

State of Connecticut

FOURTEENTH BIENNIAL REPORT OF THE
COMMISSIONERS

of the

State Geological and Natural
History Survey

1929-1930

Bulletin No. 50



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State of Connecticut
PUBLIC DOCUMENT No 47

State Geological and Natural
History Survey

W. E. BRITTON, Ph.D., D.Sc., Superintendent

Bulletin No. 50



HARTFORD

Printed by the State Geological and Natural History Survey

1931

Connecticut Geological and Natural History Survey
Department of Environmental Protection
79 Elm Street
Hartford, CT 06106-5127

State Geological and Natural History Survey
of Connecticut

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Publication approved by the Board of Finance and Control

THE HARTY PRESS, INC.
NEW HAVEN, CONN.

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LETTER OF TRANSMITTAL

New Haven, Conn., February 1, 1931.

HIS EXCELLENCY, WILBUR L. CROSS,
Governor of Connecticut,

Hartford, Connecticut.

Sir:

I have the honor to transmit to you herewith, in behalf of the Commissioners of the State Geological and Natural History Survey, as required by Statute, the fourteenth biennial report of the Superintendent, covering the two years ending December 31, 1930.

Respectfully submitted,

W. E. BRITTON,

Superintendent.

FOURTEENTH BIENNIAL REPORT OF THE
GEOLOGICAL AND NATURAL HISTORY
SURVEY OF CONNECTICUT

W. E. BRITTON, PH.D., D.S.C., *Superintendent*

NOTES OF PROGRESS

During the calendar years of 1929 and 1930, the usual progress on the projects of the Survey may be recorded.

Doctor Sharp completed his studies in coast erosion and protection as applied to Connecticut, early in 1929 and his paper was published as Bulletin No. 46.

Doctor Flint was able to finish his studies on the glacial geology of Connecticut and the results have now been published as Bulletin No. 47. During the progress of these studies, Doctor Flint indicated on maps supplied by the State Highway Department, the location of deposits of sand and gravel suitable for use in highway construction and repair, and the information was sent to the Highway Department.

The records of the Connecticut Botanical Society showing additions to the Catalogue of Flowering Plants and Ferns were typed from the cards and have just been published as Bulletin No. 48.

During 1930, the Survey was requested to publish as one of its series of bulletins a report on the Public and Semi-public Lands of Connecticut, prepared under the auspices of the Connecticut Forest and Park Association. This report will soon appear as Bulletin No. 49.

During the period covered by this report the following two projects have been completed and manuscripts submitted: The Stegocephalian Amphibia of the Connecticut Valley and Its Environs, by Roy L. Moodie, and The Minerals of Connecticut, by Dr. J. F. Schairer. There are many requests for information regarding mineral deposits in Connecticut, and it is hoped that Doctor Schairer's paper may be published at an early date, perhaps as the next bulletin containing scientific matter.

Mr. George G. Goodwin has now nearly completed the manuscript of his report on The Mammals of Connecticut, and is now making additional illustrations and has promised delivery during the winter.

Dr. William M. Agar spent his summer vacation in 1930, in the field with an assistant part of the time, in continuance of his studies on the metamorphic rocks of western Connecticut.

One new project has been taken up since the last biennial report; namely, Report on the Reptiles of Connecticut, by Professor George H. Lamson of the Connecticut Agricultural College. Professor Lamson is much interested in the snakes and proposed to prepare an illustrated report on them. I induced him to also include the turtles so that the entire reptile group would be covered by the report.

In October 1929, by request, the Superintendent prepared a brief account of the rock products of Connecticut for the Directory of the Rock Products Industry, page 43, 1929-1930.

Formerly the Survey cooperated over a period of several years with the United States Geological Survey in studying the ground waters of Connecticut. The areas covered by these studies are shown on the map in Figure 7, of Bulletin No. 44, and a list of Water Supply Papers containing the results may be found on page 20 of the present report. In all probability it will not be necessary for the Survey to again engage in this work in order to extend it over the State, as the present Water Commission is now considering, or entering into, cooperation with the United States Geological Survey to make further studies of ground waters.

Further and more detailed information concerning these publications, manuscripts and projects will appear in other pages of this report.

STONES AND MINERALS FOR EDUCATIONAL WORK

In 1928, the Survey at small outlay arranged with Dr. J. F. Schairer to prepare an authentically named collection of 75 minerals gathered in Connecticut to be used for educational purposes. The collection was turned over to Mr. R. F. Lund of the State Department of Education, who had a special shipping case constructed to hold the specimens. He tells me that the minerals are in great demand and that he has shipped the collection to high and other secondary schools all over the State.

In 1930, Dr. W. M. Agar was requested to gather a few specimens of the more typical rocks, while engaged in making his field studies in Western Connecticut. In the fall, I received from him 12 sets of rock samples of six specimens in each set. These were likewise turned over to Mr. Lund for use in educational work and exhibits. These were all from the western portion of the State; similar specimens representing other parts of the State are necessary to show a true picture of Connecticut's bedrock structure. Efforts will be made toward this end.

PLANS FOR A NEW TOPOGRAPHICAL SURVEY

Legislation was requested from the General Assembly of 1927, by the Connecticut Society of Civil Engineers, for a new topographical survey of Connecticut to be made by the United States Geological Survey, and the usual proportion of the cost to be borne by the State. The State Geological and Natural History Survey was named in the bill as the agency to represent the State in the matter, and an appropriation of \$150,000, to be expended over a period of five years, was asked to cover the cost of this work to the State. Abundant evidence of the need of a new survey was presented at the hearing before the Judiciary Committee, yet on account of lack of funds the bill was rejected.

A similar measure was before the General Assembly of 1929, except that the Governor was the only agency named in the bill, which carried an appropriation of \$250,000, as it was planned to map the State on a larger scale than called for in the former plan. This measure, too, failed because funds were not in sight. The bill before the present General Assembly of 1931, asks for even a larger appropriation. If it should fail of passage, probably each succeeding General Assembly will be asked to legislate on this subject until favorable action has been obtained.

