promoting esthetic culture;" that in some cases "extensive tree planting is not unaccompanied with evil."

(7) To furnish lumber for building and manufacturing.

(8) There is little doubt but that forests diminish insect injuries. Insects do not multiply so rapidly in and near the woods, for there the birds, the consumers of insects, build their nests and find protection. Marsh says: "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." It is pretty well established, too, that the native breeding places of our locust are barren plains, and not forest covered regions. I think it has been found, too, that the locust plague is less severe in and near forests than on the open prairies. There is good evidence to the effect that (8) forests render hail storms less frequent and severe. Hail storms on the plains of Lombardy are believed to be more frequent than before the clearing of the forests on the Alps and Appenines, and in several other provinces of Europe, hail storms are believed to be more frequent and destructive since the clearing of the forests in their vicinity.

I fear I have presumed greatly on your patience in presenting this lengthy introduction before entering on the more lengthy discussion of the relations of forests to water supply.

This topic embraces, first, the influence of forests on rainfall and evaporation, including the influence on droughts; and second, the influence of forests on drainage, including the influence on springs, streams and lakes.

One word as to the character of our knowledge on this subject. It is not absolutely perfect. It is not entirely beyond doubt or question. We observe certain facts in connection with certain other facts, but we are not positive that one is the cause of the other. We observe springs ceasing to flow and streams diminishing, and this keeping steady pace with the destruction of the forests. We confidently believe the destruction of the forests causes the diminished water supply, but this result may *possibly* be caused by geological changes in the crust of the earth.

Hence the evidence I shall present you will consist in part of the convictions of men best qualified by their study of the subject to judge; in part of observed facts which *may possibly* admit of question or of different explanations; and in part of experiments which *appear* to be, and probably are, correct and reliable; and, we may add, the support of our knowledge relating to the laws and conditions of rainfall and evaporation.

In advance, I wish to acknowledge my indebtedness to the volume entitled "Man and Nature," by Hon. Geo. P. Marsh, in which I find the fullest discussion of this subject, and from which I have quoted copiously in the following pages.

THE RELATION OF FORESTS TO RAINFALL.

Boussingault, a noted French authority on rural subjects, quotes another French writer who says "that at Malta rain has become so rare, since the woods were cleared to make room for the growth of cotton, that at the time of his visit in October, 1841, not a drop of rain had fallen for three years." Boussingault further says, "The terrible droughts which desolate the Cape Verd Islands, must also be attributed to the destruction of forests. In the

island of St. Helena, where the wooden surface has considerably extended within a few years, it has been observed that the rain has increased in the same proportion. It is now in quantity double what it was during the residence of Napoleon. In Egypt recent plantations have caused rains which hitherto were almost unknown." But in commenting on this testimony, Marsh says we have no evidence that Malta ever had any forests. In 1611 there were few trees there but such as bear fruit. The other statements referred to, have not been questioned.

Schacht, a German writer, draws the following reasonable conclusions from well known facts: "The forest, presenting a considerable surface for evaporation, gives to its own soil and to all the adjacent ground an abundant and enlivening dew. * * * This increased deposition of dew on the neighboring fields, is partly due to the forests themselves; for the dense, saturated strata of air which hover over the woods, descend in cool, calm evenings, like clouds to the valley, and in the morning beads of dew sparkle on the leaves of the grass and the flowers of the field."

Caultas, reasoning from established facts, thus concludes: "The ocean, winds and woods may be regarded as the several parts of a grand distillatory apparatus. The sea is the boiler in which vapor is raised by the solar heat, the winds are the guiding tubes which carry the vapor with them to the forests where a lower temperature prevails. This naturally condenses the vapor, and showers of rain are thus distilled from the cloud masses which float in the atmosphere, by the woods beneath them." This may sound like a pretty fancy, but concerning many of the facts there is not a particle of question. The sea, together with lakes, is the boiler from which arises the vapor which later forms the rain falling on our fields. The winds are the guiding tubes which carry this vapor and distribute it over the earth. Reason and experiment both prove that in summer forests do make the air in and about them cooler than in the open country. And it is beyond question too, that this cooling influence is exactly what is wanted to cause the fall of rain. But the doubtful point is whether this influence of the forest is ever actually sufficient to cause a fall of rain that would not otherwise occur.

Sir John F. W. Herschel enumerates, among "the influences unfavorable to rain, absence of vegetation in warm climates and especially of trees. This is, no doubt," continues he, "one of the causes of the extreme aridity of Spain. The hatred of a Spaniard toward a tree is proverbial. Many districts in France have been materially injured by denudation, and, on the other hand, rain has become more frequent in Egypt, since the more vigorous cultivation of the palm tree."

Hohenstein remarks: "With respect to the temperature in the forest, I have already observed, that at certain times of the day and of the year, it is less than in the open field. Hence, the woods may, in the day time, in the summer and toward the close of winter, tend to increase the fall of rain; but it is otherwise in summer nights, and at the beginning of winter, when there is a higher temperature in the forest, which is not favorable to that effect. * * * The wood is, further, like the mountain, a mechanical obstruction to the motion of rain clouds, and as it checks them in their course, it gives them occasion to deposit their water. These considerations render it probable that the forest increases the quantity of rain; but they do not establish the certainty of this conclusion."

Barth, after describing the conditions of soil and atmosphere produced by forests, says: "Thus, a constant evaporation is produced, which keeps the

forest atmosphere moist, even in long droughts, when all other sources of humidity in the forest itself are dried up. * * * Little is required to compel the stratum of air resting upon a wood to give up its moisture, which thus, as rain, fog or dew, is returned to the forest. * * * The warm, moist currents of air, which come from other regions, are cooled as they approach the wood, by its less heated atmosphere, and obliged to let fall the humidity with which they are charged. * * * In consequence of these relations of the forest to humidity, it follows that wooded districts have both more frequent and more abundant rain, and in general, are more humid than woodless regions; for what is true of the woods themselves in this respect, is true also of their treeless neighborhood. * * * When the districts stripped of trees, have long been deprived of rain and dew, * * * and the grass and the fruits of the field are ready to wither, the grounds which are surrounded by woods are green and flourishing." This, you will observe, is a purely theoretical conclusion.

Asbjornsen, who, like the last, is a Scandinavian writer, says: "The narratives of travelers show the deplorable consequences of felling the woods in the Island of Trinidad, Martinique, San Domingo, and indeed, in almost the entire West Indian group. * * * 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. * * * In southern France many districts have, from the same cause, become barren wastes of stone, and the cultivation of the vine and the olive has suffered severely since the baring of the neighboring mountains. Since the extensive clearings between the Spree and the Oder, the inhabitants complain that the clover crop is much less productive than before. On the other hand, examples of the beneficial influence of planting and restoring the woods are not wanting. In Scotland, where many miles square have been planted with trees, the effect has been manifest, and similar observations have been made in several places in southern France. In Lower Egypt, both at Cairo and near Alexandria, rain rarely fell in considerable quantity—for example, during the French occupation of Egypt, about 1798, it did not rain for sixteen months; but since Mehemet Ali and Abrahim Pacha executed their vast plantations, * * * 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 variety."

Babinet, a French writer, says: "The forests of the Vases and Ardennes produce the same effect, (increased rain-fall), in the northeast of France, and send us a great river, the Meuse, which is as remarkable for its volume as for the small extent of its basin." Babinet repeats the suggestion of Mignet, "that to produce a rain, a forest was as good as a mountain," and he adds, "this is literally true."

Another French writer says: "For it is established that in wooded countries it rains oftener, and that the quantity of the rain being equal, they are more humid."

Boussingault, who is an authority in agricultural science, thus sums up:—"Arguing from the meteorological facts collected in the agricultural regions, there is reason to presume that clearings diminish the annual fall of rain."

And again, he says: "In my judgment it is settled, that very large clearings must diminish the annual fall of rain in a country."

Marsh also gives us the other side of the story. He says: "On the other hand, Faissac expresses the opinion that forests have no influence on precipitation, beyond that of promoting the deposit of dew in their vicinity, and he states as a fact of experience, that the planting of large vegetables, and especially of trees, is a very efficient means of drying morasses, because the plants draw from the earth a quantity of water larger than the average annual fall of rain."

Kloden, * * * * denied "that the diminution of volume (in the Oder and Elbe), is to be ascribed to a decrease of precipitation in consequence of the felling of the forests, and states what other physicists confirm, that during the same period, (since 1878), meteorological records in various parts of Europe show rather an augmentation than reduction of rain."

Marsh also gives the observations of Belgrond, which "tend to show, contrary to general opinion, that *less* rain falls in wooded than denuded districts. Observations were made at stations about eight miles apart in two valleys, believed to be alike in all respects, except that one was entirely bare, the other well wooded. The rain fall was as follows:

	Min.
For three cold months, in the cleared valley.....	179.7
" " " " " wooded "	104 $\frac{1}{4}$
" five warm " " cleared "	158.6 $\frac{1}{2}$
" " " " " wooded "	149.6

Marsh says: "This result is so contrary to what has been generally accepted as a theoretical conclusion, that further experiment is required to determine the question." He thus sums up the whole subject of forest influence on rain-fall: "The effect of the forest then is not entirely free from doubt, and we cannot positively affirm, that the total annual quantity of rain is diminished or increased by the destruction of the woods, though both theoretical considerations and the balance of testimony strongly favor the opinion, that more rain falls in wooded than in open countries. One important conclusion, at least, upon the meteorological influence of forests, is certain and undisputed; the proposition, namely, that within their own limits, and near their own borders, they maintain a more uniform degree of humidity in the atmosphere than is observed in the cleared grounds. Scarcely less can it be questioned, that they promote the frequency of showers, and, if they do not augment the amount of precipitation, they equalize its distribution through the different seasons."

From other sources, we gather some evidence. Prof. Mathiews, of the School of Forestry, near Nancy, in France, has given the results of some experiments, which have been translated by Hon. W. C. Flagg, of Illinois. For nearly three years the rainfall was measured at two stations, about 12 miles apart, the altitude and all other conditions, so far as known, being the same, save that one was in the midst of a forest plateau, and the other in the midst of a farming region. The rainfall was as follows:

Last 8 months, 1866, forest plateau, 27.25 $\frac{1}{4}$ in., farming region, 23.25 $\frac{1}{4}$
Whole year, 1867, " " 36.44 $\frac{1}{2}$ " " 34.93
" " 1868, " " 29.48 $\frac{3}{4}$ " " 24.25

A consecutive difference in favor of the forest plateau of 4 inches, 2 $\frac{1}{2}$

inches, and $4\frac{1}{2}$ inches. A difference that would be considered conclusive proof by any one that is acquainted with experiments of this nature. But, you remember we did not accept as final the experiment giving a contrary result. So with this, we must regard it simply as one link in the chain of evidence, albeit, a strong one.

Careful and thoughtful observers in this country are almost unanimous in the belief that forests tend to a better distribution of the rainfall, if they do not actually augment it. Prof. Riley, a few years since, in a horticultural convention, expressed a doubt about the influence of forests on rainfall, and could find no one to agree with him.

