BLUE BOOK

OF THE

STATE OF ILLINOIS

1929-1930

EDITED BY
WILLIAM J. STRATTON
SECRETARY OF STATE

PRINTED BY AUTHORITY OF THE
STATE OF ILLINOIS.
THE SCIENTIFIC SURVEYS.

STATE NATURAL HISTORY SURVEY.

By Stephen A. Forbes, Chief.

A GENERAL account of the organization and operation of the State Natural History Survey Division and its predecessors, the State Laboratory of Natural History and the State Entomologist’s Office, was given in the Blue Book for 1927-1928, pages 519-525. The present article reviews briefly the major activities of the Survey since July 1, 1927.

AQUATIC BIOLOGY.

Our field operations in aquatic biology have been mainly directed this last summer to matters of special interest to the Department of Conservation, as related to fisheries and to the stocking of streams and ponds. The Sangamon River has been thoroughly explored from its headwaters to its mouth, and what we call a “preliminary survey” has been made the whole length of the Kaskaskia. Traveling with a light truck and a skiff drawn behind on a trailer, with equipment for taking fishes and other specimens of practical importance to the fishery, two of our biologists studied the general features of those parts of the latter stream large enough to support food and game fishes, doing such additional scientific work as is readily applicable to the problems of agriculture, but which do not involve extensive and detailed laboratory study; and in addition to this superficial inspection, sections of the stream at nine well distributed points on the Kaskaskia were studied intensively. Quantitative collections of the bottom fauna and plankton were made from these nine sections and are now being worked over in the laboratory; and samples of aquatic vegetation were collected and the amount of each kind in the stream was noted.

Fishes were collected from both streams with seines, hoop nets, and hook and line, and all the larger kinds were weighed and measured and scales were taken from them for use in determining their rates of growth. The larger kinds were identified in the field, with occasional or doubtful specimens preserved for verification, and the smaller kinds were all preserved and shipped to the laboratory for naming. Especial pains were taken to make the fish collections as nearly quantitative as practicable.

Careful studies have been made of the food of the fishes of Rock River, as shown by the contents of many hundred stomachs preserved for the purpose, and an important work has been done in the classification of the animals of the bottom of the stream and the tabulation of the data concerning them, particularly important because these are the main store of food for our fishes.

ROCK BOTTOM RICHEST.

From these studies it appeared that a rock bottom was the richest habitat in plant and animal life, averaging 588 pounds to the acre; that a mud bottom was next in the order of productivity (475 pounds); and that bottoms of gravel and sand were least productive (263 and 153 pounds per acre, respectively). If facts of this kind are unknown to the practical fish culturist, or ignored by him, he will often waste his product by releasing his fishes where they cannot find sufficient food for their maintenance in
competition with the species already established there, and where, by overstocking the place with more fishes than it can feed, he will actually diminish the product of the stream in his attempts to increase it.

One of the Survey biologists has made ample quantitative collections of the minute life of the water, the universal and indispensable baby food of young fishes of every description. Upon it depends, indeed, the whole system of life in our waters, and without it, consequently, they would be little better than an aquatic desert. His studies covered the entire length of Rock River, Sangamon River and the Hennepin Canal, together with streams, lakes, swamps, and sink-holes in southern Illinois.
STREAMS STUDIED FOR AQUATIC LIFE.

1. Old dredge ditches have an abundant small fish fauna when the water is not polluted. 2. A riff habitat in the Sangamon River near Mahomet; darters and suckers are characteristic of such places. 3. Headwaters of the Kaskaskia River near Bondville; one of the many streams in Champaign county investigated.
A quantitative study has also been made of the fishes of all the streams in Champaign County, a subject of peculiar interest because these streams are the headwaters of several diverging river systems which eventually empty into the Ohio through the Wabash River to the east, and into the Mississippi through the Illinois and Kaskaskia to the west. Twenty-nine thousand specimens were collected from 130 different points within the county, and all have been determined and their data tabulated for a discussion now nearly completed. This is the most detailed, critical, and thoroughly going work of its kind ever done in this country and probably in the world, and it leads to several important conclusions with regard to the distribution of species in different parts of a series of relatively small streams. One of these points to the failure of attempts made by the fisheries service to stock such streams with fishes which do not belong there, and which, if introduced, either perish or escape promptly into other waters.

