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PUBLIC HEALTH INTERESTS CONCERNED IN THE PRES-
ERVATION OF CERTAIN PRIMEVAL FORESTS AND IN
THE CULTIVATION OF GROVES AND TREES.

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THE influence of woodland shade upon the public health, presents a theme for thoughtful inquiry, and the more so, because it is almost wholly under our control, and as found beneficial, inconvenient, or injurious, it may be increased, diminished, or suppressed. We will dismiss from the present inquiry all ideas of pecuniary profit or economy, involved in the cultivation of timber as a material, or otherwise than in its presumed relations to sanitary science; and will endeavor to point out the manner in which the cultivation of trees may, within proper limits, be made a measure of utility as regards human health, and the reasons that may be assigned for this influence. In doing this, it will be proper to consider as well the direct effects of temperature, moisture, electricity, and other physical causes, as the less tangible but not less real effects by which, through the senses, they operate upon the mind.

It will be conceded that a country wholly and densely covered with a forest, more especially if the surface be level, the drainage imperfect, and decaying organic matter present, is less healthy than one more exposed to the sun and open to the winds. In a region thus densely covered, the soil and the stagnant air near the surface, are at all seasons overcharged and often saturated with moisture, and the decaying vegetation always present, will, in hot climates and seasons, tend oftentimes to malarious diseases of a typhoid, and sometimes of a malignant type. These humid conditions, in colder regions, and in winter, predispose to pulmonary and rheumatic diseases. These effects are more apparent upon the new-comer than upon one long resident, so that the immigrant may suffer, where the acclimated would feel little or no inconvenience.

It is well known that the most virulent forms of malaria have been witnessed in countries where swampy low-lands have been newly-drained and cleared, and the decaying vegetation first exposed in hot seasons to the sun and the air, in the first attempts to cultivate the soil. Yet, in most cases, where the drainage can be made complete, these conditions will wear away, as the organic matter in the soil becomes fully decomposed; and a region once noted for insalubrity may become quite free from malarial diseases, and even exceptionally healthy. Thus the Genesee country, in Western New York, and the lake region of Northern Ohio, have, by patient waiting



and persistent industry, fairly outlived the bad name acquired in the days of pioneer settlement. Other regions, like the Maremma of Tuscany, by dint of long and costly effort, guided by science, have regained their ancient prestige for salubrity; while others, like the Campagna of Rome, remain as possible fields for re-conquest, but not without heavy expenditures of life and treasure; and others, like the thetropical jungles of India and Africa, which have remained since the earliest known period the seat of deadly miasms, will probably so continue beyond the power of man to overcome, or, if too venturesome, to escape.

It may be deemed a fact established by frequent observation, that belts of woodland, intercepting the sweep of winds from the swamps, purify them from malarious emanations; but whether this be from mechanical obstruction, or from the absorption of the poisonous effluvia of the marshes, has not been sufficiently proved by scientific observation.

But aside from this influence of woodlands upon malaria, the ordinary conditions of the atmosphere dependent upon the presence or absence of forest shade, present the most interesting themes for observation. Among the most obvious of these, is a tendency to the equalization of temperature throughout the year; moderating the extremes of heat in summer and of cold in winter, as well as the changes between day and night.

We know that sudden vicissitudes of temperature, or a steady maintenance of either heat or cold, in unusual degree, and for a considerable time, operate notably as a predisposing cause of disease. A high and sustained heat, especially if it continues into the night, as in tropical climates, is debilitating in its effects. Under this influence, the muscles, and with them the heart and arteries, lose their power and tone. Respiration is reduced in frequency, the cutaneous and bilious secretions are increased, and that of the kidneys is diminished, the nervous energy is relaxed, and a general languor and debility is induced, predisposing to dysenteric and other intestinal disorders, and bringing the system to that condition most susceptible to diseases of a typhoid or adynamic type. It is at such times, especially when putrescent organic matter is allowed to diffuse its emanations near human habitations, that malignant epidemics appear and spread, until finally subdued upon the return of confirmed cold weather.

A person who has been exposed to unusual heat for a length of time, without apparent injury, may suffer sooner from the sudden alterations of temperature liable to occur at the close of the hot season; and hence autumnal fevers, and other forms of disease, appearing at the end of summer, and which are sometimes more fatal than the sickness of midsummer, may prove more malignant, because the system, weakened by long exposure to heat, is then less able to withstand these sudden transitions between heat and cold.

