STATE OF CONNECTICUT

THIRTY-THIRD

BIENNIAL REPORT

OF THE COMMISSIONERS

OF THE

STATE GEOLOGICAL AND NATURAL HISTORY SURVEY

1967-1969

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

1969

BULLETIN 102

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LETTER OF TRANSMITTAL

March 21, 1969

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-third Biennial Report of the Survey, covering the two years ending December 31, 1968.

This report which has been prepared by Dr. Joe Webb Peoples for the Commissioners, summarizes the progress made by the Survey in its continued geologic mapping and natural history programs. It also summarizes the education program at Dinosaur State Park which was started in 1968 in cooperation with the Park and Forest Commission. Since this report was prepared new figures on visitors and requests for visits by school groups clearly indicate an enormous interest on the part of the public. Nearly one thousand visitors came to the park in one day recently and school groups have been scheduled daily.

Sincerely yours,

Joseph N. Gill

Joseph N. Gill
Commissioner of Agriculture
and Natural Resources

The price of this Bulletin is 25c. 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-THIRD BIENNIAL REPORT OF THE COMMISSIONERS OF THE STATE GEOLOGICAL AND NATURAL HISTORY SURVEY

1967-1969

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 include 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 48 state geological 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 groundwater studies and many cooperate with the U. S. Geological Survey in topographic mapping.

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.

It is appropriate to continually reconsider these aims in the light of changing state needs. After a review of the accomplishments of the past biennium, the aims will be reviewed and plans for the future will be discussed.

During the past two years the Survey's activities were administered by the Director, Dr. Peoples, acting on a part time basis. In the position of Geologist, Sidney Quarrier became the first full time employee in June of 1967. He supervised the uncovering of a section of the trackway at Dinosaur Park in June and July, 1967. Since then he has handled much of the general technical correspondence, but has devoted most of his time to the educational program at Dinosaur State Park. In June of 1968 an agreement between the Survey and the State Park and Forest Commission for the Survey to handle the educational program at the Park and to furnish interpreters to explain the trackway and exhibits to visitors made it necessary to enlarge the Survey staff. A new position of Geologist was approved, and Rino Vitali was transferred from the Highway Department to this position. High school teachers and college students were hired as interpreters on a part time basis. Mrs. Louise Henney continued to handle the increasing load of office work. Dr. Lou W. Page served as general editor on a part time basis until June, 1968, when she left Middletown for a year. Other part time staff personnel were Dr. C. L. Remington of Yale University, editor and planner of the entomological publications; Dr. Henry Aldrich, map editor; Dr. Bernice Wheeler, consultant on the natural history program; Dr. Harold M. Bannerman, economic geology consultant. Dr. Bannerman has visited field parties, represented the director at various meetings and conferences, advised on a variety of problems, and has arranged special meetings and conferences.

ACCOMPLISHMENTS SINCE JANUARY 1967

The accomplishments in the two calendar years 1967 and 1968 are probably more impressive than for any other two years of the history of the Geological and Natural History Survey. They include:

1. Publication of two bulletins, five quadrangle reports which included seven geologic maps, one report of investigation, one natural area report,

one guidebook containing descriptions of 21 fieldtrips, two lists of publications, and the reprinting of one bulletin and the preliminary geologic map of the state.

2. Publication by the U.S. Geological Survey in cooperation with the State of four editions of the Connecticut State Map, scale 1:125,000, 15 geologic quadrangles, 6 aeromagnetic quadrangle maps, and miscellaneous papers.

3. The initiation of an educational program at Dinosaur State Park in cooperation with the State Park and Forest Commission. When the Park was formally openend on Oct. 17, 1968, a certificate and plaque certifying that the trackway was in the National Register of Natural Landmarks was presented. The Connecticut Survey is planning the exhibits and has personnel to interpret the trackway and exhibits to the public.

4. The U.S. Geological Survey completed the flying of the State with the airborne magnetometer and is compiling aeromagnetic quadrangle maps of all quadrangles. The compilation should be completed in 1969 and publication of 60-75 percent of the quadrangles by January, 1970.

5. Field measurements of the gravity of the state were made by the U.S.G.S. in half of the state and by the state in a quarter of the state.

6. Field mapping has been carried on by part time state personnel in 18 quadrangles.

7. Field mapping by U.S.G.S. field parties was done in 31 quadrangles.

DINOSAUR STATE PARK

During 1967 and 1968 the Geological and Natural History Survey has been cooperating with the Park and Forest Commission in the development of Connecticut's new Dinosaur State Park. From the first discovery of tracks on August 24, 1966, and the Governor's announcement preserving the site, to the completion of the exhibit building, Survey personnel and consultants have been working closely with the Park and Forest Commission to establish Connecticut's newest public site for natural history education. The Survey is currently operating the educational facilities at the Park and is providing trained guides on a full time basis. Dinosaur Park stands out as a significant step in the utilization of the State's resources for public education.

