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State of Connecticut

EIGHTH BIENNIAL REPORT OF THE
COMMISSIONERS

OF THE

State Geological and Natural
History Survey

1917 - 1918

BULLETIN No. 28

State of Connecticut
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History Survey

HERBERT E. GREGORY, SUPERINTENDENT

BULLETIN NO. 28



HARTFORD
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State Geological and Natural History Survey

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SUPERINTENDENT

HERBERT E. GREGORY

Publication Approved by the Board of Control

EIGHTH BIENNIAL REPORT OF THE COMMISSIONERS

OF THE

State Geological and Natural History Survey of Connecticut

1917 - 1918



HARTFORD
Published by the State
1919

LETTER OF TRANSMITTAL

HARTFORD, CONN., December 28, 1918.

HIS EXCELLENCY, MARCUS H. HOLCOMB,
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, the report of the Superintendent of the work, covering the two years ending December 31, 1918.

Very respectfully,

FLAVEL S. LUTHER,
Secretary of the Commission.

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

SCOPE AND PLAN OF THE STATE SURVEY.

The act of 1903 establishing the Survey proposed two subjects for investigation, viz, the geology of the State, and the natural history, or botany and zoology, of the State. It has been presumed to be the intent of the law that the appropriation should be divided with some approach to equality between geology and biology. The law further specifies three aims with reference to which the work should be prosecuted: first, the purely scientific aim of advancing our knowledge of the geology and natural history of the State; second, the economic aim of leading to the most effective conservation and utilization of the resources of the State; third, the educational aim of promoting the work of the schools of the State by the publication of the results of investigation in a form adapted for the use of teachers.

The plan of organization which was outlined in the first report has been retained. Only one salaried officer has been appointed by the Commissioners, viz, the Superintendent. Other scientific men have been engaged to investigate particular subjects and prepare reports or bulletins thereon. In past years the usual terms of contract with these scientific men have been that the investigator should receive a certain sum as compensation when the bulletin presented was accepted by the Superintendent, and that a certain allowance should also be made for the expenses of the work, the allotment for expenses to be drawn upon from time to time as the expenses were actually incurred. Some contracts have been made to pay the investigator a small sum per diem, a maximum limit being prescribed in every such case.

Experience has demonstrated that the agreements concluded between the Survey and authors have not produced the desired results. Under the old plan the funds allotted to investigators have barely covered necessary expenses, and the time allowed for the completion of a report has been practically unlimited. Consequently, the obligations to the Survey have been considered secondary, and an unreasonable length of time has elapsed between the granting of an appropriation and the publication of results. The delay has resulted in some financial loss and a con-

siderable loss to the scientific interests of the State. With the increase in appropriations for the Survey it has been possible to make such arrangements with scientific workers as to insure active and continuous interest in the problems undertaken. In making new contracts it is the policy of the Superintendent to include an agreement as to the date at which the completed report is to be submitted and to discontinue allotments for projects on which no work has been done for many years.

Each report prepared is published as a separate bulletin, the bulletins being numbered consecutively, generally in the order in which they are received. Each bulletin bears the name of the author or the names of the authors, and each author is responsible for his own work. The bulletins are issued in paper covers, but a part of the edition is reserved for binding. Bulletins 1 to 5 have been bound as Volume I, Bulletins 6 to 12 as Volume II, Bulletins 13 to 15 as Volume III, Bulletins 16 to 21 as Volume IV, and Bulletin 22 as Volume V. The bound volumes are especially desirable for public libraries and similar institutions, in which complete sets of our publications are to be preserved. The pamphlet form, in which each bulletin is complete in itself, is convenient for the large number of students, teachers, and others who have use for some particular bulletin. The publications of the Survey are distributed by the State Librarian. They are given liberally to colleges, public libraries, geological surveys, and other scientific institutions, and to scientific men of repute in the branches of science with which the respective bulletins are concerned. In many cases, books and papers of great value are received in exchange for the publications of the Survey. All books and papers thus received are deposited in the State Library. The publications of the Survey are also distributed liberally to citizens of our own State, particularly to teachers who can make use of them in their work. In the case of persons who are not known as scientific men, and who appear to have no special claim for the donation of the publications of the Survey, the bulletins are sold at prices sufficient to cover the cost of printing and transportation.