A low temperature, when extreme and long continued, operates as a direct sedative; abstracting the animal heat faster than is consistent with full health, and reducing all the vital powers, weakening the circulation, arresting or greatly reducing the cutaneous secretion, increasing that of the kidneys, and tending to cause internal congestions and pulmonary disease.

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Excessive moisture, with extremes of either heat or cold, may be said to generally aggravate their injurious tendencies. A very dry air exerts on the body the influences due to rapid evaporation and a high degree of electrical tension, which, while they may be beneficial to some persons, will in others tend to excite cutaneous inflammation, fever, and thirst. Its effect, however, if not in extreme degree, and too long continued, is more generally beneficial than otherwise.

Any causes, therefore, that tend to moderate the extremes of heat and cold. — rendering our winters warmer, our summers cooler, and the country less exposed to sweeping winds, which often bring the noxious exhalations of marshes far beyond their otherwise normal reach, — may be ranked as salutary, and worthy of attention. These effects our woodlands and groves directly tend to accomplish, in proof of which I invite your attention to the following thoughts and facts: —

The tendency to equalization of temperature between winter and summer, and between day and night, has been observed in woodlands, in all ages and countries, and is within the personal knowledge of every common observer. We seek the shelter of the grove in summer for its refreshing coolness and shade. Of the throngs that migrate from our crowded cities on the approach of the warm season, the greater part seek a rural retreat. No place is so inviting as that which offers opportunities for rambling in woodlands, and resting in the shade of trees, and our picnic excursions of a day seek nothing else. So it has been in every age and country; and Pliny, writing more than eighteen hundred years ago, thus speaks of trees, as rendered in the language of his translator, Holland: —

“In old time, trees were the very temples of the gods; and according to the ancient manner, the plain and simple peasants of the country, savoring still of antiquitie, doe at this day consecrate to one god or another, the goodliest and fairest trees that they can meet withall. And verily wee ourselves adore not with more reverence and devotion, the stately images of the gods within our temples (made though they bee with glittering gold and beautifull yvorie) than the very groves and tufts of trees, wherein wee worship the same gods in all religious silence. First and foremost, the ancient ceremonie of dedicating this and that kind of tree to several gods as proper and peculiar unto them, was alwaies observed, and continueth yet to this day. For the mightie great Oke called *Æsculus*, is consecrated to *Jupiter*; the Lawrell to *Apollo*; the Olive Tree to *Minerva*; the Myrtle to *Venus*; and the Poplar to *Hercules*. Moreover, it is received and believed generally, that the Sylvanes and Faunes, yea, and certain goddesses, are appropriate and assigned to woods and forests; yea, there is attributed unto those places a certain divine power and godhead, there to inhabite; as well as unto heaven, the proper seat for other gods.”

This esteem for groves, which in the olden time was fostered by religious sentiment, and which has in all ages and countries been favored by the common sense of mankind, must have some substantial causes; and here scientific observation may guide us in determining the elements. We have not yet in this country any series of thermometric and hygrometric records,

made with direct reference to the influence of forests and woodlands upon the climate, and the extent to which we may, through their agency, modify these conditions. The only series of observations that has hitherto been made upon this point, upon a scale sufficient to give absolute and trustworthy results, is that begun in 1867, under the direction of Dr. Ernst Ebermayer, Professor at the Forest Academy at Aschaffenberg, in Bavaria, and at stations for comparative observations established at his suggestion at other points in Europe. There are now about six of these in Bavaria, ten in Prussia, one in Mecklenburg-Schwerin, three in Alsace-Lorraine, one in Bohemia, three in Switzerland, and one or more in France. In a correspondence which I have had with Dr. Ebermayer, he expresses an earnest desire for coöperation in the United States, in order that the laws which govern these influences may be fully determined. Accidental circumstances may affect local observations; and in order to arrive at general laws, the records should be made in various countries and climates, with instruments comparable as to their scale, location, and time of observation, and as nearly alike as may be in all the circumstances that may affect their indications.

Of course each station should have two places of observation, and two sets of instruments; one in the open fields, entirely away from the local effect of the forest, and the other in the midst of its shelter, and fully within its influence.

