THE ILLINOIS STATE LABORATORY OF NATURAL HISTORY AND THE ILLINOIS STATE ENTOMOLOGIST'S OFFICE.

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The State Laboratory of Natural History has for its principal function the making of a natural history survey of the State, preference being given to subjects of educational and economic importance. It is also charged with the supply of natural history specimens to the State Museum, to the state educational institutions, and to the public schools, and the director of the Laboratory is required to present for publication, from time to time, a series of systematic reports covering the entire field of the zoology and the cryptogamic botany of Illinois.

It is established by law at the University of Illinois, the Trustees of which are the custodians of its property. They also appoint its director, and, upon his nomination, such assistants as the work of the establishment may require. Its appropriations are made as an item in the general appropriation bill for the expenses of the state government, and consequently come to it immediately from the State Treasury upon the requisition of the director of the Laboratory. It is now receiving from the state $9500 per annum, $8000 of which are for the expenses of the natural history survey, $1,000 for the publication of bulletins and reports, and $500 for the supply of natural history specimens to public schools. No appropriations have been made to it for many years for the

supply of material to the state educational institutions or to the State Museum.

The staff of the survey now consists of the director, an entomologist, two zoological assistants, an artist, and a secretary. Special assistants are employed from time to time for special purposes. Two such assistants were engaged, for example, for a year during 1906 and 1907 in making field observations and collecting data for a statistical survey of the bird life of the state, and a computer has been engaged for some months in organizing and tabulating these data for discussion. Furthermore, the relations of the Laboratory to the State Entomologist's office are so intimate and long-continued, as will presently be explained, that the service of several assistants in both offices is rendered first in one direction and then in the other as the exigencies of the work require. Indeed, the State Entomologist's work is essentially a specialized part of the natural history survey, directed primarily to economic ends, but so managed as to make the greatest possible contribution also to the scientific and educational purposes of the general survey.

The State Laboratory is quartered in the Natural History Building of the University of Illinois, in which it occupies at present five rooms. It has further assigned to its use, to become available as soon as the addition to the Natural History Building—now nearly finished—is ready for occupancy, two more large rooms, to which a third is to be added in the near future.

Apart from its collections, which have naturally become very large—about a quarter of a million of specimens of Illinois fish, for example—the most useful possession of the Laboratory is its library, which is the product of many years of careful selection and purchase of the literature of the world necessary to an investigation of the zoology and entomology of Illinois. It contains also many botanical and general biological works, and includes complete series of all the bibliographies of zoology. It now contains nearly 7000 books and something over 17,000

pamphlets, all of which are catalogued to date by titles of articles and by authors' names.

It has been the general purpose of the natural history survey, first, to work up those parts of the zoology and the cryptogamic botany of the state which are least likely to be studied thoroughly by other public agencies or by private investigators, publishing the results of these studies from time to time in special bulletin articles; and, second, to present comprehensive summaries of knowledge in each department of the zoology and botany of the state in the form of final reports. As the continued maintenance of the survey seemed for many years precarious, under the conditions then existing, its funds were for a long time used principally for the accumulation of material, and this has gone on far in advance of studies for publication. Highly valuable collections have been made, for example, from Lake Michigan, from the northern lakes of Illinois, and from the waters of the state at large, which have never yet been studied and reported on.

The controlling idea in the management and development of the survey is expressed in the introduction to the first volume of its reports, written by its director—the present writer—in 1889, four years after its legal establishment as the recognized agency of the state for the performance of this work. "Neglecting the flowering plants, and the classification and description of birds and mammals," says this report, "already fairly well studied for this region, we have paid particular attention, so far as descriptive work is concerned, to the lower plants, to reptiles, amphibians, and fishes, and to insects and aquatic invertebrates. Still greater prominence has been given to a general research on the system of actions and reactions occurring within the assemblage of living forms native to Illinois, with a view to exhibiting the laws of interaction and coordination by which the innumerable host and vast variety of the plants and animals of our region are held together as a definitely organized, living whole.

"In the preparation of the volumes of this report it will be our main final object to furnish the materials for a full and

accurate picture of the native plant and animal life of Illinois as it actually exists in our fields, woods, and waters, and to bring most prominently into view those parts of the subject which have a peculiar educational or economic value. Especially we have hoped to furnish in this series a solid and permanent basis for the study and teaching of the natural history of this state and of its different sections, thus opening to the student and the teacher the way to a familiar knowledge of the life of his neighborhood in all the relations likely to have any important bearing on popular education or on the general welfare.