In the fall of 1966, after the decision had been made to preserve the site, the coming of winter necessitated the covering of the main trackway with a complex electric blanket to prevent the severe weather from destroying the rock surface. The Department of Agriculture and Natural Resources authorized Morton Fine and Associates (architects and engineers) to conduct a comprehensive study to determine the development potential of the dinosaur trackway. This study, submitted the following April, described a multi-phased plan that included the construction of exhibit buildings, parking facilities, future land acquisition, and the establishment of a nature study area. The report indicated that further development would produce an important educational site for the public and the school systems.

The 1967 State Legislature authorized $250,000 to be used for the completion of the planning work and the construction of a temporary exhibit building and site facilities. As the large area of tracks under the electric blanket was to be preserved for a future, permanent building, excavation was started in June to uncover a new area of tracks just to the west of the main trackway. Sidney Quarrier, a geologist with the Survey, spent most of the summer working with the contractor while the new trackway was being uncovered. By early fall a 70′ by 90′ exposure of bedrock with about five hundred new tracks was ready for the construction of the temporary exhibit building. The architectural firm of Golden, Thornton and LaBau presented drawings and specifications for an air supported structure to house the new trackway, and construction of this was started early in 1968.

The interior of the exhibit building posed some new problems as how to best exhibit the trackway and explain its significance to the future visitors. Advice was widely sought, and through the efforts of Marc Sagan, chief of planning and interpretation for the National Park Service, a team of three professional interpreters came to Rocky Hill from Washington to review the exhibit facilities planned for the Park. During the three days this team was in the area, they made a detailed study of the site and met with representatives of the Park and Forest Commission, the Geological and Natural History Survey, Peabody Museum, the Governor's Advisory Committee for the Park, the architects and engineers, and others. Their report stressed several important points:

1. The uniqueness of the trackway and its particularly advantageous geographical location give the Park an almost unlimited potential to draw visitors, and further development should be continued.

2. The interpretative and educational facilities should be designed not only for the public but also for use by school and similar groups. Specific programs should be developed to enable schools to integrate a visit to the Park into their study of natural history.

3. Exhibits should be able to tell part of the "dinosaur story," but trained guides available to talk with visitors should be the mainstay of the interpretative program.

4. The large trackway under the electric blanket could possibly be best utilized as an outdoor exhibit if the effects of weathering could be controlled.

Specific recommendations were included for a number of exhibits. The National Park Service's study helped confirm much that had already been planned and added pertinent suggestions for operations in the future. Plates 1 and 2 are sketches from this report.

Construction of the temporary exhibit building proceeded during the summer of 1968, and by early fall the project was completed (see plate 3). The official opening was held on October 17, 1968, and in conjunction with this, the National Park Service presented a bronze plaque (plate 4) indicating that the Dinosaur Trackway had been designated a Registered Natural Landmark. The National Park Service's register of Natural Landmarks recognizes those natural features in the United States that are of national significance.