The instruments consist of common and self-registering thermometers, psychrometers, and means for carefully measuring the rain-fall and evaporation, direction and force of winds, barometric conditions, and, at some stations, the electricity and ozone. The temperature in the woods is taken at the level of the tree-tops, and at both places at five feet above the ground; and below the surface at depths of one half, one, two, three, and four feet. The hours of observation are at 9 A. M., and at 5 P. M. The elastic force of vapor and percentage of saturation are deduced from the wet and dry bulb thermometers, and the amount of rain and snow, and rate of evaporation by weight and measure. But one set of records is made of barometric pressure, and aspect of sky. Care is of course taken to keep out from the immediate influence of particular trees, and to see that the instruments shall give a fair average result of the conditions in which they are placed.

These observations, so far as published, tend to show the following facts:—

1. That the average annual temperature of the atmosphere in the woods is one and a half to two degrees Fahrenheit below that of the open fields.
2. That the average annual temperature at the crowns of the trees is about one and an eighth degrees above that found in dense woods at five feet from the ground; and that in the former case the average is a little over half a degree ($\frac{27}{100}$) below that of unwooded land, at a point five feet above the ground.
3. That in spring the average temperature in the forest is about 3° below that of unwooded land, the difference being relatively less among deciduous trees than among pines.

4. That the average temperature in the daytime, in summer, in thick woods, is 3.78° below that of unwooded land.

5. That the temperature of the atmosphere within the woods, in the summer season, increased 3.94° from the ground to the tops of the trees.

6. That in autumn, the difference of temperature at five feet from the ground, is scarcely $1\frac{1}{8}^{\circ}$, and,

7. That in winter the difference almost entirely disappears.

As a direct result of this difference, there is observed a current of air in the daytime, from the surface of the ground in the woods, upward and outward, the cooler air spreading over the open fields. At night, the conditions are changed, and we have currents from the fields to the woods, and thus alternately, like the land and sea breeze. In some cases the woods were found over 8° cooler by day, and $4\frac{1}{2}^{\circ}$ warmer by night, than the open field.

The differences of temperature may be ascribed, —

1. To the obstruction of the sun's rays by the foliage, or the direct effect of shade.

2. To the cooling due to evaporation that is constantly going on from the leaves in the growing season, whereby much heat becomes latent, and,

3. To the fact that wood is a slow conductor of heat, so that the body of a tree, exposed to the sun, or surrounded by warmer air, slowly absorbs heat and does not reach its maximum till late in the afternoon, nor does it cool down to the temperature of the chilly night-air till near morning. It thus absorbs heat by day, and gives it out by night.

It does not need an instrument to prove that the snows lie on the surface much longer in the shade of forests than in open fields; nor that the shaded soil, especially when covered with a matting of decaying leaves, retains moisture, and maintains the supply of water for springs and rivulets, while the open field is parched with drouth, and summer brooks diminish and disappear under the drying effects of the sun and winds. Nor is it a theoretical statement, that the retention of snows in climates where they fall, has a tendency to delay the premature blossoming of fruit trees, by tempering the heat of the early spring, until danger from late spring frosts has passed, and thus a fruitful season is secured in localities where, without this equalizing influence, it would be often lost; nor can it be doubted but that the moderation of extremes in temperature, which forest shelter secures and maintains, results in great benefit to the farmer, as well in his fruit and his grain fields as to his farm stock.

The Bavarian records show that there is less than sixty-four per cent. of evaporation from a given surface of water in the woods than in the fields, and this difference is about the same at all seasons. Probably the stagnant condition of the air is partly the cause of this, as in dense woods the winds but slightly disturb the surface. A large amount of evaporation is, however, going on through the growing season from the leaves, so that the relative humidity is greater, while the surface evaporation is less. The difference is greater in proportion to elevation, and Professor Ebermayer assumes that the increase of rain-fall caused by large areas of woodlands, in some places, is to be attributed merely to the increase of relative moisture

within the forests. It is quite evident that a cooler temperature would require less cooling in woodlands to bring the atmosphere to the dew point.

These records show that more ozone exists in higher elevations where there is much humidity, and less in the midst of a dense forest than in adjoining fields.

It has long been known that plants derive their carbon chiefly from the carbonic acid always present in the atmosphere, and that by this vital process in the leaf, the oxygen in combination is released. As carbonic acid gas is a product of respiration, combustion, and fermentation, it might accumulate in deleterious excess, but for this compensating analysis in plants, by which an element essential to life is supplied. By the laws which govern the diffusion of gases, and by the action of the winds, this process of amelioration is extended over a wide region, and is felt in the distant city, as well as the immediate neighborhood.