Speaking of records of rainfall, which he had prepared, Prof. H. B. Hough says: Although they reveal great irregularities in a series of years, at any given locality, they do not justify us in supposing that, in the general average of periods, the amount is sensibly increasing or diminishing, although they do show, in some cases, greater tendencies to drouth for a series of years together, and often a more unequal distribution of rain throughout the year. This growing tendency to droughts and floods can be directly ascribed to the clearing up of woodlands, by which the rains quickly find their way into the streams, often swelling them into destructive floods, instead of sinking into the earth to reappear as springs."

The report of a congress of land and forest cultivators, held in Vienna, after naming many cases of the influence of forests on rainfall already mentioned in this paper, describes and mentions the following: "Ismalia, upon the Suez canal, was built upon a sandy desert; but since the ground has been saturated with water, trees, bushes and plants have grown, and with the appearance of vegetation, the climate has changed." Four or five years ago, says the report, rain was unknown in these regions; but in the year, from May, 1868, to May, 1869, there were fourteen days of rain. So, also, near Trieste, a finely wooded district, was destroyed by the Venetians, and twenty-five years ago rain had ceased to fall; but to save the country from total abandonment, the Austrian government planted several millions of olive trees. It is stated, also, that the conversion of the desert of Utah into a blooming country, has raised the Salt Lake seven feet above its old level. The volume of water in the Ohio is stated to be evidently diminishing. The same is true of the Hudson, upon which the extent of navigable water is yearly receding. "I would ask you, can it be successfully denied that the same thing is true of the Mississippi, and other streams of the State? And if not, is there any better reason for it than the destruction of the trees at their rise, and along their courses?" Thus, it seems to me, is the influence of forests on evaporation.

Every one knows that of the water falling as rain, a part sinks into the soil and a part dries away. What is the influence of forests on the latter part? Trees themselves draw from the soil, through their roots, large quantities of water and exhale it in the form of vapor from their leaves. For large trees the quantity exhaled is estimated at one, two and even three barrels daily when in full growth. On the other hand, the shade of the branches and foliage, and the coating of dead leaves on the surface of the ground, by intercepting the rays of the sun and keeping the ground cool, retard very greatly direct evaporation from the soil itself. Prof. Mathiew carried his experiments to this point, and he found that the evaporation in the open field was four or five times as much as from the forest. The same conditions, too, that retard evaporation, favor the absorption and condensation of vapor from the air. But the retention and acquisition of moisture

by the soil, appears to be in excess of the loss by evaporation from the soil and by exhalation of the leaves combined, for the soil of the forest itself does not show the effects of drouth until long after cleared lands are dry and parched. Forests certainly diminish evaporation from adjacent cleared lands. The roots of forest trees pump no water from these grounds, and the trees diminish direct evaporation because they break the force of the winds, and the drying power of wind, air in motion above that of air at rest, is well known. Thus at one end there is strong reason for believing that forests increase the fall of rain, while at the other end, they certainly diminish the loss of water by evaporation. Such being the case, forests must diminish the severity of drouth.

It remains to note the influence of forests on drainage—their effect on springs and lakes and streams and floods. The files of American agricultural journals contain many instances of springs diminishing or ceasing in their flow with the disappearance of surrounding or adjacent forests, but so far as I know, these cases have never been gathered into a single volume, so that I am again obliged to borrow European examples from Marsh's *Man and Nature*. He says: As the forests are destroyed, the springs which flowed from the woods, and consequently the greater water course fed by them, diminish both in number and in volume. This fact is so familiar through the American States and British Provinces, that there are few old residents of the interior of those districts who are not able to testify to its truth as a matter of personal observation. My own recollection suggests to me several instances of this sort, and I remember one case where a small mountain spring, which disappeared soon after the clearing of the ground where it rose, was recovered about ten or twelve years ago, by simply allowing the bushes and young trees to grow up on a rocky knoll, not more than half an acre in extent, immediately above it, and has since continued to flow uninterruptedly. The uplands in the Atlantic States formerly abounded in sources and rills, but in many parts of those States which have been cleared for above a generation or two, the hill pastures now suffer severely from drouth, and in dry seasons no longer afford either water or herbage for cattle."

Clane gives an example in the forest of Mendon, near Paris, and says: "After a few rainy days pass along the Chevreuse road, which is bordered on the right by the wood, on the left by cultivated fields. The fall of water and the continuance of the rain have been the same on both sides; but the ditch on the side of the forest will remain filled with water proceeding from the infiltration through the wooded soil, long after the other, contiguous to the open ground, has performed its office of drainage and become dry. The ditch on the left will have discharged in a few hours a quantity of water, which the ditch on the right requires several days to receive and carry down to the valley."

Another case: "before the felling of the woods, within the last few years, * * * the same furnished a regular and sufficient supply of water for the iron works of Unterwyl, which was almost unaffected by drought or by heavy rains. The same has now become a torrent; every shower occasions a flood, and after a few days of fine weather, the current falls so low that it has been necessary to change the water wheels, because those of the old construction are no longer able to drive the machinery, and at last to introduce a steam engine to prevent the stoppage of the works for the want of water."

Another case. "When the factory of St. Ursanne was established, the river that furnished its power was abundant, long known and tried, and had from time immemorial sufficed for the machinery of a previous factory. Af-

terwards the woods near its source were cut. The supply of water fell off in consequence, the factory wanted water for half the year, and at last was obliged to stop altogether."

"The Wolf Spring 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 very 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 shooting 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 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 the Clos du Doubs. A few years since the grove was felled, and the ground turned again to a pasture. The spring disappeared with the wood, and is now as dry as it was ninety years ago."

Marsh quotes another case in which the forest is felled in regular succession once in twenty years. "As the annual cuttings approach a certain point, the springs yield less water, some of them none at all; but as the young growth shoots up, they flow more and more freely, and at length bubble up again in all their original abundance."

Marsh also quotes from Der. Pifer the following American example: "Within about 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 land formerly occupied by the old forest; and now the water runs through the year, notwithstanding the great droughts of the last few years."

A letter from Wm. C. Bryant, the poet and editor, is also quoted: "It is a common observation that our summers are become drier and our streams smaller. Take the Cuyahoga as an illustration. Fifty years ago, large barges loaded with goods went up and down the river, and one of the vessels engaged in the battle of Lake Erie, in which the gallant Perry was victorious, was built at Old Portage, six miles north of Albion, and floated down to the lake. Now in an ordinary stage of water, a canoe or skiff can hardly pass down the stream. Many a boat of fifty tons burden has been built and loaded in the Tuscarawas, at New Portage, and sailed to New Orleans without breaking bulk. Now the river hardly affords a supply of water, at New Portage, for the canal. The same may be said of other streams—they are drying up. And from the same cause, the destruction of our forests, our summers are growing drier, and our winters colder."

Other cases might be added, but it is unnecessary. Those given are in accordance with reason. The soil of forests is nearly always more open and porous than that of cleared land. So that rain, instead of flowing off as it falls, sinks into the soil to reappear gradually in the springs that feed the

rivulets and irrigate the meadows. Besides, the porosity of the soil, the surface is covered with leaves and twigs and roots, which impede the flow of water over the surface and cause it to sink away into the soil. Snow falling in the woods does not melt away so suddenly as on cleared land, and the water from it reaches the streams later than that from the cleared lands, thus diminishing the height, but prolonging the period of high water.

And now, in conclusion, I would ask: In view of the opinions of those well qualified to judge, and in view of the facts cited, can it be doubted that the unsparing destruction of forests is attended with disastrous results? In view of the same, and of other facts stated in this paper, can it be doubted that the planting of forests, in treeless regions, especially, will be attended with equally good results? Can it be doubted that extensive tree planting will improve the distribution of, if not actually augment the annual rainfall? Can it be doubted that it will diminish the devastation of freshets, and shorten the duration of droughts? Can it be doubted that it will maintain the number and volume of our springs, equalize the supply of water in our lakes and streams, and thus preserve navigation in our inland streams, and power for our mills and manufactories? I have tried to put you in possession of the facts, gentlemen; I leave it to your judgments to answer these questions.

AID TO GRASSHOPPER SUFFERERS.

What the Minnesota State Forestry Association Did in 1877.

The spring of 1877 opened inauspiciously for the tree planters of Minnesota. Those on the great prairies had been harrassed by grasshoppers, machine agents and creditors, "till they couldn't rest."

Discouraged and disheartened by repeated losses and failures, many who had in good faith entered timber claims, were on the point of abandoning them from sheer inability to purchase the much needed trees and cuttings for immediate planting.

I was overwhelmed with letters from such parties asking for aid. Calling the executive committee of the Association together, they appropriated a small amount for the purchase and distribution of trees and cuttings to the most unfortunate of applicants.

I immediately addressed a circular letter to all the county commissioners of the treeless counties, asking them to forward the names of worthy parties, who having in good faith entered timber claims and by reason of grasshopper damages were unable to plant, and were thereby in imminent danger of losing their claims—to forward the names of such only as would, if aided, so apply the aid as to carry out the provisions of the timber culture act, and thereby save their claims.

In response thereto several hundred names were forwarded to me by the commissioners.

Of these one hundred and seventy-three applicants were aided to an extent sufficient to save their tree claims.

Three hundred and thirty-eight thousand (338,000) white willow and cottonwood cuttings, and one hundred and eighty thousand (180,000) ash

and cottonwood trees, were thus distributed, and one hundred and seventy-three good men relieved and encouraged to prosecute their good work at the expense of the State of \$534.12.

The timber for the 338,000 cuttings, and 120,000 of these trees, were generously donated to the Association by the St. Paul & Pacific Railroad Company.

In the spring of 1878, the Association offered \$1800.00 in premiums to be distributed in accordance with the rules and regulations as published in compliance with the law granting the appropriation.

The tree planters competing therefor generally ignored the prescribed rules and regulations, and of the \$1,800.00 so offered, but \$135.00 was awarded.

With this experience before them, the executive committee have not up to this writing made up a premium list for 1879.

The cost of preparation, publication and distribution of this pamphlet will probably be of as much service to forest culture in Minnesota, as the same amount would be if distributed in premiums.

I have for many years collected and carefully preserved thousands of items bearing on forestry; and from this varied mass have selected such as seemed to me practical and reliable. I could have more easily embodied twice as much. The great difficulty has been to throw overboard much that was worthy of preservation, but which we could possibly do without.

In these pages will be found sufficient information to enable anyone of average ability to grow his own fuel, shelter and shade.

I have aimed to give just the information called for in the thousands of letters I have received on this subject, and can only say to enquirers, study this little work thoroughly and you will find therein a substantial answer to all reasonable interrogatories.

In conclusion, I wish to so far as possible, make amends for the wholesale raid I have hereby made in pursuit of knowledge under difficulties. I acknowledge to having plundered every available source of information for what I was after, and now having obtained it and spread it among the people, plead *pro bono publico* as my excuse. If I have done wrong I am willing to be forgiven. This work has been rushed through at railroad speed, in hurried moments snatched from pressing duties. I have pursued it *con amore*, and hereby dedicate it to the great army of tree planters in Minnesota, with the single word PERSEVERANCE.

Saint Paul, Minnesota, March 19th, 1879.

SYSTEM OF TIMBER CULTURE.

