SYLVICULTURE.

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By the will of André Francois Michaux, the American Philosophical Society is, to the extent of the means afforded by his legacy, charged with the trust, to contribute in this country "to the extension and progress of agriculture, and more especially in Sylviculture in the United States." This Society, also, by its Charter is under the obligation of diffusing useful knowledge; and few subjects can be more useful than the cultivation of trees.

It becomes us, therefore, to consider how we can promote the cultivation of trees in this country; how make that cultivation subserve the interests of agriculture; and in what manner, and how widely we may fulfill these duties, and diffuse useful knowledge upon these subjects.

Mr. Michaux, as well as his father, spent his life in acquiring knowledge of trees, and wrote his volumes to describe them, not only to promote science, but to teach their uses and value as timber. He has intended that we should do more. He intended that we should promote the growth of trees, and also extend the growth of agriculture; by the influence of tree-culture upon climate, soil and the water supply, whereby to increase the food of man and beast, and thereby to multiply the population of the world.

In a revoked will he had suggested the purchase of land, and the planting of it with trees. In this he no doubt intended the exhibition of many varieties of kinds to give a scientific knowledge of them, and also intended that the groves there planted should be a centre of distribution of trees and their fruits. This idea has been held in view by this Society when it placed half the income of the legacy at the disposal of the Fairmount Park Commissioners, for the purchase, planting and distribution of trees and tree seeds. With half the income applied in this manner a more extensive good can be effected than by a separate application of the whole by the Society, which would of necessity have been at a more distant place, to be seen by a few only in the time that a thousand will see the trees in the Fairmount Park, and obtain their seeds. In that Park the name of the Testator has been honored by the plantings commenced in the "Michaux Grove," while thousands of trees procured by his provision are in the Nursery, waiting to be transplanted over the Park, of nearly three thousand acres, and elsewhere. These add to the variety of our plantings, and to the self sown trees of the native woods, thus adding increased attractions for botanists and lovers of the landscapes.

When Mr. Michaux extended his views to agriculture in connection with tree-culture, we must believe that he had in mind the influences of trees

upon climate, the supply of rain and retention of water as means of growth of grass, the cereals and other crops. Let us consider then what are those influences, and how far, as beneficent, they are within the control of man; not that the means placed at our disposal by Mr. Michaux, can, in the trees they will plant, soon greatly influence climate, soil and rains; yet by affording a perpetual source of supply of trees, a perpetual example and diffusion of knowledge to others, no one can prescribe limits, in space or time, to the good these limited means may effect.

The Society will, therefore, I think, pardon me for taking a wide survey, for it and all others to fill in its outlined work, according to the measure of their ability, and in the aggregate, all may do a great good, that would not be attempted if the sphere of operation were not widely opened, and the necessity of co-operative action, and the ways and means of success, were not explained, to be kept in view at present, and in a long future. With our duty mapped out, we and our successors will see the surveyed field of operations, and will be stimulated by the grandeur and beneficence of the prospect opened for good to our fellow beings.

It cannot be doubted that Nature will ever willingly do her part of the work if not thwarted by man; nay, will do it exuberantly. The great need is to regulate and restrain his excess of destruction. Before man came upon the earth it had been densely covered by vegetation; hence its pervading coal measures, lignites, and stores of oil that have been preserved under the rocks to await the age of human intelligence necessary to develop them. In that age happily we live.

We may well believe that the earliest of our race found our world covered with forests; except in those places unfitted for their growth. These were the polar regions, where ice cuts off the growth of trees; the mountain crests where both cold and want of soil prevent all growth of trees, and arid deserts. Whether we may give trees to the deserts is only a question of procuring water and soil. Yet the seemingly barren lands cast up by the sea can be made to bear forests, and to flourish in vegetation.

Before man's appearance, the great enemies of forest life did not exist. He alone could invent the axe and light the fire. Forests were then in excess of man's needs, and were utilized in fossil coal. What evil he has done with the axe and fire, and how such evil may be repaired, we have to consider. True, the woods grow for legitimate uses; for timber, for habitations, the mechanic arts and fuel; but not for wasteful destruction. They must also be felled for needful space and soil to grow the food that man and beast may live; but not destroyed to an extent to put the supply of the food of life in peril; or to so lessen it as to lessen population. In regions covered with timber capable of tillage, in excess of that point which will support the largest population in prosperity, clearing, without waste of what can be utilized, becomes a duty; but to exceed that point is a wrong to humanity. In this we have the practical test that the wise and good will observe. Life to the greatest number of happy people is the moral and scientific problem and test of duty, as we must believe that such purpose was the intent of the Creator.

