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STATE OF ILLINOIS
DEPARTMENT OF REGISTRATION AND EDUCATION

Forest and Stream in Illinois

By STEPHEN A. FORBES, Ph. D., LL. D.
Chief of the Natural History Survey Division

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STATE OF ILLINOIS
DEPARTMENT OF REGISTRATION AND EDUCATION

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FOREST AND STREAM IN ILLINOIS *

[By STEPHEN A. FORBES, *Chief of the State Natural History Survey.*]

I come to you this evening with a very definite purpose, that of asking the interest of the Academy, and of this representative audience in general, in certain measures intended to improve the conditions of life for the people of Illinois. The topic I have chosen for a very superficial treatment—all that my time permits—is that of the forests and streams of the State, such as they were a hundred years ago, such as they have now become under our management or neglect, and such as we hope to leave them to our descendants of a hundred years hereafter.

Stream and forest are so frequently associated here in Illinois that where we see a forest we naturally look for a stream somewhere within its heart, and where we see a river we expect to see a forest bordering or imbedding it. And yet, the two are in many respects at quite opposite extremes. A forest is stable, stolid, and old. An old tree is, I suppose, the oldest living thing in the world. It digs deep into the earth and brings to expression all the properties of all the soils in which it grows; it has concentrated in its trunk and in its tissues a permanent record of the weather, the seasons, the climates, of centuries—of milleniums, perhaps, in such giants as the red woods, it preserves unchanged in its heartwood particles deposited there a quarter of a century or more ago.

A flowing stream, on the other hand, is the immediate product of its immediate environment, responding quickly to rainfall, to drouth, to changes in temperature, and even to the unstable winds. Its material substance is rarely more than a few weeks, perhaps only a few days, old. In the complexity of its sensibilities and the variety of its responses, it is so much like a living thing that one needs to be a biologist to

* Read December 8, 1918, at an open meeting of the Chicago Academy of Sciences, held in celebration of the hundredth anniversary of the admission of Illinois into the Union.

study and to understand it. And to the biologist both stream and forest are captivating subjects of inquiry, for to him a river is not water only and a forest is not wholly made up of trees. Each is an environment and its content. The birds and insects, the shrubs and annual plants of a forest area are as much a part of the forest as are the trees themselves, all being brought and held therein—an associate group, an ecological society—by conditions as compelling as those which assemble men in cities; and the plants and plankton of a river, its crustaceans, clams, turtles, fishes, and even its water birds, are there just as the water is in and on which they live, because the special features of the particular environment impel or compel them into each others' company in permanent association.

So, when I speak of the study of a river or of a forest survey I must ask you to think of them as a survey, a study, of this kind of a forest, of a river in this sense of the word.

THE FOREST

A hundred years ago, according to the careful estimate of one of the most competent Illinois botanists of the last century,* 30 per cent. of the area of this so-called Prairie State—some ten or eleven million acres, in other words—was covered by trees. Just how much of this forest primeval remains to-day in Illinois we have no means of knowing at all exactly. After a general survey of our more important forests made in 1908–10, the total woodland area of the State was estimated at two million acres; but the U. S. Census of 1910 reports over three million acres of forest still remaining on what the Census Bureau calls farms—that is, on tracts of land each under one management, on some part of which farm products are being raised; and we get no hint of the area of additional forest properties on which no farm crops are grown. All are agreed, however, that such forests as we have remaining—a possible third of our original heritage—are being commonly mismanaged, or rather not managed at all. Neither the State nor the owner of forest lands has any definite forest policy. "While our woodlands contain a large variety of valuable species, their silvicultural condition is very poor, and their productive capacity is much below normal owing to short-

* Dr. Frederick Brendel, of Peoria.