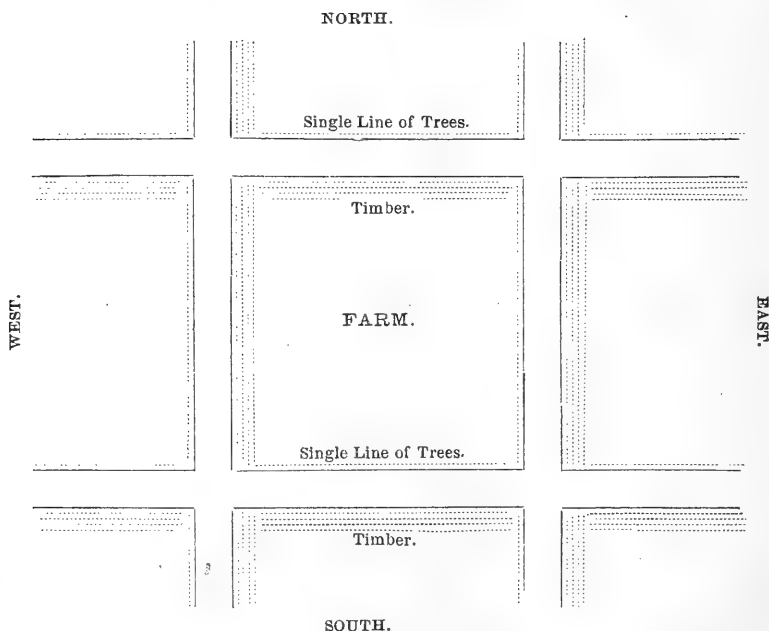
BY JOHN K. KEPNER.

As the time for tree planting will soon be here again, I would like to offer a few suggestions, bearing on the importance of pursuing the work, in a way which shall give the best results in the future. Anything which I may have to say, however, is not intended to influence those who have already prepared ground for the present season's operations; but for those who have not yet determined on any line of action, and for those who are about to break ground for the first time, and especially for those who are somewhat uncertain as to the best way of beginning, and would gladly take the experience of others as a guide, to these last I would most especially address myself, assuring them that the arguments here put forth are based on the experience and observation of nearly twenty years in Minnesota.

It will be desirable to plant somewhat systematically, notwithstanding the objec-

tionable feature of monotony urged by some, though, in fact, this is no objection at all, as the buildings and their immediate surroundings will give character to the landscape.

And among the objections to indiscriminate planting is this *very important one*. That a group or belt in the wrong place will cause the snow to drift and block up the road, while judicious planting will keep the same clear, and at the same time answer all the purposes of a wind-break. Suppose, for instance, that a farmer plant a close row or two or more of leaf-shedding trees, on the north or west side of the highway. Those who have for a few winters lived on these prairies of the North-west, know very well that the highway so planted, will be blocked with snow, and will probably be impassable the entire winter! How then, are we to prevent this? Let us plant our forest belt on the north and west boundaries of the farm; and on the south and east a single row of trees, eight or ten feet apart, to support the wires for our future fence. In this way we get all the advantages possible from forest planting, (see diagram). In the first place, if we have a tree claim, we have com-



The above may be a farm of any size, from forty acres to one thousand acres—the principle is the same.

plied with the requirements of the law; we have considerably ameliorated the rigor of the climate; we have our timber lot easy of access, as it is on the highway; we have a row of trees for live posts, and for ornament, which will never cause the snow to drift; and we have the south and east sides of the farm open to the public view, so that we can see and be seen by the traveling public. And in addition to this, we can also use the outer or inner row of our forest belt to support wires for fencing; thus having a living row of fence posts around the entire farm, which will not need renewing in our day and generation. Then across the way, we have the benefit of our neighbor's forest belt, to protect us from the south and east winds, which hardly ever cause the snow to drift, as it has been observed that nearly all our blizzards come from the north and west; and further, we have a highway so plainly defined, that the wayfaring man need not get lost in the storm; and also, this mode of planting leaves the farm in one field, which can be subdivided to suit our taste or convenience.

Along two sides of a quarter section (320 rods), twenty one rows four feet apart,

trees four feet in the row, will require about 27,000 trees, and will fully cover the ten acres necessary to acquire a title to the land. And besides this, we have here a nursery, that if we have done our duty, in the first place, the necessary thinning of which, from year to year, for the first five or six years at least, will supply materials for our future plantations. Of course, I am not talking to holders of tree claims only; but to every possessor of treeless lands, who should plant more or less, as soon as possible; and as time brings means and leisure, additional rows of the more valuable sorts can be added. Of course, if there is a spot on the farm unfit for general cultivation, that, too, can be planted with trees of some sort.

The shelter for the buildings will require additional planting. I would choose, if possible, a southern or eastern exposure; but I would not build on low or wet ground, if I could avoid it. I would have perfect drainage, for the sake of health, if I were obliged to build on the west, or even on the north side of the farm to obtain it.

For the purposes of garden, orchard, lawn and house, and for barn and stack and stock yards, ten acres would be enough for a small farm; for a larger one more ground can be spared for these purposes. And in these plantings, I would follow the same general arrangement suggested for the other plantations, that is: to plant *heavily* on the north and west, and *lightly* on the south and east; and here I would use evergreens, if I could get them, but of course, if I could not get these, I would use the best obtainable.

Respectfully,

JNO. K. KEPNER.

March 31, 1880.

THE U. S. LAND LAWS.

What the Settler is Required to do to Acquire Land Under the Homestead, Pre-emption, and Timber Culture Acts—A Clear and Succinct Statement of the Provisions of the Three Several Land Laws, Under Either of Which Land may be Acquired.

THE HOMESTEAD ACT.

The applicant must be a citizen of the United States, or must take out his first papers declaring his intention to become a citizen. He must be twenty-one years old, or the head of a family. He may enter 160 acres, or any subdivision thereof. The land office fee is \$18, if the land is within the railroad limit, or \$14 if without that limit. The applicant is required, within six months from the day of filing, to have a house built and his family moved on to the claim. His residence must be a continual one for five years. He is not, however, required to live on it day and night continuously; but he must not be absent more than six months at any one time. A longer absence will forfeit the claim. At the expiration of five years' residence, he submits his proof that he has lived on the land and cultivated it. He then gets his patent (deed) from the president of the United States. Any contract to convey a portion or the whole of his claim before making final proof destroys his rights. An abandonment of claim or a change of residence works a forfeiture. An unmarried woman may take a claim, and, if she marries, a continued residence on the land will give her title in her own name. Any time after six months of actual residence, the occupant may make final proof and pay for his land at the rate of \$2.50 per acre, if within railroad limits, or \$1.25 if without. This does not affect in any way his rights as a pre-emptor. A homestead cannot be taken for past debts.

A soldier who served in the war of the rebellion on the Union side, has a right to take a lien on 160 acres for six months upon the payment of \$2. This may be done through an attorney in fact. Evidence of the military service of the applicant must be submitted at the same time. The soldier is given a year from the date of filing his lien to build his house in and move on to his claim. Every year of service in the army, not exceeding four, is deducted from the five. He must live at least one year on the homestead, whatever the length of his military service.

THE PRE-EMPTION ACT.

The applicant for a pre-emption must possess the same qualifications as the homestead settler. The pre-emptor can take 160 acres, or any surveyed subdivision thereof. Within ninety days after making his settlement, he must file at the local land office a notice, giving the boundaries of his claim according to the government survey, and the date of his settlement or first improvements. For this filing he must pay \$2. It may be a plain statement of the facts written by himself and sent in by mail. Within thirty-three months from the date of his settlement the claimant must submit his final proof. He must show both a residence and cultivation of the land for agricultural purposes—a habitable dwelling, and an amount of other improvements, like plowing, stable, well, etc.—that will be satisfactory to the land officers, and evidence of a compliance with the spirit of the law. There is no definite valuation, as a minimum, prescribed by the law. The financial circumstances of the pre-emptor, the area claimed and the quality and general character of the land are considered in determining the sufficiency of the improvements. The time of settlement and actual residence are strictly inquired into. After six months of actual residence, the pre-emptor may submit his final proof of the requisite improvements. He must appear in person at the land office and give his testimony, and produce two creditable witnesses who will swear to the same facts. If the witnesses live at a distance and their presence would be both expensive and inconvenient, their affidavits may be taken before any officer qualified to administer an oath under the Territorial laws. Upon making his final proof, the pre-emptor may pay in cash, military land warrants, supreme court or Louisiana scrip. Within the land grant limit of any railroad the pre-emptor pays \$2.50 per acre or \$400 for his 160 acres. If outside of that limit he pays \$1.25 per acre, or \$200. Any time before the thirty-three months expires the claimant may convert his claim into a homestead by making application at the land office and paying the homestead fee. No person who quits or abandons his residence on his own land to reside on public land in the same State or Territory, or who owns 320 acres of land anywhere, is entitled to the benefits of the pre-emption law. These disabilities, however, do not apply to the homestead or timber culture act. The privileges of all of these acts cannot be duplicated or repeated. Claims before the perfection of title are not transferable.

THE TIMBER CULTURE ACT.

The land office fee under this act upon making an entry, is \$14. The applicant is entitled to enter 160 on any section naturally devoid of timber. It must be the whole section that is barren of timber and not the 160 alone. Only one tree claim can be taken on a section. It takes eight years under this act to acquire title, but actual residence is not one of the requisites in getting it. The first year the claimant breaks five acres. The second year he cultivates that five to crop and breaks five more. The third year he plants the first five acres in trees and cultivates the second five to crop. The fourth year he plants the second five in trees, and then has ten acres of trees. He keeps the trees growing so that he can show on the day of final proof, 6,750 live trees. There is a small fee on making final proof, but no other expense in securing title.

GENERAL REMARKS.

An unmarried woman of age can take advantage of the benefits of these acts the same as a man. If she marries before she has acquired title, she can proceed to prove up at the proper time the same as if she had remained single. In case of the death of the claimant before the title is perfected, his heirs or administrators may submit final proof, after the heirs had completed the requirements of the law. Settlers can avail themselves of the privileges of these laws but once. Claims are not transferable before the title there is acquired. A qualified applicant may take a pre-emption and a tree-culture at the same time, or a homestead and a tree culture at the same time. As soon as he has proved up on his pre-emption, for instance, he can take a homestead and in that way can get possession of 480 acres within a year of first settlement. All the sons and daughters of age can avail themselves of the benefits of the land laws.

A QUERY ANSWERED.

The answer to the following will be found in the above abstract of the provisions of the homestead act:

"Can a single man be away from his homestead one week or two weeks, and hold his claim providing he sleeps on it once in the week ?

"They say a man is compelled to live steady on his homestead day and night.

"I am on my place every Saturday night till Sunday evening. Can I hold my claim without any danger of losing it by doing so ?

J. K."

You need not be alarmed about losing your claim unless you are absent from it more than six months at any one time, provided you have a home on it and cultivate some of it.

TREE PLANTING.

Annual Address Before the Minnesota State Forestry Association, at the Capitol, Tuesday, January 13th, 1880, by U. S. Hollister, St. Paul.

The magnitude of the subject alone would make the study of forestry in America a grand one, dealing as it does with the vast areas of treeless plains as the basis of operations.

