STATE OF CONNECTICUT

THIRTY-FIRST

BIENNIAL REPORT

OF THE COMMISSIONERS

OF THE

STATE GEOLOGICAL AND NATURAL HISTORY SURVEY

1963-1965

STATE GEOLOGICAL AND NATURAL HISTORY SURVEY
OF CONNECTICUT
A DIVISION OF THE DEPARTMENT OF AGRICULTURE AND
NATURAL RESOURCES

1965

BULLETIN 98

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OF CONNECTICUT
A Division of the Department of Agriculture
and Natural Resources

Honorable John N. Dempsey, *Governor of Connecticut*
Joseph N. Gill, *Commissioner of the Department of Agriculture and Natural Resources*

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February 16, 1965

Honorable John N. Dempsey
Governor of Connecticut
State Capitol
Hartford, Connecticut

Dear Governor Dempsey:

I have the honor to transmit to you, herewith, on behalf of the Commissioners of the State Geological and Natural History Survey, in compliance with past custom, the Thirty-first Biennial Report of the Survey, covering the two years ending December 31, 1964.

This report which has been prepared by Dr. Joe Webb Peoples for the Commissioners, summarizes the notable progress made by the Survey in the geologic mapping of the state and in the natural history program. It also points out the need for an increased appropriation to accelerate the geologic mapping program, to publish general material on both geology and natural history, and to prepare topical economic studies.

Sincerely yours,

Joseph N. Gill

Joseph N. Gill
Commissioner of Agriculture
and Natural Resources

The price of this Bulletin is 25¢. Additional copies may be ordered from the State Librarian, Hartford, Connecticut 06115 (postpaid; Connecticut residents must add 3½ percent sales tax). Like all publications of the Connecticut Geological and Natural History Survey, one copy is available, free of charge, to public officials, exchange libraries, scientists, and teachers, who indicate to the State Librarian, under their official letterhead, that it is required for professional work. A List of Publications of the State Survey is also available from the State Librarian on request.

THIRTY-FIRST BIENNIAL REPORT OF THE COMMISSIONERS OF THE STATE GEOLOGICAL AND NATURAL HISTORY SURVEY

1963-1965

HISTORY AND ORGANIZATION

The State Geological and Natural History Survey was created by the 1903 statutes of the General Assembly (Chapter 133, Public Acts of 1903) as amended in 1915 (Chapter 185) and 1945 (H.B. No. 1145, P.A. No. 301, Sect. 2227). These statutes set up a board of Commissioners to be in general charge of the Survey. This Commission includes the Governor of the State, and five active scientists, appointed by the presidents of Connecticut College, Trinity College, University of Connecticut, Wesleyan University, and Yale University. (Currently the scientific members of the Commission include two geologists, two biologists, and a botanist.) Each Commissioner serves "without further appointment until his removal from the state, death, or resignation, unless sooner removed for cause." The Commissioners choose as Director of the Survey one of the appointed members of the Commission. (Pertinent portions of the statutes are quoted in the Appendix, which also includes a list of the Superintendents or Directors of the Survey since its inception.)

Public Act No. 637 of the January 1959 Assembly placed the Geological and Natural History Survey in the newly organized Department of Agriculture and Natural Resources.

The Connecticut Survey, one of 48 state geological surveys, shares with those of New Hampshire and Vermont the distinction of having no full-time professional employee. Three other state surveys have only one full-time employee each, six have more than 25 professional employees, and one has a total of 71. In 1963, the Connecticut Survey ranked 42nd in amount of appropriation, which ranged among the 48 state surveys from $1,229,000 to $3,992.

The state surveys differ widely in scope as well as in appropriation. Very few have, as that of Connecticut does, a natural-history function as well as a geological one. A majority have ground-water studies and many cooperate with the U. S. Geological Survey in topographic mapping. Studies and administration of mining and petroleum operations in their states are important functions of many surveys.

The published products of the surveys are also highly variable, ranging from highly technical geologic treatises to popular booklets on collecting minerals and fossils. Some surveys show a strong emphasis on economic or applied geology. More and more states are preparing popular articles for use in schools, and publications on ground water are greatly increasing. More and more states are increasing areal mapping, chiefly on a quadrangle basis, but in some states on a county basis, and in others on a regional basis. The impact of urbanization has led to an increased emphasis on geology's role in planning and engineering studies.

The aims of the Connecticut Geological and Natural History Survey were set forth in the first Biennial Report in 1904 as follows:

> 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 Zoology. 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 zoology 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.

Although these aims remain those of the Survey today, the way in which they are to be pursued needs continual re-evaluation and reinterpretation. In recent years more effort has been expended by the Survey in the geological than in the botanical and zoological fields. More has been accomplished in the advancement of pure science than in advancing economic development or in presenting material useful to educational work in the schools of the State. In a later section the subject of aims will be considered again in relation to future plans, but first it is appropriate to review the work of the past biennium.

The Survey's activities are administered by the Director, Dr. Peoples. Together with the Secretary, Mrs. Louise Henney, he also carries on such day-to-day activities as answering the many inquiries from the public. Both work on a part-time basis. Dr. C. L. Remington of Yale University plans and edits the series of entomological publications. Dr. Lou Williams Page, general editor, and Dr. Henry R. Aldrich, map editor, work as required to process the manuscripts and maps received. The resulting publications, as well as those published by the U. S. Geological Survey as products of its cooperative program with the Connecticut Survey, are sold, distributed, and exchanged with other organizations by the State Librarian, Walter Brahm.

The scientific work is carried on by university professors and graduate students. The Survey has been fortunate in interesting able people, some with world-wide reputations, who have undertaken projects at very modest stipends. The number of workers has varied widely with the availability of funds and personnel.

ACCOMPLISHMENTS SINCE JANUARY 1963

Because the Connecticut Geological and Natural History Survey is a fact-finding scientific organization which administers no laws and is responsible for no real property such as parks or forests, its accomplishments must be judged primarily by its published results and secondarily by its services to the public and to other State agencies through correspondence and oral communication.

Since January 1963, four geologic Quadrangle Reports have been published. Two more should be received from the printer early in 1965. In addition, five Bulletins, two Reports of Investigations, and a new List of Publications have been published. Also, as part of its Cooperative Program, the U. S. Geological Survey has released six publications on the geology of Connecticut: geologic maps of five quadrangles and a bulletin, and has eleven geologic quadrangle maps in press, due to appear within the year.

Although these are quite substantial accomplishments, much other work has been done, both in the field and on manuscripts. The results will be published in the next biennium or in future ones. Mapping is in progress on the surficial geology of the Ansonia and Milford quadrangles and on the bedrock geology of the South Canaan and Lyme quadrangles. During the biennium, mapping of three quadrangles has been completed: South Coventry (surficial geology), Hartford South, and Waterbury (both bedrock geology). Two additional quadrangle reports are now in review and others are expected to be submitted in the near future.

A large report on the climate of the state is being edited and the manuscripts of several reports on natural areas of the state are expected to be received in the next few months. Several entomological papers are in preparation.

GEOLOGIC PROGRAM

Quadrangle mapping

Accurate geologic maps are basic to most problems in geology. There are many types of geologic maps, and widely differing scales are needed in order to present data in appropriate detail. In May 1948, a conference of geologists and other persons interested in the Survey's geological program was asked what it considered to be the most urgently needed program within the scope of the Survey's organizational Act. The conference strongly recommended geological mapping by quadrangles, ultimately leading to the preparation of two maps of the state, one showing the bedrock geology and the other the surficial geology. Accordingly,

in recent years the Survey's major effort in geology has been the preparation of quadrangle maps and accompanying reports.

The area of the state is covered by 111 quadrangles, each including 7½″ latitude and longitude and covering about 55 sq. mi. Some of these quadrangles include parts of adjoining states and those along the southern tier cover parts of Long Island Sound. For most quadrangles two maps are prepared, one delineating the bedrock geology and the other the surficial geology.

The progress of this program has been accelerated by the cooperative agreement with the U. S. Geological Survey initiated in 1955. In addition, Federal geologists working under a cooperative agreement with the State Water Resources Commission have also done some quadrangle mapping in areas of particular interest to its program. The Geological and Natural History Survey's mapping has been done by university personnel working during the summers.