Taking in hand the light of History, let us pass over historic grounds to see what man has done to destroy the forests, and how and where he may prevent and remedy such devastations. Beginning at the supposed cradle of our race, we find in the books of the Bible and contemporary histories frequent mention of the presence of forests, the coverts of wild beasts, and accessible woods to answer instant requisitions for timber for building houses, bridges, towers and rams; of trees for shade and fruit, and fuel; and branches of trees upon which to hang malefactors. There were the cedars, firs, shittim wood, terebinth, sycamores, and oaks, upon mountains and plains, and the sacred groves upon the hills where the heathen worshiped, in a measure protected as sacred by religion and superstition; but in after time these were unavailing to save them. The fig, the date, the palm and the olive were better preserved, as necessities for food, and willows sprang spontaneous along the edges of the water.

Hesiod lived about a thousand years before Christ. Speaking of Peace, Justice and Prosperity, he says:

> "No days of famine to the righteous fall,
> But all is plenty, and delightful all;
> Nature indulgent o'er their land is seen,
> With oaks high towering are their mountains green;
> With heavy mast their arms diffusive bow
> While from their trunks rich streams of honey flow."

Thus described were they as seen, as he watched his flock and courted the Muses on Helicon. And again Hesiod describes a wooded country when he speaks of the north wind; says of it:

> "Bellowing through Thrace, tears up the lofty woods,
> Hardens the earth, and binds the rapid floods!
> The mountain oak, high towering to the skies,
> Torn from his roots across the valley lies;
> Wide spreading ruin threatens all the shore,
> Loud groans the earth, and all the forests roar."

The beasts;

> "Through Woods, and through the shady vale they run
> To various haunts, the pinching cold to shun:
> Some to the thicket of the forest flock,
> And some, for shelter, seek the hollow rock."

Evelyn cites with satisfaction that when Xerxes passed conqueror through Achaia, he would not suffer his army to violate a tree; "it being observed by the Ancients that the gods never permitted him to escape unpunished who injured groves."

Near five hundred years before Christ, Eschylus makes the Chorus sing to Prometheus Bound,

> "Thy woes, beneath the sacred shade
> Of Asia's pastured forests laid,
> The chaste inhabitant bewails,
> Thy groans re-echoing through his plaintive vales."

And nearly five hundred years after the Christian Era, Basil the Great

writing to Gregory the Great, from the Isis that empties into the south side of the Black Sea, thus describes his home in that part of Asia Minor: "A high mountain clothed with thick woods, is watered to the north by fresh and ever flowing streams. At the foot lies an extended plain, rendered fruitful by the vapors with which it is moistened. The surrounding forest, crowded with trees of different kinds, encloses me as in a strong fortress." Humbolt's Cosmos, 393.

Herodotus had thus nine hundred years before described the country further to the East. "This part of Media, towards Saspires, is high and mountainous, and abounding with forests; the rest of the country is a spacious plain."

Of the north of Africa Herodotus says, "All the more western parts of Libya, are much more woody, and more infested with wild beasts, than that where the Libyan Nomades reside; for the abode of these latter advancing eastward, is low and sandy. From hence westward, where those inhabit who till the ground, it is mountainous, full of wood, &c." (Ch. 99; Sec. 191.)

Libya, or the region called Tripoli, extending from Egypt to Tunis, in the early Christian centuries while under Roman rule, was productive and populus, and when overrun by the followers of Mahomet, towards the end of the eighth century, was reputed to contain six millions of souls, and eighty-five Christian Bishops (Dr. F. L. Oswald), and now probably not a million inhabit the same space. Elesée Recluse says that "the examination of the soil and the remains which are contained in it, proves that at a recent geological epoch, the Sahara was much less sterile than it now is. The Tribes of the Algerian Sahara say, that at the time of the Romans the Ouad-Souf was a great river, but some one threw a speli upon it, and it disappeared. (The Earth, 95.) That spell was an evil one, the destruction of the forests.

Dr. Oswald says, "On the plateau of Sidi-Belbez, in the very centre of the Sahara, Champollion traced the course of former rivers and creeks by the depressions in the soil and the shape of the smooth-washed pebbles. He also found tree stumps almost petrified, and covered by a six foot stratum of burning sand." He quotes Champollion as saying, "And so the astounding 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 on 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." How certain, how sad, is this great truth! How awful then to think of the millions more who might have lived but for man's ignorance, and folly and wickedness; and to reflect upon the incalculable loss of happiness to those who did live, and have struggled with a deteriorated Nature for a miserable existence!

According to Cæsar and Tacitus, middle Europe was found by the Romans heavily covered with forests, and in Gaul and Britain were the deeply shaded woods where the Druids had practiced their gloomy religious rites, and offered in sacrifice the victims of their terrible superstition.