BULLETINS PUBLISHED.

The Survey has already published the following bulletins:

1. First Biennial Report of the Commissioners of the State Geological and Natural History Survey, 1903-1904. 1904. 18 pp.
2. A Preliminary Report on the Protozoa of the Fresh Waters of Connecticut, by H. W. Conn. 1905. 69 pp., 34 pls.
3. A Preliminary Report on the Hymeniales of Connecticut, by E. A. White. 1905. 81 pp., 40 pls.

4. The Clays and Clay Industries of Connecticut, by G. F. Loughlin. 1905. 121 pp., 13 pls., 1 fig.
5. The Ustilagineae, or Smuts, of Connecticut, by G. P. Clinton. 1905. 45 pp., 7 pls.
6. Manual of the Geology of Connecticut, by W. N. Rice and H. E. Gregory. 1906. 273 pp., 31 pls., 22 figs.
7. Preliminary Geological Map of Connecticut, by H. E. Gregory and H. H. Robinson. 1907. 39 pp., 1 map, 1 fig.
8. Bibliography of Connecticut Geology, by H. E. Gregory. 1907. 123 pp.
9. Second Biennial Report of the Commissioners of the State Geological and Natural History Survey, 1905-1906. 1906. 23 pp.
10. A Preliminary Report on the Algae of the Fresh Waters of Connecticut, by H. W. Conn and L. W. (Hazen) Webster. 1908. 78 pp., 44 pls.
11. The Bryophytes of Connecticut, by A. W. Evans and G. E. Nichols. 1908. 203 pp.
12. Third Biennial Report of the Commissioners of the State Geological and Natural History Survey, 1907-1908. 1908. 30 pp.
13. The Lithology of Connecticut, by Joseph Barrell and G. F. Loughlin. 1910. 207 pp., 6 tables.
14. Catalogue of the Flowering Plants and Ferns of Connecticut growing without cultivation, by a Committee of the Connecticut Botanical Society. 1910. 569 pp.
15. Second Report on the Hymeniales of Connecticut, by E. A. White. 1910. 70 pp., 28 pls.
16. Guide to the Insects of Connecticut, prepared under the direction of W. E. Britton. Part I, General Introduction, by W. E. Britton. Part II, The Euplexoptera and Orthoptera of Connecticut, by B. H. Walden. 1911. 169 pp., 11 pls., 66 figs.
17. Fourth Biennial Report of the Commissioners of the State Geological and Natural History Survey, 1909-1910. 1910. 31 pp.
18. Triassic Fishes of Connecticut, by C. R. Eastman. 1911. 77 pp., 11 pls., 8 figs.
19. Echinoderms of Connecticut, by W. R. Coe. 1912. 152 pp., 32 pls., 29 figs.
20. The Birds of Connecticut, by J. H. Sage and L. B. Bishop, assisted by W. P. Bliss. 1913. 320 pp.
21. Fifth Biennial Report of the Commissioners of the State Geological and Natural History Survey, 1911-1912. 1912. 27 pp.
22. Guide to the Insects of Connecticut, prepared under the direction of W. E. Britton. Part III, The Hymenoptera, or Wasp-like Insects of Connecticut, by Henry Lorenz Vierick in collaboration with A. D. MacGillivray, C. T. Brues, W. M. Wheeler, and S. A. Rohwer. 1916. 824 pp., 10 pls., 15 figs.
23. Central Connecticut in Geologic Time, by Joseph Barrell. 1915. 44 pp., 9 figs.
24. Triassic Life of the Connecticut Valley, by R. S. Lull. 1915. 285 pp., 12 pls., 3 maps, 126 figs., 1 section.

