

State of Connecticut

FIRST BIENNIAL REPORT OF THE
COMMISSIONERS

OF THE

State Geological and Natural
History Survey

1903-1904

State of Connecticut

PUBLIC DOCUMENT No. 47

State Geological and Natural
History Survey

COMMISSIONERS

ABIRAM CHAMBERLAIN, Governor of Connecticut (*Chairman*)
ARTHUR TWINING HADLEY, President of Yale University
BRADFORD PAUL RAYMOND, President of Wesleyan University
FLAVEL SWEETEN LUTHER, President of Trinity College (*Secretary*)
RUFUS WHITTAKER STIMSON, President of Connecticut Agricultural College

SUPERINTENDENT

WILLIAM NORTH RICE

BULLETIN No. 1



HARTFORD PRESS

The Case, Lockwood & Brainard Company

1904

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To His Excellency,

ABIRAM CHAMBERLAIN, *Governor of Connecticut:*

SIR: The Commission established by the General Assembly through "An Act Concerning the Establishment of a State Geological and Natural History Survey" present the appended report showing the progress and condition of the survey.

The Commission was organized at a meeting held June 15, 1903, pursuant to a call of the Governor of the State, and under his chairmanship.

All the members of the Commission designated by the Act of Establishment were present and accepted office.

The President of Trinity College was chosen Secretary.

At a meeting held June 25, 1903, Professor William North Rice of Wesleyan University was appointed Superintendent. The work described in the following pages has been carried on under his efficient administration.

Very respectfully,

FLAVEL S. LUTHER,

Secretary of the Commission.

HARTFORD, Dec. 23, 1904.

STATE GEOLOGICAL AND NATURAL HISTORY SURVEY.

APPOINTMENT OF SUPERINTENDENT.

The Act establishing the State Geological and Natural History Survey was approved June 3, 1903. The Commissioners under whose direction the Survey was placed by the terms of the Act, appointed, at a meeting held June 25, 1903, William North Rice, Professor of Geology in Wesleyan University, to be Superintendent of the Survey. A certain delay in the development of plans for the work of the Survey was inevitable. As the appointment to the Superintendency came to Mr. Rice unexpectedly, he was not able at once to decide whether, consistently with other duties, he could undertake the responsibilities of the office. Moreover, almost immediately after the date of his appointment, the gentlemen especially interested in the Survey, whom it was desirable to consult in regard to the plans for the work, were scattered for their summer vacations. It was, therefore, not until September 17th that Mr. Rice notified the Secretary of the Commission of his acceptance. In the course of the next few weeks plans for the work of the Survey were developed. At a meeting of the Commission, held on November 16th, a general plan of organization was adopted, and most of the lines of work to be undertaken were decided upon.

AIMS OF THE SURVEY.

The Survey is styled, in the Act for its establishment, a Geological and Natural History Survey. This title, and the still more explicit language of Section 2, we have understood as requiring that attention should be given both to the rocky framework of the state and to its vegetable and animal life — both to the Geology of the state and to its Botany and Zoölogy. The language of that section further implies that three distinct aims should be regarded in the work of the Survey: first, the advancement of our knowledge of the geology, botany, and

zoölogy of the state as a matter of pure science; second, the acquisition and publication of such knowledge of the resources and products of the state as will serve its industrial and economic interests; third, the presentation of the results of investigations in such form as to be useful in the educational work carried on in the various schools of the state. These three aims, the purely scientific, the economic, and the educational, we have endeavored constantly to keep in mind in all plans which have been made.

PLAN OF ORGANIZATION.