We are interested in forestry, not for its grandeur, but for its practical utility as affecting the comfort and value of thousands of human homes on our western frontier. We are interested in it because it adds to the attractiveness of the country, because it equalizes the distribution of the rainfall, and thus adds to the productiveness of our farms, because it affords shelter for man and beast, and fuel and building material for the dwellings of men—because it adds to the money value of our farms; and from being a source of income to the farmer and adding to his thrift—it sends a pulsation of prosperity through all channels of trade from the Red River of the North to the Atlantic Ocean.

Men who could understand this—men of wisdom and public spirit—established the Minnesota State Forestry Association; and like kindred orders in other States, it has received but little of the public support its importance deserves.

THE PEOPLE OF ST. PAUL

alone ought to crowd this room at your annual meetings; and they could well afford to give it the financial support to place its teachings before the people of the Northwest. Every step toward making the prairies more inhabitable, turns the tide of immigration toward our State. Every carload of immigrants puts money into our pockets, directly by the purchase of wares they need, and indirectly by developing the crude resources of our untamed lands. Traders in every commodity, manufacturers, artisans, laborers, all receive new life from immigration, and it is the work of this association to aid this by demonstrating that our prairies can be made gardens of agriculture.

The great attractive feature of the prairie country—the one feature that makes it the most inviting to the husbandman—is at the same time its most repulsive feature, and that is its treeless condition.

The deep, rich soil of our western prairies, without tree or shrub to vex the plow, seem a very paradise for the agriculturalist, and but for their treeless aspect might well be heralded as

THE GARDEN OF THE WORLD.

Why do these prairies exist? Their treeless condition has been attributed to many causes.

The tough, wiry sod, making it impossible for young trees to get a start, has been given as one reason: but the sod was not there when forests were in their infancy.

Alkali, says another. But we answer that all prairies are not alkali lands.

Too loose and friable alluvium for the growth of trees, says another. But we find some of our grandest forests growing on the river bottoms, deeper, richer, purer alluvium than is found on any upland prairie.

Too dry, says a fourth. But away on the Rocky mountains, resting on the rock, sending little fibrous roots into the crevices for nourishment, we find grand old trees.

Another claims that in the beginning of the epoch of vegetation the soil was too wet for the growth of trees; and yet we find the American larch growing in the water, and oaks, cedars, sycamores and a host of others growing out in river beds, their roots forming arches of support, lifting their trunks from the water.

THE FIRE THEORY

was for a long time the accepted one; but why did not the forests burn off when the trees were yet in their infancy and rank grass had almost undisputed possession of the soil?—for it is a positive geological fact that the herb preceded the tree.

You may say that the difference in texture or the constituent elements between prairie and timber land must have something to do with the growth or absence of forests.

Not at all. It is the influence of the trees, their shade, and retention of moisture, the leaves and twigs that for centuries have fallen and decayed, that makes the difference in the soil.

Go out on the prairie, plant trees closely, and at the end of the very short period of ten years put your spade into the soil in that grove and you will find a vast change in its texture and appearance.

We must conclude that the prairies are not the result of unfavorable conditions of soil or of

CLIMATIC INFLUENCE.

We may speculate on the origin of the prairies—go back in imagination to the time of the subsidence of the waters—and that an epoch of forests preceded the waters of the glacial period, that the mountains were covered with trees that the waters did not reach, and from these groves on the mountains, as the water subsided, gradually extending until large areas were covered with yet spreading forests. No matter, it is sufficient for us to know that whatever reason we may give for the presence of the prairies and the absence of the forests, not one of them can be substantiated that points to the theory that prairies exist because trees will not grow on them. And this brings us directly to the practical part of our subject, and the only excuse for offering here a simple, practical essay upon the subject of tree planting, is the lamentable ignorance upon nearly every detail of the great plan of covering our prairies with forests, on the part of those who are setting out in the undertaking.

They read the law relating to tree claims, and as soon as they understand that, they think they are fully fledged horticulturalists, and go to work most unsystematically and ignorantly, lose their tree claim and condemn a law that won't grow trees.

I have a letter now, written this month, ordering soft maple seed to be sent immediately, as the writer wants to get it well frozen before planting time in the spring.

Another in December wanted elm seed. Still another writes that he intends to break five acres as a tree claim early in the spring, and wants to know how much seed of pine and spruce it will require to seed his five acres of newly broken sod. Away out in Dakota they are asking for sweet chestnut, horse chestnut, buckeye and catalpa seedlings, and if they can get them will plant largely, without stopping to ask if these trees will

ENDURE OUR WINTERS.

Having decided to plant trees, the first step must be the preparation of the soil. I do not claim that you cannot grow trees by planting in newly broken sod land, but I do say most emphatically, don't do it; as you can better afford to wait a year or two until your land is in good condition from cropping.

As a rule, reduce your land to a seed bed fit to plant corn before planting trees in it. Practical planters complain that they lose a great many trees from drying of the roots after planting, or in other words, from the effect of the summer drouth.

The reason is plain: the land is not thoroughly subdued—the soil is a mass of woody fibre, composed of the roots of the prairie grass. It is reduced by the harrow or pulverizer, but still it is loose and lumpy. It cannot be packed tightly about the roots. Air is admitted, and the work of destruction goes on. At least one crop of grain should be taken from the land, and it is better if you take off two or even three crops before planting many trees.

THE NATURAL CONDITION

of the soil has something to do with this. In some localities it is much tougher than in others, for instance, in southwestern Minnesota the land is as thoroughly subdued after one crop is removed, as it would be in the northwestern part of the State after two crops. Men must use their judgment in this matter, keeping it in mind that the better the condition of soil, the more economical and profitable will be their tree planting operations.

After we have the ground prepared we must decide what to plant, and in answering the question we must not ask ourselves which is the most valuable timber or nut bearing tree, but must ask which is the most valuable to us in our circumstances, because of its ease of propagation and consequent cheapness.

It is a peculiar freak of nature that the most worthless timber is of the easiest propagation, the hardest in its nature and of the most rapid growth.

In this condition we find the cottonwood easy of propagation, hardy and rapid growing—but of poor texture, the timber of no commercial value—and yet for the poor man, planting a tree claim, the most valuable tree in the list—and placed at the head of the list for no other reason than because it is the only tree admitted on a tree claim that can be safely propagated both from cuttings and from seed.

The seed ripens here in early June, and has been considered a difficult

one to handle with success—but nature annually grows millions of seedlings that can usually be

PURCHASED VERY CHEAPLY.

I saw in October, thousands of seedlings growing on land broken the June preceding—self sown—three miles away from the trees producing the seed—and this on the tough, wiry sod of Big Stone county.

I have gathered seeds from the tree, planted them in a carefully prepared seed bed and not one germinated. I have scattered them carelessly through a cultivated garden, making no attempt to cover them, and got thousands of fine seedlings the first year. Again, this plan has failed.

It seems necessary, in the light of experiment, that the seed of the cottonwood should be lightly covered—either by harrow or the washing of rain—which, followed by a few days of moist, humid atmosphere, seems to insure success.

It seems most probable that if seeds of cottonwood are exposed to the sun for a week after sowing, and become thoroughly dried or sun baked, their vitality is destroyed.

I have had the best luck sowing these seeds on the sandy shores of a lake and harrowing in. For all locations the best plan is to select a time for sowing just before a rain, and let the seeds take care of themselves.

IF THE STOCK IS FRESH

you have a good chance for success, no matter what the character of the soil.

It may be well to state here that the seeds should be gathered just as the pods begin to open, and before heating must be spread in a dry place out of the wind, to open, when they may be sown. Cottonwood seed kept over winter is probably worthless.

There are no known means of liberating the seed from its cotton covering, and as it is very light, a still time must be selected in which to sow it. As usually measured, there are about 7,000 seeds to the bushel.

In selecting cuttings, choose clean, two-year old wood, or strong, well-ripened one-year. Cut from eight to ten inches long and as near one-half inch in diameter as economical cutting will allow. Larger cuttings will root and do nearly as well, but are more expensive to transport and handle.

Never cut them when frozen. If cut in autumn or during warm days in winter, pack in damp straw or sawdust until wanted. These will bear transportation long distances, even with careless packing.

Plant at least eight inches deep, leaving from one to two inches of cutting above the surface of the ground. Plant in early spring as soon after the ground settles as possible. If the ground is mellow, or loose the cuttings may be pushed down by hand, but it is probably economy to make a hole with a dibbler or bar, taking care to tread the earth firm around the cutting after planting, to effectually

EXCLUDE THE AIR.

This is important in all tree planting. The earth must be compacted around the roots, for just in proportion as it is left porous or open to admit air, just in that proportion you imperil the life of the tree.

The safest and most satisfactory planting of forest trees is from seedlings, and this applies not only to the cottonwood, but to all the deciduous trees and evergreens.

It is bad policy to plant most kinds of tree seed on the ground where the tree is to remain permanently.

If you intend to propagate from seed, it is much better to grow the seedlings in a carefully prepared seed bed, and transplant to their permanent location when one, two or three years old, as the necessities of the case may require.

Seedlings of oak, hickory, butternut and black walnut transplant so badly that it is better to plant seeds of these trees in permanent location.

Next in order we will name the ash leaved maple, or box elder. It is a hardy, strong grower, the timber is heavier and better for all purposes than the cottonwood, and if it could be propagated by cuttings, would far out rank that tree as a valuable, economical tree for the frontier planter.

IT MUST BE STARTED FROM SEED,

which ripens in September, and if the ground is ready it may be planted in the fall, covering about an inch. It is easily preserved through the winter for spring planting, by selecting a dry place and scattering the seed on the ground to the depth of two inches and covering with old straw or leaves.

This is a simple and safe method of keeping the seeds of ash, hard maple, acorns, and the seeds of all nut bearing trees.

In planting or preserving all variety of tree seeds, it will be found a valuable rule to follow, to imitate the disposition that nature makes of them as closely as possible.

The seedlings of box elder should not be allowed to grow more than two years in seed bed before transplanting, owing to their tendency to grow one strong tap root deep into the ground, making them difficult to dig or transplant. Box elder seed number about 10,000 to the measured bushel.

THE SOFT MAPLE

must have a place owing to the ease with which it can be grown from seed. The tree is a good one if we except its tendency to split down at the forks under heavy snow or wind. If looked after and head-in or pruned properly, it is a good safe tree, and is still popular with many, notwithstanding the frequent attempts to cry it down. The seed ripens in June, and should be planted soon after ripening, and will make a strong little tree from ten to fourteen inches the first season. It is the best soft seed to plant in a permanent location, as it is a strong grower, and is ready to begin roughing it as soon as it appears above ground. The seed cannot be kept through the winter for spring planting—four weeks from time of ripening being about the time it can safely be preserved by any known means. There are about 6,000 seeds to the measured bushel; and here let me say that in estimating the quantity of seed wanted for a given space by the number of seeds in a bushel, it is safe to allow fifty per cent. for bad seed and accident to the seed or seedling before it reaches its intended destination.

THE WHITE ASH

must be highly recommended, as it is one of the most valuable hard wood trees in this country. It is a rapid grower, perfectly hardy, and prefers low or flat low lands, though it will do well on any good soil. The only excuse for placing it so low on the list is that we are looking for trees for the frontier planter, who has but little means, and the seed of the ash is

always scarce in this country, and very expensive, costing usually about five times as much as soft maple or box elder. The seedlings are consequently more expensive, which is unfortunate, as it ought to supplant all we have mentioned before it. The seed ripens in the latter part of September, and must be treated the same as box elder. It has about 11,000 seeds to the bushel.