"Classification and description must furnish the foundation of such a work; but to these will be added accounts of habits, of life history, and of relations to nature in detail and at large, as full as the state of our knowledge and the funds at our disposal will permit."

Although the word *ecology* had not become current in America twenty years ago, and the idea covered by it can hardly be said to have been a familiar one, it will be noticed that the survey here characterized is essentially an ecological one—a fact which has enabled us to harmonize very easily our plans, and the operations in progress, with the ideals and aspirations of the young ecologists of the Illinois Academy.

Consistently with the general idea of the study by the state, within our field of ecological biology, of those subjects of educational or economic importance which are not likely to be pursued by others, the general topic of the food of birds, fishes, and certain groups of insects was taken up, many years ago, with a view to a precise knowledge of the place and efficiency of these groups in the general system of nature—a topic of such special difficulty, and requiring so unusual a preparation and so large an expenditure of time and money, as to put it beyond the reach of the ordinary worker. The Illinois survey was, in fact, the pioneer in this field, and its papers, published in the first two volumes of the State Laboratory Bulletin, still remain standard on this subject.

A statistical study of the birds of the state, made with a view to a determination of the number of birds of each species

and the local and seasonal distribution of each, is a related subject also requiring the resources of an institution, and has consequently been entered upon by us recently.

Another topic likewise beyond the reach of ordinary agencies is the study of the whole system of the minute plant and animal life of the waters of the state—the so-called plankton,— and in this field extensive researches were made by us during five successive years, from 1894 to 1899, by means of a biological station equipment maintained on the Illinois River at Havana, in which practically continuous work was done throughout the year. This is by far the largest and most elaborate study of the plankton of a river system ever prosecuted, and a part of its results—those pertaining to the plankton of the main stream —have been published by us in two volumes of the Bulletin, containing 890 pages of text and illustrated by fifty-six plates. Although strictly scientific in its aims and methods, this aquatic work lies really at the foundation of intelligent fish-culture, the plankton of our waters being an important element in the food of the young of all fishes, and hence an important part of the natural resources of the state.

The publications of the survey thus far include eight volumes of bulletins,—the last not yet complete,—containing 4224 pages and 246 plates, and three volumes of final reports—two on the birds and one on the fishes of the state, the latter accompanied by a separate atlas of 102 maps.

Some of the more important papers of the bulletin series are those on the food of birds, fishes, and insects, already referred to, and descriptive articles on the *Hepaticae* of North America and on certain families of fungi; lists and descriptions of Illinois fishes; several articles on the *Crustacea* of Illinois; studies on the contagious diseases of insects, made especially with reference to their economic utilization; descriptive papers on Illinois reptiles and amphibians; a paper on the animals of the Mississippi bottoms near Quincy; many articles on various families of Illinois insects; a study of the entomology of the Illinois River and adjacent waters; numerous studies of the earthworms of the state and their allies; papers on the *Protozoa*

and *Rotifera* of the Illinois River and adjacent lakes; a series of articles on the plankton, resulting from our biological station work; a paper on the leeches of Illinois; articles on the species, local distribution, and ecological relations of Illinois fishes; and an article on the biology of the sand areas of Illinois.

The character and object of the final reports of the survey are best illustrated by the volume on the fishes of the state, now just out of press. I have two additional volumes of this series in early prospect—one a long-delayed treatment of the more important birds of the state from an ecological and economic standpoint, intended to bring together in a single volume the essential substance of our statistical and economic work and that of the United States Biological Survey on the more abundant and significant species of Illinois birds; and another on the entomology of the state, which shall similarly summarize the more prominent and important results of economic work in this field, treated, however, in a broad way, from the standpoint of the modern ecologist.

Operations now actually in progress include continuous work on Illinois insects, on which several bulletin papers are in course of preparation by assistants of the survey; a study of the mammals of the state, particularly those of Champaign county, which subject is being worked out in full local and ecological detail; a survey of the forest resources of the state, begun during the past summer under a cooperative arrangement with the United States Forest Service; and a census of the birds of the state, upon which two papers have already been published, and the complete data for which are now being organized by statistical methods.