Now pass from eastward of Persia westward, and take a survey of both sides of the Mediterranean as far as the Atlantic ocean, and we behold countries on every hand stripped of their forests, with decrease of rains, with fallen rivers, extended deserts, and depleted populations. This change from plenty to poverty is justly ascribed mainly to the destruction of the forests, which exposed the lands to a burning sun. The waters were dried up, and the soil was washed away by floods, or driven off by the winds, or covered over by ever drifting sands.

The following are the percentages of woodlands left in the once densely timbered countries of Europe where forests have not been adequately protected: Naples, 9.43; Sardinia, 12.29; Italy, 20.7; Spain, 5.52; Portugal, 4.40; France, 16.79; Belgium, 18.52; Holland, 7.10; Denmark, 5.50; Great Britain, 5; Switzerland, 15; while Germany yet has 26.½; Russia in Europe, 40; Sweden, 60; and Norway 66 per cent. of their surface in forests.

The lessons taught us by the other continents of the Eastern Hemisphere, are both to avoid the cause of aridity, and to repair in time the mischiefs caused by man's improvidence. We have in the west our "bad lands," our natural deserts, grassless and treeless, for want of water, and our grass covered prairies, also treeless, which can only be made productive of trees by the presence of water, and the absence of fires. Waters must be had by rains, or be drawn from the earth, or saved in reservoirs or tanks, to be spent in irrigation. We also have our exhausted lands on the Atlantic seaboard, which only need rest from tillage, and to be sown with the seeds and planted with forest trees.

What we can do for these may be seen by observing what has been begun to be done in other countries, not more favorably situated, where men have yet life and energy sufficing to repair ancestral delinquency. France has taken alarm and has begun the work of reparation. John Croumbie Brown has published a book of 351 pages entitled, "Reboisement in France," in which he describes the evils suffered, and the remedies of prevention and restoration. He shows the effect of stripping the mountains in east France of their trees has been to increase snow and land slides, which destroying that set in motion, also destroys that swept over in the descent, and that covered by the deposit. When the rains come, or the snows melt, the torrents come quick, are rapid and resistless. They undermine the banks, and carry destruction with them. Nature here again begins the work of restoration by scattering the seeds of the forest, and men have learned the wisdom of co-operating with Nature, and of letting her more alone. They now protect the forests, and the forests promote "intiltration, retention, and percolation of water through the soil and subsoil, on which they grow." p. 38, 50. In other Departments the like

success has been attained as in the High Alps. Where the trees grow, the springs flow; where cut down the springs dry up, and the streams grow less in their channels. There is less rain fall, and the soil retains less of what falls.

On the west side of France from the Gironde to Bayone, are the *Landes*, or Sand-dunes, which are sands carried inland from the seashore by the winds, until they cover 2,500,000 acres, and threatened to engulf the departments of Landes and Gironde. These, however, have been planted with the pine and other trees, and the forests now protect the country behind them, and the sands have been considerably subdued by cultivation, and arrested in their inward progress.

In Algerian Africa the French Engineers, from 1856 to 1864, had dug eighty-three wells, which together yielded nearly twelve millions of gallons of water per minute, sufficient to nourish 125,000 palm trees. (The Earth, by Elisée Reclus, 95); so that even the desert may be made to yield fountains of water, and can be clothed with arborial fruit and verdure; and it may be in this way that our treeless regions of the Far West can be attacked by American enterprise. Our warm south and south-west would, with supply of rain and irrigation, yield greatly increased quantities of semi-tropical fruit and forest trees of most valuable kinds.

It is the work of reparation of the wrong that man has done to Nature, and the prevention of the repetition of such wrong, that must now be the subject of our consideration, practical action, and admonition to others.

Let us first be sure that we are acting upon a true theory. There are those who think that forests have but little or no influence in producing or attracting rains; men whose opinions are entitled to great consideration and respect. Yet we well know that whenever the currents of air, laden with the moisture of evaporation, strike the cooler mountains, rain is precipitated. So woods, we may believe, may be so elevated and cool as to produce showers from clouds charged near to the point of precipitation, as the dew falls by a slight difference of temperature between day and night.

Men in the valley or plain often do see clouds pass over them to fall as rain on hills and woods more elevated. We know too that countries have less rain-fall by reason of the deprivation of their forests. Travelers so report of Malta, the Cape Verde Islands, St. Helena, and in Aragua, Venezuela, according to Humbolt; and in Egypt, where the date palm and the olive have of recent time been plentifully planted, the rains have become more frequent: (Dr. Franklin B. Hough's Report to Congress in 1874, p. 21). Dr. Oswald reports that a rise has taken place in Egypt in the annual rain-fall, from 9 to 16 inches, since the increased planting of trees.