25. Sixth Biennial Report of the Commissioners of the State Geological and Natural History Survey, 1913-1914. 1915. 24 pp.

26. The Arthrostraca of Connecticut, by Beverly Waugh Kunkel. 1918. 261 pp., 84 figs.

27. Seventh Biennial Report of the Commissioners of the State Geological and Natural History Survey, 1915-1916. 1917. 17 pp.

Interest in these publications and their usefulness to the people of Connecticut is indicated to some degree by the number of requests for copies. The following summary is furnished by the State Librarian:

Bulletin	Date issued	Number of copies printed	Number of copies now on hand
1.....	1904	3,000	8
2.....	1905	3,500	Out of print
3.....	1905	3,500	140
4.....	1905	3,500	325
5.....	1905	3,500	400
6.....	1906	4,000	Out of print
7.....	1907	3,500	100
8.....	1907	3,500	440
9.....	1906	3,000	210
10.....	1908	3,500	615
11.....	1908	3,000	740
12.....	1908	3,000	27
13.....	1910	3,500	1,000
14.....	1910	4,000	1,000
15.....	1910	3,500	1,400
16.....	1911	3,500	1,000
17.....	1910	3,000	500
18.....	1911	3,500	800
19.....	1912	3,500	1,300
20.....	1913	4,500	1,000
21.....	1912	3,000	1,200
22.....	1916	3,500	1,300
23.....	1915	4,000	1,600
24.....	1915	4,000	1,200
25.....	1915	2,900	200
26.....	1918	3,000	Not yet distributed
27.....	1917	2,900	75
Vol. I	} 600 copies of each bulletin as listed above used for binding		280
" II			232
" III			294
" IV			338
" V			425

The editions of Bulletins 2 and 6 are exhausted for distribution purposes, as is also the Geological Map mounted for use on walls, accompanying Bulletin 7. The State Librarian remarks:

"Bulletin 2 has been and still is very popular, judging from the requests received. Bulletin 6, Manual of the Geology of

Connecticut, should certainly be reprinted, as it has been out of print some time and is a popular bulletin, perhaps the most popular of those issued."

Copies of all bulletins may still be obtained in bound volumes. The publications made in co-operation with the United States Geological Survey are given on page 14.

Since the last Biennial Report, Bulletins 22 and 26 have been published. Bulletin 22, The Hymenoptera, or Wasp-like Insects, of Connecticut, is Part III of a Guide to the Insects of Connecticut (Parts I and II appeared as Bulletin 16), and was prepared under the direction of Wilton Everett Britton, State Entomologist and Entomologist of the Connecticut Agricultural Experiment Station, by Henry Lorenz Viereck, Assistant Biologist, United States Biological Survey, in collaboration with A. D. MacGillivray, Associate Professor of Systematic Entomology, University of Illinois; C. T. Brues, Instructor in Economic Entomology, Bussey Institution, Harvard University; W. M. Wheeler, Professor of Economic Entomology, Bussey Institution, Harvard University; and S. A. Rohwer, Specialist in Forest Hymenoptera, United States Bureau of Entomology. It is an exhaustive presentation of the subject, all Hymenoptera so far found in the State being listed; it has 824 pages, and many requests for reproduction in other scientific papers have come for several of its 25 illustrations.

According to some authorities, the Hymenoptera, which include ants, wasps, bees, etc., comprise the largest and most specialized order of insects. The species differ widely in form and habit; some are of economic value because they are parasitic on injurious insects (which suggests a plan to breed such parasites for the purpose of destroying injurious insects); some, because they pollinate flowers; and others, because they produce honey.