**TAG FISH FOR SURVEY PURPOSES.**

To determine what waters and what situations in them are best adapted to the growth of the most important fishes, it is necessary to know how widely individuals of each species range, and what are their rates of growth in each situation. To get reliable data on these subjects, quantities of specimens caught in the nets or by hook and line are marked by numbered metal tags and returned to the stream, and persons capturing them are requested, through newspaper articles, posters, and other means of publicity to return the tags to the Survey with information as to the precise times and places of capture of the numbered fishes, and their length and weight when taken. About a thousand of the larger food and game fishes of the Sangamon and Kaskaskia Rivers have been thus numbered and set free, and returns from fishermen have already begun to come in for comparison with our records made when the fishes were released. This work is to be continued from year to year until a sufficient mass of data has been accumulated to warrant general conclusions.

Another quite independent feature of our recent aquatic work is a systematic inspection of artificial ponds or small lakes in different parts of the State, made at the special request of the Director of the Department of Conservation, with a view to an accurate knowledge of their fitness for the maintenance of stocks of valuable fishes of special interest to the game fisherman, and seventeen such small bodies of water have been critically studied at thirteen points in southern and central Illinois, together with four of the fish hatcheries of the State and three heavily polluted streams.

**BOTANY.**

The botanists of the Survey, in addition to their general botanical work, have been especially engaged upon an extensive search for late-season corn diseases in 1928 and the determination of specimens of crop diseases in general, collected during the summer of that year. Particular attention was paid to the diseases of fruits, use being made of precise methods of determination, record, and report, the first ever attempted on the prevalence and intensity of such diseases. In 1929 a similar work was done on the diseases of wheat, oats, and barley, peaches, apples, and pears in all parts of the State for comparison with corresponding records of other years and under other conditions.

Many addresses on plant diseases and methods of controlling them have been made to high schools, farm bureaus, and other assemblies—48 in 1928 and 57 in 1929—illustrated by specimens, lantern slides, mounted pictures, and demonstration materials.

Extraordinary measures have been taken for a timely dissemination of information concerning the local occurrence of plant diseases and means for their control. By a careful State-wide canvass carried on during the late summer and fall of 1927, it was learned that a single disease of wheat fields known as stinking smut had reduced the actual value of the marketed
THE EFFECT OF "PEACH YELLOWS."

A peach tree near Centralia nearly dead from this disease, which the Natural History Survey has been studying.
wheat by more than half a million dollars, with a very much greater loss in the field not represented by the grain as delivered at the elevator; but by an active intensive educational campaign for the instruction of farmers in methods of treating seed wheat for the prevention of this disease, market loss of 1928 on this account was reduced to less than three thousand dollars. In this campaign and from time to time within the past year, numerous short articles on diseases of crops have been supplied to newspapers throughout the state, and special mimeographed statements have been sent to farm advisers and other interested parties, thus supplementing the personal interviews with growers in connection with the field work of the botanists.

PEACH YELLOWS INVESTIGATED.

Peach yellows was discovered in 1927 near Centralia, and the Natural History Survey was called upon to make an examination of orchards in order to determine how wide-spread this threat to the peach-growing industry was becoming. Our findings in 1927 and 1928 led to a very intensive search in 1929, with the result that the yellows disease is now known to occur in eleven orchards in Jefferson, Marion, Pike, and Pulaski counties, a total of 37 trees having thus far been found to show unmistakable symptoms of the disease, and a large number of other trees having been marked for close observation in 1930. The Illinois cases of yellows appear to be following the same destructive course that characterizes the disease in the eastern states; consequently, every effort is being made to familiarize peach growers with the disease, so that they can protect their orchards against destruction by recognizing the first appearance of infection and eliminating it before it has an opportunity to spread. To this end a demonstration of diseased trees was conducted at Centralia in September, and a well-illustrated pamphlet is in preparation, and lantern-slide lectures and exhibits are planned for the meetings of the State Horticultural Society.