The present topographical maps were printed 40 years ago, based upon field surveys made in the decade between 1880 and 1890, when methods were crude in comparison with those of the present day. Consequently, there are many errors in boundary and contour lines as well as in watercourses and highways, and engineers are constantly discovering them. Then there have been many changes in town boundaries, names, and especially in new highways, making the old maps well nigh obsolete. The geological field work of this Survey shows the great need of a more accurate and up-to-date topographical map, and it is a pity that such a map could not have been available for use by Doctor Flint in Bulletin No. 47.

ORGANIZATION AND POLICY

Since the establishment of the Survey in 1903, the Superintendent has been the only officer to draw a regular salary, and that a modest one for part-time duties. The present Superintendent is Entomologist of the Connecticut Agricultural Experiment Station, and may be consulted at his office there. Clerical assistance is needed in writing letters, typing manuscripts and reading proof. Consequently since 1926, a small portion of the salary of the secretary of the Department has been paid each month out of the Survey appropriation for

doing the necessary stenographic and secretarial work. This arrangement had the approval of the Director of the Connecticut Agricultural Experiment Station and of the State Board of Finance and Control, and is far more convenient than to have the work done outside the office.

It has been customary to employ graduate students, instructors and professors to conduct certain investigations, usually requiring field trips, during the summer vacation period. In such cases temporary salaries and expenses are paid for brief periods. In some cases, it is necessary only to pay expenses and in other cases perhaps no salary is paid but arrangements are made to pay a lump sum upon the submittal of the completed manuscript. The manuscripts of several bulletins were obtained without cost to the Survey; in recent years this has been true of Bulletins Nos. 36, 37, 42, 43, 48 and 49. With Bulletins Nos. 36, 42 and 43, the manuscripts were prepared as theses in partial fulfillment of the requirements for the degree of doctor of philosophy. As such papers are rather too voluminous to be available for publication in scientific journals, the authors were very glad to have them published by the Survey, and the Survey was fortunate to be able to add them to its list of creditable bulletins.

The cost of printing the Survey bulletins is not paid out of the Survey appropriation, but is defrayed from a special appropriation for printing State documents after publication has been authorized in each case by the State Board of Finance and Control.

MEETING OF THE COMMISSIONERS

During the period covered by this report the Commissioners have held one meeting at the Governor's office, State Capitol, Hartford, on November 13, 1929. It was not well attended. In fact, on account of the many engagements of the Commissioners, it is rather difficult to set a time for a meeting when all can be present. For several years President Beach had served as secretary of the Commission, but on his resignation as president of the Connecticut Agricultural College, it was necessary to elect a new secretary, and at the meeting on November 13, Dr. George A. Works, who had just taken up his duties as president of the Connecticut Agricultural College, was elected secretary of the Commission. But alas, Doctor Works resigned inside the year. He has been succeeded by Dr. Charles Chester McCracken. The Survey Commission is again without a secretary.

The Superintendent sends occasional letters to each Commissioner reporting briefly on the progress of Survey matters and explaining any new plans or projects which may arise.

He makes certain recommendations and asks the Commissioners to voice approval or disapproval thereof. In this manner, many questions are decided satisfactorily even though meetings are held infrequently. Former Governor Trumbull once expressed his opinion to the effect that every State Board or Commission should hold meetings at least once each year.

RECENT BULLETINS

Since the submittal of the Thirteenth Biennial Report of the Commissioners, five bulletins have gone to press. These are Bulletins Nos. 45, 46, 47, 48 and 49, and all but Bulletin No. 49 have been completed. These bulletins may be described briefly as follows:

Bulletin No. 45. Thirteenth Biennial Report of the Commissioners of the State Geological and Natural History Survey, 1927-1928, 32 pages, 3 plates, 1929. This report contains an obituary of Professor William North Rice, the first Superintendent of the Survey, who died November 13, 1928, and a list of his principal scientific publications; portraits of Professor Rice, Professor H. E. Gregory and Dr. H. H. Robinson, the three former Superintendents of the Survey; twenty-five years of the work of the Survey including a communication from Professor Gregory; list of bulletins published; distribution of bulletins; researches in progress; needed investigations; financial statement.

Bulletin No. 46. The Physical History of the Connecticut Shoreline, by Henry Staats Sharp, Ph.D., Instructor in Geology, Columbia University, 97 pages, 8 plates and 29 figures, 1929. This is the result of studies made by Doctor Sharp under the direction of Professor Douglas Johnson, and submitted in partial fulfillment of the requirements of the degree of Doctor of Philosophy at Columbia University. Though the changes along the Connecticut shore are insignificant when compared with some other coast states, nevertheless they occur. These minor changes are caused by tides and storms which cut away the shore in some places and deposit the material in other places. Suggestions for protection of the shore are contained in this bulletin. Doctor Sharp examined the entire Connecticut coast and the conditions that he found are well described and explained in this bulletin. The figures are from drawings and the plates are all from photographs taken in Connecticut.

Bulletin No. 47. The Glacial Geology of Connecticut, by Richard Foster Flint, Ph.D., Assistant Professor of Geology, Yale University, 294 pages, 64 plates, 42 figures, 1 map, 1930. Doctor Flint spent a goodly portion of two summers in the

field, going over the entire State, and from a new outlook has pointed out certain features which have apparently been overlooked by other observers, upon which his conclusions are based. Details are given of the chief features of his field survey in each of the drainage basins of Connecticut, illustrated by photographs and diagrams. The chief glacial features are shown on a map of the scale of 1-125,000, which is folded and placed in a pocket inside the back cover. Doctor Flint was obliged to use the old topographic map but he has carefully revised all names, corrected inaccuracies in boundaries and water courses so far as possible, and added new highways and reservoirs. This bulletin should be of great interest not only to geologists and teachers, but to engineers, contractors and to the citizens of the State.