sighted methods of cutting and to injury from grazing and fire. Their ownership is favorable to forest management, but there is little appreciation of the possibility and advantage of increased yield by proper methods of treatment, and practically all industries dependent on local timber supplies are on the decline." And this abuse of our present holdings is not by any means the worst of our errors. A vast acreage has been cleared of trees and brought under the plow which ought to have been left in forests permanently. The Soil Survey of Illinois has now made progress sufficient to warrant general statements concerning the State as a whole, and from the director of this survey I learn that there are about six million acres of Illinois land that either are or ought to be permanently in trees, the soils of this great tract—25 per cent. larger than the whole State of Connecticut—being better adapted to the growth of trees than to any other agricultural use, and its broken surfaces making it liable to virtual ruin by erosion when brought under the plow. Much of it has, indeed, already been so ruined, and more of it has been abandoned after unprofitable attempts to cultivate it as farm land. The "abandoned lands of Illinois" is an expression strange to the ears of most of us, who still think of the State as an area of inexhaustible fertility.

We have already begun to search for a remedy for these conditions. Besides a commercial survey of twenty-six counties made in 1908–10 to which I have already alluded—a survey made conjointly by the United States Forest Service and the Natural History Survey of the State—we have this year begun, with the aid of a whole-hearted group of Illinois naturalists, a survey of a much more thoroughgoing type. Several members of the faculties of the University of Chicago, the Northwestern University, the University of Illinois, and the Eastern Illinois State Normal School, and the teacher of botany in the Lake View High School in Chicago, have given the State, without compensation, large instalments of their vacation time, assisted also, in several instances, by their graduate students working on the same generous terms; have made careful surveys of the tree growths of selected tracts in Jo Daviess, Cook, Vermilion, La Salle, Adams, Coles, and Cumberland counties; and are now preparing reports to be illustrated by photographs and maps for

publication in the Bulletin of the Natural History Survey.

And we shall seek this winter to secure the permanent appointment of a forestry expert as a State forester, and shall then turn him loose in the State to study the situation, to interview, to lecture, and to publish in a general educational campaign, and to come to conclusions as to what it is best to do for forestry in Illinois, so that two years hence we may have a rational, correct, and well-settled program of conservation and development to present to the Governor and the Legislature for their consideration.

It is our plan to survey not merely the present forest areas, but to cover all the broken country especially adapted to the growth of trees, coming to conclusions as to the best use to be made of each tract of land, the kinds of trees with which it might best be planted, the rate of growth of the more important species in each situation and in each kind of soil, and the returns to be expected from forest culture in comparison with other uses of this land. And we shall not for a moment leave out of sight the fact that an Illinois forest is much more than an equipment for money-making, that it is often of greater use for educational, recreational, and esthetic purposes, as in parks and other places of public and private resort, than it is for the production of wealth; and all these various values must be taken into account in a public survey. The life of a forest as a whole, and not of its trees alone, and all the ways, whatever they may be, in which our forest lands may be made valuable to man, are the real subjects of study in a thoroughgoing survey. It is such a survey as this that we hope to see established in Illinois—one which will bring to bear upon its problems and applications the highest science, the soundest practical judgment, the shrewdest private enterprise, and the finest public spirit of our people; and it is for such a survey that I have to ask the approval and the assistance of this Academy, and of all those concerned to whom these presents may come.

THE RIVER

The problem of the protection, utilization, and development of our aquatic resources is much more complicated and difficult than that of our forests, because

there are many discordant interests centered along our water courses—commercial fisheries interests; the interests of the sporting fisherman, the two often antagonistic; a great agricultural interest in the enclosure reclamation, and cultivation of land subject to overflow; manufacturing interests, which poison the streams with the wastes of huge factories; municipal interests, which find in the nearest river the most convenient and the cheapest means of sewage disposal, and the interest of those who live beside the stream, or resort to it for labor, business, or pleasure, that it shall be kept inoffensive if not inviting, and healthful if not altogether clean.