THE HARD OR SUGAR MAPLE

is so well known, so beautiful, so valuable in every way, that it ought to have a place in every collection. Its slow growth is a very objectionable feature. It is grown from seed which ripens in October, and may be treated like box elder. The seeds are small and usually sold by the pound. The elm is deservedly popular, and is easily grown from seed, which ripens in early June, and requires the same treatment as soft maple. Of the oaks and nut bearing trees, the difficulty in transporting fresh seed, and in transplanting and handling seedlings, will for the time being make them less popular than their mediocre competitors. Of these you must procure fresh seed, and be sure that it reaches its destination without having become either heated or dried in transportation. Treat the same as recommended for box elder, except that, owing to the depredations of mice and gophers, it is the safest not to plant until spring, and then plant where the trees are to be permanently located. The

BALM OF GILEAD,

Lombardy poplar, and the willows, though all easily grown from cuttings, yet are so entirely worthless for forest planting that they are noticed only to condemn them. The black locust is a good tree, but owing to its almost entire destruction by the borer in all the older sections of the country, I would not recommend its general culture. It is not intended to slight the conifers by mentioning them last, but owing to the difficulty in growing them from seed, the high price of seedlings, and the care required in handling; they are too expensive a luxury for the frontier, but valuable and worth all they cost. There is not a tree of the whole deciduous list equal to the Scotch pine for hardiness and adaptability to our soil and climate. It is the most rapid grower of all the evergreens, of dense habit for windbreak or timber, its general planting should be encouraged in every way. It is the only first-class evergreen for our western prairies, all the others being most at home in wet lands, and more apt to be affected by our dry summers.

THE AUSTRIAN PINE,

white pine, Norway spruce, and arbor vitæ should have a place in ornamental planting, but for utility we had better stand by the Scotch pine. The European larch, though a cone-bearing tree, is not an evergreen. It is the most rapid growing conifer, outstripping the Scotch pine, and the wood is the most durable, excepting the red cedar. Like the Scotch pine, it is admirably adapted for dry, sandy locations, and will grow finely on soil too poor for any other valuable tree. The cone-bearing trees are all propagated from seed, but it is a nice task in horticulture to succeed in growing the seedlings. The difficulty is not in the germinating qualities of the seeds, for with the exceptions of the red and white cedars, all germinate freely. The critical time is when the little pine or spruce just begins its career when an inch high and before it has formed its second leaves. Then the least breath of unfavorable air, an hour's hot sun, or too dry or too humid an atmosphere for an hour, and it is all over with the infant monarch. In the language of the horticulturalist: it has damped off, and not a vestige is left to prove that a seed was ever planted there. I have seen a bed of

SCOTCH PINES

all up nicely, their dark green covering the ground like a carpet, and in six hours not one left in ten thousand. The most approved plan is to surround the bed planted with seeds of evergreens, with common fence boards set on edge and nailed to the posts at the corners, leaving an air space of two inches under the board. Covering these with laths, leaving space equal to the width of the lath, running and south, so as to change the light upon the plants, as the sun passes over. Water plentifully evenings during a dry time, and sprinkle occasionally with dry sand during a wet time, and if planted in a light, clean, rich soil, ten chances to one your evergreen seedlings will pull through. It is imperative in handling evergreens, large or small, that the roots be kept shaded and damp while handling. The sap is a conifer is of a resinous nature, and when once dried, it is insoluble under the influence of the soil in which it is planted, hence, the tree is practically dead, as soon as

THE ROOTS ARE DRIED.

Twenty minutes' exposure of the roots to a hot sun is usually sufficient to destroy all hope of saving the tree. The European larch has been mentioned as one of the most valuable trees, but it is urged against it that it is difficult to transplant. The larch starts to grow at a very low temperature, or when it is too cold for any other tree to start to bud. Once started, and there is no use in attempting to transplant it, for it will surely die. Handled before it buds, and it is one of the easiest and safest to transplant. From this we must always remember to get our larch seedlings on hand early in spring, or what is better, procure them in the fall, heel them in, so as to plant as soon as the ground is open.

In selecting a list of trees for prairie planting, we must name them, not in the order of real merit, but in the order of economical availability, as best answering the purpose of the tree planter of limited means. We will place them: 1st, cottonwood; 2nd, box elder; 3rd, soft maple; 4th, white ash; 5th, elm; 6th, European larch. Of the evergreens, Scotch pine first and last.

Now, on the other hand, if I was planting a forest for profit, and had plenty of means, I would not plant one cottonwood or maple. A ten acre plat should have two rows of Scotch pine all around it, immediately inside of these four rows of European larch. Now we have the plat surrounded by a windbreak of sturdy, rapid growing trees. Across one side plant in regular rows two acres of box elder, two feet apart each way, to be thinned out for fuel. This tree is planted in this quantity because it grows more rapidly than the other more valuable trees, and will furnish more fuel during early growth. If no fuel was needed, I would not plant this tree, but would plant half the space inside the larch with white ash, and the balance with oak, hickory, black walnut and butternut.

Imagine a farm of 160 acres in a square, bounded upon the east, north and west by a double row of European larch, and inside of this a double row of Scotch pine, the rows eight feet apart, the four rows occupying twenty-four feet. Bound it on the south by a single row of European larch, sixteen feet apart. Locate the buildings on the south line in the center from east to west, and surround them upon the east, north and south at a comfortable distance with trees for utility. In case of the smaller plat we located the pines on the outside. This was for effect. The larch grows so much faster than the pine that it overtops it, and the dark green of the Scotch pine is relieved and contrasted by the light green of the larch. In case of the line

around the 160 acres, the pines are planted inside the rows of European larch, because we want the best view of effect from inside the enclosure.

We will suppose these trees well cared for for ten years. The larch stands thirty feet high, the pines twenty, and forest trees about the barn from ten to forty feet. You pass that farm, and through the open row of larch you get a grand view. Every man who passes that farm, respects the planter. To the inhabitants of this farm a blizzard has no terrors, and if all the farms were so well protected, that suggestive name for a storm would soon be forgotten. You drive into that farm and it is like driving into a barn—you have a feeling of security and comfort, no matter how the storm may be raging. You find a comfortable fire from the wood cut on the farm, and you find farm stock enjoying sunshine and shelter. If you are there in harvest you will find the grain standing well, and probably when other farms are selling for ten dollars an acre, you will next hear that our friend has sold his for twenty-five dollars an acre, thus getting a profit on his planting besides the comfort it afforded him for ten years. Don't think yourself a philanthropist or public spirited in planting trees for your country's sake, but plant them understandingly for your own personal profit—plant them for the money that is in them, then you will get interested in your work, and do your country good without intending it.

TREES ARE LANDMARKS

in human life. Is there one of you but can remember every branch on some old oak or elm near your boyhood home—some tree that was your friend, the memory of which recalls a thousand incidents of childhood? The poetry and songs of every people have expressed their love for trees. The arbors of the world have listened during all time to man's veneration for God's first temples.

The Minnesota Forestry Association has done a good work, and to its working members are due the thanks of the whole northwest. Future generations will thank them, and their names will live when the stripling trees they plant shall become gnarled monarchs of the forest.

THINNING, TRIMMING AND PRUNING THE FOREST.

To L. B. Hodges, Editor M. Forestry Manual:

In discussing the various questions which will constantly be arising in this new field of our agricultural labors, we must all soon realize our great ignorance in regard to the best modes of procedure. No exception is offered by the topics now to be presented under the three separate heads, which it is proposed to consider in this chapter. *How and when* shall we *thin out* the trees of our artificial plantations or of our natural groves? for there is no doubt they will soon be too thick, if all grow which we so thickly set into the fertile soil. *How and when* shall we be called upon to *trim*, and reduce the superfluous growth of the spreading trees, that must very soon interlock their branches to their mutual injury? And again, how shall we proceed in the matter of **PRUNING**, or lopping off the great limbs which may after a while interfere with the proper balance of the trees under our care?

These several questions have been presented, no doubt, to many minds among our tree-planters, and while some over anxious ones have already suggested plans for the treatment of the groves they have yet to plant, and will descant with great confidence upon the systematic methods they expect to pursue in the future, others, less confident in their knowledge *a priori*

of what will be best to do in the premises, may feel somewhat appalled by an apprehension of coming difficulties. Those who have used their powers of observation in the wild wood, and who have studied Nature's methods of procedure under like conditions, will have little concern as to the result, and may feel confidence that the exercise of common sense will enable them to solve all these riddles, as they may arise.

Yes, study Nature. Go to the natural thickets and observe the result of the planting of her prolific hand. See the crowded saplings of her sowing, with tall, straight, clean stems—watch them from year to year; when they are of mixed sorts, see how soon those of most rapid growth will shoot upwards and over-power the inferiors by spreading out their foliage to the sun and air, while their baleful shade makes quick work with the underlings, smothering and killing them, and thus *thinning* the grove. When the trees are naturally massed in groups of a single species, a similar result will be observed, for there will be some difference in their thriftiness and strength; in this struggle for existence the survival of the fittest (strongest) will always be the result, the weaklings sicken and die out successively, and the process of thinning goes on, producing the desired result. The dead trees soon fall to the ground, retain the fallen leaves upon the surface and decaying with them increase the humus; acting as a mulch, they check evaporation, retain the precipitated moisture, and in fact, make the best possible forest soil. Occasionally you may find that the trees thus thickly crowded together have been forced to make too great a growth upward, in proportion to the diameter of their stems, which can only be developed in proportion to the spread of their tops. Nature will cure this too, but you may desire to aid nature, and now comes the opportunity to practice some of the beautiful theoretical “systems” that have been suggested. You may “destroy alternate rows,” utilizing them or not as may be desired. But even here it will be best to make a selection of the poorest, and there will always be some inferior plants in every row. But if the trees cannot be utilized profitably, it is better to leave them to the soil and to contribute toward bringing it into the most favorable forestal condition. Even in that case, it may be better, and is certainly cheaper, to lop off the tops of the supernumeraries by heading them in, with hatchet or billhook, which will so subordinate them to their un-mutilated fellows, that they will soon feel the effect of the over-shade, which causes them to dwindle and die. It is true that a young forest treated in this manner does not present a very attractive appearance, and cannot be put on parade before the average visitor; but this is just the way in which the best and choicest results have been attained both in Natural and in artificial forests. It is a question of cost, of time and of timber—how most cheaply to produce the best result. The rule may be thus stated: never thin the trees while they are making a satisfactory growth upwards, and at the same time increasing annually in their diameter, so that the two directions of growth maintain due proportions.

Great care needs to be exercised to avoid thinning too rapidly, the process should be slowly progressive. The young saplings that have been crowded so as to effect a rapid increase of height, will not bear exposure to the sun and air, by the sudden removal of continuous lines through the plantation; the bark will be scalded, and the tops will lean across these openings, and, not unfrequently, bend quite down to the ground; the winds and snow-storms will also prove disastrous to the trees that are thus suddenly exposed to their influence.