Bulletin No. 48. Additions to the Flora of Connecticut, by a committee of the Connecticut Botanical Society, consisting of Edgar Burton Harger, Ph. B., Charles Burr Graves, M. D., Edwin Hubert Eames, M. D., Charles Alfred Weatherby, A. M., Richard William Woodward, A. B., and George Henry Bartlett, Ph. B., 94 pages, 1930. This is really a supplement to Bulletin No. 14. Since the publication of Bulletin No. 14 in 1910, additions have been found from time to time by members of the Connecticut Botanical Society. Two lists of such additions have been printed in journals, but ever since then further additions have been made. Bulletin No. 48 includes all additions from 1910 up to the time the last page proof was released for printing. The total number of species and varieties, excluding fugitives, listed in Bulletin No. 14 was 2,228. Bulletin No. 48, adds 371 species and varieties, which after deducting fugitives, makes a grand total of 2,511. This bulletin will be a great convenience to all botanists and plant collectors who use the original list, Bulletin No. 14. It is also desirable to have complete information on the subject included in the bulletins of the Survey.

Bulletin No. 49. Public and Semi-Public Lands of Connecticut, by Philip Laurance Buttrick, formerly secretary of the Connecticut Forest and Park Association, 151 pages, 6 figures and 13 maps, 1930. This bulletin contains a full discussion of the reasons and methods of procedure in setting aside lands for public use, and likewise for semi-public lands. It also discusses the future needs of Connecticut, particularly in forests and parks, as based upon the probable increase in population. Tables I - XXXVIII give statistics of parks, forests, and other public and semi-public lands, and such areas are shown on a map (scale 1-250,000) folded in an envelope inside the back cover. This bulletin was initiated by the State Forest and

Park Association and the manuscript was prepared in its office. It should be of interest to many State commissions and institutions as well as to private individuals. (Now in press to be issued shortly.)

UNPUBLISHED MANUSCRIPTS ON HAND

Minerals of Connecticut, by Dr. J. F. Schairer. There has long been great need for a popular bulletin giving information about the minerals of Connecticut. Many minerals occur in the State and some of them are remarkable in character and have been mentioned in textbooks. Some of them have been mined commercially in past years, and a few mines are still worked, but most of them have been abandoned. The openings are soon covered by forest growth and there is grave danger that the sites may be lost to record and forgotten altogether. This paper records these sites, gives considerable information concerning minerals and their formation, but is not intended to be a guide for the identification of minerals. The manuscript contains about 260 typed pages and it will probably be one of the first scientific bulletins to be published.

Higher Crustaceans of Connecticut, by the late Professor A. E. Verrill. This manuscript was submitted several years ago and contains about 600 typed pages and nearly 100 pages of illustrations. Since Professor Verrill's death, the paper has been submitted to specialists who seem to agree that it should be revised before publication. A rather large figure was mentioned as the cost of revision, so no action has been taken. It is hoped, however, that this paper may soon be revised and published for the benefit of the people of Connecticut.

Stegocephalian Amphibia of the Triassic, by Roy L. Moodie. Though few, if any, fossil Amphibia have actually been found in Connecticut, material is much more abundant from adjacent territory, and it is fair to assume that they occurred in Connecticut. Mr. Moodie, an authority on the subject, has submitted a brief paper of about 44 typed pages, 10 figures and 14 plates, which will be of interest chiefly to geologists and paleontologists.

Additions to the Check-List of the Insects of Connecticut, by W. E. Britton, with the assistance of members of the Department of Entomology at the Agricultural Experiment Station. This manuscript now contains about 150 typed pages and is constantly being revised and enlarged. At an early date it should be issued by the Survey as the First Supplement to the Check-List of the Insects of Connecticut (Bulletin No. 31) though numbered as a separate bulletin.

Clays of Central Connecticut, by G. T. Wickwire. This is a report of the reëxamination of the larger areas in the central portion of Connecticut where brick clays occur, and contains estimates of the probable quantities of brick clays in these areas and the number of years that the supplies will last at the present rate of exploitation. It is now 25 years since Doctor Loughlin's more comprehensive report, was published as Bulletin No. 4 of this Survey. Mr. Wickwire's paper contains 28 typed pages.

RESEARCHES NOW IN PROGRESS

Metamorphic Rocks of Connecticut. The bedrock geology of eastern Connecticut has now been covered, chiefly by Professor W. G. Foye, of Wesleyan University. Dr. W. M. Agar, of Columbia University, is now at work on similar studies of the western portion of the State, and has devoted his summer vacation periods to this work for several years. These studies are very difficult, and it is uncertain how many seasons may be required to cover the remaining portions of the State. When this work has been completed, it will be possible to use the results, together with those of Doctor Flint, in preparing a new or revised bulletin on the geology of Connecticut. Bulletin No. 6 has long been out of print but the demand for it still continues.

Mammals of Connecticut. For about three years Mr. George G. Goodwin, of the Division of Mammals, American Museum of Natural History, New York, has been at work on a report on the mammals of the State, and the manuscript has been promised for submittal this winter. It is understood that this paper will include not only all of the land mammals of Connecticut, but also the seals, whales and sharks that occasionally appear in coastal waters. As this paper will contain many new illustrations, it should be of interest to everyone, and should be published at an early date.

Connecticut Weather and Climate. Mr. Leonard M. Tarr, local forecast official of the New Haven office of the United States Weather Bureau, has been at work on a paper on the weather and climate of Connecticut, projected several years ago. This paper will discuss the amount and distribution of rainfall, temperatures, storms, sunny and cloudy days, humidity, direction and velocity of air currents, all of which contribute toward what we know as the climate of Connecticut. Mr. Tarr now expects to finish the manuscript early next spring, and when published, it should prove interesting to all residents of Connecticut.