I am hoping next to develop our work by a further investigation of our natural resources, with reference to their present condition and management, and to measures for their conservation and improvement. I hope to finish the forest survey, already begun, to complete and extend our statistical work on the birds of the state, and to continue and complete our study of our aquatic resources, particularly those contained in the Illinois and the Mississippi rivers and the waters most closely

connected with those streams. The Illinois River especially is an enormous storehouse of material wealth, the natural product of which is little appreciated, and the conditions of whose improvement have but just begun to be understood. With the extraordinary advantage given us by our biological station work on the river we could readily make a quantitative study of the plankton and the other biological products of the entire stream, and I am asking from the state legislature an opportunity to do this work.

Our previous five-year period of active operations on the river at Havana closed just before the opening of the Chicago drainage canal. Sufficient time has now elapsed since that revolutionary event to allow a reestablishment of the biological equilibrium in the waters of the Illinois, and a repetition of that work on quantitative lines would enable us to determine the influence on the life of the river of a large and sudden increase in the flow of water down its bed. An economic survey of the plant and animal life of the stream would give us a better basis than we now have for a convincing estimate of its value to us, present and prospective, actual and possible.

With all the operations being planned for the drainage and protection of its bottom-lands, for the deepening of its channel, and for the erection of enormous manufacturing plants upon its banks, there is imminent danger that it will presently be converted into a mere drainage ditch, barren of useful life, and a menace to the public health. A knowledge of its present and prospective values will be a great aid to us in providing against its pollution and economic destruction by the unregulated development of manufacturing plants along its banks.

In connection with the proposed work at Havana I hope to set on foot a general ecological survey of a cross-section of the Illinois basin, beginning with the black lands of Logan county and extending across the river to the similar lands of Fulton county. Such a work I hope to see begun the coming summer, with the aid of the ecologists of the Academy, and carried through as an example and model of work of this description.

Thinking that you would doubtless be more interested in a statement of the work now in progress and in immediate prospect than in an account of the development of our operations, I have left myself time for only a brief sketch of the history of the State Laboratory from its origin in the Museum of the old State Natural History Society. This museum, transferred to the State Board of Education at Normal in 1871 for the use and benefit of the state, received from them the name of the Illinois Museum of Natural History, and their intentions concerning it were described in resolutions adopted December 15, 1875, in which they say: "We regard the Museum as a State Institution, devoted to the prosecution of a natural history survey of the state, * * * * and we consider it an important part of its work to supply collections of specimens to public schools, * * * * and especially to provide all needed facilities for the instruction of teachers in natural history, and in the most approved and successful methods of teaching the same."

In the law of 1877, however, which established a State Museum at Springfield under the name of the Illinois State Historical Library and Natural History Museum, it was directed that the old museum of natural history at Normal be converted into a state laboratory of natural history, at which the collection, preservation, and determination of all zoological and botanical material for the State Museum should be done; and it was further made a part of the duty of the director of this laboratory to provide, as soon as possible, a series of specimens illustrating the zoology and botany of the state, and to deposit them from time to time in the State Museum. In this same act $1000 per annum was appropriated, to be expended under the direction of the director of the State Laboratory at Normal, for the purpose of increasing the collections in natural history in the State Museum at Springfield. The collection of birds now in the museum, the mounted mammals, the casts of fishes, most of the insect collections, and a considerable quantity of botanical material are among the products of these appropriations so made.

In 1883 the status of the State Laboratory was materially changed by the appointment of its director to the office of State Entomologist, then made vacant by the resignation of Dr. Cyrus Thomas,—an appointment made and accepted with the understanding that the work of the State Entomologist and that of the State Laboratory of Natural History were to be merged and managed as one.

In 1884 the opportunity arose for a transfer of both the State Laboratory and the Entomologist's office to the State University at Urbana, a situation evidently more natural and more promising for its future than association with a normal school, and this transfer, arranged by friendly agreement of all the parties concerned, was ratified by an act of the state legislature approved June 27, 1885, which act is the present fundamental law of the State Laboratory of Natural History.

At the University it has remained for twenty-five years, nominally controlled by the university Trustees, but practically independent in its management. The most notable fact of its history was the opening, by joint arrangement with the University in 1894, of a station on the Illinois River for the investigation of the biology of that stream, and the maintenance of this station for continuous work during the five following years.