For various reasons, and especially in view of the small amount of the appropriation, and in view of the fact that the appropriation was made only for a single biennial term, with no definite promise of renewal, it seemed desirable that the organization of the Survey should be extremely simple. Under the conditions above mentioned it would have seemed unreasonable to create a long list of official positions with such titles as those of State Geologist, State Botanist, State Entomologist, etc. The establishment of a number of official titles of that sort would offer an expectation of permanent tenure to persons employed in the scientific work of the Survey, and would create an expectation that, in case those persons were not reappointed for the ensuing biennial term, there would be a number of official vacancies to be filled by the appointment of other persons. It was deemed desirable that the form of organization should be such as to imply no promises of any kind beyond the present biennial term. Accordingly, no appointment with official title has been made by the Commissioners in addition to the appointment of a Superintendent as provided explicitly in the Act establishing the Survey. Other scientific men have been employed to investigate specific subjects and to prepare reports thereon. In each case the Commissioners have fixed upon a certain sum as compensation, payable when the report in regard to the particular investigation is accepted. In addition to the sum appropriated as compensation, the Commissioners have appropriated in each case a certain sum to be drawn upon, so far as necessary, for payment of traveling expenses, services of stenographers and other assist-

ants, purchase of necessary apparatus and materials, and all other expenses incident to the prosecution of the work. The compensation of the Superintendent alone has been arranged in the form of a salary payable in quarterly instalments. A certain sum has been appropriated, also, for expenses of the Superintendent, to be drawn upon so far as necessary, as in the case of the other scientists employed on the Survey.

SCIENTIFIC WORK UNDERTAKEN.

The special works which have been undertaken may be classified in the three departments of Geology, Botany, and Zoology.

I. Geology.

1. A Manual of the Geology of Connecticut, so far as it is known at present. The former Geological Survey of Connecticut, which was established in 1835, ended its work with the publication of Percival's Report on the Geology of Connecticut in 1842. Considering the difficulties under which that Report was prepared, it will ever remain a monumental work in its minute accuracy of observation of the rocks of the state. At that time the science of dynamic geology was not yet far enough advanced to throw much light upon the interpretation of the geological phenomena of the state; and whatever theoretical views Percival may have held he seems to have almost entirely concealed. In the last half-century the science of geology in general has greatly advanced, and much more can be done now than then in the way of theoretical interpretation of the facts. Since the publication of Percival's Report a great deal of good geological work has been done in Connecticut, partly by men connected with the United States Geological Survey, and partly by those who have worked on their own responsibility. The results of that work, however, in so far as they have been published, are scattered through numerous volumes of government reports, scientific journals, and proceedings of learned societies. In this condition they are almost inaccessible to the great number of teachers in our high schools and other intelligent people in the state, who are not geologists by profession, but who desire to know something of the geo-

logical structure and history of the state. It was therefore believed that the preparation of such a manual as has been undertaken would be very useful, particularly in the line of education. Numerous conversations with teachers have yielded abundant evidence of the general demand for such a work. In some cases it will doubtless be put into the hands of classes as a text-book or book of reference, though it will be chiefly used by teachers. This work has been undertaken by the Superintendent of the Survey and Professor Herbert E. Gregory of Yale University, the former of whom contributes an introductory chapter on the relation of the geography of the state to its geological structure, and a chapter on the Triassic sandstones; while the latter contributes chapters on the crystalline rocks, and on the glacial geology of the state.

2. A Geological Map of the state, on a scale of four miles to the inch. This will be the first geological map of the entire state, in any considerable detail, which has been attempted since that of Percival in 1842. It is needless to remark on the value of such a map, whether from the standpoint of pure science or with reference to economic and educational purposes. The new map will contain all the topography which is given in the topographic map, on a scale of two miles to the inch, published in 1893 by the coöperation of the national government and the state government. The greater part of the so-called "culture" represented on that map, as roads, houses, etc., will be omitted, in order that the geological coloring may be put on without making the map confused. In central and western Connecticut sufficient data for a map on that scale had already been accumulated by the labors of the geologists employed under the direction of the United States Geological Survey, and the result of their work, whether published or unpublished, has been courteously placed at our disposal. In much of the eastern part of the state, however, there had been not even a geological reconnaissance since the time of Percival. The preparation of the map required, therefore, a large amount of field work in eastern Connecticut, which was accomplished, for the most part, in the summer of 1904. The preparation of this map has been undertaken by

Professor Herbert E. Gregory and H. H. Robinson, Ph.D., of Yale University.