Common and Conspicuous Plant Galls of Connecticut. For many years the Department of Entomology of the Agricultural Experiment Station has been acquiring and photographing plant galls. Most of this material has been collected by members of the Department, and it now remains to put the records into the form of a manuscript to be published as a popular bulletin. The Commissioners have already authorized such a bulletin if it can be freely illustrated and put out in a larger edition, of, say 10,000 copies, so that it may have a wider popular distribution in Connecticut. Such a bulletin would have a considerable educational value for use in schools.

Reptiles of Connecticut. Professor G. H. Lamson, of the Department of Zoology, Connecticut Agricultural College, is now at work on a paper for the Survey on the snakes and turtles of the State. It will be illustrated and will be not only a guide for the identification of the several species occurring in Connecticut, but will contain information about their habits and economic importance. A bulletin containing such information will surely meet a popular demand.

Rusts of Connecticut. Drs. G. P. Clinton, Botanist of the Connecticut Agricultural Experiment Station, and W. R. Hunt, author of Bulletin No. 36, are planning to prepare another paper on the rusts that will supplement Bulletin No. 36, and will contain keys and illustrations to the genera, and also list the species occurring in the State.

The Acarina or Mites of Connecticut. For several years, Dr. Philip Garman has collected and studied the mites occurring in Connecticut, many of which are of economic importance. Some species annoy or live upon animals, and some injure plants. Already Doctor Garman has discovered in Connecticut several European species not before known to occur in the United States. As little is known about these minute animals, it will probably be several years before a comprehensive treatise can be prepared on the subject, but it is hoped that a preliminary report may be submitted at an early date.

The Diptera or Two-winged Flies of Connecticut. With the assistance of Dr. R. B. Friend, Assistant Entomologist of the Agricultural Experiment Station, the Superintendent of the Survey has projected a rather ambitious work on the Diptera similar to that on the Hemiptera, Bulletin No. 34, and to be a part of the same series, Guide to the Insects of Connecticut. Like the Hemiptera, it must be the joint work of a large number of specialists, each treating the family or group in which he is a specialist. As much collecting and study

must be done, considerable time must necessarily elapse — probably five years at least — before the paper can be finished. Some of the assignments have already been made, and certain families could be written up in a short time, but it will be difficult to work up some of the families and groups or even to get anyone to attempt it. Once finished, however, such a work on the Diptera would prove exceedingly useful.

OTHER NEEDED INVESTIGATIONS

In addition to the investigations enumerated above, in geology, there may be need of studies of quartz, feldspar, limestones, sandstones, sand and gravel, all of considerable economic importance in Connecticut.

In zoology, there is need of bulletins on the fishes and Amphibia of the State; also on the sponges, zoophytes, annulata, spiders and mollusks. Smaller groups of birds of great economic importance might well be given detailed treatment in Survey bulletins. There still remain many orders of insects not covered in Survey publications.

In botany, there are several groups of fungi which should be studied and reports issued regarding them. Some of these are the downy mildews, and the fungi occurring on shade and forest trees. There should also be a publication dealing with the native trees and shrubs of Connecticut.

PUBLICATIONS

The Survey has now published 49 bulletins (if we include one now in press) containing 7,657 pages, 462 plates, 748 figures and 20 maps not counting the list of bulletins in the back of each publication. Of this number, 12 bulletins, Nos. 1, 9, 12, 17, 21, 25, 27, 28, 32, 35, 38 and 45, totaling 274 pages, are administrative reports and contain little or no scientific matter. Altogether, 37 bulletins containing scientific matter have been published, with a total of 7,383 pages. Sixteen bulletins, Nos. 4, 6, 7, 8, 13, 18, 23, 24, 29, 30, 33, 40, 41, 44, 46 and 47, deal with geology and contain 2,113 pages, 169 plates, 305 figures, and 7 maps, many small maps being numbered as figures. Eleven bulletins, Nos. 3, 5, 10, 11, 14, 15, 36, 37, 42, 43 and 48, deal with botany and contain 1,739 pages, 156 plates and 55 figures. Nine bulletins, Nos. 2, 16, 19, 20, 22, 26, 31, 34 and 39, deal with zoology and contain 3,380 pages, 129 plates and 380 figures. Five of the zoology bulletins, Nos. 16, 22, 31, 34 and 39, are devoted to insects and contain 2,528 pages, 63 plates and 267 figures. One bulletin now in press, No. 49, does not belong in geology, botany or zoology and it is here placed

under geography. It contains 151 pages, 6 figures and 13 maps.

The following list gives the number, title, author, number of pages and illustrations of each bulletin which the Survey has published up to this time:

BULLETINS

1. First Biennial Report of the Commissioners of the State Geological and Natural History Survey, 1903-1904; 18 pp., 23 cm., 1904.
2. A Preliminary Report on the Protozoa of the Fresh Waters of Connecticut: by Herbert William Conn, Ph.D.; 69 pp., 34 pls., 23 cm., 1905. (*Out of print as a separate bulletin. To be obtained only in Vol I, containing Bulletins 1-5. Price \$1.75 postpaid.*)
3. A Preliminary Report on the Hymeniales of Connecticut: by Edward Albert White, B.S.; 81 pp., 40 pls., 23 cm., 1905. (*Out of print as a separate bulletin. To be obtained only in Vol. I, containing Bulletins 1-5. Price \$1.75 postpaid.*)
4. The Clays and Clay Industries of Connecticut: by Gerald Francis Loughlin, S.B.; 121 pp., 13 pls., 23 cm., 1905.
5. The Ustilagineae, or Smuts, of Connecticut: by George Perkins Clinton, S.D.; 45 pp., 55 figs., 23 cm., 1905.
6. Manual of the Geology of Connecticut: by William North Rice, Ph.D., LL.D., and Herbert Ernest Gregory, Ph.D.; 273 pp., 31 pls., 22 figs. (10 maps), 23 cm., 1906. (*Out of print and cannot be supplied.*)
7. Preliminary Geological Map of Connecticut: by Herbert Ernest Gregory, Ph.D., and Henry Hollister Robinson, Ph.D.; 39 pp., 2 maps (1 in pocket), 23 cm., 1907. (*Out of print and cannot be supplied.*)
8. Bibliography of Connecticut Geology: by Herbert Ernest Gregory, Ph.D.; 123 pp., 23 cm., 1907.
9. Second Biennial Report of the Commissioners of the State Geological and Natural History Survey, 1905-1906; 23 pp., 23 cm., 1906.
10. A Preliminary Report on the Algae of the Fresh Waters of Connecticut: by Herbert William Conn, Ph.D., and Lucia Washburn (Hazen) Webster, M.S.; 78 pp., 44 pls., 23 cm., 1908.
11. The Bryophytes of Connecticut: by Alexander William Evans, Ph.D., and George Elwood Nichols, B.A.; 203 pp., 23 cm., 1908.
12. Third Biennial Report of the Commissioners of the State Geological and Natural History Survey, 1907-1908; 30 pp., 23 cm., 1908.
13. The Lithology of Connecticut: by Joseph Barrell, Ph.D., and Gerald Francis Loughlin, Ph.D.; 207 pp., 6 tables, 23 cm., 1910.
14. Catalogue of the Flowering Plants and Ferns of Connecticut growing without cultivation: by a Committee of the Connecticut Botanical Society consisting of Charles Burr Graves, A.B., M.D., Edwin Hubert Eames, M.D., Charles Humphrey Bissell, Luman Andrews, Edgar Burton Harger, Ph.B., and Charles Alfred Weatherby, A.M.; 569 pp., 23 cm., 1910.
15. Second Report on the Hymeniales of Connecticut: by Edward Albert White, B.S.; 70 pp., 28 pls., 23 cm., 1910.

16. Guide to the Insects of Connecticut: prepared under the direction of Wilton Everett Britton, Ph.D. Part I. General Introduction: by Wilton Everett Britton, Ph.D. Part II. The Euplexoptera and Orthoptera of Connecticut: by Benjamin Hovey Walden, B.Agr.; 169 pp., 11 pls., 16 figs. (1 map), 23 cm., 1911.
17. Fourth Biennial Report of the Commissioners of the State Geological and Natural History Survey, 1909-10; 31 pp., 23 cm., 1910.
18. Triassic Fishes of Connecticut: by Charles Rochester Eastman, Ph.D.; 78 pp., 11 pls., 8 figs., 23 cm., 1911.
19. Echinoderms of Connecticut: by Wesley Roswell Coe, Ph.D.; 152 pp., 32 pls., 29 figs., 23 cm., 1912.
20. The Birds of Connecticut: by John Hall Sage, M.S., and Louis Bennett Bishop, M.D., assisted by Walter Parks Bliss, M.A.; 370 pp., 23 cm., 1913.
21. Fifth Biennial Report of the Commissioners of the State Geological and Natural History Survey, 1911-1912; 27 pp., 23 cm., 1912.
22. Guide to the Insects of Connecticut: prepared under the direction of Wilton Everett Britton, Ph.D. Part III. The Hymenoptera, or Wasp-like Insects, of Connecticut; by Henry Lorenz Viereck, with the collaboration of Alexander Dyer MacGillivray, Ph.D., Charles Thomas Brues, M.S., William Morton Wheeler, Ph.D., and Sievert Allen Rohwer; 824 pp., 10 pls., 15 figs., 23 cm., 1916.
23. Central Connecticut in the Geologic Past: by Joseph Barrell, Ph.D.; 44 pp., 5 pls., 23 cm., 1915.
24. Triassic Life of the Connecticut Valley: by Richard Swann Lull, Ph.D.; 285 pp., 3 maps, 12 pls., 126 figs., 23 cm., 1915.
25. Sixth Biennial Report of the Commissioners of the State Geological and Natural History Survey, 1913-1914; 24 pp., 23 cm., 1915.
26. The Arthrostraca of Connecticut: by Beverly Waugh Kunkel, Ph.D.; 261 pp., 84 figs., 23 cm., 1918.
27. Seventh Biennial Report of the Commissioners of the State Geological and Natural History Survey, 1915-1916; 17 pp., 23 cm., 1917.
28. Eighth Biennial Report of the Commissioners of the State Geological and Natural History Survey, 1917-1918; 21 pp., 23 cm., 1919.
29. The Quaternary Geology of the New Haven Region, Connecticut: by Freeman Ward, Ph.D.; 80 pp., 9 pls., 17 figs., 23 cm., 1920.
30. Drainage Modifications, and Glaciation in the Danbury Region, Connecticut: by Ruth Sawyer Harvey, Ph.D.; 59 pp., 5 pls., 10 figs., 23 cm., 1920.
31. Check List of the Insects of Connecticut: by Wilton Everett Britton, Ph.D.; 397 pp., 23 cm., 1920.
32. Ninth Biennial Report of the Commissioners of the State Geological and Natural History Survey, 1919-1920; 18 pp., 23 cm., 1920.
33. Geology of the Stonington Region, Connecticut: by Laura Hatch Martin, Ph.D.; 70 pp., 1 map, 8 figs., 23 cm., 1925.