Bulletin 26, The Arthrostraca of Connecticut, by Beverly Waugh Kunkel, Professor of Biology at Lafayette College, treats of the sessile-eyed Crustacea; Amphipoda, which have bodies flattened laterally, and Isopoda, flattened dorso-ventrally. A few species destroy submerged timbers, which they use for food and shelter, and some of the terrestrial Isopoda damage vegetation. But many are helpful as scavengers along the shore. They occur in great numbers and form a large part of the food of edible fishes. The bulletin has descriptions and figures of native forms and a general account of the anatomy and biology of this group of Crustacea.

BULLETINS ACCEPTED FOR PUBLICATION.

On account of the abnormal cost of printing and of the desirability of curtailing expenses not connected with the war, no requests for approval of publication of Survey Bulletins were made to the Board of Control during the years 1917-18. Four bulletins previously accepted by the Superintendent have been editorially revised and are now ready for the press. They are as follows:

A Check-list of Insects of Connecticut, by Wilton Everett Britton, will be of value to institutions as well as to individuals in the identification of insects in the State. As Mr. Britton has been assisted in his work of records and identification of species by collectors and specialists in entomology in and near Connecticut, the list, though necessarily incomplete, is believed to be accurate. It has been preceded by Bulletins 16 and 22 of this Survey, which also deal with the insects of the State, and is to be followed by another now in preparation dealing with Hemiptera.

A paper on the Quaternary Geology of the Southern Lowland of Connecticut has been prepared by Freeman Ward. It consists of descriptions of the preglacial, glacial, and postglacial conditions of the New Haven region and also of descriptions of the land formation, composition, and the causes thereof.

A paper has been prepared by Miss Ruth Sawyer Harvey on Drainage and Glaciation in the Central Housatonic Basin. The streams in this basin vary from the normal type and are discussed in relation to their geologic history. A general description of the region centering at Danbury is given from a geologic standpoint.

The Physical Geography and Geology of the Pawcatuck Valley has been prepared by Miss Laura Hatch. Its aim is to give a complete geologic and physiographic description of a region which contains type physiographic and petrographic features. A description of the area about Westerly, Rhode Island, is included.

Arrangements were made in previous years for the preparation of several bulletins which have not reached completion. Their status is as follows:

The Decapods of Connecticut, by A. E. Verrill. The introduction and the systematic portion have been completed, making over 200 printed pages, and 111 illustrations have been prepared. A bibliography is to accompany the report, which otherwise is nearly complete.

Hemiptera of Connecticut. Ten zoologists, under the direction of W. E. Britton, are contributing to this work, which is nearly completed.

The Bacteria of the Fresh Waters of Connecticut, by H. W. Conn and L. R. (Potter) Hedenburg. The first draft of this work was submitted to the Superintendent and later recalled for extensive revision. At the time of his death, April 18, 1917, the manuscript had not been finished by Professor Conn, and it is unlikely that it can be prepared for publication by another student of bacteriology. Professor Conn is the author of the first scientific report of the State Survey—a paper which has found wide use.

Report on Thames River Terraces, by F. P. Gulliver. The request of the author to be released from his obligations to complete the proposed work on the region about Norwich and New London has been granted.

Peat Deposits of Connecticut, by C. A. Davis, assisted by E. C. Miller and T. T. Giffen. Under the direction of Professor William North Rice, formerly Superintendent of the Connecticut Survey, an investigation of the peat resources of the State was made from July to October, 1907, and continued during 1908, 1909, and 1914. This work was placed in charge of C. A. Davis, the foremost American authority on occurrence and utilization of peat. All the swamps, both fresh and salt water, of the State were studied and the amount and character of the deposits determined by specially devised sounding apparatus. The field work was supplemented by chemical analyses and microscopic studies and by tests of the value of the product as fuel and as fertilizer. It was pioneer work of high grade, and the methods of study developed have been successfully employed elsewhere. At the time of his death in April, 1916, the completed report had been in the hands of Professor Davis for nearly two years awaiting final revision. A thorough but fruitless search for this manuscript has been made. Fortunately, some of the field notebooks and maps remain, but there is little hope that material for publication can be obtained without practically taking up the work anew.