Peach “rosette” has never been found definitely in Illinois, but it occurs rather commonly wherever peach yellows occurs in eastern states, and on this account our botanists are continually on the watch for “rosette” in this state.

One of our botanists, Mr. L. R. Tehon, collaborated with one of our former foresters, Mr. R. B. Miller, now of the Department of Conservation, in the preparation of a semi-popular work on “The Native and Naturalized Trees of Illinois,” which has been published in the 18th volume of our Bulletin series, as noted in the list at the end of this article.

FORESTRY.

The work in forestry extension has been successfully carried on under the cooperative arrangement described in the last Blue Book. Working under plans approved by the Forest Service of the Department of Agriculture, supervised by the Agricultural Experiment Station of the University of Illinois, and financed by the Natural History Survey and the federal department, the extension forester has given his time mainly to problems of woodlot management. He made special inspections of various woodland tracts at the request of the owners and supplied the desired advice as to methods of management, relative yields and values of timber crops, and the marketing of wood products. He also conducted numerous demonstrations for which arrangements were made through the farm bureau in each county. Special mention should also be made of his study of the values of forest lands in Illinois; his conferences with committees of the General Assembly concerning legislation in forestry, and with officials of the Public Welfare Department concerning forestry policies; his supervision of the planting of 10,500 trees on a University experiment farm in southern Illinois; and his mapping of forest areas, present and past, in Kankakee County, done with reference to the future control of the corn borer when it enters Illinois.

This work was interrupted on July 1, 1929, by the resignation of the forester to accept an appointment in the National Forest Service. A country-wide canvass, however, brought us a well-qualified successor, who has
now entered on his duties as extension forester of the Natural History Survey.
His work will be mainly educational, concerned especially with the problems
of woodlot management, pending such time as the University of Illinois may
avail itself of the existing State law directing the establishment of a forestry
division in its Department of Agriculture whenever an appropriation shall
be made to it especially for that purpose.

ENTOMOLOGY.

Among the many projects in economic entomology which have engaged
our staff during the last two years, only a few of the more important ac-
complishments can be outlined here. Particular attention has been given to
preparations for the control of the European corn borer when it enters
Illinois, as it is certain to do soon; to a study of the Oriental fruit moth,
which has lately come in from the south and is steadily extending its range
through the peach-growing districts; to experiments for the more certain
control of the codling moth in apple orchards; to a general survey of the
aphids, or plant lice, of the state; and to the protection of greenhouse crops
against the various pests that seriously handicap the horticultural industry.
A brief statement of recent progress in each of these lines follows.

The corn borer problem has been attacked from several widely different
angles. (1) Intensive studies of the borer's work in experimental fields
planted with 39 varieties of corn have been made in the heavily infested
area of Ohio, in cooperation with the United States Bureau of Entomology
and the Illinois Agricultural Experiment Station, to determine the relative
degree of infestation and the comparative yield for each variety. (2) At
Urbana our experiments with parasites of the borer have been continued and
have yielded results so promising that an additional breeding room for the
parasites has been provided, to make possible their production in numbers
large enough to test thoroughly their efficiency in the field. During the last
two seasons our success with one species of wasp-like parasite, Trichogramma
minutum, which lays its eggs within the eggs of various borers and numer-
ous other pests, has been such as to furnish a basis for hope that this species
will aid in the control of the codling moth and possibly also the Oriental
fruit moth and some other pests as well as the corn borer. (3) By means
of exhibits and lectures and through the press, public interest has been
fostered in aspects of the corn borer problem that bear on agricultural
practices in the Corn Belt. (4) The so-called Joint (Canadian and Ameri-
can) Committee on European Corn Borer has had our assistance in the
formulation of general policies and specific recommendations for the con-
certed action of all the states and provinces concerned in the control of the
invading pest.

STUDY ORIENTAL FRUIT MOTH.