Permit me to take, as a marked example, the largest river of the State, the one from which Illinois derives its name. Two hundred and seventy-three miles in length, formed by the junction of the Kankakee River and the Des Plaines, and receiving now a large contribution of Lake Michigan water by way of Chicago River and the drainage canal of the Sanitary District of Chicago, it may be said to rise at the very gates of this great city. It is in many ways a remarkable stream, unlike any other in the country. "It is peculiarly characteristic of the State of Illinois, and next to its prairies, was its leading natural feature. Its broad bottom-lands, the bed of a former outlet of the Great Lakes system, covered with huge trees, completely flooded when the river is highest and holding many marshes and shallow lakes at its lowest stages, are a relic of the time, not so very far removed, when the limpid waters of the great glacial lakes rolled down its valley in a mighty flood on their course to the southern gulf. It gave to the discoverers of Illinois the first means of access to our territory, and on its banks was built the first fortified post. It was the first great artery of transportation into and through the State, and among the first colonial settlements were those established on its banks." It was, until recently, and perhaps is yet, by far the richest river in the country in the product of purely fresh-water fisheries. According to the U. S. Census its yield in fishes only, in 1908, was equivalent to a dollar for every two feet of its length in prices paid to fishermen, or in those paid by the consumer, to more than two dollars for each foot. Its frequently beautiful and occasionally picturesque scenery is attracting more attention every year,

and the time is surely at hand when the people of Illinois will learn to appreciate and develop this great gift of nature in the various directions in which it may be made to serve their interests and their pleasures.

Just now, however, it is at the very lowest estate of its whole history. Virtually all the sewage of Chicago is delivered to it, and the same may be said of every city and town upon its banks. By diking and drainage operations it is being robbed of the haunts of its water birds and the principal breeding-grounds and feeding-grounds of its fishes, and corn will presently be growing every year on some 200,000 acres of forest, marsh, and lake over which its waters spread a few years ago in time of flood.

A brief outline of a few of the main features of its recent biological history will help you to see what is happening to it and why, and what ought to be done by us if we are to give to our descendants of the coming century as much as we should of the values which came into the hands of our predecessors a hundred years ago.

A critical moment in the history of the stream was January 17, 1900, when, by the opening of the drainage canal of the Sanitary District of Chicago, the Illinois again became, after a lapse of ages, a partial outlet to the waters of the Great Lakes. The flow through the two canals, the Illinois and Michigan and the sanitary canal, both deriving their waters from the same source, was equal in 1913 to the average natural flow of the river at Peoria, a hundred and ten miles down stream. This increment from the canals is of course virtually constant at all seasons of the year, while the natural flow of the stream varies greatly from time to time, with the result that, when the river is lowest, about four-fifths of its water comes from Lake Michigan, and when it is highest, only about a tenth, the ratio of Michigan water to that derived from the watershed of the stream, rising and falling inversely to the rise and fall of the river gages. The river consequently can not now fall as low, under like conditions, as before 1900, the rising river begins sooner to spread over its bottomlands, the overflows are more extensive, the bottom-land lakes are filled to a greater depth and cover a larger area, and the water recedes more slowly after a rise, all these effects being necessarily more

obvious and pronounced on the upper smaller part of the stream than on the lower larger part.

Now, the productivity of a river depends, other things being equal, upon the area of shallow water along its banks and draining freely into it from its border-lands, for it is in such shallow water that plant and animal life is, generally speaking, most abundant. The immediate effect of the opening of the canal must consequently have been to increase the total yield of the stream, and this conclusion is confirmed by many comparative collections made by us by quantitative methods for long periods before and after 1900.

Coincident, however, with this admission of lake water to the river has come another powerful influence in the admission of the total sewage of Chicago as carried by the canals; and this has worked in opposite directions in the different parts of the stream. The organic matter of the sewage in process of decomposition so fouls the water of the upper river, especially in midsummer, that its natural plant and animal life is then virtually destroyed or displaced, and characteristic sewage organisms take its place. I quote from a survey report published by us in 1913:

"In the seventeen-mile section of the Illinois from Morris, nine miles below its origin, to the upper dam the river reaches its lowest point of pollutational distress, becoming, when very hot weather coincides with a low stage of water, a thoroughly sick stream. Its oxygen is nearly all gone; its carbon dioxide rises to the maximum; its sediments become substantially like the sludge of a septic tank; its surface bubbles with the gases of decomposition escaping from sludge banks on its bottom; its odor is offensive; and its color is gray with suspended specks and larger clusters of sewage organisms carried down from the stony floor of the polluted Des Plaines, or swept from their attachments along the banks of the Illinois. On its surface are also floating masses of decaying debris borne up by the gases developing within them, and covered and fringed with the 'sewage fungus' and the bell animalcule usually associated in these waters. The vegetation and drift at the edge of the stream are also everywhere slimy with these foul-water plants and minute filth-loving animals. * * *

"The normal life of the stream practically disappears in the absence of oxygen; its fishes withdraw to

neighboring unpolluted waters; its mollusks, crustaceans, ordinary insect larvae and other more or less sedimentary forms disappear to be replaced mainly by slime-worms and Chironomus larvae in the sludge; and its chlorophyll-bearing plants linger only along the edges in shallow water. With the advent of cooler weather and higher river levels, most of these marked symptoms disappear, and a few fishes may even make their way into the stream, particularly in the vicinity of the mouths of creeks. In spring and in fall, bubbling from the bottom ceases, the odor of the water is no longer repellent, a few invertebrate animals reappear, and the oxygen ratios rise to a considerable fraction of those normal to the Kankakee. The extent of this seasonal oscillation depends, of course, upon the rainfall and temperature; and the opposite extreme is reached in winter, when midstream oxygen ratios may be fully as high as those of the summer time for Chillicothe and Peoria."

A careful survey, chemical and biological, made last August and September, showed us that the fouling of the waters was extending steadily down stream at an average rate, during the last six years, of five to ten miles a year,* and that the Illinois River from its origin at Dresden Heights to Peoria Lake, ninety-three miles down, is now nearly deserted by fishes, at

* The recent degeneration of the Illinois River above Peoria is shown by the following table, bringing into comparison the oxygen content of the water over a sixty-mile stretch of the river from Depue to Pekin as shown by analyses made in the summers of 1911 and 1912 and again in July and August, 1918.

RATIOS OF DISSOLVED OXYGEN IN ILLINOIS RIVER WATER, STATED IN PARTS PER MILLION, SUMMERS OF 1911 AND 1912 IN COMPARISON WITH SUMMER OF 1918.

Stations.	Parts per million 1911, 1912	Parts per million 1918.	Ratio of later period to earlier.
Depue	2.65	0.16	1—16.6
Hennepin	2.41	0.25	1—9.6
Henry	2.35	0.65	1—3.6
Lacon	2.45	0.92	1—2.7
Chillicothe	3.27	1.17	1—2.8
Pekin	5.61	2.08	1—2.7

What these oxygen ratios signify as compared with those of a tolerably clean water may be shown by a comparison of them with the ratios of dissolved oxygen for the Kankakee and with those of Depue Lake. August 21, 1911, the oxygen of the Kankakee River just above its mouth stood at 8.47 parts per million at 10 a.m., and at 10.15 parts per million at 2 p.m., the increased ratio in the afternoon being due to the oxygen given off by water-plants under the influence of sunshine; while in Depue Lake, September 11, 1911, the oxygen ratio stood at 12.92 parts per million when that of the river just above the lake was 2.65 parts per million.

least in summer, its dominant life then being that of a contaminate stream. Peoria Lake, however, a shallow expanse of the river about seventeen miles long and a mile and a half wide at its broadest part, serves at present as a kind of a check valve against the extension of these conditions farther down the stream, and in and below the lake the life of the river becomes nearly normal. The sewage load of the stream is steadily increasing year by year, however, and how long it may be before this frail barrier is broken through of course we can not say.