COOPERATION WITH THE UNITED STATES GEOLOGICAL SURVEY.

During the years 1911 to 1917 the State Geological and Natural History Survey cooperated with the United States Geological Survey in a study of the water resources of Connecticut. During this time, 69 towns, which comprise 35 per cent of the area of the State and include 50 per cent of its population, were surveyed.

The list of towns covered by this investigation is given in Bulletin 27, page 13, of the State Survey. Further work was discontinued on June 30, 1917, for the duration of the war. It is desirable to resume work and complete the investigation in the near future.

By the terms of the contract, the United States Geological Survey assumed responsibility for the prosecution of the work, and Herbert E. Gregory, Geologist of the Federal Survey, was appointed to direct the investigations. The purpose of the series of studies is to determine the position, amount, and quality of the waters—particularly underground waters—of the State of Connecticut and to discuss their economic utilization. The value of such studies depends upon their usefulness not only to communities using a common supply, but to individual landholders, and the preparation of reports has, therefore, involved detailed mapping and local descriptions. The position of ground water with reference to the land surface has been determined, areas of open field, forest, rock, and types of glacial soil have been outlined; water from springs, wells, and brooks has been analyzed; and studies of the most economical and sanitary supplies for farms and villages have been made. By description and discussion in the text, by tabulation of statistics and representation of data on maps and sections, the conclusions of the authors regarding amount, quality, and availability of water supply of each town are given.

By agreement, the results of these investigations of the water resources of Connecticut are to be published as water-supply papers of the United States Geological Survey, and the expense of publication is to be met by the Federal Treasury. Each water-supply paper will bear the title: "Prepared in Cooperation with the Connecticut Geological and Natural History Survey," and the contract reserves the right of the State of Connecticut to publish or republish all or parts of the reports.

The following publications have appeared:

Ground Water in the Hartford, Stamford, Salisbury, Willimantic, and Saybrook Areas, Connecticut, by H. E. Gregory and A. J. Ellis. Water-Supply Paper 374, 1916. 150 pp., 13 pls., 10 figs.

Ground Water in the Waterbury Area, Connecticut, by A. J. Ellis. Water-Supply Paper 397, 1916. 73 pp., 4 pls., 10 figs.

Water-Supply Paper 374 represents the first systematic attempt to investigate the ground water in the State. The area described covers 715 square miles and includes the towns of Hartford, West Hartford, Newington, Wethersfield, East Hartford, Manchester, Windsor, East Windsor, South Windsor, Bloomfield, Stamford, Greenwich, Salisbury, Canaan, North Canaan, Wind-

ham, Franklin, Saybrook, Essex, Westbrook, and Old Lyme. The aim of the paper is to show how much water is stored underground, how the supply fluctuates, what its quality is, how it can be procured, and how much can be secured from streams.

Water-Supply Paper 397 covers work on an area of about 171 square miles, and includes the towns of Ansonia, Seymour, Oxford, Beacon Falls, Naugatuck, Middlebury, Waterbury, Watertown, Thomaston. This region is rich in good water-power sites and well provided with water for municipal supplies, but the conflicting demands of water users have given rise to local problems of conservation. This report records facts and recommendations on which regulations for the use of water may be based.

These publications and also Water-Supply Paper 232, by H. E. Gregory, Underground Water Resources of Connecticut, which deals with the State as a whole, may be obtained free of charge from the Director, United States Geological Survey, Washington, D. C.

The call for these studies of water resources of the State is somewhat greater than for many similar public documents. The first edition of Water-Supply Paper 232, issued in 1909, was exhausted, and of the second printing 330 copies were in stock on December 1, 1918. Seventy-five copies of Water-Supply Paper 374, issued in 1916, and 100 copies of Water-Supply Paper 397, issued in 1916, were on hand December 1, 1918.