In thinning you should always remove the inferior plants; in those plantations that are massed in groups of a single species, take out the sick and

the crooked ones, and in mixed planting or in natural groups, the inferior kinds should be first removed, such as may have been planted as nurses or to fill up the spaces between those that are rarer and more expensive stock, and such kinds as are prone to branch out low if they are allowed too much room. For this purpose many bushes which have no timber value, are often introduced in making mixed plantations, to perform this nursing office to the more valuable timber trees that are intended, eventually, to occupy the soil; in which case these nurses may be allowed to dwindle away as they become overgrown by the permanent stand of useful kinds. In such a case, however, a sort of thinning may be necessary in the early years of the plantations, when the more rapid growth of the nurses may need curbing by cutting them back, lest they might overpower the slower advance of the valuable kinds intended for the future forest trees. This has already been realized in the case of willows, used as nurses for oaks. In Germany the Scotch pine is often planted with the oaks, the latter set about thirty feet apart, and allowed to struggle along, with perhaps a little thinning away of the pines near them until the pine crop is harvested, at the end of fifty or sixty years. The oaks then take possession for a century or so, and are allowed to form their umbrageous tops. It was observed, however, that in this method, while the oaks had tall straight shafts, they were apt to be too slender, and often suffered when exposed to the sun and wind after the removal of the pines, unless these were gradually cut away. In their early years, the oaks are sturdy stalwarts, and will endure a vast amount of suppression by other rapidly growing trees, during which, as when cut-back annually by fires on the borders of the prairies, they continue to form strong roots, and when the fires cease or the fast trees are removed from a plantation, the sturdy oaks spring up and grow rapidly, soon forming a valuable forest. This peculiarity of the oaks, attaches also to the hickories, and perhaps to some other species, and after observing nature's methods of stocking the forests with these valuable kinds, that are too often neglected by impatient man, because of their comparatively slow progress during infancy, it has been suggested* to plant the nuts and acorns among the cheap trees, such as cottonwoods, willows, box-elder and water-maples, after they have got fairly started, or at any time during their progress, using every third or fourth row, and so soon as the firstlings of these attain useful size they may be cut out, and after the new comers are established, the adjoining rows, on either or both sides, must be taken down to give them room to develop the future forest, as space is needed by these more valuable trees; this need not be done for some years, meanwhile the trees to be cut will have attained useful size.

Do not be misled by promises of great profits from the early thinnings of your forest plantations; to the farmer the possession of a grove close at hand will indeed be of inestimable value for many purposes, and in the prairie country, in a very few years, the young trees will come into play as material for his fencing, for fuel, et cetera. If situated near a town or village where tree planting is encouraged, the groves may sometimes be thinned very profitably after the second year, to supply shade-trees for the streets; these bring good prices.

Like my brethren tree-planters, however, it must be confessed that the longer this delightful occupation is pursued, and the more extensively it is practiced, the more do we find, and by so much the longer, that it is necessary for us to observe and to study, that we may approach perfection. There is always something still to learn. It is now just half a century since the

*Trans. Iowa Hort. Soc. Vol. XIII, 1878, p. 300, article, GROUPING IN PLANTATIONS.

planting of trees for timber first engaged my attention in Ohio, and about the same time the management of natural woodlands was undertaken. The planting was not extensive, but has yielded satisfactory results, and the management, which covered a considerable area, perhaps nearly a half-section of old and young timber, was the scene of many blunders, some of which were expensive and some were errors fatal beyond redemption, but the present annual increased value of that tract is estimated at 6 per cent., while, in some portions, the timber is beautiful and annually ripening for the axe.

Within the last quarter century forestry has been pursued upon another tract, very differently situated, and largely consisting of the natural growth of the locust, upon old fields, much worn by tenant-farming during the past forty years. Thinning and trimming has here been practiced, but chiefly for the sake of removing the dead and decaying results of natural causes, which had already reduced the stand of trees sufficiently for the well-being of those which remained.

Within the last ten years, only, have any continuous efforts been made to reproduce the forests by artificial planting of seeds and trees of various kinds; these have been more or less satisfactorily adapted to the situation selected for them. Errors many have here been committed, it is true, and perhaps it is yet too soon to have discovered them all, nor would it be cogent to the subject just now in hand to detail them. This episode should be apologized for as a piece of egotism, and is only to be excused as being the field from which have been drawn, in great degree, the facts upon which are based the principles on which are founded the postulates above given in respect to the *thinning* of forest plantations.

TRIMMING.

On the subject of trimming little need be said beyond an explanation of why it is ever done, and why so little needs to be done. The object of trimming is especially to form the future tree, chiefly by directing its growth into the desired channel to produce that effect. Trees vary remarkably in their natural habit or style of growth in branching, some are naturally upright, with one main leader, and these form beautiful conical trees when growing singly—beautiful on the lawn; they also form beautiful shafts when the crowding of dense forests has trimmed them with nature's shears, saws and axes, so quietly, so gradually and so silently that no one has ever heard the axes lifted up against the *thick trees*. Others with very different habit, have a proneness to form side branches and double or multiple leaders, that often require human interference, even when subjected to the close planting which our prairie foresters have so wisely adopted, even in the teeth of the wide planting encouraged, or at least permitted, by act of congress. These last may frequently require trimming, and this is readily done by slashing off or shortening-in the superfluous leaders and the straggling branches which, when thus snubbed, will soon succumb to natural causes. It is wholly unnecessary to cut off neatly all or any of the side branches, like a nursery grown plant that is being prepared for the street, where, as the observed of all observers, it would be exposed to finical criticism, and where, for its own safety, it should have been carefully schooled, not only for the sake of appearances, but also to prepare and harden it for the rude buffetings of the world to which it will be exposed. We are now considering the young forest trees, in close companionship, and secluded from the public gaze and from unfriendly criticism. These need the nourishment of every leaf, upon every twig, that can reach the pasture of the air about them, so that strength for future greatness may be stored up in their stocks and widely spread roots.

This shortening to check erratic growth should be done chiefly during the summer.

There is a kind of treatment sometimes advisable for young trees that may properly be considered a sort of trimming. This consists of cutting them down close to the ground. Some persons prefer to cut certain kinds before planting, setting out the little stumps, and in some species this has proved more successful than leaving the tops; indeed, some planters never set out a tulip tree without first mutilating it in this way. For most trees, however, it is best to defer the operation until the early spring of the next or even the second season after planting, according to the growth they have made. This treatment is especially applicable to slow or indifferent growers, and to such as are prone to form crooked and low-branching stocks. The object sought by this decapitation of the little trees, is to secure a vigorous, upright, straight and clear stem the first season. If more than one shoot appear, the supernumeraries must be rubbed out. This treatment has often been found to insure more growth in one summer than has been made during many years, in trees that had become stunted and bark-bound and unthrifty from whatever cause. The removal, or subordinating of an extra leader, should always be done as soon as observed, summer or winter, by cutting back, by bending aside, or by twisting the weaker one so as to direct the current of sap, and for this purpose it may be desirable to force the remaining shoot, if inclined to one side, and secure it in a vertical position. In the winter, however, it is much easier, and equally efficacious, to cut back the top shoot to a healthy bud on the upper side, from which a strong upright leader will be produced the next season.

Nothing has been said in reference to trimming off the side shoots except incidentally, and every one must have observed, or will soon observe, the happy effect resulting from the close planting now so urgently advised and so generally practiced by all intelligent tree-planters.

PRUNING.

We now come to take a hasty glance at the last topic of our triplet of forest surgery. Pruning should not be confounded with Trimming. The former is a "capital operation," resulting in the removal of great parts that have been allowed to remain already too long where they are not wanted, or those which have been mutilated by injury and now disfigure the tree.

Hence it will appear that in any forest plantation which has been well managed, extensive pruning will seldom be required; never as a formative and training process, like Trimming, but only called into requisition, like the surgeon's art, as a curative agency.

Much skill and care is requisite as to the manner of doing the work, the season at which it may best be performed, and the treatment, or materials which should be applied to the wounds inflicted, after the diagnosis has been determined, and the removal is decided upon. Pruning is not applicable during the infancy of trees, rarely in their adolescence, except where the subject stands singly or in a scattered group, but more frequently it is applicable to older and more mature trees. Just here may be seen the superiority of German forestry over that of other countries, for there pruning is anticipated by judicious trimming and management.

A small section of young oaks, of some thirty years' growth, was seen in the forest attached to Windsor Castle, the favorite royal residence of England's queen, in which more heavy pruning had been done than had been seen in traversing and inspecting thousands of acres in Germany, in Bohemia, famous for its woods, and in other provinces of Austria, on which the

same oaks largely prevailed. It is admitted that this species, the *pedunculata*, has a spreading habit and is prone to branch low; it must also be remembered that the foresters of England have for centuries been accustomed to take advantage of this form of the tree, great volumes having been written full of instructions directing how to increase this branching habit, in order to produce the curved masses of timber needed for her naval constructions, before iron had so nearly driven wood from her navy—so that even within thirty or forty years, the oaks referred to may have been planted widely and trained with a view to the production of ship-timbers. The point of particular interest, in this case, however, was the admirable manner in which the forest manager, Mr. Menzies, had done his work—the surgery was perfect—it had been most scientifically, judiciously and seasonably performed, the wounds were healing over rapidly, though, of course, they never united by “*first intention*,” still, the cut surfaces were in a fair way to be safely “*sequestered*” without decay by the newly formed alburnum, which showed the perfection of wood-surgery.

Pardon the technicalities of the profession, but the enthusiasm of former days, when engaged to some extent in the mutilation *for repair* of human subjects, was so thoroughly aroused by observing this capital work of Mr. Menzie's upon the Queen's own oaks, that even the recollection now excites a thrill of professional admiration, which can only be calmed by expression in words.

Great care should be exercised in the manner of performing the work, and much consideration should be bestowed upon the season best fitted for pruning. The object being the removal of parts in such a manner as to avoid injury, and to prevent the decay from the exposed surface extending to the bole of the tree and the destruction of the timber. The mature wood of a tree, though sound and called healthy, can scarcely be called a living tissue, has no powers of reproduction, and may be considered rather as a skeleton of the organism, the living parts of which are confined to the outer portions of the wood, and the inner layers of the bark—and of these the very last are the formative tissues, while the truly vital organs are the buds at the extremities of the twigs and branches. Though there are dormant buds, capable of producing living shoots, that have long remained inactive, but which may be aroused to activity, when needed, and which spring into life even from the stumps of old trees of some species, while other trees have the power of forming adventitious buds, even upon their roots under ground, whence come numerous suckers, as in some poplars and other species, and these are capable of forming trees with an independent existence, still it is the visible terminal buds on the previous years' growth that constitute the true points of vitality in the normal condition of the tree. It is to the healthy activity of these, and the shoots which annually proceed from them, that we must look for all increase of woody fiber, and for all deposits of new material to repair the damage done by pruning, which necessarily exposes more or less of the perfected woody tissue, that is itself considered dead matter, with no power of reparation.

Hence the importance of so arranging the direction of the saw in cutting off great limbs, that the stumps shall be left in the best possible shape for receiving the new deposits destined to shield the exposed tissues from the action of the atmosphere that would induce decay.