The Oriental fruit moth, which seriously endangers profitable peach
culture in an Illinois area containing about two million peach trees and
yielding an average income of two million dollars a year, is being investi-
gated with respect to its distribution, life history, and habits in this state.
As much as 25 per cent and even 35 per cent of the fruit in some orchards
was infested by this insect in 1929. Of the sixteen kinds of insecticides we
have tried this season, two gave approximately 90 per cent freedom from
infestation, and another, entirely new and not previously used on any
orchard, gave 95 per cent of the fruit free from injury. To expedite the
work in this problem, we have undertaken to provide material for continuous
experimentation throughout the year, without waiting for the growing season
of the fruit, and are making arrangements for rearing young peach trees in
our greenhouse. We have collected more than 15,000 larvae of the moth,
to be kept in storage over winter and used for experiment under artificial
conditions, independent of the weather.

The outstanding results of our recent experiments aiming at better
control of the codling moth have consisted in definite evidence that late
broods of this insect can be controlled by applications of certain emulsions
made from highly refined light lubricating oils. Besides being more effective than the arsenical poisons which leave an objectionable residue on the fruit, these emulsions are harmless to the tree and also to the consumer of the fruit. As a supplement to spraying, the use of chemically treated bands on apple trees has been found effective.

Among the greenhouse pests against which improved control measures have been devised by our entomologists, the cyclamen mite deserves special mention, for it has caused losses to individual growers in the Chicago region amounting to many hundreds and even thousands of dollars. A simple, cheap, easy, and effective method for its control has been found in the use of paradichlorobenzene. Placing about one-sixth of an ounce of this chemical, or a ball of it about the size of an ordinary moth ball, in the cyclamen flats when the plants are first set out will stop a heavy infestation of mites, without injuring the plants. This is believed to be the most practical method yet devised, and it is being thoroughly tested both at Urbana and in some of the larger greenhouses near Chicago. An aid to the control of the greenhouse leaf tyer, one of the most destructive pests of flowers grown under glass, has been found in the use of a dust made up of sulphur (85%) and arsenate of lead (15%). Other greenhouse pests for which new control measures are being tried include millipedes, centipedes, and earthworms.

PLANT LICE COLLECTIONS.

The systematic entomologists on the survey staff have made a state-wide study of plant lice—a very remarkable piece of work covering 225 species of these insects, of which about 25 are new to science. Their collections illustrating the subject are in the form of nearly 10,000 microscope slides, all permanently numbered, labeled, and filed in our entomological series, together with maps of the state showing the distribution and other essential data for 150 species. A series of photographs has also been made illustrating many types of deformation produced by the lice on the various plants which they infest, and substantial progress has been made in the preparation of a report for the publication in the Survey's Bulletin.

Other recent taxonomic studies of groups of insects include a work on the fall and winter stoneflies of the state, already published, and one on sawflies, now ready for the press.

Besides being enriched by the addition of some 20,000 specimens during the last biennium, the collection of insects now in the custody of the Survey—some half million in all—has profited as a whole by the restudy and rearrangement in pest-proof cases of various groups of insects, to insure their preservation and to facilitate their use.

Progress has been made also on a large number of other problems in entomology, a complete solution of which calls for varied and long-continued observations and experiments. Life history studies of the peach tree borer, made to determine exactly the time when control measures should be taken,
and experiments with combination sprays for the control by one operation of both peach leaf curl and San Jose scale, are examples on which satisfactory progress has been made.

OTHER STUDIES AND EXPERIMENTS.

Mention should be made also of the completion of a nine-year series of field experiments in the seeding of wheat at different dates and the correlated degrees of infestation by the Hessian fly in representative areas over the state; the annual studies of seasonal abundance of the plum curculio, which have made it possible to warn orchardists each year and to advise them as to the best time to spray; the perfection of new methods for the control of the onion maggot by the use of certain oil sprays, alone or combined with Bordeaux mixture, and for the control of the onion thrips by the use of a homemade nicotine dust—thus lightening the losses in truck-gardening; and the prosecution of research work on insects infesting forage crops.

One of the curious deformations of poplar tree buds caused by plant lice. Almost every kind of tree, shrub and flower is subject to attacks of one or more species of plant lice.