The office of State Entomologist stands second in point of origin and first in period of service, on the list of the state agencies of scientific and economic research. Established by law in 1867, it has been continuously maintained for forty-two years— a longer period of activity, in fact, than that of the geological survey, which, although estalished in 1851, was suspended for twenty-eight years. It had its origin in an energetic demand of the State Horticultural Society of Illinois, whose president, Parker Earle, in 1865, seems to have been the first to make prominent public mention of the subject. In a meeting of the society held at Normal, December 19 of that year, he says: "And first, the appointment of a state entomologist. The time has been in this state when it required some moral courage for any one to advocate the appointment, and *compensation from the treasury,* of an officer to look after the bugs, but I venture

the opinion that there is no subject in which you, as amateur or professional horticulturists, have a more direct, immediate, or larger pecuniary interest than in entomology—the laws of insect life, a discriminating knowledge of the forms and habits of your insect friends and foes. * * * * No one who has given the subject any attention will question the truth of the statement that the people of Illinois are to-day many millions of dollars poorer by reason of noxious insects; nor the additional statement that a very large proportion of this loss might have been averted by the labors of a competent entomologist with a little means at his disposal. * * *

"*Let us have* a state entomologist; and luckily we need not go beyond the limits of our own state to find one of the most competent character."

This suggestion was approved by the society at this meeting, and was followed the next year by the hearty endorsement of its next president, who said, in his annual address: "The lessons of the year are instructive, and strengthen the conviction that fruit-growers had better give up the business, or give more attention to the insects that are laying waste their orchards. It is my belief that fully one half of the fruit trees within the range of my acquaintance are suffering from diseases wholly the result of insect ravages, and that more than half of their fruits the past summer have been wasted from the same cause." He expresses a desire for "a bureau of entomology, to act independently until it shall be adopted by the long-looked-for agricultural college, to be provided by the state with all facilities for organizing and carrying on a systematic warfare upon these, so far, triumphant enemies of the farmer and the horticulturist."

The resolution of the society upon this feature of the president's address was expressed in the following emphatic form: "*Resolved,* That we most urgently pray the honorable legislature of our great state to appoint a state entomologist, that agriculturists and horticulturists may not quite despair of ever overcoming the giant insectivorous difficulties in the way of success in their professions. As one eminently qualified, and the

highest in his profession in the whole West, we most hopefully mention the name of Benjamin D. Walsh, of Rock Island."

As a result of this movement an act was passed in 1867 authorizing the Governor to appoint, with the consent of the Senate, some competent scientific person as state entomologist, whose duty it should be to investigate the entomology of the state of Illinois, and to study the history of the insects injurious to the products of the horticulturist and the agriculturist. Under this general and rather inadequate warrant the work of the office was prosecuted by Walsh, LeBaron, Thomas, and the present writer, expanding with the development of its field and becoming more complicated and precise in response to the various demands made upon it, until, in 1907, a new law was passed, by which it was made the duty of the Entomologist to investigate, by himself or by his assistants, all insects dangerous or injurious in this state to agricultural and horticultural plants and crops, to live stock, to nursery trees and plants, to the products of the truck-farm and the vegetable garden, to the shade trees and other ornamental vegetation of cities and towns, to the products of mills and the contents of warehouses, and to all other valuable property; and to investigate all insects in the state injurious or dangerous to the public health. He is further required to conduct experiments for the prevention and control of injuries to person and property by such insects, and to instruct the people of the state, by lecture and demonstration, in the best methods of preserving and protecting their property and their health against insect injuries.

Consequent upon the appearance in Illinois of the San Jose scale, first discovered here in 1896, a law was passed in 1899 putting upon the State Entomologist the further duty of inspecting annually all nurseries in the state, and, where the stock and premises of these nurseries were found free from dangerous insects and fungus pests, of issuing to their owners certificates of inspection, without which it became illegal for them to do a nursery business. He is likewise required to supervise importations of nursery stock into the state, and to inspect all orchards and other similar property which he has

reason to suppose to be infested by dangerous insects or infected with contagious plant diseases. Power to quarantine, and to issue directions for the treatment of diseased or infested property, are likewise given him by this law, which is enforced by the provision of fines for its violation. Although drawn with special reference to nurseries and other horticultural property, and with principal reference to the San Jose scale, I am advised by the Attorney General of the state that this law is broad enough in its terms to enable the entomologist to interpose for the protection of any property whatsoever endangered by insects or fungus pests on adjoining premises. Minor modifications of the law were made at the last session of the legislature, without affecting, however, the provisions just described.