Two index maps, figures 1 and 2, show the status of quadrangle mapping to July 1, 1964. Figure 3, showing the progress of mapping by the State Survey (that done by the U. S. Geological Survey is not included), indicates that by January 1, 1965, 16 of the 41 quadrangle maps begun had been published and field mapping had been completed on 21 others. Of these, one report is due to be printed in January, one in March, two are to be published by New York State, and two others are in the review stage. Table 1 shows the status of all quadrangles for which field work has been completed, either by the Federal Survey or by the State Survey.

The numbers and percentages of quadrangles in various stages are summarized in table 2. The number of quadrangles now in press or in review is impressive; most of those in press will be published during 1965. If the remainder of those for which field mapping is completed can be published in the next biennium, bedrock maps of 55 percent of the quadrangles of the state and surficial maps of 35 percent will have been published by July 1, 1967.

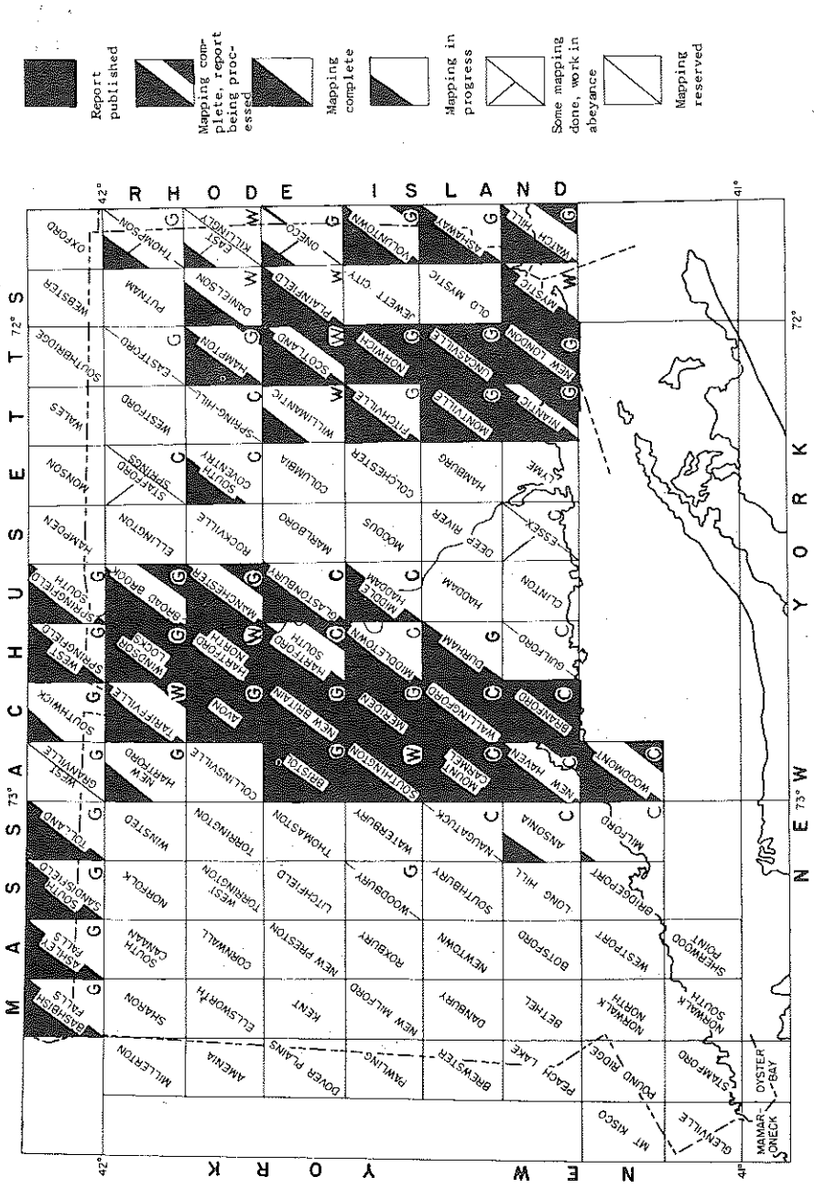

Fig. 1. Status of surficial geologic mapping as of July 1, 1964. C = mapping by State Geological and Natural History Survey of Connecticut; G = mapping by U. S. Geological Survey, Geologic Division; W = mapping by U. S. Geological Survey, Water Resources Division.

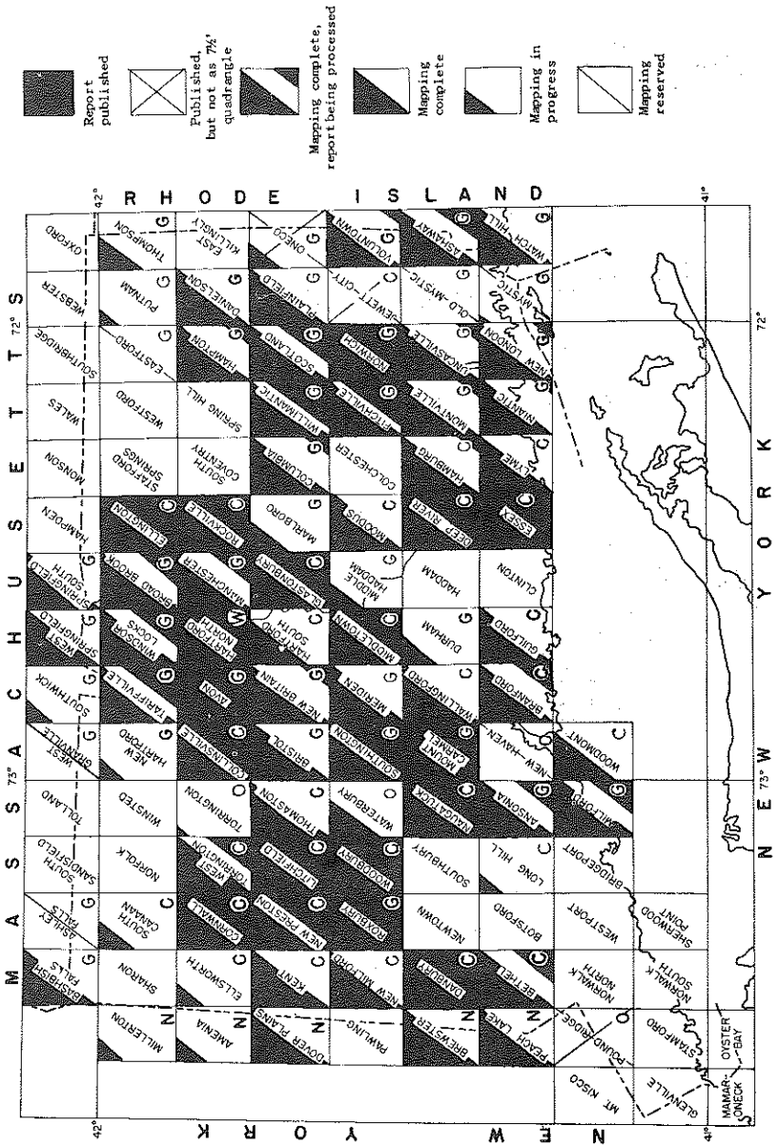

Fig. 2. Status of bedrock geologic mapping as of July 1, 1964. C = mapping by State Geological and Natural History Survey of Connecticut; G = mapping by U. S. Geological Survey, Geologic Division; W = Mapping by U. S. Geological Survey, Water Resources Division; N = mapping by New York State Geological Survey; O = mapping by the other organizations.