The past biennium also saw the end of our long series of comprehensive experiments on the chinch-bug with reference to the reactions of this insect to weather and climate. The sometimes overwhelming attacks of this pest on cereal crops are evidently due to its sensitiveness to varying conditions of temperature, moisture, light, etc., and we should be able to foresee its extraordinary outbreaks and take timely measures of protection and avoidance. Our carefully controlled experiments have been designed to show just what the critical conditions are and just how the insect reacts to each condition separately and to combinations of conditions. Although not yet completely evaluated, the data clearly indicate that wide variations in numbers of chinch-bugs are due to variations in weather, especially in May and June,
in which months wet weather is fatal to the bugs and dry weather is essential to their abundance. They thrive under high but variable temperatures ranging between 78° and 108°F., but they die at constant temperatures of 85°F. They thrive best in prevailing sunny weather. The complete report of these experiments is now being written and will appear as an article in our Bulletin series.

GENERAL EDUCATIONAL OPERATIONS.

In my last report I made mention of the beginnings of a movement to bring the Natural History Survey into closer and more significant relation to the public high schools of the State, which led to the appointment of a committee of high school teachers of biology to assist us in selecting from our publications the volumes, bulletins, and circulars most likely to be of use to teachers of zoology and botany, and their pupils, as accessory material for study and instruction. These publications, produced during the fifty-seven years since I was placed in charge of the work, comprise seventeen volumes of our bulletin, eighteen biennial reports of the State Entomologist, two volumes on the ornithology of the State, and a volume and atlas on its fishes, besides a considerable number of miscellaneous pamphlets on various special subjects—a total of 14,400 pages on the biology of Illinois, illustrated by hundreds of text figures, 916 full-page plates, and 212 maps.

A careful inspection of this material was first made by two members of the scientific staff of the Survey who were formerly high school teachers of biology, and copies of all the papers and volumes found by them probably useful for our purpose were sent to each member of this committee, and from their reports we have made up a list of seventy of our publications approved by them for educational uses; and from the University of Illinois list of accredited high schools outside of Chicago we have selected 100 schools to each of which we shall send next September a set of these approved publications.

The Chicago schools differ so widely in many respects from those down the State that we will make a separate study of their requirements, with a view to a special selection and assignment of publications adapted to their needs.

I am also planning the revision and republication of some of our bulletins not well adapted in their present form to use in the high schools, together with the preparation of special circulars, bulletins, and handbooks for high school use on subjects not adequately represented in our present series.

PUBLICATIONS.

The State Natural History Survey has four current series of publications: (1) The Bulletin series, which consists chiefly of reports of research investigations; (2) the Entomological series of circulars on harmful insects, their habits and control; (3) the Forestry series of circulars, dealing with various problems in the preservation and improvement of wooded areas and in the utilization of waste land for the growing of timber crops; and (4) the series of Final Reports on the Natural History Survey of Illinois, of which three volumes have been issued, two dealing with birds and one with fishes. Other papers, mostly reprints of articles contributed by members of the Survey staff to scientific and trade journals, are issued as separate pamphlets. A new series of educational handbooks, especially adapted to the needs of students in high schools and colleges, is being inaugurated, as stated above. Many of the early numbers in the bulletin series and most of the series of Reports of the State Entomologist, which was discontinued in 1917, are out of print, but some 300 titles are still available for exchange and distribution, and a classified list of these has just been issued.

Publications issued since July 1, 1927, and others now being prepared for the press are as follows:
BULLETIN SERIES.

VOLUME XVII.
1927-1928.

Title page, Table of Contents, and Index. (pp. i-viii, 477-485.) Issued March, 1929.


Art. 5. Some properties of oil emulsions influencing insecticidal efficiency. By L. L. English. [With a foreword by W. F. Flint.] (pp. 233-259, with 8 text fig.) March, 1928.


VOLUME XVIII.
1929.


Art. 2. Fall and winter stonellies, or Plecoptera, of Illinois. By Theodore H. Frison. (pp. 340-409, with 77 text fig.) May, 1929.