Papers in process of publication are the following:

Waters of the Pomperaug Valley, Connecticut, by A. J. Ellis. (Manuscript in preparation.) This report is based on field work done in 1913 and a series of stream, well, precipitation, and evaporation measurements carried on continuously from May, 1913, to December, 1916, by Ernest W. Parkin, George A. Parkin, and Ralph V. Wooden, under the direction of A. J. Ellis and H. S. Palmer. About 10 per cent of this report has been prepared.

Ground Water in the Meriden Area, Connecticut, by Gerald A. Waring. (Manuscript completed.) This report covers the towns of Meriden, Berlin, Middlefield, Middletown, Cromwell, and Rocky Hill. It includes chapters on the geography and geology of each town and discusses the water supplies in detail under the headings: water in till, water in stratified drift, water in bed-rock, springs, wells, quality of water. This report is with the editors awaiting the preparation of the illustrations.

Water Resources of the Cheshire-Granby Area, Connecticut, by Harold S. Palmer. (Manuscript completed.) This report treats of the geography, surface geology, and water resources of the following towns: Cheshire, Prospect, Southington, Wolcott. New

Britain, Plainville, Bristol, Plymouth, Farmington, Avon, Burlington, Harwinton, Simsbury, Canton, New Hartford, Granby, Barkhamsted, and Hartland. This report is with the editors awaiting the preparation of the illustrations.

Ground Waters of the Suffield, Glastonbury, and Norwalk Areas, Connecticut, by Harold S. Palmer. (Manuscript completed.) The towns covered by this report are Suffield, East Granby, Windsor Locks, Enfield; Glastonbury, Marlborough; Norwalk, Darien, New Canaan, Westport, Weston, Wilton, and Ridgefield, which were surveyed in 1916. The report is awaiting editing and approval for printing.

These reports are for general distribution and when published may be obtained free of charge by addressing: Director, United States Geological Survey, Washington, D. C.

The total expense to the State of Connecticut for the six years' investigation of water resources under the cooperative agreement is \$6,000. The Federal Government has expended an equal amount in addition to the cost of supervision and administration and the large expense of publication.

It is believed that this work, probably the most exhaustive study of a water-supply problem so far undertaken for a large area, has high value. The publications record basal studies whose results will become more useful as the population increases and problems of water rights and of sanitation become more complicated.

MILITARY MAPPING.

Previous to 1917 practically no attention had been given by Federal or State surveys to the organization of geological and geographical information for military purposes. Military mapping, which is a prominent feature of scientific work in European countries, had not been undertaken. The declaration of war in the spring of 1917 called attention to the dearth of information regarding road materials, water supply, the nature of the sea coast, and other geographic matters of large military importance. It was also found that the few American Army officers who possessed the necessary training for geologic work were urgently needed for other duties. To meet the emergency, the Council of National Defense, acting through the National Research Council, undertook to procure for the Engineer Corps of the Army reliable information regarding materials for road making and fortification construction along the Atlantic seaboard, and to make this information available at the earliest possible moment by the preparation of a series of confidential reports and maps covering

the States along the Atlantic and Gulf borders from Maine to Texas. The Superintendent of the State Survey was asked to serve as a member of the committee in charge of this work, and the Survey was asked to assume responsibility for providing the military authorities with desired information regarding Connecticut.

After consultation with the Governor and other members of the Commission, it was decided to undertake this work as a contribution of the State to national needs and to use such part of the Survey appropriation as was necessary for this purpose. Work was begun May 1, 1917, and the completed report and maps were submitted on September 1, 1917. During the three months that the work was in progress, the field force, in addition to the Superintendent, included the following men:

Kirk Bryan, instructor in geology, Yale University, now with the Army Engineer Corps in France, served until called for work on the Mexican border on July 1.

Chester R. Longwell, instructor in geology, Yale University, now Captain of Artillery in France, was in the field from June 18 until called to Plattsburg on August 21.