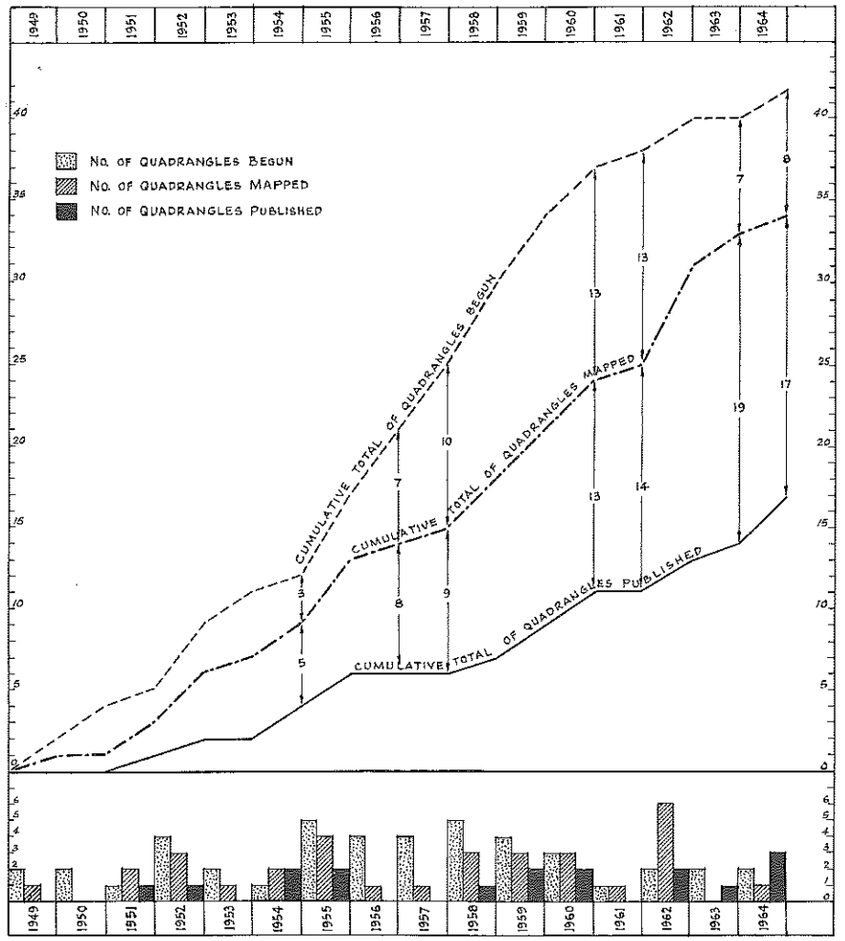

Fig. 3. The number of quadrangle geologic maps begun, mapped, and published by the State Geological and Natural History Survey of Connecticut yearly, from 1949 through 1964, are shown in the lower portion of the figure. The curves show the yearly cumulative figures for quadrangles begun, mapped, and published. The figures between the curves indicate the backlogs of initiated but uncompleted mapping of quadrangles, and between completed mapping and publication, respectively, for certain years. (Publication figure for 1959 includes one quadrangle published by the U.S. Geological Survey; the mapping of this quadrangle was done under the auspices of the State Geological and Natural History Survey of Connecticut.)

Table 1.—Status of geologic quadrangle maps and manuscripts as of January 1, 1965

U.S GEOLOGICAL SURVEY		*CONNECTICUT GEOLOGICAL AND NATURAL HISTORY SURVEY*	
Bedrock	*Surficial*	*Bedrock*	*Surficial*
		Published	
(9)	(12)	(13)	(3)
GQ121 Roxbury	GQ119 New Britain	MS3 Litchfield	QR10 Wallingford
GQ134 Avon	GQ137 Windsor Locks	MS5 New reston	QR12 Mt. Carmel
GQ144 Norwich	GQ138 Uncasville	QR3 Woodbury	QR14 Branford
GQ199 Mt. Carmel	GQ145 Bristol	QR4 Ellington	
GQ200 Southington	GQ148 Montville	QR5 Glastonbury	
GQ223 Hartford North	GQ146 Southington	QR6 Rockville	
GQ335 Willimantic	GQ147 Avon	QR7 Danbury	
Bull. 1161-I	GQ150 Meriden	QR8 Middletown	
Fitchville	GQ165 Norwich	QR9 Naugatuck	
GQ388 Windsor Locks	GQ176 New London	QR11 Cornwall	
	GQ223 Hartford North	QR13 Deep River	
	GQ329 Niantic	QR15 Essex	
		QR16 Collinsville	
		In press	
(9)	(6)	(3)	(2)
GQ370 Tariffville	GQ392 Scotland	QR17 West Torrington	QR18 New Haven
GQ392 Scotland	GQ433 Manchester	Peach Lake[1]	and Woodmont
GQ403 Ashaway	GQ410 Watch Hill	Brewster[1]	
GQ475 Ansonia	GQ434 Broad Brook		
GQ426 Milford	GQ468 Hampton		
GQ433 Manchester	GQ469 Voluntown		
GQ434 Broad Brook			
GQ436 Voluntown			
GQ468 Hampton			
		In review	
(9)	(6)	(1)	(1)
New Britain	Fitchville	Hamburg	Hartford South
Plainfield	Bashbish Falls		
Bashbish Falls	West Springfield		
Uncasville	Danielson		
Niantic	Plainfield		
Montville	Tariffville		
New London			
Columbia			
West Springfield			
		Mapping completed; report in preparation	
(7)	(5)	(10)	(4)
Springfield South	Springfield South	Branford	Middletown
Danielson	Durham	Wallingford	Middle Haddam
Bristol	Ashaway	Thomaston	Glastonbury
Marlborough	Mystic	Bethel	South Coventry
Meriden	Southwick	New Milford	
Watch Hill		Kent	
Southwick		Moodus	
		Guilford	
		Hartford South	
		Waterbury	

[1]To be published by the State of New York

Table 2.—Summary of quadrangle geologic mapping in Connecticut as of January 15, 1965 (Connecticut Geological and Natural History Survey and U. S. Geological Survey)

	Bedrock	*Surficial*
Number of quadrangles covering the state	111	111
Quadrangle maps published	23 (21%)	15 (13.5%)
Quadrangle maps in press	13	9
Quadrangle maps in review	8	6
Quadrangle maps for which field work is completed	17	9
Quadrangles partly mapped	16	10
Total number of unpublished quadrangle maps completed at least through the field-work stage	61 (55%)	39 (35%)

Cooperative Program with the U. S. Geological Survey

The U. S. Geological Survey has three cooperative agreements by which program costs are shared with the State of Connecticut. One agreement, with the Highway Department, is for the revision of the topographic quadrangle maps of Connecticut; a second agreement, with the Water Resources Commission, is for water-resource studies; the third is with the Geological and Natural History Survey for geologic mapping.

Since 1957, this last agreement has called for an appropriation of $40,000 each year by the State, which is matched by the U. S. Geological Survey. The Federal Survey furnishes the personnel and directs the quadrangle mapping financed by the cooperative funds, and pays the full cost of publishing the results of this work. (The resulting maps and reports, published and in press, are listed in the Appendix, and the status of cooperative quadrangle mapping is included in figures 1 and 2.)

Cooperation has been excellent between university geologists mapping for the State Survey and personnel of the U. S. Geological Survey, both those assigned to the cooperative program and those allied with the Water Resources Commission. Information and ideas have been exchanged at all levels, with profit to all three programs. Ideally, quadrangle mapping should precede water-inventory work, because a groundwater geologist must have a map of at least the surficial deposits for his studies. Such maps were not available at the start of the water-inventory study of the Quinebaug Basin; therefore Allan Randall had to map the surficial geology of most of the Danielson and Plainfield quadrangles before he could begin his study. On the completion of his water-resources project, he was paid from funds of the cooperative program to

continue mapping these two quadrangles in order to add the detail necessary for their publication in the Geologic Quadrangle series. The two maps have now been submitted for review. This is an example of the sort of cooperation that has greatly aided the program.

Under the plans of the Cooperative Program with the U. S. Geological Survey, all resulting maps were to be published in the Geologic Quadrangle series. At the time of the original agreement, the maps were accompanied by a text of about 8,000 words. Later, the Federal Survey decided to publish the maps of the series without text. It is obvious that a geologist who maps a quadrangle obtains much more information on the geology of the area than can be shown on the map alone. It is therefore to be hoped that bulletins giving reasonably detailed descriptions of the geology will be prepared to accompany the maps. There need not be a bulletin for each quadrangle; one might describe the geology of a much larger area, such as that covered by four to six quadrangles.

Concurrent with the U. S. Geological Survey's mapping, laboratory studies, including chemical analyses and radioactive age determinations of rocks, have been made at no expense to the State. Only a few of these studies have been published. In U. S. G. S. Bulletin 1161-I ("Petrochemistry and Bedrock Geology of the Fitchville Quadrangle, Connecticut," by George L. Snyder), 49 chemical analyses of rocks from the Norwich and Fitchville quadrangles are published, together with spectrographic analyses of the trace elements. These represent the first large block of chemical analyses of the metamorphic rocks of Connecticut. In the same bulletin eight radioactive age determinations are reported for Connecticut rocks. Other age determinations are contained in a paper now being prepared for publication.