Entomological Series.

Circ. No. 11. Habits and control of termites. By August E. Miller. (12 pp., 7 fig.) 1928. [Revision of Circ. No. 10.]


Educational Series.


Other Circulars, Pamphlets, and Reprints.

FLINT, W. P.—

FLINT, W. P., AND CHANDLER, S. C.—
1929. Oriental fruit moth invades Illinois.

Ill. Agr. Exp. Sta. Circ. No. 338, 7 pp., 1 map, 3 text fig.

FLINT, W. P., DUNGAN, G. H., AND YOUNG, A. L.—
1929. Developments in the corn borer battle.


FLINT, W. P., AND FRANKENFELD, J. C.—
1928. Preventing insect damage to stored seed grain.

* Reprint of Jour. Econ. Ent., vol. 21, pp. 143-146.

FLINT, W. P., HACKLEMAN, J. C., BAUER, F. C., AND BLAUSER, I. P.—
1928. Learning to live with the European corn borer.

Ill. Agr. Exp. Sta. Circ. No. 321, 16 pp., 1 map, 10 text fig.

FORBES, S. A.—
1928. The effects of stream pollution on fishes and their food. Reprinted in 1928 by the Natural History Survey as a separate pamphlet (13 pp.), from Outdoor America for Sept., 1926.

1928. Forces line up to battle the corn borer. 
1929. What can the natural history survey do for the high school? 
FORBES, S. A. AND HOUDEK, P. K.—
1929. State Natural History Survey and the high school. 
TEHON, L. R.—
   Reprint of Torreya, vol. 29, pp. 42-46, with 1 fig.
Tehon, L. R., AND DANIELS, E. Y.—
1927. Notes on the parasitic fungi of Illinois—II.
Tehon, L. R., AND STOFT, G. L.—
1928. An ascomycetes leaf spot of cowpea. 
   Reprint of Phytopathology, vol. 18, pp. 701-704.
1929. Notes on the parasitic fungi of Illinois—IV. 
   Reprint of Mycologia, vol. 21, pp. 180-196, with 1 pl.

* Obtainable from Mr. Flint's office.
† Obtainable from the Agricultural Experiment Station, Urbana, Illinois.
‡ Obtainable from Mr. Tehon's office.

THE STATE WATER SURVEY.

BY ARTHUR M. BUSWELL, Chief.

ILLINOIS is unique in that she was the first State so to recognize the importance of a knowledge of her water resources that a special organization known as the State Water Survey was created to undertake investigations of this very important natural resource.

According to the records the first analysis and studies of the chemical and sanitary condition of the water supplies of the State was made in October, 1895. At this time there was no organization for the detailed study of these waters as exists at present, but rather samples of water were submitted for analysis by municipality, industry or individuals interested.

The authority to undertake the sanitary and chemical study of the waters of the State as inaugurated by Dr. Palmer was given in 1897 by "An Act to establish a chemical survey of the waters of Illinois," approved June 7, 1897, in force July 1, 1897. This was followed later by further legislation entitled, "An Act imposing new and additional duties upon the State Water Survey, and making appropriations therefor," approved May 25, 1911, in force July 1, 1911.

In 1917 a very considerable change in the administration of the State government was brought about through the passage of an Act known as "The Civil Administrative Code," approved March 7, 1917, in force July 1, 1917.

Under this Act, "Section 3," there are created eleven departments of State government; the tenth, in order of designation is the Department of Registration and Education, the governmental head of which is the Director of Registration and Education.

The outline of authority or powers for the Department of Registration and Education is set forth in section 58. Those portions of this section which apply directly to the Water Survey Division read:

Section 58. The Department of Registration and Education shall have power:

Paragraph 13. To investigate and study the natural resources of the State and to prepare plans for the conservation and development of the natural resources and for that purpose the officers and employees thereof may enter and cross all lands in this State doing no damage to private property.

Paragraph 14. To cooperate with and advise departments having administrative powers and duties relating to the natural resources of the State, and to cooperate with similar departments in other States and with the United States Government.