34. Guide to the Insects of Connecticut: prepared under the direction of Wilton Everett Britton, Ph.D. Part IV. The Hemiptera or Sucking Insects of Connecticut: by Wilton Everett Britton, Ph.D., with collaboration of James Francis Abbott, Ph.D., Arthur Challen Baker, Ph.D., Harry Gardner Barber, A.M., William Thompson Davis, Dwight Moore DeLong, Ph.D., William Delbert Funkhouser, Ph.D., Harry Hazelton Knight, Ph.D., Asa Chandler Maxson, Herbert Osborn, D.Sc., Howard Madison Parshley, Sc.D., Edith Marion Patch, Ph.D., Louis Agassiz Stearns, M.Sc., José Rollin de la Torre-Bueno, F.E.S., Edward Payson Van Duzee, Harley Frost Wilson, M.S.; 807 pp., 20 pls., 169 figs., 23 cm., 1923.
35. Tenth and Eleventh Biennial Reports of the Commissioners of the State Geological and Natural History Survey, 1921-1924; 17 pp., 23 cm., 1924.
36. The Uredinales or Rusts of Connecticut and Other New England States: by Willis Roberts Hunt, Ph.D.; 198 pp., 2 figs., 23 cm., 1926.
37. Catalogue of the Lichens of Connecticut: by Alexander William Evans, Ph.D., and Rose Meyrowitz, M.S.; 56 pp., 23 cm., 1926.
38. Twelfth Biennial Report of the Commissioners of the State Geological and Natural History Survey, 1925-1926; 23 pp., 1 pl., 23 cm., 1927.
39. The Odonata or Dragonflies of Connecticut: by Philip Garman, Ph.D.; 331 pp., 22 pls., 67 figs., 23 cm., 1927.
40. The Geology of the Shepaug Aqueduct Tunnel, Litchfield County, Connecticut: by William Macdonough Agar, Ph.D., with a chapter by Robert A. Cairns; 38 pp., 8 pls., 2 maps, 3 figs., 23 cm., 1927.
41. Guide to the Geology of Middletown, Connecticut, and Vicinity: by William North Rice, Ph.D., LL.D., and Wilbur Garland Foye, Ph.D.; 137 pp., 3 pls., 33 figs., 23 cm., 1927.
42. The Algae of Connecticut; by Clarence John Hylander, Ph.D., 245 pp., 28 pls., 23 cm., 1928.
43. The Life Forms of Connecticut Plants and Their Significance in Relation to Climate; by Beulah Ennis, Ph.D.; 100 pp., 20 pls., 23 cm., 1928.
44. Report on the Water Resources of Connecticut, by Roscoe Henry Suttie, C.E.; 168 pp., 7 figs., 23 cm., 1928.
45. Thirteenth Biennial Report of the Commissioners of the State Geological and Natural History Survey, 1927-1928; 32 pp., 23 cm., 1929.
46. The Physical History of the Connecticut Shoreline: by Henry Staats Sharp, Ph.D.; 97 pp., 8 pls., 28 figs., 23 cm., 1929.
47. The Glacial Geology of Connecticut: by Richard Foster Flint, Ph.D.; 294 pp., 64 pls., 42 figs., 1 map (in pocket), 23 cm., 1929.
48. Additions to the Flora of Connecticut (First Supplement to Bulletin No. 14): by a Committee of the Connecticut Botanical Society consisting of Edgar Burton Harger, Ph.B., Charles Burr Graves, A.B., M.D., Edwin Hubert Eames, M.D., Charles Alfred Weatherby, A.M., Richard William Woodward, A.B., and George Henry Bartlett, Ph.B.; 94 pp., 23 cm., 1930.
49. Public and Semi-Public Lands of Connecticut: by Philip Laurance Buttrick, M.F.; 151 pp., 13 maps, 6 figs., 23 cm., 1930. (In press.)

BOUND VOLUMES

A few hundred copies of each bulletin of the foregoing list have been reserved for binding, and these have been assembled and bound in the following order:

- Volume I, contains Bulletins 1-5.
- II, contains Bulletins 6-12.
- III, contains Bulletins 13-15.
- IV, contains Bulletins 16-21.
- V, contains Bulletin 22.
- VI, contains Bulletins 23-32.
- VII, contains Bulletins 33-35.
- VIII, contains Bulletins 36-42.

WORK DONE IN COÖPERATION WITH THE
UNITED STATES GEOLOGICAL SURVEY

Considerable work has been done by the State Survey in coöperation with the United States Geological Survey. The reports of such investigations have been published by the United States Geological Survey, and are as follows:

REPORT ON GRANITES

Bulletin 484. The Granites of Connecticut, by T. Nelson Dale and Herbert E. Gregory, 137 pp., 12 figs., 7 pls., 1911.

WATER-SUPPLY PAPERS

232. Underground Water Resources of Connecticut, by Herbert E. Gregory, with a study of the occurrence of water in crystalline rocks, by E. E. Ellis, 200 pp., 31 figs., 5 pls., 1909.

374. Ground Water in the Hartford, Stamford, Salisbury, Willimantic, and Saybrook areas, Connecticut, by Herbert E. Gregory, and Arthur J. Ellis, 150 pp., 10 figs., 8 pls., 1916.

In addition to the towns given in title, includes Bloomfield, Canaan, East Hartford, East Windsor, Essex, Franklin, Greenwich, Manchester, Newington, North Canaan, Old Lyme, South Windsor, Westbrook, West Hartford, Wethersfield, Windham, and Windsor.

397. Ground Water in the Waterbury area, Connecticut, by Arthur J. Ellis, 73 pp., 10 figs., 4 pls., 1916.

Also includes Ansonia, Beacon Falls, Middlebury, Naugatuck, Oxford, Seymour, Thomaston, and Watertown.

449. Ground Water in the Meriden area, Connecticut, by Gerald A. Waring, 83 pp., 10 figs., 7 pls., 1920.

Also includes Berlin, Cromwell, Middlefield, Middletown, and Rocky Hill.

466. Ground Water in the Southington-Granby area, Connecticut, by Harold S. Palmer, 219 pp., 30 figs., 7 pls., 1921.

Also includes Avon, Barkhamsted, Bristol, Burlington, Canton, Cheshire, Farmington, Harwinton, Hartland, New Britain, New Hartford, Plainville, Plymouth, Prospect, Simsbury, and Wolcott.

470. Ground Water in the Norwalk, Suffield, and Glastonbury areas, Connecticut, by Harold S. Palmer, 171 pp., 18 figs., 12 pls., 1920.

Also includes Darien, East Granby, Enfield, Marlborough, New Canaan, Ridgefield, Weston, Westport, Wilton, and Windsor Locks.