Geologic maps of the state

Two geologic maps of the state as a whole are planned, one delineating the bedrock geology and the other showing the surficial geology. The scale chosen is 1:125,000 (1 in. = approximately 2 mi.). However, a new topographic base map, as discussed elsewhere in this report, is necessary before either of these maps can be compiled. The plans for the two maps are as follows:

BEDROCK GEOLOGIC MAP

Soon after the Geological and Natural History Survey was organized in 1903, a provisional geologic map of the state on the scale of 1:250,000 was compiled and printed. It was intended that this would be replaced when more geological work was done. The edition of this map was exhausted in 1922 and there was strong pressure for reprinting or replacement of it.

About 1952 Dr. John Rodgers of Yale was asked to compile a new Preliminary Geological Map. This was published in 1956, followed in 1959 by an explanatory booklet. The map, using only one color for geologic boundaries, and printed on a base without topographic contours, was intended as a stimulus to the geological mapping needed for a more

adequate state map. It has given the general public some idea of the geology of the state as a whole. If a proper topographic base can be prepared by July 1967, the compilation of a new bedrock map of the state can be begun, and special studies undertaken to fill any gaps left in quadrangle bedrock mapping. The scale of the map would be appropriate for use in the classrooms of colleges and secondary schools, and to give general information to regional planners and economic developers. Connecticut has lagged behind New Hampshire, Vermont, New York, and New Jersey, which do have modern bedrock maps of their states.

SURFICIAL GEOLOGIC MAP

In 1947 the Survey published Bulletin 47, "The Glacial Geology of Connecticut," by Richard F. Flint. This publication, with its accompanying map, is not only a very important scientific contribution; it has been widely used by engineers seeking deposits of sand and gravel, by road planners, and by many others. It is now out of print. The topographic base on which the glacial deposits of the state were plotted is also out of print—it is also out of date and falls far below modern base-map standards. Recent quadrangle mapping has given far more detailed information about the glacial geology of the state than was available in 1947, and a new map of these surficial deposits is badly needed. Dr. Flint will compile a new map as soon as a satisfactory topographic base map is available. He is already reducing to the apropriate scale new surficial geological data as fast as it is obtained.

Aeromagnetic mapping

During World War II, methods of measuring continuous changes in the intensity of the earth's magnetic field from an airplane in flight were developed. Since that time, aeromagnetic surveying has been widely used in the search for mineral deposits and petroleum, and also as a significant aid to geologic mapping. The U. S. Geological Survey uses a plane equipped to measure simultaneously both radiation and magnetic intensity, and has flown it over most of New England with flight lines a mile apart. Although these flights were made primarily to measure the background of radiation in the area, magnetic intensity was also determined. Aeromagnetic maps compiled from these data for six Connecticut quadrangles were published by the U. S. Geological Survey in 1962. (See list in Appendix.)

When it became apparent that closer spacing was desirable, intermediate lines were flown for several blocks of quadrangles in Massachusetts and for a block of twelve quadrangles in eastern Connecticut. Aeromagnetic maps of six quadrangles along the Massachusetts-Connecticut boundary are in press and the maps of the twelve eastern Connecticut quadrangles have been compiled. The intermediate lines on eight other quadrangles are expected to be flown in the spring of 1965.

These aeromagnetic maps should aid in the interpretation of geologic structures and may also reveal areas which should be examined for mineral deposits.

Mineral resources

Connecticut is not a large producer of minerals, ranking 45th among the states in the value of its mineral production in 1963, although, as figure 4 shows, this value has about tripled since 1950. According to the United States Bureau of Mines, the value of the state's mineral production for 1964 was $21.8 million, the highest production for Connecticut on record. Stone, and sand and gravel accounted for 91 percent of the total. Lime, feldspar, and clays are the other principal products (table 4).

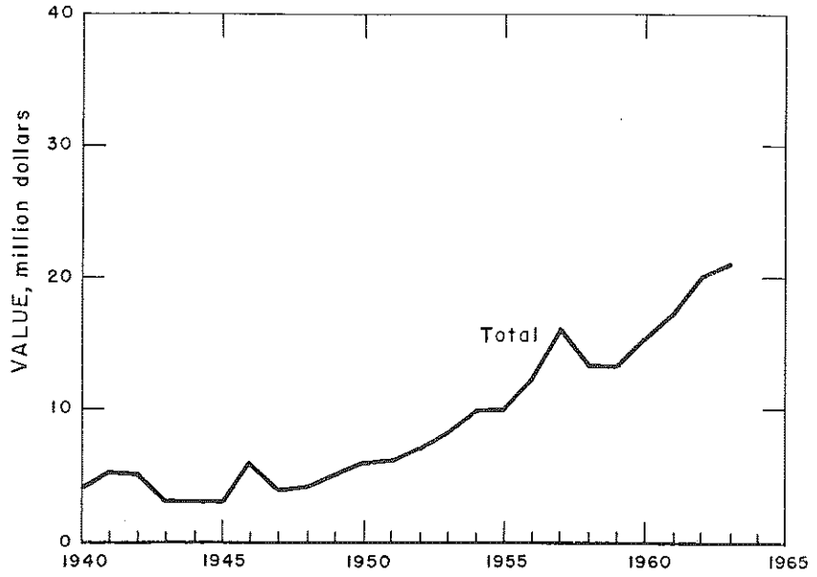

Fig. 4. Value of mineral production in Connecticut, 1940-1963 (Reproduced from the U. S. Bureau of Mines **Minerals Yearbook**, 1963.)

Table 3.—Value of mineral production in Connecticut (in thousands of constant 1957-1959 dollars)[1]

Year	*Value*	*Year*	*Value*
1952	$ 7,891	1958	$13,245
1953	8,266	1959	12,738
1954	9,973	1960	15,243
1955	10,718	1961	16,601
1956	11,495	1962	19,817
1957	16,316	1963	20,657

[1]This table appeared as table 2 of the U.S. Bureau of Mines *Minerals Yearbook*, 1963.

As long as highway and other construction remains at a high level, production of stone and of sand and gravel will doubtless remain high. There have been some inquiries about sites for new crushed-stone operations and concerning clay, sand, and gravel possibilities as well.

Table 4.—Mineral production in Connecticut (quantity in short tons; value in thousands of dollars)[1]

	1962		*1963*	
Mineral	*Quantity*	*Value*	*Quantity*	*Value*
Beryllium concentrate	7	4	—	—
Clays	178,942	287	189,344	339
Gem stones	—[2]	8	—[2]	8
Lime	35,180	635	35,262	666
Sand and gravel	10,208,000	9,244	10,503,000	9,343
Stone	5,090	8,816	5,318	9,612
Fledspar, kaolin, mica, and peat	—[3]	760	—[3]	646
Total		19,754		20,614

[1]From information in table 1, U. S. Bureau of Mines *Minerals Yearbook*, 1963. Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Weight not recorded

[3]Figures not available

In recent years the production of clay for the manufacture of bricks has declined, but two new plants are using clay, one for the manufacture of flower pots and the other for light-weight aggregate which is produced in a rotary kiln.

Kyanite has been found at a number of places in the state and it is possible that detailed examination would reveal deposits capable of economic development. It is also possible that greater economic use of the carbonate rocks of the western part of the state might be possible. Careful mapping is needed to delineate beds high in calcium and magnesium.

Cooperation with other agencies and with universities

The Survey has maintained a close relationship with geologists of the Water Resources Commission who are working on the ground-water inventory of the state. There is continual exchange of information between the Survey and the State Highway Department: the maps which the Survey produces are useful to the geologists and engineers of that department, and drilling data from the Highway Department is often of great value in making these maps.

For the last five years an annual conference on Connecticut geology has been held at Middletown, attended primarily by workers on the geology of the state, 75 of whom were present at the 1964 gathering. These conferences have aided greatly in the exchange of information and have stimulated research on geological problems in the state.