It can scarcely be doubted but that woodlands thus tend to promote the public health, and that some benefit may result from parks and belts of woodland near the great cities, from this cause.

Electrical Conditions. — There can be no reasonable doubt but that groves and woodlands exercise a notable influence upon the electrical conditions of the atmosphere, but it remains to be demonstrated, by future researches, as to what effect this may have upon the public health. We know that there can be no evaporation, no condensation of vapor, no expansion or contraction in any form; in short, no change of place in nature without a disturbance of the equilibrium of electrical forces, and that when this is not conveyed away by conducting bodies, it will be shown by the electrometer and sometimes to our senses. We further know that electricity is dissipated by points; and that an insulated branch of a tree cannot be charged, so as to manifest the presence of electricity for many moments after the connection with the prime conductor is withdrawn. When we consider the millions of points raised high in air, bristling from every leaf, and thorn, and pubescent fibre, on the foliage of a single tree, we may well believe that the general result must favor the rapid equalization of electricity, whenever, from any cause, its equilibrium is disturbed.

A house surrounded by high trees is seldom struck by lightning, and in the vine districts of France it has been observed that vineyards are more liable to injury from this cause, where the timber has been cut away. If it be proved, as maintained by high scientific opinion, that hail-storms are of electrical origin, this view of the importance of trees in equalizing atmospheric and terrestrial electrical perturbations, acquires a double value.

The agency of woodlands in fixing drifting sands, and in intercepting and breaking the force of ocean winds, is obvious, nor can we fail to see therein an important relation to the public health, as well as great advantage in an agricultural point of view. Still greater benefits are promised in climates where the Australian gum trees (*Eucalyptus* of various species) will thrive, if half that is said in their favor proves true. It is claimed, concerning them, that when planted in marshy groves, they absorb and evaporate the moisture of the soil, so as to serve as a measure of drainage in a notable

degree, while the foliage emits a balsamic aroma, tending to counteract malarious effluvia, and to render the atmosphere salubrious around them. It is an unfortunate circumstance that the Eucalyptus grows only to perfection in a very warm climate, and that its range with us is limited to the southern border of the Union, and a part of California.

The hygienic and curative influence of a pine forest, in the case of persons predisposed to phthisis, and in the incipient stages of that disease, has been claimed by some, and deserves more careful observation.

But although we find many benefits to the public from the presence of sylvan shade, there is a limit beyond which we should not pass, — a kind of golden mean between too little and too much, and no country or people is so fortunate as that wherein this due balance is carefully maintained. With too much, we have a cool, humid climate; with too little, we have a climate liable to alternate extremes of heat and cold, — to unreasonable and excessive floods and to destructive drouths, with all the adverse effect upon the public health and human happiness which these conditions imply. Passing rapidly from the side of excess, we have already, in many parts of the country, begun to realize the evils presented in the other extreme, and may find them much more difficult to overcome. Perhaps nothing short of actual want, and the high prices which scarcity is sure to bring, will ever thoroughly arouse our people to a realizing sense of the necessity of timber culture, and our only hope of its success, then, lies in a sublime faith in that trait in the American character, which is sure to be manifested, whenever it appears that there is *money* in it.

Although we claim many benefits to the public from sylvan shade near the large centres of population, there is a limit which we should not pass. A house too densely shaded is too dark and too damp for health. Its free ventilation is obstructed, and sometimes the larvæ of insects and other direct annoyances, render trees too near a dwelling little better than nuisances. This is eminently true with respect to narrow streets in cities, where sunlight and the free circulation of air are more needed than shade.

Business often requires as much light as possible, and hence a thoroughfare of trade, or a seat of manufacture, might be seriously incommoded by the shade of trees. But along the wide avenue, upon plats of ground reserved for public enjoyment, and in the open grounds of suburbs, inviting opportunities are presented for the display of good taste, and for refined enjoyment, in the cultivation of trees best suited to the conditions, and of greatest service for ornament and shade.

The municipal authorities in many of our cities have been wisely intrusted with the care of shade trees in public streets, so that the owner of the adjacent ground may not plant or remove whatever tree he pleases; but under the right of eminent domain, the public agents are empowered to control these measures for the public good. This imposes upon those intrusted with these duties a grave responsibility, which, if realized, will lead to a careful study of the principles involved, and, if rightly improved, will result in great good.