With this object in view the cut should be made with the saw, as smoothly as possible, and the section should rarely be in a line or plane parallel to the axis of the stem—but inclining away from the stem from the point of insertion above. The cut of an axe is smoother, but can rarely be made in

this manner, even when practiced from below, and even then it is apt to make a ragged, tearing wound at the upper side, just where the deposit of new wood should be begun, and where it is usually most abundant—following round the wound at its margins. The axe is a very inferior tool for pruning, and should be discarded for a sharp saw, though in some hands the axe may be used for the first cut; this is to be made one, two or three feet out the limb to be removed, and even then care should be taken to cut well under, so that the falling limb cannot tear away portions of the stump. The same care should be taken in using the saw exclusively; and in all limbs of considerable size two cuts should be practiced, to avoid the strain of the leverage of the outward portions.

It is a good plan to start the sawing of the inner cut first, so as to take advantage of this leverage, but arrest it so soon as the cut begins to gape, and before it can split and tear, then insert the tool a foot or more beyond, or from the stem, and rapidly cut off the outer portion. The stump of the reduced limb is then easily managed, and should be carefully supported while the section is completed. The wound may now be smoothly pared with knife or chisel, especially all round the bark, and the deposit of cambium has little to interfere with it.

It is well now to make some application to protect the wood from the elements: a coating of paint will answer—even whitewash, or a more elegant application of shellac, put on with a brush. Forsyth, who wrote a book on pruning, strongly recommended a poultice of cow manure and clay tempered together; this has long been supplanted by the use of grafting wax, and in our time coal tar is often used as a good protective, though rather too much of an irritant to the highly organized cells of the reparative cambium layer, which is to heal the wound.

Projecting stumps and snags, whether the result of careless lopping or natural fractures by winds or snows, or by felling other trees, should never be left; they are not merely blemishes, but serious injuries to the tree; they can never be healed over by deposit, and the decay set up in them will extend to the valuable portions of the timber in the stem.

The Season for pruning is a matter demanding careful consideration. The two periods most highly recommended are those of perfect rest, late in the autumn, and of high activity of the wood-producing process, or at midsummer, when the shoots of the current season have been completed, and have formed their terminal buds, because at this time the transformation of cambium cells into those of the woody fibre is in its greatest activity, and the process of healing will at once begin.

The season of rest that is often recommended, for heavy pruning, is confined to fine, dry autumn weather and to the approach of winter, when the tissues rapidly dry up for a short distance and become case-hardened, to resist the wet. The winter and spring should be avoided in performing this work. No cutting should ever be practiced when the tissues are frozen, unless, indeed, it be hacking the growth of a willow—prairie or swamp, which is then more effectually killed than at any other period of the year, and also more easily approached upon the ice. Nor should we attempt to cut off a limb in the early spring while the sap is in active flow and of a thin and watery consistency. It then overflows from the wood and gives the tree a most unsightly appearance, besides wasting the natural forces and substance of growth; the wood exposed under these conditions is prone to rapid decay, and the healing process is hindered, or often entirely prevented. Wait until the sap has changed its character, and is full of reparative material, as above suggested.

As one of the good results of the great world's Expositions, you will permit a reference to the great amount of valuable literature connected with the industrial arts which accompanies the exhibitions of the results of those industries, as was particularly manifest at the World Fairs at Vienna and Paris. Brochures connected with all departments of Forestry, and illustrating methods and practices, were numerous and highly instructive. On the table beside me is one of a collection received from the last Paris Fair, held at the Trocadero, and written by Mr. A. Martinet, an inspector of the French forests, which treats especially upon this branch of the subject, Pruning of Trees. Would that the illustrations alone could be placed before you to show the effects of good and bad pruning. Of the latter, however, we have no lack in every part of the country where trees of any considerable size can be found, either wild or cultivated—for the lopping of the ax, rivals in the damage effected the invasions of storms or other accidents. In a well conducted system of Forestry, such as we hope to see grow up under the fostering care of the government at the National Forest-School of the future, and carried out by the intelligence of educated American Foresters, we shall one day see among us plantations so well managed as to produce the best results, and to need the least possible amount of pruning.

One of yourselves, thoroughly devoted to this great branch of agriculture, and fully convinced of the necessity of its early and extensive introduction upon the wide region of the western plains, has well said: "the American people can do almost anything if we will but show them *how* and get them interested in the doing of it." Men who cannot be interested in tree-planting by those who are so practiced, so devoted, and so enthusiastic in the pursuit as Leonard B. Hodges, and his co-adjutors, do not deserve a portion of the fertile soil of Minnesota.

Yes! he and others "*are doing it*,"—they are teaching the people how to begin this great work, and in their efforts in the cause, they are also knocking at the doors of Congress for aid to educate us all toward greater perfection in the work. Their enthusiasm is reflected even from Ohio, as is manifested in this feeble effort on behalf of Forestry; though but a mite, a mere atom thrown into the swelling cumulus upon which is, one day, to be erected the great structure of an enlightened, *American Forestry*.

Your success in the efforts you are making, and the success of your worthy leaders, who are doing so much for you and for your State, aye, and for the Nation, meet the warmest sympathy in the bosom of your absent friend.

JOHN A. WARDER.

North Bend, Ohio, March 31, 1880.

TO MY READERS :

In preparing this second edition of the Manual, I have thrown out some seventeen pages from the old edition, and in their room have placed the valuable contributions of Dr. John A. Warder and U. S. Hollister.

Much original matter, the individual experiences of practical men who have succeeded in growing timber on our great prairies, has necessarily been omitted from this edition. Reason: want of funds. Whenever the people of Minnesota, through their ser-

vants, the Legislature, appropriate the necessary amount, this valuable experience will be published for their benefit.

With the most rigid economy, bordering on meanness, this State Forestry Association of Minnesota has managed its affairs in such a way as to keep within its means and pay all its bills, without asking the passage of any deficiency bill.

We now issue a second edition of the Manual of 6,225 copies, which virtually exhausts our exchequer.

This edition will be sent free to all men trying to make homes on our prairies, but they must send six cents in money or stamps to prepay postage on each copy.

It seems a small thing, and in fact it is small for the great prosperous State of Minnesota to get down to this. I presume the next Legislature will do something to remedy it. I have received a very large number of postals and letters asking for the Manual, in which no stamps or money for postage was enclosed, and from my own pocket have paid a heap of postage. The postage and stationary cost as much as the book. In other words, this edition of the Manual costs \$650.00. If we had paid the postage on the first edition, which is already distributed all over Minnesota, we would have been unable to publish this second edition.

This explanation seems due to hundreds who have written for the Manual and neglected to send postage, and still wonder why they don't receive either the Manual or an answer of some kind.

The first year of our existence as an Association, I had to answer about four hundred letters on the subject of forestry. This year, this sort of correspondence has run up to four hundred letters in a single month. Were it not for the Manual, I could not answer half of them. I mention this to show the rapidly increasing interest in forestry in Minnesota. It is encouraging.

To the great number who have voluntarily tendered me their very appreciative opinions of the Manual, I tender my thanks.

That it so far fills the bill, and is received with satisfaction, and studied eagerly by those for whom it was prepared, is to me a great reward.

But we must all keep whacking away at this good work, so that when the time comes for us to "lay down the shovel and the hoe," we can know to a dead certainty, that we have done *our* part toward making this section of God's footstool better than we found it.

St. Paul, Minn., March 31, 1880.

LEONARD B. HODGES.