Concurrent with the development of the Survey's mapping program has come an increased interest in Connecticut geology on the part of

the colleges and universities of this state as well as in out-of-state institutions. In addition to projects financed by the state and carried out by faculty and graduate students of these various universities, other projects, financed by university funds, have contributed to the knowledge of the geology of Connecticut. Stanley Bernold mapped the bedrock geology of the Guilford quadrangle as a doctorate thesis at Yale University, and it is hoped that he will prepare his map and text for publication in the Survey's Quadrangle Report series—the only expenses to the State will be manuscript fee and printing costs. At the present time, William Crowley, also of Yale, is mapping the Long Hill and Bridgeport quadrangles as a doctorate dissertation. It is hoped that he will submit reports on these quadrangles for publication. A group of students under the supervision of Dr. Richard Armstrong at Yale is mapping the bedrock geology of the Southbury quadrangle; in a few years this map may be ready for publication.

Underway at the Department of Geology of the University of Connecticut is a research program on Connecticut geology. Dr. Janet Aitken has virtually completed the mapping of the bedrock geology of the South Coventry quadrangle, which will be submitted to the Survey for publication. She expects to complete the mapping of the Stafford Springs quadrangle with no field-work expense to the Survey. Other staff research projects which are in progress at University of Connecticut are:

Analysis of small-scale fold structures in northeastern Connecticut (Janet Aitken)
Effects of glacial stagnation: a comparison of parts of Connecticut and Illinois (F. L. Doyle)
Experimental drive-point well development (Larry Frankel)
Systematic compositional and/or structural variations in minerals from selected igneous and metamorphic rocks of Connecticut and nearby states (Homer Liese)

In addition, various student projects are planned.

At Wesleyan University, Dr. J. R. Balsley has been interested in the causes of magnetism of rocks, and Dr. Jelle de Boer in paleomagnetism. Some of the recent investigations made by students working under their supervision are:

A magnetic study of the Higganum dike (Barre A. Seibert)
An engineering study of an area in Haddam, Connecticut, using geophysical methods (V. S. Balendran)
Magnetic study of the Mt. Carmel area (David Kingwill)
Magnetic study of the Lebanon Gabbro (Roger Young)

Some of these studies are worthy of publication and it is hoped that they can be published, at least in part. All have been aided by the work done in the Survey's program, and they have added significant data.

Dr. Robert M. Gates of the University of Wisconsin has been coming to Connecticut to pursue geologic studies since 1948. Much of his work has been financed by the Survey, but he has also received support from the Wisconsin Alumni Research Fund and from the National Science Foundation. He has brought with him students whose thesis work has

been largely supported by University funds. Wisconsin master's degree theses related to the geology of western Connecticut submitted in recent years are as follows:

Petrologic study of the textural features of the magmatic Nonewaug Granite (Paul E. Scheerer)
The petrology of the type Thomaston (Reynolds Bridge) Granite (Ray Thede)
Minor structures and their significance in the Hartland Formation (Charles W. Martin)
Putnam Schist near Norwich, Connecticut (Karl E. Seifert)
The bedrock geology in the vicinity of Torrington, Connecticut (Judith M. Smith)
The age relations of the Mount Tom hornblende gneiss and the dioritic gneisses of the Mt. Prospect Complex (Dewayne C. H. Martin)
Amphibolites and related rocks in the West Torrington quadrangle, Connecticut (Nikolas I. Christensen)
The sedimentary origin of the Housatonic Highlands Gneiss Complex in the Cornwall, Connecticut, area (Thomas A. Vogel)

In addition, three Wisconsin doctorate dissertations concerned Connecticut geology:

Petrology, metamorphism, and structure of the Hartland Formation in central-western Connecticut (Charles W. Martin)
The genesis of plagioclase twinning in the Nonewaug Granite (Karl E. Seifert)
The Hodges Mafic Complex: A study of the structural control of basic intrusives (Nikolas I. Christensen)

Dr. Lawrence Lundgren of the University of Rochester has mapped four quadrangles for the Survey; in addition, some of his students are working on geologic problems of Connecticut, financed by the University of Rochester and by grants from other institutions. The following doctorate dissertations on Connecticut geology are underway at Rochester:

Metamorphism of ultramafic rocks in eastern Connecticut (Jane K. Bassett)
Mineral assemblages of the Hebron and Mine Brook Formations in relation to metamorphic zones in contiguous pelitic schists (Howard Pratt)
Structure and stratigraphy of the Monson area, Massachusetts (John Peper)

At the University of Massachusetts several students have undertaken geologic work in Connecticut for theses. These include:

Geology of the northern part of the Torrington quadrangle, Connecticut (Joseph Gonthier)
Bedrock geology of the western half of the Marlborough quadrangle, Connecticut (Orville B. Lloyd)

Ervin Otvos made a study of beach erosion near Westbrook and Joseph Gaffney is engaged in a study of glacial geology in southeastern Connecticut.

Recent theses on Connecticut geological problems at other universities are as follows:

Ground-water resources of the Town of Colchester, Connecticut (Grant Kimmel, Columbia University)
Geology of the Red Mountain area, Sharon, Connecticut (H. R. Craig, Jr., University of Cincinnati)

At Massachusetts Institute of Technology, age determinations of Connecticut rocks have been made, using some of the modern radioactive methods. One of the most recent studies is by D. G. Brookins and P. M. Hurley (American Journal of Science, vol. 263, p. 1-16, 1965). Reprints of this paper will be distributed on a limited basis by the Survey.

This list is by no means complete, but it does show the very substantial amount of research on the geology of the state in progress at various educational institutions.

NATURAL HISTORY PROGRAM

Entomology

Many years ago entomological studies were begun by the Survey. This distinguished series of publications is continuing under the leadership and editorship of Dr. Charles Remington of Yale University. During the present biennium two bulletins of the series, "Guides to the Insects of Connecticut," were published. Both belong to Part VI of the series, dealing with the Diptera or True Flies of the state. Bulletin 93, the Eighth Fascicle, contains "Scatopsidae," and "Hyperoscelidae" by Edwin F. Cook, "Blepharoceridae" and "Deuterophlebiidae," by Charles P. Alexander, and "Dixidae," by Wesley R. Nowell. Bulletin 97, the Ninth Fascicle, is "Simuliidae and Thaumaleidae," by Alan Stone.

Other volumes in this series are being prepared by a group of leading entomologists. Major new volumes are in preparation on the Centipedes and Millipedes, two previously little-known groups.

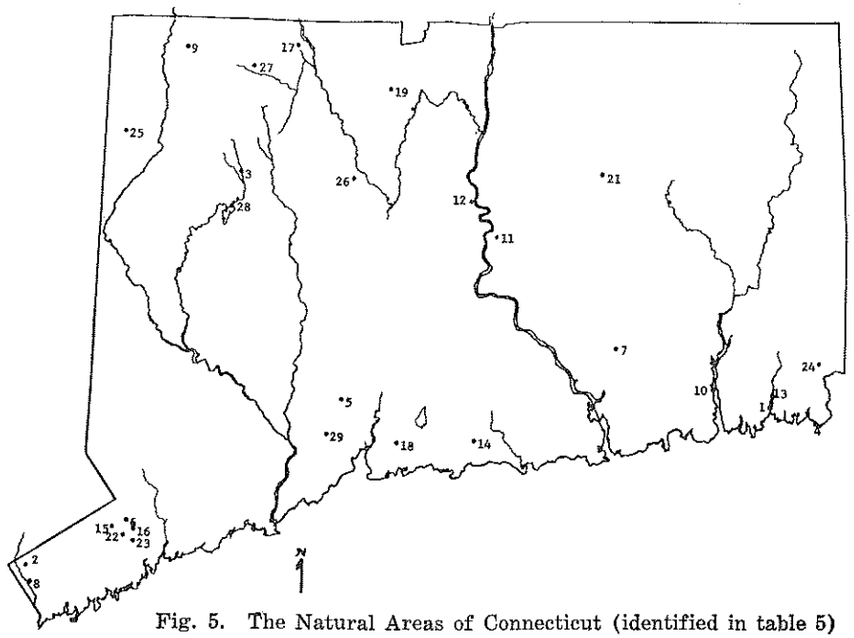

Fig. 5. The Natural Areas of Connecticut (identified in table 5)

Ecology

For a number of years, ecological studies have been made at the Connecticut College Arboretum. These pioneer studies, supported in part by the Geological and Natural History Survey, have stimulated interest in the ecology of other natural areas. The Nature Conservancy, a private agency that is developing a national system of preserves, has set up a number of them in Connecticut. Other organizations have also established preserves in other natural areas of the state.