With reference to city parks, I cannot too strongly commend the plans

that seek to give the greatest benefit to the greatest number, and within easy reach of the humbler classes, that stand in greatest need of their refreshing and refining influences.

Were the alternative presented between a grand public park, in one mass, adorned with all that could charm the eye and cultivate the most refined taste, yet from distance or regulation accessible only to the wealthy ; or, on the other hand, a series of small reservations scattered here and there within easy reach of the masses of the population, connecting by shaded avenues, supplied with fountains and resting-places, and tastefully improved with such imitations of wild rustic scenery as opportunities allowed, we think the true philanthropist would not for a moment hesitate in the choice which should confer the greatest happiness upon the greatest number. If we can afford both, very well. If not, then let those having means seek their opportunities where they can readily find them, in more distant places of fashionable resort, where interest is sure to create attractions for those that pay.

Finally, but not least, I will briefly notice an effect upon the public health which may be fairly claimed for groves and trees, in the cheerful and tranquilizing influence which they exert upon the mind, more especially when worn down by mental labor, or convalescent from sickness ; and this simple remedy alone might, if seasonably applied, save the lives of thousands of infants, who, for the want of the fresh air of the fields and groves, are every year dying in the crowded quarters of our great cities. The contact with nature, in such cases, has often a renovating and restorative power of positive value, and which every medical adviser must have witnessed with great satisfaction. Permit me to cite a case in point, and with this I will leave the subject to your consideration. Over twenty years ago, while engaged in a historical study, I became interested in tracing the origin and condition of a remnant of one of our Indian tribes, — the St. Regis Indians, living on the south bank of the St. Lawrence, on the line of forty-five degrees north latitude, partly in the State of New York, but mainly in Canada. In 1855 I took an opportunity of personally enumerating the families living on the American side of the boundary, as a part of the State census labors then in my charge, and I found them numbering 413. Ten years later (1865) they were enumerated by a man of my own selection, and I know he did it well. He found the number 426 — an increase of but 13. In the month of June of the present year, I accepted an invitation of our State officials for again taking their census, as an opportunity for studying the growth of a people who long ago had made me an honorary member of their tribe ; and personally, with a guide and interpreter, I visited every family, and carefully enumerated every person. The number was 737, an increase of 311, or over 73 per cent. in ten years ! There had been no immigration whatever, and the tables showed these increasing numbers in the multitude of children under ten years of age. Here was a study, and the solution was not difficult. Some thirty years or more ago, these people had been permitted by a State law to lease their lands for twenty-one years ; and the privilege was granted to many white persons, who cleared small farms,

and made improvements, which they were obliged to leave when their leases expired. The Indians coming into possession had moved out of their squalid village, and had become small farmers, with an abundance of farm produce for subsistence, and plenty of pure air. As many children had been born before as there had been since, but they had nearly all died.

This striking argument in favor of pure air and rural life should not be lost upon those who would benefit their fellow men. We cannot remove the humble poor of our great cities away from the labors by which they earn their daily bread, nor plant them upon farms, like the Indians of St. Regis ; but we can provide them with sylvan shade and fresh air, within easy reach, or means of cheap transit to such places, whenever their wasted energies require. More especially is this needed for those of tender age, who pine and die in the crowded tenements of our cities from the want of pure air, and the invigorating inspiration of rural life. In this direction lies our greatest hope of future benefit to our crowded cities, towards which, by the imperative demands of business employment, the surplus of our population is steadily and increasingly tending, by the law of necessity, as uniform and unavoidable as that of gravitation itself ; and which, if we cannot prevent we must endeavor to control, or, so far as possible, alleviate.

Now, the fresh air and rural scenery, to which we should invite the classes most needing their invigorating influence, are not to be sought in sunburnt fields and naked sands, but in cool groves, enlivened with the song of birds that there find a safe resting-place and their subsistence upon the insects that harm by their excessive numbers, when not repressed. The wasted energies of life are renewed by communion with nature in her wild and rugged forms, which gain new interest when brought in near contrast with the improvements of the city, and scattered here and there near the marts of trade and the beaten paths of industry. Let us, then, bring home glimpses of nature from the wildwood, to relieve the monotony of city life, if by so doing we refresh the weary, and make existence enjoyment, where but for this timely provision it might prove a burden.

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