It was by this law of 1899 that the office of State Entomologist was first given a legal habitation and abiding place; although upon the appointment of the present incumbent in July, 1882, quarters had been assigned the office, by courtesy of the State Board of Education, in the building of the State Normal School at Normal, and on the transfer of the office to the Illinois Industrial University two years later, it was, by similar courtesy of the Trustees, adequately housed in one of the university buildings. The preceding entomologists had, however, been virtually without office accommodations, each making such arrangements for himself as he found necessary, and the location of the office shifted, consequently, with the residence of the entomologist. In Walsh's time it was at Rock Island; in LeBaron's, at Geneva; and in Thomas's, at Carbondale.

The practical merger of the work of the entomologist with that of the State Laboratory of Natural History in 1883, as already described, greatly increased its facilities and opportunities for special work. At the time of this merger it had neither appropriations for its expenses, nor a dollar's worth of property of any description, its sole resources being the private library and collections of the entomologist himself. From that time forward, however, it had at its disposal the collections, library, quarters, and assistants of the State Laboratory of

Natural History; and appropriations in its support were thereafter regularly made in connection with those for the Laboratory. By the transfer to the University, and the subsequent establishment of an Agricultural Experiment Station there, its opportunities and resources were, of course, greatly increased, and it now receives separate appropriations to the amount of $27,000 per annum, $5,000 of which are set aside each year for the expenses of its inspection and insecticide work.

It has on its staff at the present time, besides the entomologist himself, ten regular assistants, a draftsman, a chief inspector, four sub-inspectors on temporary engagement only, and a foreman of insecticide operations with about a dozen laborers under his charge.

The principal subjects now under investigation are the life histories and economic control of the various species of May-beetles and click-beetles, and their larvæ, the white-grubs and wireworms; the economic control of the corn root-aphis; the forest insects of the state; those affecting shade trees and other ornamental vegetation in cities and towns; insect pests of greenhouses and the truck-farms in the vicinity of Chicago; the house-fly pest in cities and towns, upon which a large amount of experimental work was done last summer; and various insects injurious to fruits whose life histories have not yet been worked out, and whose economic control presents problems requiring special investigation.

The published reports of the office are twenty-four in number, thirteen of which have been prepared by the present incumbent. The twenty-fifth report is now going through the press. The twenty-four now printed contain, in all, 4827 pages, of which 104 were contributed by Walsh, 419 by LeBaron, 1187 by Thomas, and 3117 by Forbes. Their contents are too varied to be capable of a brief classification. They consist mainly of miscellaneous articles on single topics, worked out to the practical end of an economic control of some form of insect injury, usually verified by repeated trial in the field; or of comprehensive, monographic articles on all the insect injuries to some single crop, with elaborate recommendations for gen-

eral management and for special treatment directed to the prevention or arrest of such injuries.

Most of these articles are now issued first as bulletins of the Agricultural Experiment Station, in an edition of 50,000 copies, an additional thousand copies being run off in form for subsequent binding as the biennal report of the entomologist. By this arrangement the entomologist has the benefit of the mailing list and the postal frank of the Experiment Station, of which he is in fact the Consulting Entomologist by formal appointment, and is able also to get his finished papers at once distributed, without waiting for the completion of his entire report.

While the lines of work represented by these two closely affiliated state departments of scientific investigation have been carried forward frequently under many difficulties, due largely to the fact that their constituencies were unorganized or imperfectly organized, and hence could not exert their proper influence in favor of their own interests, this condition has now virtually disappeared in the State Horticultural Society, in the State Farmers' Institute, in the State Association of Florists, and other like organizations, and now in the State Commission for the Conservation of our Natural Resources, and especially in the Illinois Academy of Science, we have active, powerful, public-spirited agencies which can be relied upon to promote every good work of this description with their endorsement, with their aid, with their judicious criticism of its aims, plans, and methods; and the next ten years will, in my judgment, see greater progress than the last twenty-five in the advancement of a useful knowledge of the State of Illinois, set forth in such forms as to make it available for the educational and economic welfare of its people.