3. An investigation of the Clays of Connecticut, both in their geological and in their economic relations. The importance of the manufacture of brick and tile, and other forms of clay industries in this state, renders such an investigation and report eminently appropriate. This investigation has been undertaken by G. F. Loughlin, B.S.

II. Botany.

1. An annotated list of the Phanerogams and the Higher Cryptogams of the state. Such a list will be, from the standpoint of pure science, a valuable contribution to our knowledge of botanical geography. In the notes due attention will be given to the economic relations of plants which are valued for their beauty or for their useful products, and to those which are troublesome weeds, or which possess poisonous or otherwise injurious properties. A short time before the organization of the Survey a society of the botanists of the state, both professional and amateur, had been formed under the name of the Connecticut Botanical Society. The members of this society, and especially committees representing the society, were already energetically at work gathering materials for such a Flora of the state. They responded most cordially to the suggestion that they find in the newly organized State Survey a medium for the publication of the results of their labor.

2. Reports on certain groups of the Fungi of Connecticut. This work has been undertaken by Professor E. A. White of the Connecticut Agricultural College and G. P. Clinton, Ph.D., of the State Agricultural Experiment Station in New Haven. The former of these authors is to report on the large, fleshy fungi (Hymeniales), some of which are valuable as food, while others are dangerous on account of their poisonous qualities. The latter is to report on the smuts (Ustilagineæ). These minute and lowly organized plants are of very serious economic interest, since among them are many destructive parasites of the plants which yield valuable agricultural products.

III. Zoölogy.

1. A list of the Birds of Connecticut, with notes in regard to their migrations, their food, and other matters bearing upon their economic relations. Besides the value of such a report as a contribution to the science of geographical distribution, the treatment which will be given of the economic relations of the different species of birds residing in our state or migrating through its territory will be of great importance for the agricultural interests of the state. This report will be, also, of great educational value, and will serve, in large degree, to encourage that loving study of bird life which has been of late years one of the most fascinating and wholesome phases of nature study. This work has been undertaken by Mr. John H. Sage of Portland, Secretary of the American Ornithologists' Union, and Dr. L. B. Bishop of New Haven.

2. A study of the Microscopic Life of the Fresh Waters of the state, and particularly of the reservoirs and other sources of drinking water. The State Board of Health has, indeed, published in former years the result of a good many analyses of drinking waters, and considerable information in regard to bacteria and other forms of minute life which have been observed in our waters; but there has been no attempt at any systematic enumeration or study of the forms of microscopic life existing in the waters. It seemed eminently desirable that a beginning should be made in that line of study, though it was obvious that it would be impossible to make any complete survey of our waters during the present biennial term. Apart from the purely scientific value of such investigation, it has been believed that the publication of a report with good figures of the principal forms of minute life in our waters would be of great educational value to the teachers of biology in our high schools, and to the large number of amateur students of microscopic life throughout the state. It appeared, also, not unlikely that such an investigation might yield results of economic importance in regard to means of avoiding the contamination of reservoirs by the presence of injurious or disagreeable organisms. This investigation has been undertaken by Professor H. W. Conn of Wesleyan University.

APPROPRIATIONS.

The amounts appropriated for the compensation of the various scientific men employed in the work of the Survey, and for the expenses of the different investigations, are indicated in the following table:

Name.	Work.	Com- pensation.	Ex- penses.
W. N. Rice, . . .	Superintendence, . . .	\$400	\$300
H. E. Gregory, . . .	Manual of Geology of Connecticut, . . .	150	50
H. E. Gregory and H. H. Robinson, . . .	Geological Map, . . .	450	200
G. F. Loughlin, . . .	Report on Clays, . . .	30	20
Conn. Botanical Society, .	Flora of Connecticut, .		100
E. A. White and G. P. Clinton, . . .	Reports on Fungi, . . .	200	100
J. H. Sage and L. B. Bishop, . . .	Report on Birds, . . .	200	200
H. W. Conn, . . .	Study of Microscopic Fresh-water Life, . . .	400	200

PROGRESS MADE.

In all the scientific labors which have been undertaken good progress has been made, and several of the reports are nearly or quite ready for publication.