It is quite certain that trees preserve the waters in the ground, and maintain the flow of the springs and streams. If trees be felled, and the sun be let in, the ground is dried, and its moisture is carried away by evaporation instead of percolating into the earth to reach the channels of the springs, and these also dry up. If the springs fail, the rivulets must fail, and rivers must fall.

Reclus says, "Trees, after they have received the water upon their foliage, let it trickle down drop by drop on the gradually softened earth, and thus facilitate the gentle permeation of the moisture into the substratum; another part of the water running down the trunk, and along the roots, at once finds its way to the lower strata." (The Earth, 223).

The facts are abundant in proof that to part with the trees is to lose the springs they protect, the running streams the springs supply, and the volume of the broad river. These lost, all the charm of the landscape has fled, and then this source of man's refinement and civilization has also left the world. With loss of rains and springs the fruitfulness of the earth also passes away. Grass fails for flock and herd, and the bread of life for man is no longer sure, and only because man has betrayed his trust.

Australia affords corroborative testimony. In the *Tribune* of December 1st, I find this statement: "Mr. Landsborough, an explorer of note, says, 'Keeping sheep is no longer so profitable there as it used to be, but on the other hand, large tracts of land that were worthless before, have latterly become fit for agriculture. There is a decided increase of forests and of moisture in parts of Australia, giving hope that eventually the whole interior desert may be reclaimed. The direct effect of sheep-raising has been to keep down the tall grass which formerly afforded material for destructive fires. The trees, young and old, had been periodically burnt by these fires, until the country becoming almost treeless, its climate had been rendered arid and its soil sterile. If the facts in Australia can be established, they will afford the most remarkable instance yet recorded of climate being modified by the labors and surroundings of civilized man.'"

Trees, better than all else, protect the slopes from washing into gullies, and the loss of the soil by rains. A carpet of grass will do much to protect the earth from washing; but is not impervious to the beatings of storms, and the small beginnings of erosions ever enlarge their channels by undermining the roots of grass. The sides of our hills and the sodded slopes of railroads show this. The force of the unintercepted drops of the driving rains does the work of excoriation. The leaves of the sheltering forest break the force of the rain, and the arrested waters trickle in slow drops to the ground, and gradually soak into it without washing the soil. The covering of the fallen leaves also prevents disturbance of the soil, and the leaves growing above, and those dead below as well, intercept the rays of the sun, and check evaporation. The retained waters must find their exit by the springs.

The forests in due proportion are also shelter and protection of the growing crops of the farmer from the force of driving storms. They are a shelter for grazing cattle, and shelter for house and barn, and man and beast thus kept warmer thrive better. Trees also shelter trees, and northwardly planted belts largely increase the growths of nurseries and orchards.

Now what is the due proportion of woodlands? A Duke of Burgundy's rule, as quoted by Dr. Oswald, is, "One-third to the hunter, two-thirds to the husbandman." William Penn's direction to his colonists was, that

"in clearing the ground care be taken to leave one acre of trees for every five acres cleared; especially to preserve oak and mulberry trees for silk and shipping." His father, Admiral Penn, would have included in it "shipping," for the purpose of maintaining a navy; still an object of our statesmen so far as iron has not superceded wood.

Thus William Penn's rule was to leave one for five acres cleared, or $16\frac{2}{3}$ per cent. of wood appendant to each farm; of course, so much besides the wooded hills, sand-dunes and mountain tracts. For the entire country, and for the general good of forestry and agriculture his proportion of woodland is probably something too small. The proportion of woodlands in the entire area of these *States*, taking into consideration water surface, cities, highways, &c., is 29 per cent.; including Territories, is 25 per cent.; showing a disproportion of our Territories to be woodless.

Dr. Hough gives the rule of proportion of wood with reference to the true test. He says "There can be no doubt but that injuries may result, as well to agricultural interests as to the public, from an excess of forest growth. It is the highest aim of forestry to attain the golden mean between too much and too little, and on this due balance of field and grove depends that equilibrium of health and wealth that promises the greatest amount of human happiness to the greatest number, and through the longest period of time." Report, p. 32.

It is impracticable to bring the different States or sections of the United States to approximate any uniform standard as to the proper proportion of woodlands. It would generally be unprofitable to attempt to make arable, steep, stony and rough mountain lands, or poor sandy tracts, or deep swamps and ever-glades. But it is the interest of all to keep these wooded, and to reforest the lands worn out by cropping, that they may not become dry deserts. But every vast continuity of forest should be broken for agriculture, intercourse and security of health, property and life, and regions of prairie and deserts be made to bear a due proportion of forests.