From another point of view, we may regard the river water as a fluid and flowing soil, the basis of the growth of aquatic organisms, and Chicago sewage as a fertilizer enriching this soil and making it more productive when the raw sewage elements have been worked over by decay and oxygenation, and thus made available as food for aquatic plants and animals, and through them finally, by way of fishes especially, as food for man. This process of conversion and assimilation of the organic contents of a flowing stream of course takes time, and time in a river means progress downward; and it takes temperature also, proceeding rapidly with midsummer heat and slowly in midwinter cold. The current of the Illinois has been accelerated, of course, by the volume of lake water added to it by the canals, but it is still slow enough to give sufficient time for the conversion of much Chicago sewage into available food by the time it has reached the middle course of the stream, and this middle course is also much the most important for fisheries. At present, therefore, the Illinois fisherman and the consumer of his fish have, so far as we know, no definite reason to complain of the total effect of the influx of city sewage, for it has probably profited more than it has injured them. Although it has destroyed the fishery of the smaller, less important, upper hundred miles of the river proper, it seems to have increased the yield of the eighty miles next following. It is especially because the pollution of the stream is increasing that we have reason to apprehend more serious economic consequences.

And now of recent years there has come on another still more disturbing factor, that of the reclamation and improvement of the rich river bottom-lands and the drainage of many lakes whose beds are now fields

of corn. This process is inevitable because it is highly profitable, bringing in returns much larger than could be got in any other way ; but it leaves the Illinois River much as Samson was left when shorn of his locks by the self-seeking Delilah. Already the annual yield of the Illinois has fallen off at least one-half since the last census data were obtained in 1908 ; and this process is also progressive, although the greater part of the bottom-lands which are reclaimable have now been reclaimed. The effect upon the river is to impoverish its biology in two different ways, by drying up its most productive waters and by hemming in its flow in times of flood, thus speeding up its current so that it carries its sewage content more rapidly downward, leaving less time for its transformation and utilization, and pouring it out unused at the mouth of the stream in much larger ratio than formerly—an enormous loss of food resources to the Illinois which inures possibly to the benefit of the Mississippi, into which our stream empties.

Such is a very sketchy description of only a part of the vicissitudes to which the long-suffering Illinois is being subjected during these latest years of its checkered history, and there are more yet to follow. What will probably be the biological effect of the changes contemplated by the waterway engineers in making the Illinois again a connecting link of transportation between the Great Lakes and the Gulf, is a subject for some other time and place.

And if you ask me what is to be done under the circumstances in the public interest, I shall have to answer that I do not know, but that I want to find out. When present and prospective drainage projects are completed, there will still remain, in the Illinois valley below La Salle, 170,000 acres under water or subject to overflow at times of highest flood, a valuable fisheries property in itself and capable, as we may believe, of material improvement if intelligently handled in the public interest. Some day we shall have, and I hope, quite soon, a fisheries experiment station on the Illinois equipped to do for the important streams of the State and for the great rivers which nearly surround it, something like what the agricultural experiment station does for Illinois farm lands. We have in hand such a project, in fact, for which we propose fish ponds and a headquarters building on land, and with

the other equipment, chemical, biological, and practical, mainly on houseboats similar to the floating laboratory of biology which we have had for more than twenty years on the Illinois, all capable of being shifted from place to place, as may be necessary, in our extensive field. By the general and special studies possible with such an equipment, a policy of management and control should be worked out in the general interest, such as an intelligent and resourceful owner would establish if our public waters were his private property.

The problem of streams pollution consequent on current methods of sewage disposal lies, of course, quite outside the field of our Natural History Survey; but any citizen may say, as I do now, that the intelligence, conscience, public spirit, money, and power of the city of Chicago and of the other municipalities concerned are surely sufficient for its solution. A people which will do in a spirit of boundless self-sacrifice what we have done in the past two years for the welfare of foreign nations, will not balk permanently at the few millions needed to make our waters wholesome, clean, and physically decent for the use of the people of Illinois; and I believe that this Academy may help materially to hasten the day when the law of the State forbidding the pollution or defilement of any stream or lake in Illinois by the deposit, addition, or discharge therein of any foul or injurious substance such that fish and other aquatic life is destroyed, may be fairly and wisely enforced by the State department upon which that duty now rests.

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