537. A study of Coastal Ground Water, with Special Reference to Connecticut, by John S. Brown, 101 pp., 20 figs., 6 pls., 1925. Includes a narrow strip and islands along the shore of the towns of Milford, Orange, West Haven, New Haven, East Haven, Branford, Guilford, Madison, and Clinton.

540. Ground Water in the New Haven Area, Connecticut, by John S. Brown, 206 pp., 19 figs., 15 pls., 1928. Includes Milford, Orange, West Haven, New Haven, Woodbridge, Bethany, Hamden, North Haven, East Haven, Branford, North Branford, Wallingford, Guilford, Madison, Killingworth, Durham, Haddam and Chester.

597-B. Ground Water of the Pomperaug Basin, by Oscar E. Meinzer and Norah Dowell Stearns, 146 pp., 9 figs., 9 pls., 1929. Includes Bethlehem, Southbury and Woodbury.

CLASSIFICATION OF SURVEY BULLETINS

From the beginning the Survey bulletins have been of two kinds as follows:

1. Administrative reports.
2. Scientific bulletins.

The former give an account of the organization and policy of the Survey and a report of the progress of the Survey work but contain little or no real scientific matter.

The scientific bulletins have dealt with geology, botany and zoology, and whether consciously or unconsciously have been somewhat evenly divided between these three subjects. Now geography has been added to the list of subjects. The classified list of bulletins by numbers is as follows:

Administrative reports: Bulletins 1, 9, 12, 17, 21, 25, 27, 28, 32, 35, 38 and 45.

Geology: Bulletins 4, 6, 7, 8, 13, 18, 23, 24, 29, 30, 33, 40, 41, 44, 46 and 47.

Botany: Bulletins 3, 5, 10, 11, 14, 15, 36, 37, 42, 43 and 48.

Zoology: Bulletins 2, 16, 19, 20, 22, 26, 31, 34 and 39.

Geography: Bulletin 49 (in press).

DISTRIBUTION OF SURVEY PUBLICATIONS

All bulletins issued by the Survey are distributed by the State Librarian, Mr. George S. Godard, who is the Distribution and Exchange Agent for the Survey. These publications are distributed liberally to colleges and universities, geological and natural history surveys, scientific societies and public libraries.

They are usually sent to scientists who are specializing in the subjects covered by the bulletins. They are also sent freely on request to residents of Connecticut, and particularly, when circumstances permit, to teachers for use in their classes. Other persons may purchase them at prices which barely cover the cost of printing and transportation.

Many important scientific books and papers are received by exchanges and otherwise, and these are deposited in the State Library at Hartford and help to form a most valuable reference collection, which is constantly being increased.

Mr. Godard writes as follows:

"I think the Connecticut Geological and Natural History Survey is to be congratulated on the standard established and subjects already covered in the several bulletins published. The wide and persistent demand which comes from all parts of our country and abroad for certain of these bulletins, some of which are out of print, indicates that the publications are meeting a real need.

"As Distribution and Exchange Agent of the Survey since its establishment, I have been in close personal touch with the requests for, and letters of commendation upon, the several bulletins published by the Connecticut Geological and Natural History Survey, from all parts of the civilized world. Such letters of appreciation would of themselves form an interesting bulletin should they be published. They are certainly appreciated and constitute one form of helpful Connecticut publicity."

The following table shows the date of issue, size of edition, and the number of copies now on hand of each bulletin and bound volume published by the Survey. It will be noted that Bulletins 1, 2, 3, 6, 7, 12 and 28 are already out of print and can be furnished only in the bound volumes. That there is a constant demand for the scientific bulletins is shown by the number of copies on hand, in the right-hand column.

BULLETINS

Bulletin	Date of issue	Size of Edition	Copies on hand
1.....	1904	3,000	Out of print
2.....	1905	3,500	Out of print
3.....	1905	3,500	Out of print
4.....	1905	3,500	183
5.....	1905	3,500	330
6.....	1906	4,000	Out of print
7.....	1907	3,500	Out of print
8.....	1907	3,500	339
9.....	1906	3,000	634
10.....	1908	3,500	293

11.....	1908	3,000	90
12.....	1908	3,000	Out of print
13.....	1910	3,500	134
14.....	1910	4,000	662
15.....	1910	3,500	918
16.....	1911	3,500	399
17.....	1910	3,000	710
18.....	1911	3,500	673
19.....	1912	3,500	1,247
20.....	1913	4,500	623
21.....	1912	3,000	1,188
22.....	1916	3,500	457
23.....	1915	4,000	1,171
24.....	1915	4,000	955
25.....	1915	2,900	220
26.....	1918	3,000	682
27.....	1917	2,900	1,094
28.....	1919	2,500	Out of print
29.....	1920	2,500	921
30.....	1920	2,500	354
31.....	1920	3,000	542
32.....	1920	2,900	418
33.....	1925	2,500	2,129
34.....	1923	3,000	548
35.....	1924	2,500	1,460
36.....	1926	3,000	1,549
37.....	1926	3,000	1,602
38.....	1927	2,500	414
39.....	1927	3,000	889
40.....	1927	3,000	1,430
41.....	1927	3,000	836
42.....	1928	3,000	1,435
43.....	1928	3,000	1,381
44.....	1928	3,000	1,596
45.....	1929	2,500	1,347
46.....	1929	3,000	1,747

BOUND VOLUMES

Volume	Date of issue	Size of Edition	Copies on hand
I.....	1905	600	22
II.....	1908	600	Out of print
III.....	1910	600	177
IV.....	1914	600	207
V.....	1916	600	259
VI.....	1921	400	196
VII.....	1926	300	198
VIII.....	1928	300	188

LEGISLATION ESTABLISHING THE STATE
GEOLOGICAL AND NATURAL HISTORY SURVEY

The State Geological and Natural History Survey was established in 1903 by act of the General Assembly (Chapter 133, Public Acts of 1903) and amended in 1915 (Chapter 185, Public Acts of 1915) to include as one of its commissioners the president of the Connecticut College for Women.