And farm lands should be interspersed with trees to preserve them in the best agricultural condition. To do this, few farmers, though they draw their fuel from the mines, are inclined, by planting areas of cultivated or pastured fields. This they would not consider economical. But they could with little loss of useful space, plant the most sunny side of every road passing through their farms, and thus the farming soil would be little shaded, and the roots of the trees draw the greater part of their nourishment from the soil under the highway. The public would be gainers in grateful shade, and the farmers would have the protection of the roadside trees and their shade; and finally, their use as timber as they come to maturity, and are replaced by renewed plantings. To do so much, an enlightened self-interest should impel them.

In addition let every farmer keep open and flowing all his springs for drink for his herds and flocks; plant around them groves of trees, both to preserve the flow of the water, and to afford shade to man and beast.

Every railroad company should plant trees on the sunny side of their line

of tracks for shade, and for cross-ties and car timber, against the time when lumber will surely become more scarce; and should, for its best self-interest, use every device to avoid firing the forests, and use cross ties that have been barked, creosoted, kyanized, or saturated with boiling tar. The interest they have at stake to economize is incalculable.

Legislation is not here suggested, except it be to authorize the roadside planting; and, perhaps, counties to offer rewards for such planting. The functions of our Society in regard to tree planting are two: to diffuse useful knowledge, and to execute the trusts of the Michaux legacy, yet this is to co-operate in a sphere of action that is boundless and endless. True, our fund is small, but held by a perpetual trustee, its munificence should be perpetual; its beneficent effects never cease to spread, and the knowledge we impart and incentive we give, may bring sympathetic and enduring aid by many others, by the States, and the United States.

When we consider that trees require the growth of many years; that large tracts of country are denuded, which can be more profitably used by reforesting than otherwise, and that to make the reforesting useful and profitable, there must be choice of trees, and skill in the manner of their management and care, we must see that no time should be lost. This generation should begin the work effectively, and enjoin the duty upon those to follow.

The kinds of trees to be preferred by considerations of durability and their multifarious uses, are the American White Oak; the American White Pine; the American White Ash; the American Elm; the Chestnut, Walnut, Hickory and Larch. To this list of trees is to be added the Eucalyptus, or Blue Gum, of Australia, for its anti-malarial properties, and for its rapid growth, yet excellent timber. Its wood is white, about as hard, but a little stronger than the best Eastern Ash. (J. T. Stratton, Agl. Reps. of '75, p. 345). The planting and management must be left to professional skill.

The Massachusetts Society for Promoting Agriculture, who received two-fifths of the Michaux Estate, have offered prizes for the cultivation of plantations of not less than five acres, to be planted with the European Larch, Scotch and Corsican Pine, and American White Ash. The competition will be likely to exact the use of farm lands, while agricultural economy requires the chief sowing and planting of trees to be on the stony places, and profitless sandy spots, such as are often savingly allotted to bury the dead. These too may be planted with economy and pleasing effect.

Annexed to their circular is a very valuable Essay by Professor C. S. Sargent, Director of the Botanic Garden and Arboretum of Harvard University. This I have read since writing the preceding pages, and the facts and opinions by him expressed, sustain the foregoing views. He shows by sufficient testimony that woods do produce rainfalls; do preserve springs and rivers; do protect the soil and crops, nurseries and orchards; that sandy lands though exposed to the fierce winds of the seashore, have pro-

duced largely in Massachusetts, the Larch and Scotch Pine, besides Oaks, Ashes, Maples, Norway Spruce and Austrian and Corsican Pines. He recommends a protecting belt of trees to be planted on the northern side of every farm. The proper proportion of forest for Massachusetts he considers to be 25 per cent. Besides the woodlands in the State, there are nearly two millions of acres of unimproved lands, 1,200,000 acres of which is admirably suited for forest growth, the value of the timber on which, in fifty years, could only be reckoned by hundreds of millions. True, this would devote half the State to Sylviculture; yet, he thinks it would be its most profitable use, and be a benefit to that and other States.

Professor Sargent expresses his concern at the rapid destruction of timber in the United States, as sure to enhance its price, and produce many agricultural evils. He says, "Every year the destruction of the American forests threaten us with new dangers. Every year renders it more imperative to provide some measures to check the evils which our predecessors in their ignorance have left us as a legacy, with which to begin the second century of our Republic."

The Professor calculates so large a timber profit to his State, besides other advantages as to make it a moral duty, and patriotic achievement, to engage in tree planting, and insists that railroad corporations must plant in their own interest.

If farmers would generally plant one side the highways, and a row or belt of sheltering trees on the north side of their farms, and they and the Governments should see that all untillable grounds should be kept in the growth of timber as far as practicable, exempt from plunder and fires, we should attain that proportion of trees over the whole country which is required by the best interests of agriculture and the general good of the people. This should be the aim of all.