The text of the Manual of Geology is nearly completed. Some work will be necessary in the preparation of illustrations before the work is ready for the printer. It will, however, in all probability be completed within a few weeks.

The field work for the Geological Map of Connecticut was accomplished by Professor Gregory and Dr. Robinson, with the assistance of Mr. Loughlin, in the summer of 1904, and a manuscript map will be ready to be placed in the hands of the engraver at an early date.

Mr. Loughlin's report on the Clays of Connecticut is nearly ready for publication.

The Connecticut Botanical Society has made good progress in the preparation of the Flora of the state.

The reports of Professor White and Dr. Clinton on certain groups of Fungi will be ready for the printer within a few weeks.

Mr. Sage and Dr. Bishop have made good progress in their work on the Birds.

A preliminary report on the Protozoa of our fresh waters has been placed by Professor Conn in the hands of the Superintendent. The drawings for the illustration of this work have already been given to the engraver. They are to be reproduced inexpensively but effectively by a photographic process.

PLAN OF PUBLICATION.

Each Report prepared is to be published as a separate Bulletin, the Bulletins to be numbered consecutively, generally in the order of time in which they are received. Each Bulletin will bear the name of the author or the names of the authors, and each author will be responsible for his own work.

The various Bulletins will be issued in paper covers, but a portion of the edition will be reserved for binding. From time to time the Bulletins which have been published will be assembled in volumes of convenient size, generally not less than five hundred pages, nor more than one thousand. The colleges, public libraries, geological surveys, and learned societies to which the publications will be sent, and, in general, the institutions in which it is likely that complete sets of the publications of the Survey will be preserved, will have the option of receiving the separate Bulletins as they are published, or of receiving at less frequent intervals the bound volumes.

An arrangement has been made with the State Library which will be mutually beneficial to the two institutions. The State Librarian has kindly undertaken to give attention to the distribution of the publications of the Survey; and the publications which are received in exchange from other geological surveys and from various learned societies and scientific institutions will be deposited in the State Library. In this way it is believed that the operations of the Survey will lead to the acquisition of much valuable material for the State Library.

LEGISLATION DESIRED IN REGARD TO PUBLICATION OF REPORTS OF THE SURVEY.

The general law of the state limits the edition to be printed of any report to 1,375 copies, in the absence of any special legal

provision for a larger edition. Such a number will be altogether inadequate for the distribution which should be made of the reports of the Survey. Such reports issued by other states are widely distributed to colleges, scientific institutions, public libraries, scientific men, teachers, and others. The editions printed are never less than 1,500, and generally range from 3,000 to 8,000. It is very desirable that such reports should be liberally distributed to citizens of the state whose economic and educational interests they are intended to advance. A careful consideration of the classes of persons and institutions that should be reached by the publications of the Survey, and a consideration of the usage of similar organizations in other states, lead to the conclusion that not less than 3,500 copies should be published in the case of most of the Bulletins of the Survey; and that in some cases the edition should be considerably larger than that number. The Manual of Connecticut Geology, and the Report of Messrs. Sage and Bishop on the the Birds of Connecticut, will be so largely used by the teachers of the state in their work that we believe an edition of 4,500 copies of each of these Bulletins should be published. As has been already indicated, some of the Bulletins are substantially ready for the printer, and others will be ready within a few weeks. It is therefore earnestly desired that the General Assembly, at as early a date as may be practicable, pass an act authorizing the printing of 3,000 copies of this, the regular Report of the Survey; 4,500 copies of two of the special reports, namely, the Manual of Connecticut Geology, and the Report on Birds; and 3,500 copies of the other special reports of the Survey.

PLANS FOR FUTURE WORK.

While it would be useless and inexpedient to attempt anything like an enumeration of all the scientific investigations of the resources and products of our state which should be made in future years, it may be fitting to give some intimation of reasonable plans for work in the near future, that the members of the General Assembly may be better prepared to reach a wise conclusion in regard to the continuance of the appropriation for the work of the Survey.