The Survey has begun an ecological study of the state's present natural areas. Dr. Frank Egler of Norfolk and Dr. William Niering of Connecticut College have surveyed the vegetation pattern in twenty-one of these, leaving eight more areas for further field work (see fig. 5 and table 5. Of the areas where field work is completed, eight are in the preliminary draft stage, and one, dealing with the Yale Natural Preserve, is in the final stage of revision before being submitted to the Survey's editor.

Table 5.—Status of Connecticut natural-area studies

Area no.[1]	*Name*	*Owner*	*Status*
1	Akeley Tract Nature Reserve	The Nature Conservancy	Preliminary manuscript
2	Audubon Center of Greenwich	National Audubon Soc.	Preliminary manuscript
3	Bantam River Preserve	The Nature Conservancy	Field work incomplete
4	Barn Island Peninsula	State of Connecticut	Field work incomplete
5	Bethany Bog	Yale University	Preliminary manuscript
6	Browning Wildlife Sanctuary	New Canaan Audubon Soc.	Field work incomplete
7	Burnham Brook Preserve	The Nature Conservancy	Field studies complete
8	Byram River Gorge Preserve	The Nature Conservancy	Field work incomplete
9	Canaan Mountain	State of Connecticut	Preliminary manuscript
10	Connecticut Arboretum	Connecticut College	Field studies complete
11	Cotton Hollow Preserve	The Nature Conservancy	Field studies complete
12	Folly Brook	City of Hartford and The Nature Conservancy	Preliminary manuscript
13	Gallup Salt Water Marsh Preserve	Private[2]	Field studies complete
14	Guilford Salt Meadows Sanctuary	National Audubon Soc.	Field work incomplete
15	Kelley Lowlands Sanctuary	New Canaan Audubon Soc.	Preliminary manuscript
16	Kelley Uplands Sanctuary	New Canaan Audubon Soc.	Preliminary manuscript
17	Kitchel Wilderness Preserve	State of Connecticut	Field studies complete
18	Lydia Hytt's Pond	Yale University	Field work incomplete
19	McLean Game Refuge	—	Preliminary manuscript
20	Miles Sanctuary	National Audubon Soc.	Field work incomplete
21	Nathan Hale Natural Area	State of Connecticut	Field studies complete
22	New Canaan Nature Center	—	Field work incomplete
23	Old Stamford Road Sanctuary	Town of New Canaan	Field work incomplete
24	Pequot-sepos Wildlife Sanctuary	—	Field studies complete
25	Sharon Audubon Center	National Audubon Soc.	Field work incomplete
26	Taine Mountain Preserve	The Nature Conservancy	Field studies complete
27	Walcott Preserve	The Nature Conservancy	Field studies complete
28	White Memorial Foundation Natural Areas	—	Field studies complete
29	Yale Natural Preserve	Yale University	Manuscript completed

[1]For location by number see figure 5
[2]Easement owned by The Nature Conservancy

These bulletins on natural areas will serve as a permanent ecological record of the tracts and can serve as a basis for future comparative studies. For most of the areas they will constitute the first published data on natural history. Written to aid the layman in enjoying and understanding the natural processes taking place within these specific areas, they will also serve as a basis and stimulus for more detailed ecological studies.

WEATHER AND CLIMATE

Twenty-five years ago the Survey published Bulletin 61, "The Weather and Climate of Connecticut," by Joseph M. Kirk—a very useful publication. Long out of print and also out of date, it will soon be replaced by a new report on the state's weather and climate by State Climatologist Joseph J. Brumbach which is now being readied for the printer by the Survey editor.

DISTRIBUTION OF PUBLICATIONS

The Distribution Agent of the Survey is Walter Brahm, State Librarian, who reports: "The Survey publications are sent to state and public libraries, universities, colleges, teachers colleges, high schools, geologists and entomologists. The total number of distributary libraries is 445 with a subtotal for Connecticut amounting to 168. Material is sent on exchange to all 50 states and also to foreign countries."

Geologic Quadrangles published by the U. S. Geological Survey are bought by the Connecticut Survey for resale by the State Library. The funds from the sales are deposited with the General Fund. The sales of the publications of the State and Federal Surveys by the State Library reported by Mr. Brahm are shown in table 6. From July 1, 1962, to June 30, 1964, 4,400 publications were sold, amounting to $3,519.00

Table 6.—Publication sales, July 1, 1962, to June 30, 1964

	7-1-62 to 6-30-63		7-1-63 to 6-30-64	
	Units	*Sales*	*Units*	*Sales*
Connecticut Geological and Natural History Survey publications	696	$ 598.00	811	$ 754.00
U.S. Geological Survey publications	1,393	1,045.00	1,500	1,122.00
Totals	2,089	$1,643.00	2,311	$1,876.00

Mr. Brahm reports that stock of the following reports has been exhausted since July 1, 1963:

Bulletin 24, Triassic Life of the Connecticut Valley, by R. S. Lull
Bulletin 64, Guide to the Insects of Connecticut. Part VI. The Diptera or True Flies of Connecticut. First Fascicle.

The following publications now out of print have been recommended by the State Library for reprinting:

Bulletin 4, The Clays and Clay Industries of Connecticut
Bulletin 6, Manual of the Geology of Connecticut
Bulletin 14, Catalogue of the Flowering Plants and Ferns of Connecticut
Bulletin 20, The Birds of Connecticut
Bulletin 23, Central Connecticut in the Geologic Past
Bulletin 46, The Physical History of the Connecticut Shoreline
Bulletin 47, The Glacial Geology of Connecticut
Bulletin 53, The Mammals of Connecticut
Bulletin 54, The Reptiles of Connecticut
Bulletin 56, Marbles and Limestones of Connecticut
Bulletin 57, The Amphibia of Connecticut
Bulletin 61, The Weather and Climate of Connecticut
Bulletin 64, Guide to the Insects of Connecticut. Part VI. First Fascicle.
Misc. Series No. 1, Rocks and Minerals of Connecticut

FINANCES

For the last several years the appropriation for the Survey, exclusive of the $40,000 per year for cooperation with the U. S. Geological Survey, has been as follows, for fiscal years ending July 1:

1956	$ 23,930.00
1957	16,443.20
1958	30,000.00
1959	32,250.00
1960	30,208.00
1961	27,513.00
1962	22,012.00
1963	22,021.00
1964	30,900.00
1965	29,835.00
	$265,112.20

A financial statement covering the period from July 1, 1962, to June 30, 1964, is given in table 7.

Table 7.—Financial statement, biennial period, July 1, 1962, to June 30, 1964

Income	*Expenditures*	
	1962-1963	
Appropriation, $22,021	Salaries	$ 5,090
Cooperative with U.S. Geological	Field workers	3,178
Survey, $40,000	Editors	1,148
	Printing	8,946
	Dues	46
	Fees	551
	Travel	669
	Telephone	409
	Sundry	124
	Office expenses	165
	Total	$20,326
	1963-1964	
Appropriation, $29,900	Salaries	$ 5,312
Cooperative with U.S. Geological	Field workers	4,738
Survey, $40,000	Editors	2,219
	Printing	12,985
	Dues	29
	Fees	256
	Travel	1,288
	Telephone	380
	Sundry	71
	Office expenses	249
	Maps	1,261[1]
	Total	$28,788
	1964-1965	
Appropriation, $29,835		
Cooperative with U.S. Geological		
Survey, $40,000		

[1]For U.S. Geological Survey maps to be resold by State Library; revenue from the sales is returned to the General Fund.

The appropriation for the present fiscal year is about 10 percent higher than the average for the last ten years, but 10 percent lower than the appropriation of fiscal year 1959. Costs have gone up in the last ten years and, in addition, an increasing number of manuscripts have been available for publication. In order to publish without undue delay, an increasing proportion of the budget has had to be allotted to printing costs, and, of course, editing costs have also risen. Field activities have consequently been reduced.

Funds available and expenditures made during the life of the Cooperative Program with the U. S. Geological Survey are summarized in table 8. The expenditures of the Federal Survey listed there do not include publication costs or some laboratory costs for thin-section study and chemical analyses.