This act as amended is now Sections 2227-2230, Chapter 122, page 759 of the General Statutes, revision of 1930, and reads as follows:

STATE GEOLOGICAL AND NATURAL
HISTORY SURVEY.

SEC. 2227. Appointment and duties of commission. The State Geological and Natural History Survey shall continue to be under the direction of a commission composed of the governor, the president of Yale University, the president of Wesleyan University, the president of Trinity College, the president of the Connecticut Agricultural College and the president of the Connecticut College for Women, or so many of them as shall accept such office, each of whom shall serve without compensation, but shall be reimbursed for expenses incurred in the performance of official duties; and said commissioners shall have general charge of the survey, and shall appoint as superintendent of the same a scientist of established reputation, and such assistants and employees as may be necessary; and they shall also determine the compensation of, and may remove, all persons employed by the commission.

SEC. 2228. Objects of survey. Said survey shall have for its objects: (1) An examination of the geological formation of the state, with special reference to such economic products as building stones, clays, ores and other mineral substances; (2) an examination of the animal and plant life of the state, with special reference to its economic and educational value; (3) the preparation of special maps to illustrate the resources of the state; (4) the preparation of special reports, with necessary illustrations and maps, which shall embrace both a general and detailed description of the geology and natural history of the state.

SEC. 2229. Reports; distribution and sale. Said commissioners shall cause to be prepared a report to the general assembly before each meeting of the same, showing the progress and condition of the survey, together with such other information as they may deem useful or as the general assembly may require. The regular and special reports of the survey, with illustrations and maps, shall be prepared for publication, and, when printed, the reports shall be distributed or sold by the commissioners as the interests of the state and of science may demand, and all moneys obtained by the sale of the reports shall be paid into the state treasury.

SEC. 2230. Disposition of material collected. All material collected, after having served the purposes of the survey, shall be distributed by the commissioners to the educational institutions of the state in such manner as to be of the greatest advantage to the educational interests of the state, or, if deemed advisable by said commissioners, the whole or any part of such material shall be put on permanent exhibition.

FINANCIAL STATEMENT

Receipts

Appropriation for biennial period ending June 30, 1929:

For scientific work	\$6,500.00
For office expenses	1,500.00
Total	\$8,000.00

Expenditures

Salaries and wages	\$5,132.46
Printing and illustrations	76.26
Stationery and office supplies	11.06
Postage	15.82
Telegraph and telephone	2.32
Express	1.68
Scientific apparatus and supplies	36.88
Chemical analyses and rock sections	88.50
Traveling expenses	2,561.32
Miscellaneous	23.94
Total	\$7,950.24
Balance, June 30, 1929	49.76
GRAND TOTAL	\$8,000.00

Receipts

Appropriation for biennial period ending June 30, 1931..... \$8,000.00

Expenditures

Salaries and wages	\$3,171.00
Printing and illustrations	24.44
Stationery and office supplies	40.65
Postage	10.83
Telegraph and telephone	5.95
Express	3.35
Chemical analyses and rock sections	81.00
Traveling expenses	767.47
Total	\$4,104.69
Balance, December 31, 1930	3,895.31
GRAND TOTAL	\$8,000.00

APPROPRIATIONS

At the start in 1902, the Survey appropriation was \$3,000 for the biennial period, and the work was conducted on this basis until 1917, when the General Assembly increased the biennial appropriation to \$6,000. This appropriation was renewed by each General Assembly until 1927, when it was raised to \$8,000, \$6,500 being for scientific work and \$1,500 for office expenses. In 1927 and for 1929, \$10,000 was requested, but not granted nor even recommended by the State Board of Finance and Control. The same amount (\$10,000) was requested in the Budget prepared in 1930, to be acted upon by the General Assembly of 1931, and this time it has the support of the recommendations of the State Board of Finance and Control. In view of the important part which the Survey plays in the scientific and educational work of the State, not to mention its economic aspects, and considering the very large appropriations granted for other purposes, \$10,000 for two years is not excessive and would hardly be felt by the citizens of the State.

COMMISSIONERS

WILBUR LUCIUS CROSS,
Governor of Connecticut
JAMES ROWLAND ANGELL,
President of Yale University
REMSEN BRINCKERHOFF OGLEBY,
President of Trinity College
W. E. BRITTON, *Superintendent*
Connecticut Agricultural Experiment Station
New Haven, Conn.



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Geological and Natural History
Survey
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President of Wesleyan University
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President of Connecticut Agricultural College
MISS KATHARINE BLUNT
President of Connecticut College for Women
GEORGE S. GODARD, *State Librarian*
Distribution and Exchange Agent

FOURTEENTH BIENNIAL REPORT

The Fourteenth Biennial Report of the Commissioners of the State Geological and Natural History Survey, covering the years of 1929 and 1930 has just been issued as Bulletin No. 50. This pamphlet of 26 pages contains notes of progress of the activities of the Survey, brief outlines of four recent bulletins, unpublished manuscripts on hand, researches now in progress, other needed investigations, a list of the publications of the Survey with an inventory of the copies of each remaining in stock, and financial statement. It also contains the law under which the Survey was established, a statement regarding the organization and policy of the Survey and the appropriations that have been made for carrying on its work.

This bulletin will be distributed by the State Librarian, Mr. George S. Godard, Hartford, Conn. Although this bulletin is an administrative report and contains no scientific information, it is intended to follow a liberal policy in gratuitously distributing Survey publications to public libraries, colleges, scientific institutions, and to scientific men, teachers and others who require particular bulletins for their work, especially to those who are citizens of Connecticut. Postage 5 cents. Price to others 10 cents postpaid.

Applications or inquiries should be addressed to

GEORGE S. GODARD,
State Librarian.

Hartford, Connecticut,
April 8, 1931.