M. H. Bissell, graduate student in geology, was engaged in field work and drafting from June 1 to September 1.

Malcolm R. Thorpe carried on field work on the islands in Long Island Sound during July and August.

Joseph Barrell, professor of geology, Yale University, was in the field four days in June.

W. L. Barrows, professor of geology at Trinity College, was engaged in the study of gravel deposits from June 1 to July 18.

W. E. Ford, assistant professor of mineralogy in the Sheffield Scientific School, offered his services and began work, but at the request of the committee was transferred to Maine, where his services were much needed.

In addition to the contributions of the Survey field staff, valuable material for the final report was furnished by the Highway Commission, the Connecticut Company, and the New York, New Haven & Hartford Railroad Company. Data obtained by the Survey in the course of its regular work in past years was also utilized.

The estimated cost of the work was \$2,500, the actual cost was \$788.94. This unexpected saving was made possible by the attitude of Mr. Bryan, Professors Barrows, Ford, and Barrell, and Mr. Thorpe, who rendered service without remuneration, and by the cooperation of the United States Geological Survey and of Mr. Lucius Storrs, president of the Connecticut Company, who furnished expensive base maps.

The report and military map of the Connecticut coast is at present considered confidential, and a description of its contents is, therefore, not permissible. It is kept on file in Washington and has been used by the National Research Council, the Highways Transport Committee, and the Shipping Board. Abstracts have been made by various military departments and State divisions. The report has given rise to considerable correspondence and a number of letters of commendation. Permission has been granted to publish the following:

November 26, 1918.

Professor Herbert E. Gregory, Superintendent,
Geological and Natural History Survey of Connecticut,
Yale University, New Haven, Conn.

Sir:—The War Department has found that the material gathered by the Geological and Natural History Survey forces has been of considerable value as military information in the military mapping program now in process. Particularly has the data been of value on road materials, including existing and possible sites.

Such data should be of great advantage to a military commander in times of emergency, which would require rapid transportation, with the resulting necessity of good military roads in that part of the United States.

Very respectfully,
W. M. BLACK,
Major General, Chief of Engineers
By:
(Signed) E. H. MARKS,
Colonel of Engineers.

OTHER STATE SURVEY WORK.

In accordance with the vote of the Commissioners, taken by letter December, 1917, arrangements were made with Dr. George E. Nichols for the preparation of a bulletin on the Ecology of Connecticut, a study of types of vegetation and their distribution with reference to soil, topography, and water. Such an investigation is desirable for scientific purposes and furnishes basal data for reclamation of abandoned lands and utilization of swamp lands. During the past summer one and one-half months were devoted to field work; the remainder of the time at the disposal of Dr. Nichols was required for studies of the occurrence and availability of sphagnum moss suitable for surgical dressings.

A bulletin on the Snakes of Connecticut, for which provision was made by the Commissioners in June, 1917, is being prepared by E. Burlingham Schurr, formerly curator of the Museum of Natural History and Art, New Britain, Connecticut.

The Superintendent has assisted the United States Geological Survey and the War Industries Board in the search for pyrite,

graphite, mica, high-grade clay, and sand for optical glass in accordance with a program for the investigation of war minerals. An unusually large number of inquiries regarding the mineral and quarry resources of the State have been received, and advice has been given to individuals and corporations outside of Connecticut in regard to suitable locations for manufacturing plants which plan to make large use of gravel, trap rock, and clay or peat.

At the request of the Committee on Appropriations and the Board of Control, the Superintendent has acted as adviser to various State commissions in matters relating to selection of sites for buildings, development of water supplies, and location of construction materials. At the request of the Governor he has served as a member of the committee on selecting a site for the proposed new State Prison.

PLANS FOR FUTURE WORK.