Table 8.—Funds available and expenditures made, Cooperative Program with U. S. Geological Survey, 1956-1964

Fiscal year[1]	*Funds available*		*Total*	*Amount spent*
	State	*U.S.G.S.*		
1956	$20,000	$20,000	$40,000	$33,340
1957	20,000	20,000	40,000	37,801
1958	40,000	40,000	80,000	75,310
1959	40,000	40,000	80,000	89,227[2]
1960	40,000	40,000	80,000	79,905
1961	40,000	40,000	80,000	82,420[2]
1962	40,000	40,000	80,000	80,000
1963	40,000	40,000	80,000	82,036[2]
1964	40,000	40,000	80,000	80,861[2]

[1]Ending July 1
[2]Excess above $80,000 paid by U. S. Geological Survey

FUTURE PLANS AND RECOMMENDATIONS

Immediate plans

The plans for the remainder of the fiscal year ending June 30, 1965, include a very modest field program. Dr. R. F. Flint will continue surficial mapping in the Ansonia and Milford quadrangles as the time available to him and the weather permit. Dr. Lawrence Lundgren, Jr., expects to complete the bedrock mapping of the Lyme quadrangle, and in June, Dr. Charles Martin will begin mapping the bedrock geology of the Torrington quadrangle. Drs. Frank Egler and William Niering will continue the field study of Natural Areas in Connecticut.

It is hoped that they will also continue the preparation of reports on Natural Areas where field work is completed, and that several authors of quadrangle reports will make progress on manuscripts which they have not yet submitted for publication. (See tables 5 and 1.)

Dr. Remington expects to receive some of the proposed entomology manuscripts and to prepare them for publication. Dr. Page will edit the two quadrangle reports on hand and, if possible, any others which are received.

Long-range plans and recommendations

GEOLOGY

In considering plans for the future, thought has been given to the three aims of the Survey cited from the First Biennial Report (see p. 2).

The Quadrangle Reports have been an important contribution to science; they definitely should and will be continued. Geologic mapping is so fundamental to an understanding of the geology of the state that increased funds have been requested for the next biennium, in order to increase the pace both of the cooperative mapping and of mapping by part-time State employees. It will probably also be wise to use some of the cooperative funds for topical or commodity studies by Federal Survey geologists who have specialistic knowledge. The aeromagnetic mapping of the state should be completed, both for its aid to geologic mapping and its possibility of suggesting locations of mineral deposits. (The aeromagnetic mapping already completed has been done at no cost to the State.)

The second aim of the Survey was given as "the acquisition and publication of such knowledge of the resources and products of the state as will serve its industrial and economic interests." Not enough attention has been devoted to this aim in recent years. While it is true that basic geologic maps are essential to any economic appraisal, and that advice concerning mineral resources has been given from time to time to the Development Commission and to construction men as well, many special studies are needed. Among these are:

1. Clay resources of Connecticut
2. Economic geology of the Stockbridge Marble belt
3. Sand and gravel resources of Connecticut
4. Kyanite deposits of Connecticut
5. Raw materials for light-weight aggregate
6. Underground storage for oil and gas

Perhaps most important of all would be a contribution to the urban geology of the state. Geology has an important role to play in the problems of urban planning and development—a role which is not widely realized. In 1946 a prominent geologist startled a number of U. S. Geological Survey scientists by stating that detailed mapping of the geology of the nation's ten largest cities was perhaps the most important job that the Federal Survey could do. Dr. Peter Flawn, State Geologist of Texas, presented a very interesting paper at the Symposium on Geoscience and Urban Development held at Baylor University, Waco, Texas, on February 13, 1964. He said in part:

> . . . In my opinion, as a direct result of population growth, the areas of **resources** and **environmental science and engineering** are the most important areas for scientific and engineering research in the coming decades. It is urgent that we intensify and expand our present feeble efforts in these fields—in training and in research. It is not a matter of whether we can afford such expansion—as in current debates over sending expeditions into space—it is a matter of survival and to hell with the cost! . . .
>
> Geological considerations are important in the development of a city in two broad areas: (1) Resources and (2) Municipal Engineering.

> Water is the prime municipal resource. With few exceptions, cities were built where there was a supply of water adequate for the original demand. However, nearly all cities have outgrown their local water supply and must transport water. . . .
>
> Less critical city resources are the construction materials. The kind and quantity of construction materials available certainly control a city's appearance and affect municipal engineering. Brick and tile clays, dimension stone, concrete aggregate—sand and gravel and crushed stone—are examples of this kind of resource. . . .
>
> Construction materials are already in short supply around many large cities and growing smaller cities. For example, in Texas in 1963 the total value of sand and gravel produced was over half a million dollars less than in 1962, while all other construction minerals showed increases. The decline was not due to a lessening of demand. In some areas, sand and gravel deposits have been depleted so that they are being replaced in their former markets by higher priced crushed stone.
>
> Several years ago, leaders of the Denver, Colorado, metropolitan area became concerned about the decline of sand and gravel reserves in the area. A study was initiated by the Intercounty Regional Planning Commission. Its report showed: (1) Original reserves available to the city were 925 million tons. (2) Remaining were 244 million tons (24 years supply at current rate of exploitation). (3) Since 1950, 50 million tons had been produced but because of new construction built on sand and gravel deposits, available reserves had diminished by 250 million tons. The Commission recommended that land use be regulated by zoning to protect and conserve sand and gravel reserves. . . .
>
> Under the general heading of **municipal engineering** we consider (1) what kind of geologic foundation the city rests on, (2) the structural fabric of the foundation, (3) the porosity and permeability of the foundation, (4) the topography and climate, and (5) the tectonic stability of the area. If we are going to pile great weights on top of rocks, anchor bridges or dams to rocks, drill holes and dig tunnels in rocks, lay slabs on top of rocks, or dispose of waste in rocks, we must know how the rocks or soils are going to react under a variety of conditions, e.g., when they are very dry or very wet, when they freeze or thaw, when the slope is flat to gentle or very steep, and when they are subjected to earthquake or gravity stresses. (I am, of course, using rock in the broad sense to include earth materials in general.) The availability of these data not only determines where, if anywhere, there can be high-rise structures on the city skyline—the availability of these data can be a matter of life or death. This is particularly true in cities where pressure for land has resulted in construction on unstable slopes, in known slide areas, and over active faults. If poorly engineered city public works projects induce slope failure or slides, the city's liability may be a matter of millions of dollars. . . .

> To me, it is a fantastic truth that most cities do not have a geologic map and do not employ a geologist. The use of a geological consultant (except on special problems) is not the solution. What is needed is **continuing** geological supevision to permit day-to-day accumulation of data so that the city can take advantage of and exploit its terrain, foundation materials, and resources. In particular, the geologist's job should be the construction and maintenance of an accurate largescale geologic map. Such a map will pay for itself time and time again, and for the geologist as well. When not employed on geological tasks, the geologist can run survey lines or do other routine engineering work. The geologist is necessary here because geologic maps made by engineers are notoriously inadequate. The engineer can log holes or describe sample pits, but the interpretative part of the map between holes is and should be the geologist's job.
>
> Such a map, like a mine map, must be kept up to date with every new excavation dug or hole bored. It thus comes close to being a fairly accurate model of the surface. The city geologist should inspect every excavation. Although hundreds of excavations are made in a city in the course of a year, they are rapidly filled. What a tragedy the information is lost. What a tragedy the city does not realize how much it needs these data. . . .

Although a study such as that described by Dr. Flawn is primarily a municipal job, a pilot study of a city area by the Survey could demonstrate the value of engineering geology and show the way for continuing studies by appropriate agencies.

An increasing number of the regional planning agencies have asked for information which will aid them in such problems as regional planning itself, in appraising the subsurface for airfields, in basic information for water-resource studies, and in mineral-resource appraisals.

A study of the engineering geology of one of our major urban centers is recommended as a future project.

NATURAL HISTORY

As in the geological program, the greatest contributions in the natural history field made by the State Survey over the past two years have been to pure science; the importance of the entomological bulletins has been recognized widely. The Natural Area reports, intended both for the general public and for use in schools, should be a significant contribution to education. A conference to consider long-range plans for Natural History studies in the state is being planned. It is hoped that this conference will add new ideas to the many suggestions already received.

Among the needed publications which have been in preparation for a long time are "Birds of Connecticut," by Alexander Bergstrom, and "Mammals of Connecticut," by R. M. Wetzel. New bulletins are also needed on reptiles, molluscs, and Amphibia. "The Flora of Connecticut," published in 1910, is out of print and needs revision.