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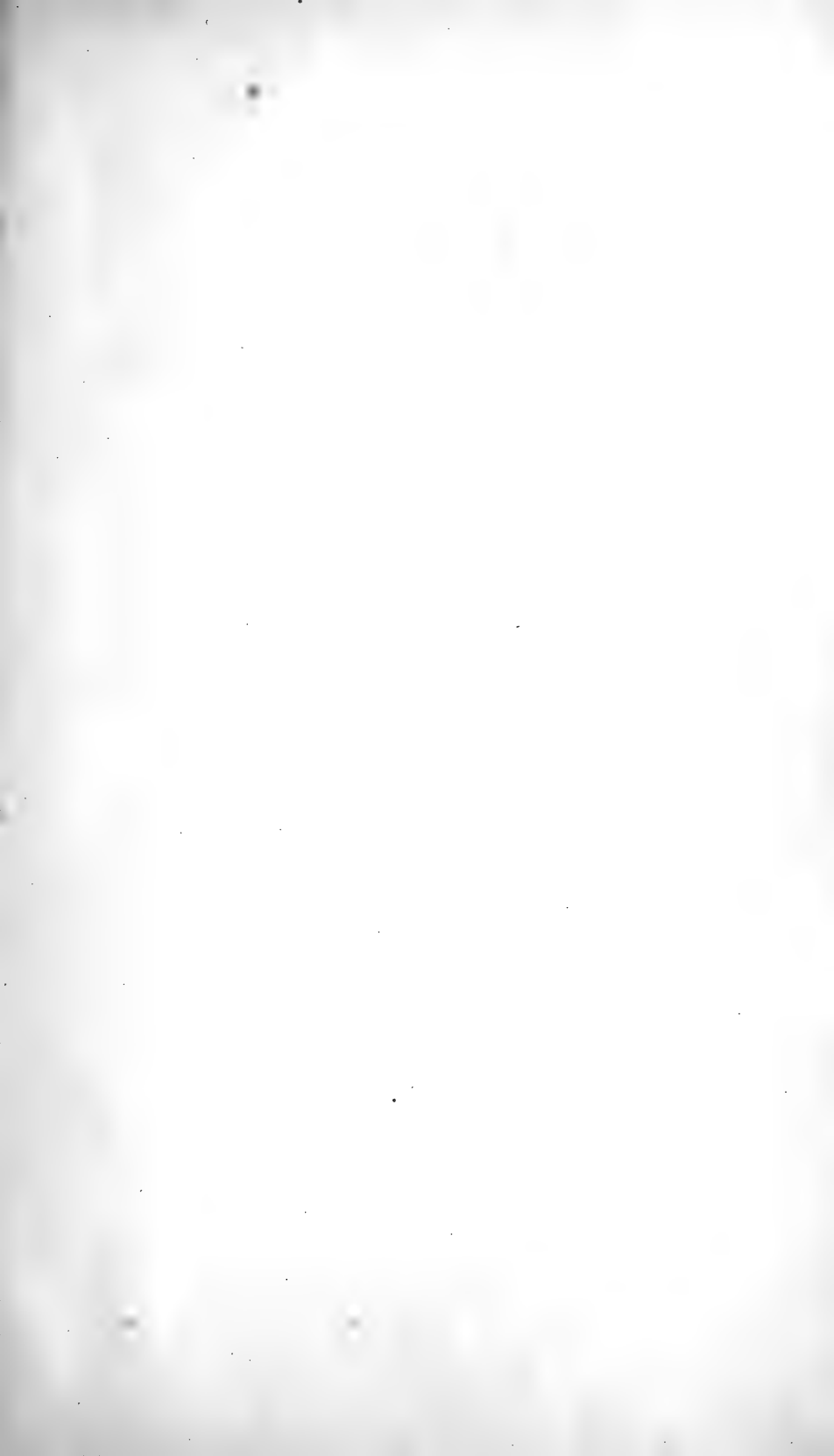
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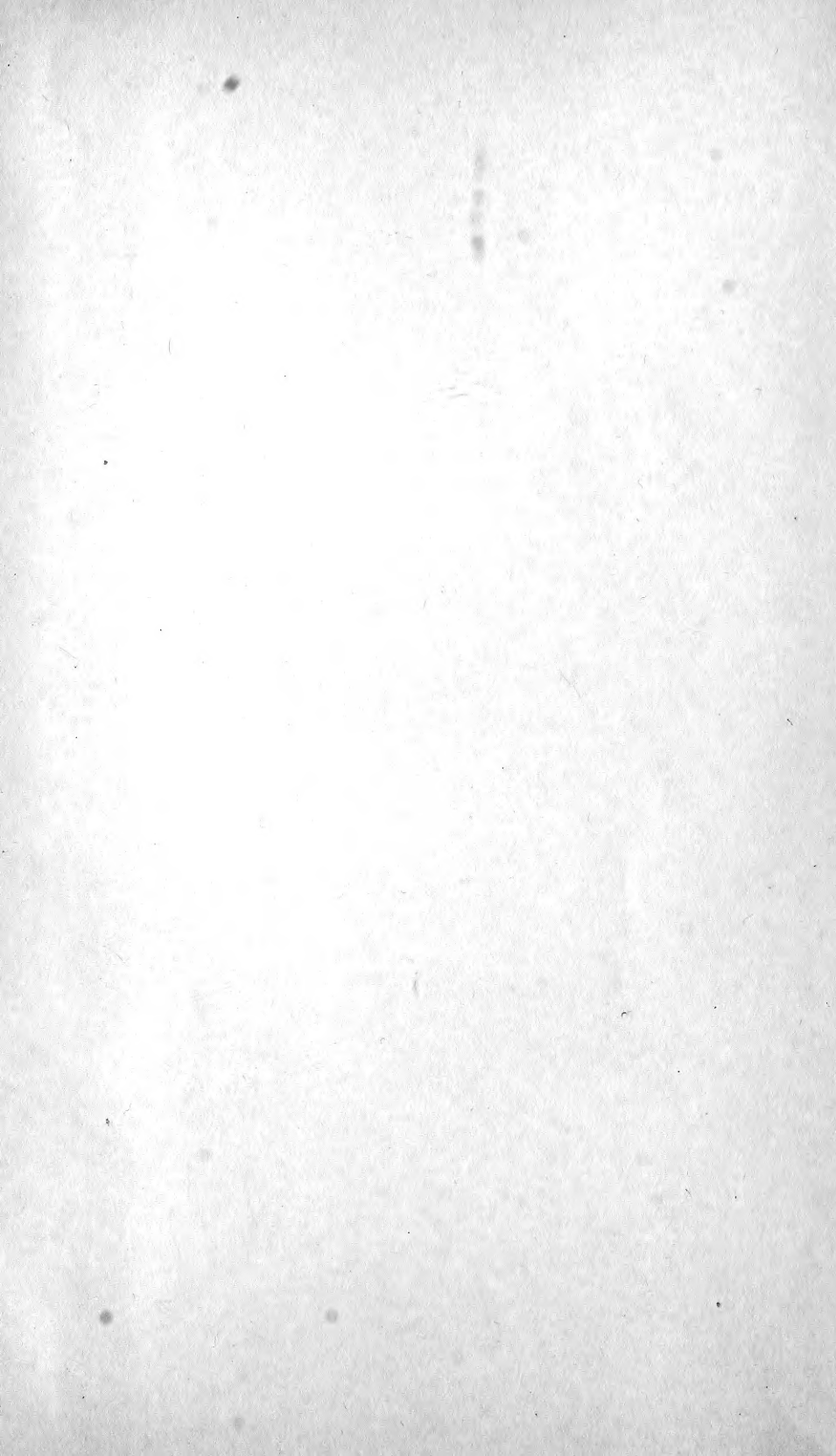
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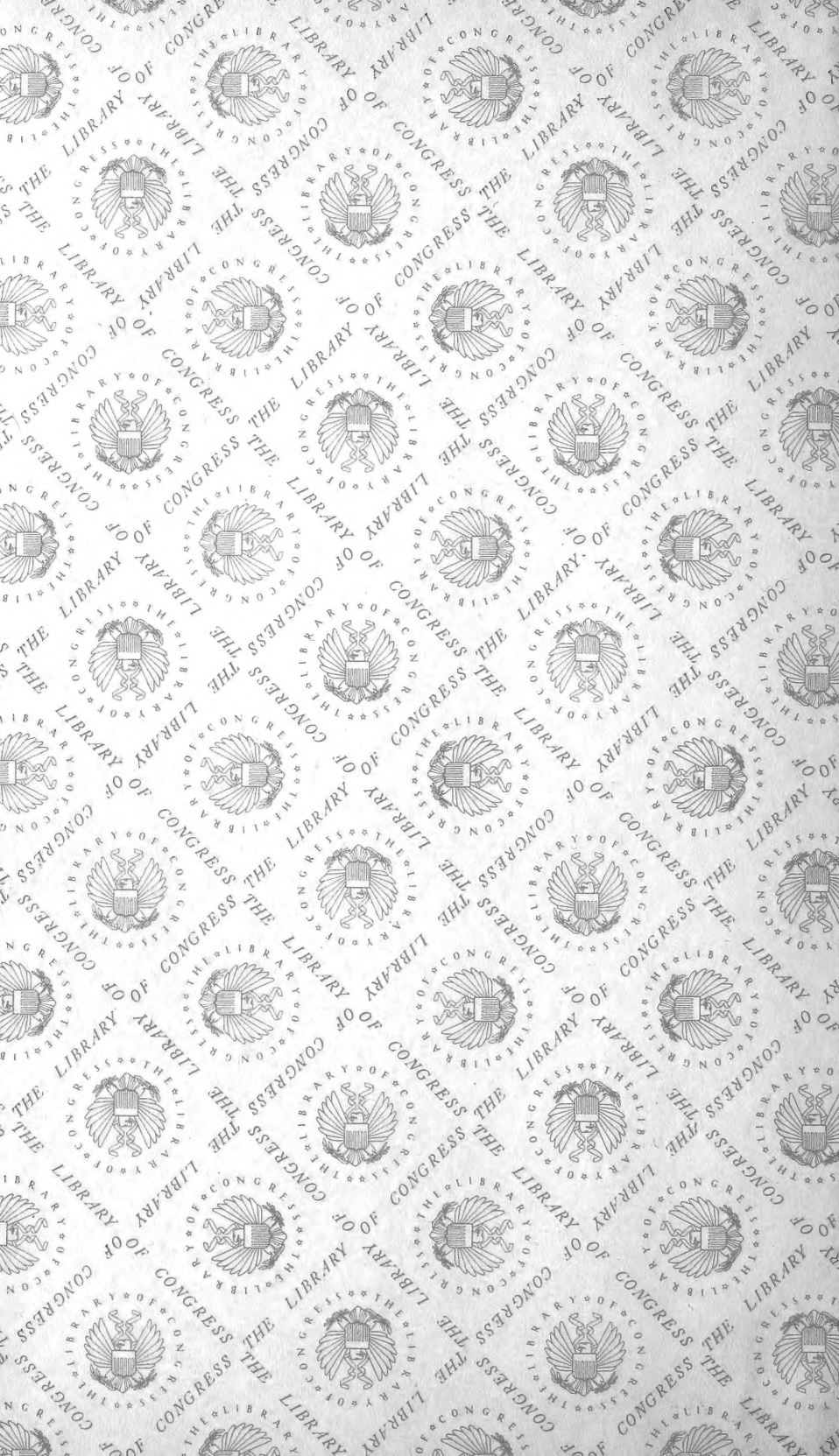
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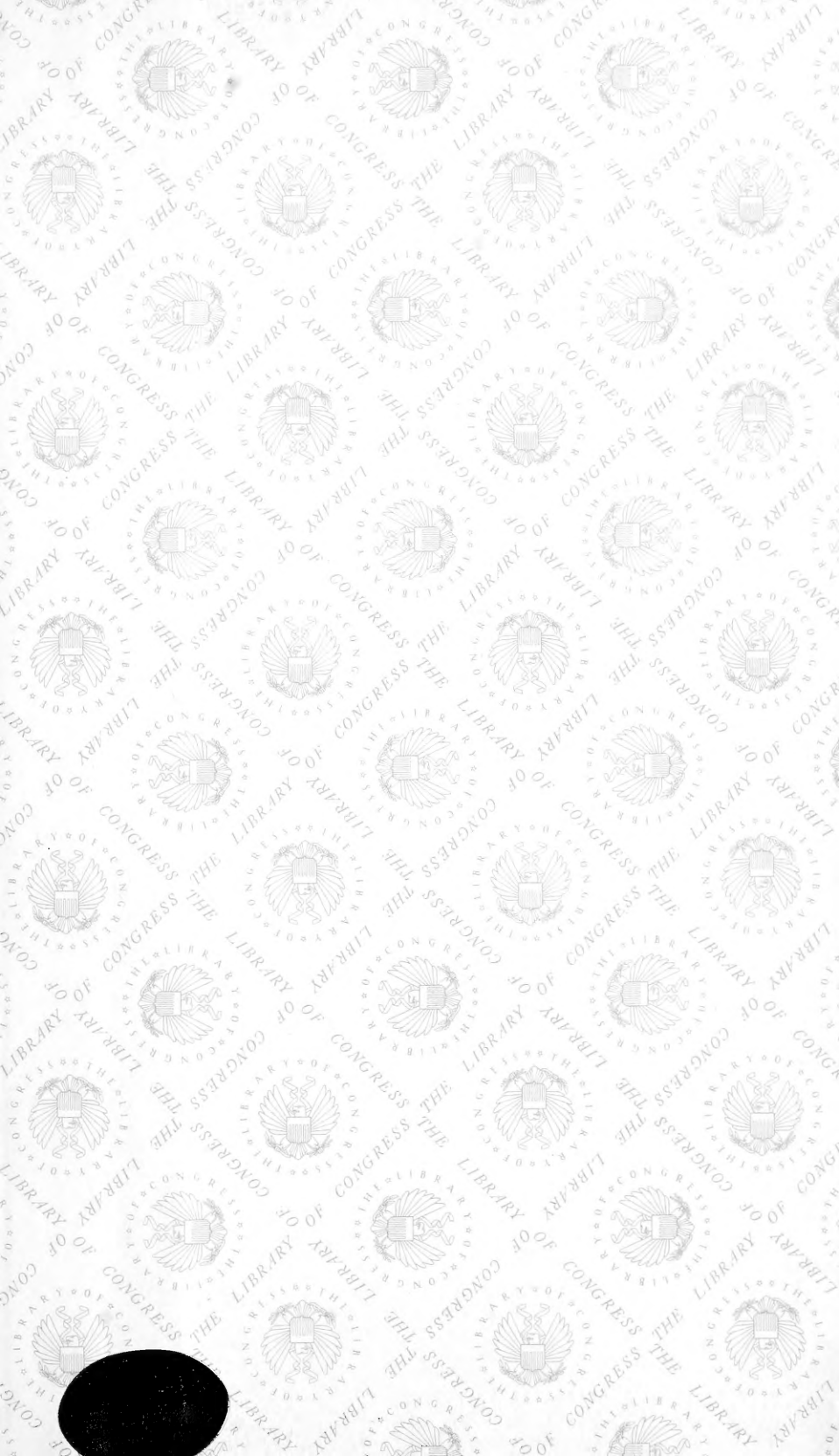
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