In Pennsylvania we have begun no considerable tree planting, except it be that in Fairmount Park. There, besides previous plantings, the Commissioners have planted within eighteen months, 12,082 trees, of the value of $14,490; and have yet in the Nursery 33,394 trees.

From the reserved moiety of the Michaux income, the American Philosophical Society has established in the Park the course of Lectures delivered by Dr. Rothrock on Arboriculture and Botany, who dwells emphatically upon the importance of woods for the preservation of water and soil and in protection of agriculture.

Citizens of Pennsylvania have, however, commenced an important Sylviculture in Eastern Virginia. Landreth & Co., of Philadelphia, have for six years and a half been planting 300 acres of black walnuts, and in a few years will complete some thousand acres in hard wood nut bearing trees. Mr. Burnet Landreth, a member of the firm, without fear of inciting rivalry, and without any apprehension that the growing market for timber can be overstocked, has published their doings in the *Journal of Forestry*, published in London. He seems actuated by the spirit of patriotism more than the love of profit. He laments that the White Pines of our State have

gone, and those further north-west are rapidly going, leaving no succession in kind, and the Oaks and Hemlocks are fast departing, which are sometimes cut down to get the bark for the tanner, with but the contingent chance of selling the wood for cross ties and lumber. When felled both objects should certainly be secured.

Landreth & Co., buy worn-out lands cheaply ; buy them near navigable waters, for cheap transportation by water, sow or plant nuts of chestnut, walnut and hickory, or sow the seeds of the white pine, which they find to grow in the South, and leave the yellow pine seeds to sow themselves. They see a boundless area of timber growth before them and others ; trees of slow return ; but know that the market will await its maturity, and will be ever a rising one, as the country shall become more shorn of timber, denser in population, and more demand the consumption of timber. The profit awaited will be surely compensatory for capital, labor and interest thus invested ; and though for many years unproductive of annual income, the timber crop when it matures will be found to cover all the investment, with no interest of capital expended, but there self-invested by ligneous increment. It is an inheritance laid up for heirs ; a good to them ; a good to the nation. Yet the harvest is not all postponed, and to be but once, at distant period ; for the process may be one of successive thinnings of small trees thickly planted, and of old trees of different kinds maturing at different times, thus bringing repetitions of profits. The sowings of nature and the plantings of man may also be in every successive year, and different tracts thus yield annual returns as trees are fit to cut. The plantings should be annually repeated as the woods shall be thinned. It should be a rule, except in needed thinnings, never to cut down thrifty trees that are yet rapidly making wood. An economical instinct will teach all this to the provident forest proprietor. As certainly as the axe and portable saw mills cut up the best timber of the forest, as they surely are rapidly doing, the plantings of man, and the protected growths of nature, should follow with equal pace, with selections of kinds most profitable, except where cleared land is fit and required for agriculture. The whole country has but its 25 per cent., while there are excessive quantities in large tracts in some sections, and no forests in other vast areas. This shows another distribution of trees must be a work of the future.

Philadelphia should not overlook the interest she has in keeping well wooded the sources of the Schuylkill, the river that gives her chief supply of water. The Schuylkill Navigation Company began this beneficent work of supply of water and wooded protection by building their magnificent mountain reservoirs, and buying wooded tracts, by the shade of trees to protect the springs that supply them.

It will also be to the interest of the city to build, in the future, more mountain reservoirs, and protect their supply of trees, that she may have adequate stores of waters, there to meet the exigency of summer drouths, when here population shall have increased. The secured wooded water sheds, and the plantings in progress in Fairmount Park subserve the same

purpose; but with the city's growth her needs will increase of conserving her water supply at a distance, that our second beautiful river may continue adequate to the wants of a metropolis of millions.

Here should be specially brought to notice, the necessity of a vast amount of tree planting in the prairies and plains that extend over the central length and breadth of our northern continent. With great depths of alluvial soil, protected by the heavy prairie grasses, which through the centuries have annually added their decaying richness to the vegetable mould, the rolling or flat prairie regions have but occasional groups of trees. The cause of the absence of trees seems to have been the frequent fires that swept over the prairies, for wherever protected by the settlers from fire a thick and flourishing growth of trees springs up, and the plantings also thrive.

The prairies need trees the more, to induce precipitation of rain, and to protect the soil, springs and streams from evaporation, by reason of the immense extent of wheat and corn crops now grown in continuous fields of a thousand or more acres, each spring sown or planted, thus exposing the bare ground for more than half the year, in the intervals of the crops, to the drying sun, to be swept away alike by winds and rains. And heavy belts of growing timber are wanted for more than the attraction and retention of rain and water; are wanted to make it something more possible to arrest the great prairie fires; and also, to break the force of the storms and tornadoes that so destructively sweep the central parts of our continent; where no sheltering mountains or hills exist to arrest the force, and disperse the winds. Some such benefit has already been perceived and acknowledged.