I. Geology.

The geology and physical geography of Connecticut possess features of unusual interest. The bulletins already published, the Manual of Geology, the Geological Map, Clays and Clay Industries, Triassic Life, and other reports, have been found useful. It is desirable to continue geologic investigation to include other and more detailed studies of areas and special problems. Among the bulletins which should be prepared are the following:

Connecticut during the Ice Age. An explanatory description of the surface deposits, lakes, waterfalls, eskers, drumlins, and other topographic features for which the glaciers of Pleistocene time are responsible. Requests for the publication of such a report have come from teachers and other citizens.

Igneous and Metamorphic Rocks of Selected Areas. The structure and composition of the rocks of eastern and of western Connecticut are exceedingly complex, but the solution of the problems which they present is very desirable as a contribution to the geologic history of the United States. A tentative agreement for undertaking such studies has been made with Professor W. G. Foye of Wesleyan University.

Mineralogy of Connecticut. A descriptive list of the minerals of the State, their occurrence, their geologic relations, and economic value.

Physical Geography. A number of papers of moderate size dealing with the geographic factors concerned with the location of cities, of routes of travel, and the development of industries

would find a useful place. The reports should be made of type localities and eventually combined to form a bulletin on the physical geography of the State. Professor Rice has indicated his willingness to prepare a paper on the Middletown region, and tentative arrangements have been made for the study of other areas.

Feldspars of Connecticut. A bulletin describing the location and extent of feldspar deposits and their availability for commercial purposes.

Road-making Materials. A study of rocks of the State with reference to their suitability for use as crushed stone for road construction and concrete.

II. Botany.

The systematic botany of the flowering plants of southern New England is comparatively well known and a list of flowering plants and ferns of Connecticut has been published by the Survey. Of the flowerless plants, the mosses, liverworts, fungi, fresh-water algæ and bacteria have been treated in Survey reports, which have received high commendation. Work on the Ecology of the State is now in progress. Bulletins on the following subjects would be welcomed by students and investigators:

The Marine Algæ of the Connecticut Shore
The Lichens of Connecticut

The work done in past years on the swamps and the peat deposits of the State by C. A. Davis and others should be taken up anew in cooperation with the United States Department of Agriculture and Federal committees on land reclamation and drainage. There is an increasing interest in these subjects.

III. Zoology.

Bulletins on the birds of Connecticut, on the fresh-water Protozoa, on the Echinoderms, on the Amphipods and Isopods, and two parts of a Guide to the Insects of Connecticut have been published. Professor Verrill reports that his paper on the Crustacea is nearing completion. It is desirable that in future years bulletins should appear on mammals, fishes, reptiles, Amphibia, and on selected species of marine fauna. Their publication is desirable from both educational and economic viewpoints.

APPROPRIATION DESIRED.

In the last Biennial Report attention was called to the difficulty experienced in conducting the Survey on the meager appropriation granted in previous years, and the conclusion was reached that

"It will be impossible to continue the work permanently on this basis. To offer a man of high scientific attainments \$50 or \$100 for an authoritative report on an investigation which may require his unoccupied time for two or three years is to demand a large public service with very little recognition. It is doubtful if the good will of such men as the Survey desires to employ can be treated as an asset for an indefinite length of time under conditions like this. If the work of the Survey is to be carried on in an efficient manner a biennial appropriation of at least \$5,000 will soon become essential."

It is a pleasure to state that the views of the Commission met with a sympathetic response. Following a conference with the Committee on Appropriations and the Board of Control, at which the function of the Survey was somewhat fully discussed, an appropriation of \$6,000 for the years 1917-19 was recommended and later voted by the Legislature. Because of conditions arising out of the war, care has been taken to reduce the expenditures by eliminating proposed work, by accepting a large amount of voluntary service from individuals, and by cooperation with State and Federal agencies. It is, therefore, not unlikely that a considerable part of the present appropriation will remain unexpended. It is desirable, however, that the scientific and educational problems which come within the scope of the Survey be again taken up and completed. In order to do this the appropriation of \$6,000 for the present biennium should be renewed for the years 1919-21.