In geology it may be said that the study of a large part of the area of the state has been little more than reconnaissance. Numerous and perplexing problems in the geology of the state demand laborious investigation. The Manual of Geology and the Geological Map which are being prepared for publication must be considered rather as reports of progress than as final reports upon the geological structure of the state. They will be useful, indeed, but a large part of their usefulness will be in the aid which they will afford to future study, by which their errors will be rectified and their deficiencies will be supplemented. The Geological Map which is being prepared for publication gives only the formations of consolidated rock of pre-Quaternary age, omitting all reference to the glacial drift and the aqueous and aqueo-glacial deposits associated with it. A publication which should be attempted at an early date is a map of the surface geology of the state. While Connecticut is not rich in metallic ores which can be profitably exploited, it possesses a vast wealth in its building stones. A most suitable subject for investigation and report under the auspices of the State Survey would be the building stones of the state. Another report might well deal with the mineralogy of the state. Many of the localities of the state have long been famous for rare and interesting minerals, but no attempt has been made in recent times to compile and present in available form the knowledge of such localities.

The annotated Flora of the state which is being prepared by the Connecticut Botanical Society will be of great value, but it is only the beginning of work which may in future be done in the department of botany. Particularly there is a demand for extensive study of the plants of the state in their relations to the inorganic and organic conditions which constitute their environment. The distribution of the plants with reference to altitude, geological formation, distance from the sea, temperature, and rainfall, and the grouping of plants into plant societies in different areas of the state, are among the subjects which demand investigation. Besides the work which should be done upon the higher plants, attention should be given to the plants of lower organization, many of which are

of great economic importance. A beginning has been made in this direction, but only a beginning. Professor Conn and his assistant, Miss L. W. Hazen, have done some work on the fresh-water Algæ, on which a report will probably be ready for publication at an early date; but that report, when it appears, will be only a preliminary report. A vast amount of work yet remains to be done. The Bacteria of our waters are of profound significance, both scientifically and economically. The perils involved in the presence of pathogenic bacteria in reservoirs and other sources of drinking water, and the problems connected with the pollution of rivers by sewage, give to this group of organisms a portentous importance. Professor Conn has already done a considerable amount of work on the bacteria of our waters, but the investigation is not so far advanced as to afford results suitable for publication. The work of Professor White and Dr. Clinton on certain groups of the Fungi is a good beginning, but is very far from being a completion of the work which a State Survey may rightly undertake in this department.

In zoölogy, one line of work very important in both scientific and economic relations has not been entered upon at all by the present State Survey; that is the department of economic entomology. The study of the insects injurious or beneficial to the agriculture of the state is a field demanding a vast amount of investigation. Professor Conn's Report on the Protozoa of our fresh waters is justly styled "a Preliminary Report." It is very desirable that the work which has been so well begun should be continued. Besides the Protozoa there are other minute forms of animal life in our fresh waters whose systematic study has not been commenced. In a state which has so long a line of sea-coast as Connecticut, and whose fishery industries are so important as ours, a State Survey may well be expected to do a large amount of work in marine zoölogy—a field which the present Survey has not yet attempted to enter.

The advance of science, while it solves some problems, suggests new problems. The changes which are continually being made in the processes of the arts and manufactures bring into use from time to time, and create a demand for, new forms

of raw material. The study of the resources and products of any area takes on new meanings with the progress of science and art. The work of the past must be supplemented by new studies in each generation.

It must be remembered that the state of Connecticut has had no Geological or Natural History Survey since that of Shepard and Percival from 1835 to 1842. It is indeed true that the state of Connecticut coöperated with the United States Geological Survey in the preparation of the invaluable topographical atlas of the state. Much valuable scientific work, also, has been done by the State Board of Health, Board of Agriculture, and Agricultural Experiment Stations, and other organizations. But no attempt in the direction of systematic study of the resources and products of the state has been attempted for about two generations. In the mean while, many of our sister states have maintained and are still maintaining Geological and Natural History Surveys, which have issued publications of great scientific value and of great utility to the arts and industries in which scientific knowledge finds practical application. The work which has been done in accordance with the Act of the General Assembly in the session of 1903 is only a beginning. If it was wise then to establish a Survey, it is wise now to provide the necessary appropriation for its continuance.