In the prairie and treeless regions of the central West, where settled, the settlers have perceived it to be their interest to plant, and to save the spontaneous growths of trees, and beyond the incentive of interest, the pleasurable occupation has kindled an enthusiasm for Arboriculture. The fires are fought, and less frequently lighted; coal, when at hand, is preferably used for fuel, and the spontaneous second growth is generally better than the original forests where these had been. In the State of Minnesota, Martin County, "thousands of acres of young timber trees are growing, some spontaneous, others planted;" in Redwood, "The cultivation of forests on the prairies will amount to from 1 to 20 acres per quarter section;" in Steele County, "Some attention has been given to planting forest trees, and the interest is on the increase, as the experiments have been quite successful; many small groves of quick growing varieties being planted near dwellings;" in Watonwan, 1,000 acres are under cultivation, in groves of from one to 12 acres; in Nobles County, "An association has been organized, and the children in each school are being organized into Centennial bands of little foresters, with promises of badges and more valuable prizes for planting trees." In the State of Iowa, Crawford County, "Large numbers of the more thrifty farmers have planted groves of maples, cotton wood, black walnut and box elder, which have grown

with great rapidity, and the vast expanse of treeless prairies, which a few years ago stretched in every direction as far as the eye could see, is now dotted over with beautiful groves, which greatly add to the wealth of the county," and in Cherokee County it is reported, "A great many are planting timber, which grows fast." For Missouri it is reported that, "In the portions of the State that were originally prairie land or openings, spontaneous and thrifty forests have sprung up and increased, as increasing settlements have prevented annual prairie fires;" for the County of Greene it is stated, "Nearly all the old timber is inferior, for the reason that the woodlands produce abundant grass, which is burned over every season, and injures the trunks of the trees. Forests, from which the fires are kept are very thrifty, many of the trees adding one inch to their diameter annually." See Agl. Rep. for 1875.

For Kansas and Nebraska, the Report of 1875, says, "On original prairies, forest growth is increasing rapidly from two causes: The first is, the arrest of prairie fires by cultivation, which has resulted extensively in the spontaneous springing up on uncultivated portions of a thick growth of young trees, which grow with wonderful thrift; the second cause being the planting of forests, now doubly stimulated by legislative encouragement, and by assured success in respect to both growth and profit. In addition to personal advantages to the planter, in the increased comfort, beauty, and money value of his premises, it is claimed that a public benefit is already perceptible in a modification of the climate, particularly in the way of assuaging the severity of the once unimpeded winds." Of Jefferson County, Kansas, it is said, "The forest area is rapidly increasing in consequence of stopping the prairie fires, and the planting of new groves;" while of Barton County, it is said, "Flattering results have been obtained from planting tree seeds and cuttings."

Tree planting in California is receiving much attention. Before the 1st January, 1876, James T. Stratton had planted in Alameda County, 195 acres with 130,000 Eucalyptus trees, that is the Blue Gum of Australia, eight feet apart each way. The company owning the railroad between Los Angelos and Anahelm, in Southern California, had planted 140 acres, with about 80,000 Eucalyptus trees. In the spring of this year it was announced that, "The Central Pacific Railroad Company has lately arranged to have 40,000 *Eucalyptus Globulus* trees set along the 500 miles of the right of way of the company. This is only the first installment, as it will require about 800,000 of the trees for the 500 miles of valley where they are to be cultivated. The immediate object of the plan is to increase the humidity of the region, and lesson the liability to droughts."

The United States Government has begun to take a deep interest in the subject of the preservation of American Forests. This appears to have had inception in a Memorial to Congress of the American Association for the Advancement of Science, upon the cultivation of timber and the preservation of forests, in August 1873, signed by Franklin B. Hough and George B. Emerson their Committee, which being referred to the Com-

mittee of the House on Public Lands, Dr. Hough, on March 16th, 1874, submitted to Washington Townsend, Chairman of that Committee, his views at length on the subject of the Memorial. These were printed by order of the House, in a Report of 118 pages. It is a full, yet compact statement of many facts and statistics, which abundantly sustain the conclusions herein expressed. There followed in October 1875, the Report of the Commissioner of Agriculture for that year, a division under the head "Statistics of Forestry," from p. 244 to 358, giving the forest area of every county in every State in the Union, in number of acres, and the percentage of the whole number in the County and State, with other valuable information. It is very important in its promise of future reports, and also from the fact that will be the basis of contrast, to show the progress of reforesting the country. An Act of Congress of August 15th, 1876, gives earnest that Congress will guard this great national interest, especially as it made an appropriation for the compensation of a competent commissioner to investigate and report upon the preservation of the forests, and the exportation of timber and other products of the forests. I have an answer to my inquiry, from Dr. Hough, the Commissioner, saying that he is at Washington to print his report in that of the Commissioner of Agriculture; that he has tried to do justice to Michaux and others; thinks the facts he has collected opportune, and that the interest in forestry is growing. The President's Message to Congress of this month earnestly recommends legislation to protect the timber belonging to the Government, and the preservation of the forests of our country.