Dr. Remington has recommended a replacement of Bulletin 68 on the Culicidae or mosquitoes which is now out of print. Mosquitoes are of major medical and pest significance in the state and a new bulletin with all of the latest information would fill a great need.

Ecological studies other than those of the Natural Area program should be made. It is not sufficient to study individual groups of organisms; their relationships to each other and to their environment must be investigated as well. The hearings on the proposed nuclear-energy power plant revealed how little is actually known about the interrelationships of the physical environment on the organisms of the Connecticut River, and how much a given change in the physical parameters would affect the ecological system. More precise fundamental information about various ecological systems is needed in order to judge the effects which our changing civilization may bring. In a democracy the citizen needs basic data in order to make intelligent choices.

EDUCATIONAL SERVICES

A large percentage of the requests for information which the Survey receives are from teachers and students. This is particularly true in geology since Earth Science courses have been established widely in the schools of Connecticut and adjacent states. The requests for rock and mineral specimens have to be denied. Although the furnishing of mineral specimens to individual pupils is of doubtful pedagogical value, well described sets made up for schools, as was done by the Survey in the past, would be of great value. Also, guidebooks describing worthwhile field trips should be most helpful to teachers, as well as summary topical reports on various aspects of the geology and natural history of the state would be a major contribution to the educational process. One guidebook is now being prepared and others are being discussed. A bulletin on minerals and a mineral map of the state are under consideration. Popular guidebooks to the State Parks would also fill a definite need, and it would be most helpful if both geology and natural history were included in the same book. The Canadian Geological Survey and many state surveys have published useful guidebooks of State and National Parks.

ADMINISTRATION AND FISCAL

In the Cooperative Mapping Program with the U. S. Geological Survey, stress has recently been placed on preparing maps for publication, with the result that a large number are now being drafted and printed. At the present rate, an average of one quadrangle per month will be published. This pace cannot be continued indefinitely without increasing the pace of field work. In the budget request for the next biennium an increase in cooperative funds has been made, both to cover the increased cost of a man year of work due to federal pay increases over the past several years, and to hasten field work. Two additional geologists are needed to map the surficial geology in western Connecticut; this information is needed for the Water Inventory Program of the Water Resources Commission and for highway work.

It is believed that the Survey has maintained a record of publication and public service of which it can be proud, albeit with a modest appropriation and with only part-time personnel to guide its operations. Because it has produced publications which are receiving increasing attention, requests for information and for the legitimate services which it should perform are increasing. As a result, the full-time services of an additional geologist have again been asked for in the budget request submitted for the biennium beginning July 1, 1965 and ending June 30, 1967. In addition to answering much of the technical correspondence and carrying on some of the administrative work, this geologist would be expected to keep in close touch with the mineral industry of the state and with the Highway Department, and to supply geological information as requested by the Development Commission, Regional Planning Agencies, and municipalities. He would also prepare for publication reports on topical or regional studies.

APPENDIX

Statutes creating the Connecticut Geological and Natural History Survey, and amendments thereto

Sec. 24-1. 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 and a member of each of the faculties of Yale University, Wesleyan University, Trinity College, The University of Connecticut and the Connecticut College for Women. Each appointed commission member shall be designated by the president or other adminstrative head of the institution from whose faculty the member is drawn. Each person so designated, upon acceptance of such office, shall serve as such commissioner without further appointment until his removal from the state, death or resignation, unless sooner removed for cause. Any vacancy occurring in the membership of the commission shall be filled by a new designation by the president or other administrative head of the institution from whose faculty the vacated membership was originally drawn. Said commissioners shall have general charge of the survey, and shall choose as superintendent of the same one of the appointed members of the commission, and may appoint such assistants as may be necessary. The compensation to be paid such superintendent and such assistants shall be determined pursuant to the provisions of section 4-40. Each member of the commission shall serve without compensation, but shall be reimbursed for expenses incurred in the performance of official duties, except that the superintendent of said commission shall be compensated in the manner hereinabove prescribed. (1949 Rev., S. 3542.)

Sec. 24-2. 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. (1949 Rev., S. 3543.)

Sec. 24-3. Reports; distribution and sale. Said commissioners shall cause to be prepared a report to the general assembly before each regular session of the same, showing the progress and condition of the survey, together with such other information as they deem useful or as the general assembly requires. 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. (1949 Rev., S. 3544.)

Sec. 24-4. 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. (1949 Rev., S. 3545.)

Superintendents and Directors of the Connecticut Geological and Natural History Survey

Superintendent or Director	Location of Survey Office	Dates
William North Rice	Wesleyan University	1903-16
Herbert Ernest Gregory	Yale University	1916-21
Henry Hollister Robinson	Yale University	1921-25
Wilton Everett Britton	Connecticut Agricultural Experiment Station	1925-39
Edward Leffinwell Troxell	Trinity College	1939-54
John Becker Lucke	University of Connecticut	1954-60
Joe Webb Peoples	Wesleyan University	1960-

Publications of the Connecticut Geologcal and Natural History Survey, Jan. 1, 1963-Jan. 1, 1965

PUBLISHED

Quadrangle maps and reports

QR 13. The Bedrock Geology of the Deep River Quadrangle, by Lawrence Lundgren, Jr.

QR 14. The Surficial Geology of the Branford Quadrangle, by Richard F. Flint

QR 15. The Bedrock Geology of the Essex Quadrangle, by Lawrence Lundgren, Jr.

QR 16. The Bedrock Geology of the Collinsville Quadrangle, by Rolfe S. Stanley

Bulletin series

Bulletin 93. Guide to the Insects of Connecticut. Part VI. The Diptera or True Flies of Connecticut. Eighth Fascicle: Scatopsidae and Hyperoscelidae, by Edwin F. Cook; Blepharoceridae and Deuterophlebiidae, by Charles P. Alexander; Dixidae, by Wesley R. Nowell

Bulletin 94. Marine Sedimentary Environments in the Vicinity of the Norwalk Islands, Connecticut, by Charles W. Ellis

Bulletin 95. Twenty-ninth and Thirtieth Biennial Reports of the Commissioners of the State Geological and Natural History Survey

Bulletin 96. Fossils of the Connecticut Valley, by Edwin H. Colbert

Bulletin 97. Guide to the Insects of Connecticut. Part VI. The Diptera or True Flies of Connecticut. Ninth Fascicle: Simuliidae and Thaumaleidae, by Alan Stone

Report of Investigations series

RI 2. Foxon Fault and Gaillard Graben in the Triassic of Southern Connecticut, by John E. Sanders, Charles V. Guidotti, and Pat Wilde

Reprint series

Late Newark Fault versus Pre-Newark Peneplain in Connecticut, by Crawford E. Fritts(**American Journal of Science**, v. 261, 1963, p. 268-281)

IN PRESS

Quadrangle maps and reports

QR 17. The Bedrock Geology of the West Torrington Quadrangle, by Robert M. Gates

QR 18. The Surficial Geology of the New Haven and Woodmont Quadrangles, by Richard F. Flint

Report of Investigations series

RI 3. Petrology and Stratigraphy of the Hampden Basalt, by Randolph W. Chapman

Reprint series

Rb-Sr Geochronological Investigations in the Middle Haddam and Glastonbury Quadrangles, Eastern Connecticut, by D. G. Brookins and P. M. Hurley (**American Journal of Science**, v. 263, 1965)

Publications of the U. S. Geological Survey in Cooperative Program with the Connecticut Geological and Natural History Survey, Jan. 1, 1963-Jan. 1, 1965

PUBLISHED

Geologic Quadrangle series

GQ 199. Bedrock Geology of the Mount Carmel Quadrangle, by C. E. Fritts
GQ 200. Bedrock Geology of the Southington Quadrangle, by C. E. Fritts
GQ 223. Geology of the Hartford North Quadrangle, by R. V. Cushman

GQ 329. Surficial Geology of the Niantic Quadrangle, by R. Goldsmith
GQ 335. Bedrock Geology of the Willimantic Quadrangle, by G. L. Snyder
GQ 388. Bedrock Geology of the Windsor Locks Quadrangle, by Robert W. Schnabel and John H. Eric

Map series

Map I-401. Contour Map of the Bedrock Surface of the Broad Brook Quadrangle, by R. V. Cushman and R. B. Colton
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