

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

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

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

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

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

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

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## CORRELATION OF FORESTRY AND THE SCIENCES.

W. H. FREEMAN.

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

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

lack of attention in the preservation and cultivation of forests, even for their own good aside from the good of science. Forestry is a subject of very recent agitation in America and especially is it so in Indiana, but it is growing steadily.

President Roosevelt voices this condition of the knowledge of forestry in the opening sentence of his message bearing on the subject. He says, "Public opinion throughout the United States has moved steadily toward a just appreciation of the value of forests." Trusting that you all are familiar with what he says about forestry in his message, I shall, expressing my appreciation for such eminent recognition of it, pass to the discussion of the connective phases mentioned at the beginning.

Forestry as a science issue, it seems to me, is far-reaching in its influences. I think with consistent reason it can be shown that there is scarcely an industrial or intellectual life which forestry does not affect directly or indirectly.

Geography and forestry are closely connected in matters of climate, drainage and surface contour. Forests by their presence have marked influences on climate in governing the phenomena of temperature, moisture and storms. It is asserted by students of the subject that the denudation of forests is the cause of the growing extremes of temperature, violent atmospheric changes, changed precipitation, moisture waste through heightened evaporation and the unimpeded flow over the surface to the streams.

The arguments are: First, the forest foliage, as a transpiratory agent, is a great source of moisture to the atmosphere; second, the foliage by its shade prevents the sun's rays from striking the earth's surface and thus prevents evaporation; third, the forest litter, humus and roots, collect, hold and store the rainfall for the gradual and constant resource of water for streams and springs; fourth, the lack of forest litter, humus and roots permits the rainfall to flow quickly over the surface to the streams and away, thus facilitating the drying up of springs and streams and restricting the climatic agents.

In addition to the facts stated above, deforestation means the uninterrupted sway of the winds to carry destruction with them and allows the sun's rays unbroken to overheat the surface and cause abnormal atmospheric conditions resulting in violent storms.

I need only to remind you that the climatic equilibrium is different from ten years ago. The temperature extremes for the year 1886 were

101 and 25. In 1896 they were 103 and 22. More frequent storms of destructive character occur throughout the summer, and the fall and lay of snow is not so constant as formerly. I am not prepared to say that the annual precipitation is much less than before deforestation, but believe the almost certain annual drouth is heightened because the rainfall is not conserved to the soil because of the conditions before mentioned.

Forestry and drainage are reciprocal. The surface drainage is changed. No one rationally doubts it. It is contracted generally, more quickly spasmodic in overflow and becoming more intermittent. The streams in former times under conditions of dense woods contained water all the year round. The rivers dammed by fallen trees and drift prevented the hasty escape of the water from their beds. But now the drifts are gone and for the greater part of the year the streams are stagnant and dead. This is true, especially of the Pigeon, Eel and Wabash rivers. Many of the lakes have shrunk in area and the small creeks and streams no longer exist.

The same causes answer for these conditions as for the climate; lessened transpiratory agents, increased facilities for evaporation, aided escape of the rainfall and destroyed storage conditions.

The unhindered flow of the rainfall over the surface correlates forestry and erosion. Erosion is altering in many places, to a considerable extent, the contour of the State and resulting in serious damage to the streams. The surface is being gullied and the soil carried into the streams and springs, thereby clogging and filling them up.

This devastation of the streams relates forestry and zoölogy. The congestion of the streams with the erosive sediment filling up the deep holes and the intermittent flow are destructive to the propagation of many of the fishes. The drying up of the deeper sloughs and swamps is exterminating the mollusks and crustaceans. The same may be said of every other water-inhabiting species.

It may be argued that in many instances it is well such is the case, but for science it is not good.

Forestry and ornithology are mutually related. The destruction of the forests means the destruction and extinction of many of the birds. Trees are the natural homes of most of our beautiful birds. It is in the forest that they nest and hatch their young. The larger food birds of both land and water habitations are almost entirely extinct in this State. The same is true of many of the finest species of plumage and song birds.

All these facts so far given, you may say, are not because of forestry, but from the lack of it. It is sadly true, and forestry at best can not hope to retrieve, but it can, if properly conducted, nourish the neglected condition and foster the remnants. The science of engineering and forestry are mutually affected, as is also manufacture and construction. "Timber physics" is the term applied to these relations. Forestry in its most complete development should strive to make known the properties of all timbers used for purposes of engineering, manufacture and construction. This knowledge should be extended to cover the properties of timber structure, physical conditions of growth and mechanical qualities. To be of value the tests made should be of the largest number, specimen and physical limitations. A definite knowledge of these and their relation to the mechanical properties will be of inestimable value to users of wood in the lines of work mentioned.

Since we are beginning to plant forests, the production of wood merely is of the smallest consideration, but to produce at the same time quality of wood is the thing to be considered. It is the endless variability in timber physics that has kept it in the background, but I believe with the thorough inauguration of systematic forestry it must come to the front.

It is a well-known fact by all who have to handle wood in constructive connections that our knowledge, technically, of wood properties is very unsatisfactory and has resulted in untold loss in every conceivable manner.

In matters of forestry and government there are to be found at the present time some of the most scientific problems for legislation and control. The management and control of the United States forest reserves against depredations of cutting, grazing, cultivation and fires, and the problem of irrigation and irrigation reservoirs for the reclamation of the arid sections of the Middle West from regions of desolation to areas of life, industry and prosperity involve difficulties of interstate significance and large public interest.

In closing, I say it seems to me the points discussed are some of the ways in which forestry and the sciences are related. As "scientific, like spiritual truth, has ever from the beginning been descending from Heaven to man," so let it continue, and remain for science to substitute facts for appearances and demonstrations for impressions.

Facts in all these, definitely ascertained and generally disseminated and taught in the schools, will rebound in lasting good to an energetic people. This means for Indiana. The saying, "We hail science as man's

truest friend and noble helper" was never more applicable than now and at home. I appeal to you as men of science to lend a helping hand and bring forth the truth to a receptive humanity.

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## RELATION OF SCIENTIFIC ORGANIZATIONS TO MANUFACTURERS.

R. B. POLK.

In looking over the constitution and by-laws of this organization, I find stated among its objects the following: "To assist by investigation and discussion in developing and making known the material, educational and other resources and riches of the State. To arrange and prepare for publication such reports of investigation and discussions as may further the aims and objects of the Academy as set forth in these articles."

Being identified with the manufacture of certain food products, and being a member of this organization, has induced me to give some thought to the results which might be produced if there could be consummated a closer relationship between this society and manufacturers. In suggesting that a movement of this kind be inaugurated, I am taking it for granted that the paramount motives of this organization are for the enlightenment of the public at large, and the advancement of science in general.

It is a fact that there is a certain amount of prejudice on the part of manufacturers against scientists, which I believe to be directly due to a lack of understanding and coöperation. There is, in fact, too much antagonism between manufacturers and our health officers. This is, perhaps, due, to some extent, to impractical and incompetent men being placed in these positions. It may, indeed, be laid in some cases to the fault of the laws they are trying to enforce. And, though I whisper it, it may be due to a desire on the part of some manufacturers to use fraudulent methods in the sale of their goods.

It is a belief too primary to question that science in the hands of men of genius has been directly responsible for nearly all great improvements in the production of pure foods. We have to but mention such names as Appert, Pasteur, Liebig, Hansen, Jorgensen and others and investigate their works to substantiate this assertion.