The proposition before us invokes physical causes for physical effects. Yet are these very interesting to our mind and feelings. They concern deeply human life and happiness. The mind must plan and execute the work; must appreciate the beneficent results, and not without gratified emotions in view of the good to come. The purposed means will seek to influence the elements; in a measure to rule the powers of the air; to draw rains from the clouds; to detain the waters in the earth to flush the springs and swell the streams; will both drain the marshes, and cause wells and fountains to flow in the desert; cause the grasses and cereals to cover the fields, and the forests and woods and trees to grow on mountains, hills and plains. Yet all this, is not to speak or act presumptuously, for it is but to use the powers placed at man's disposal. It is to do more extensively what has been done; what is therefore practicable. Man is to engineer, to plow and plant, and sow and water, but God must give the increase. Man is to obey the first command, "Replenish the earth and subdue it." Obedient to this we have the promise, "I will give you rain in due season, and the land shall yield her increase, and the trees of the field shall yield their fruit."

That the evils reviewed have been terribly aggravated during many centuries, should not discourage us. The full remedy may require as many centuries as the cause has been operative; but every step of repair is beneficent progress. The world is now fuller of resources than ever before. Man's enginery is gigantic; his machinery is imbued with intelligence.

He can destroy faster ; but knows how to repair his injuries sooner. But to cease to do evil is to begin to do good ; for Nature only asks man's leave to renew her beneficent growths. Stop the fires on the prairies, lighted by the hunter for unknown centuries, and Nature will clothe them with forests. Plant with trees, and protect the self sown seeds of the forests along the waste lands of the seaboard, and they are born who may see them all reforested ; see them also renew a virgin forest soil. We have just begun many beginnings. Let them be followed up by many zealous co-operators, and our country will exhibit a prosperity, salubrity, and beauty never before seen, and in due time will become the dwelling-place of millions more human souls, else not to be born ; souls to be happy on earth, and to people heaven. If this world was worth the making it must be man's duty to make it teem with happy life.

ADDENDA.—Since reading the above paper, Prof. Lesley has kindly sent me two quotations which strongly support the views and purposes of the essay read. E. K. P.

I. "The country from the head of St. Croix river [in Wisconsin] to Bayfield is covered with drift. . . . not an outcrop for fifty miles. Most of the district is destitute of living springs and streams. Numerous depressions in the drift are partly filled with water . . . . . The soil is sandy and barren, supporting only a stunted growth of 'jack' pines and 'scrub oaks.' Fire has killed the timber over wide areas, on which grass was growing, exhibiting before our eyes nature's simple method of converting woodland into prairie. The reverse process is just as simple. When prairies are no longer swept over by fire, timber springs up, re-converting prairie into woodland. Grass, with fire as an ally, can beat timber. Timber can beat grass when it has no fire to fight."—Report of O. W Wight in Geology of Wisconsin, p. 76, 1877.

II. "In the whole Kingdom of King Devánámpriya Priyadarsín, as also in the adjacent countries ; . . . . the Kingdom of Antiochus, the Grecian King and his neighbor Kings, the system of caring for the sick, both men and cattle, followed by King D. P. has been everywhere brought into practice. Wherever useful healing herbs for man and beast failed, these he introduced and cultivated. Wherever roots and fruits were wanting, these he introduced and cultivated. He caused also wells to be dug and trees to be planted on the roads for the benefit of cattle."—Dr. Kern's translation of the Girnár rock inscription in India, second section of the tablet. See p. 193 and Plate 1. Jour. R. Asiat. S. Vol. IX. part 2. July, 1877.

What Christian nation has provided so humanely for traveling man and beast? The purpose of trees and shade as above advocated is immediately practicable and beneficent. Let us also open the roadside springs and wells, and furnish the cup for cold water ; and maintain the supply of medicinal herbs, roots and barks. This we will begin in the Park as soon as the Pharmaceutists will lend their efficient co-operation. Except in the hospitals of our large cities, and county poorhouses, the sick wayfarer must depend upon humane tavern landlords and benevolent citizens, who seldom fail in Christian charity. But may God and man save us from *Tramps*!