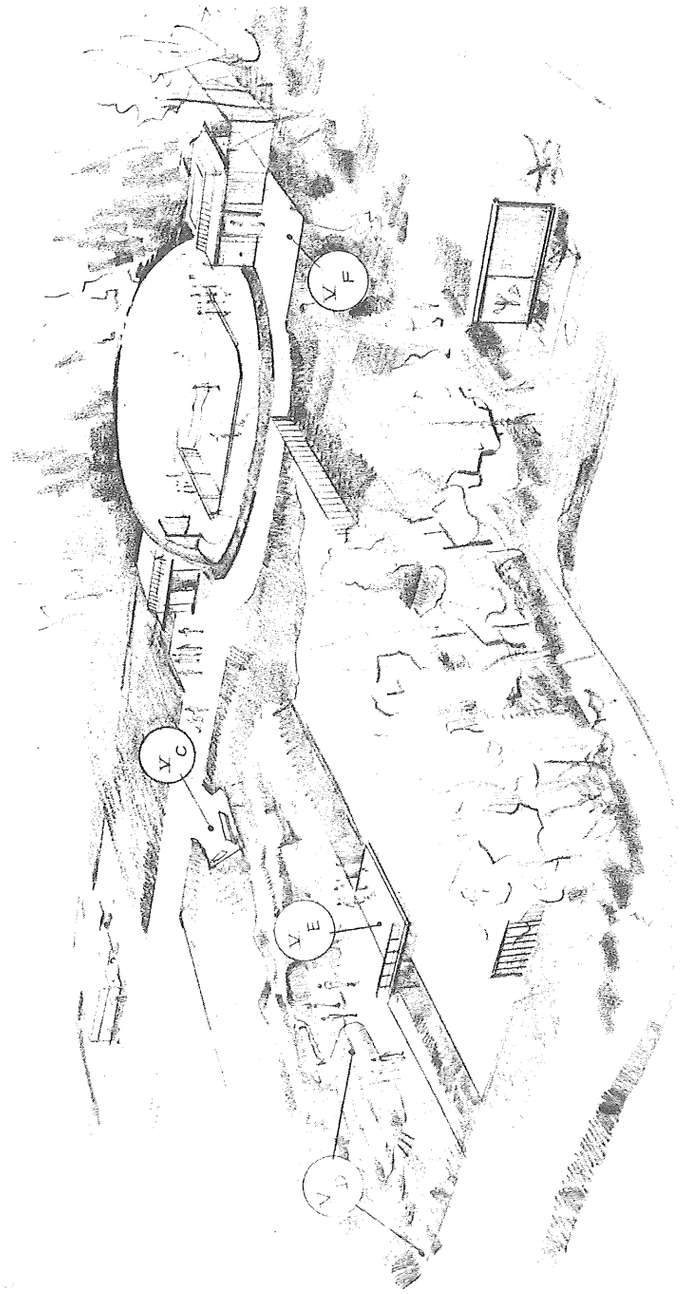

Plate 1. Potential site development for Dinosaur State Park, proposed by National Park Service. Circled numerals refer to possible exhibit areas.

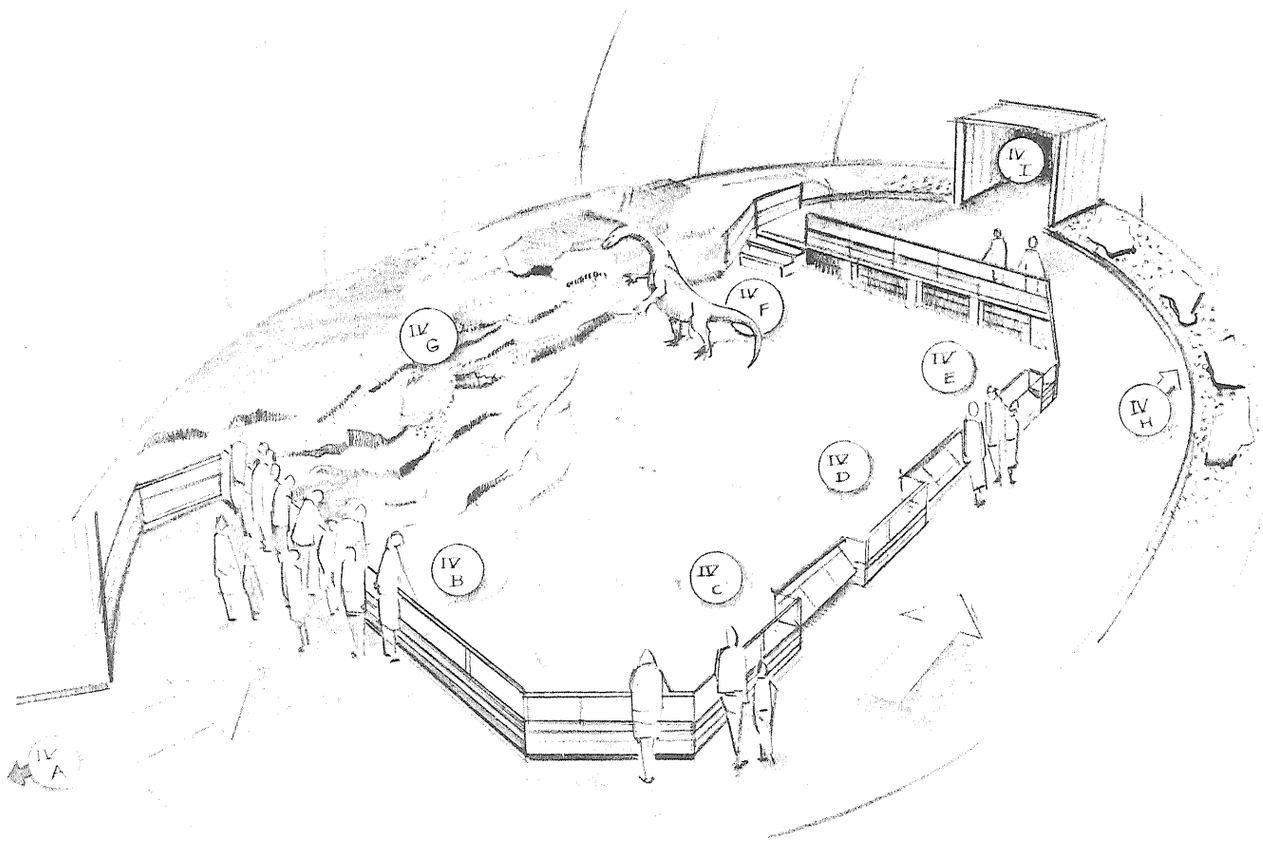

Plate 2. Potential development of the interior of exhibit building at Dinosaur State Park, proposed by National Park Service. Circled numerals refer to possible exhibit areas.

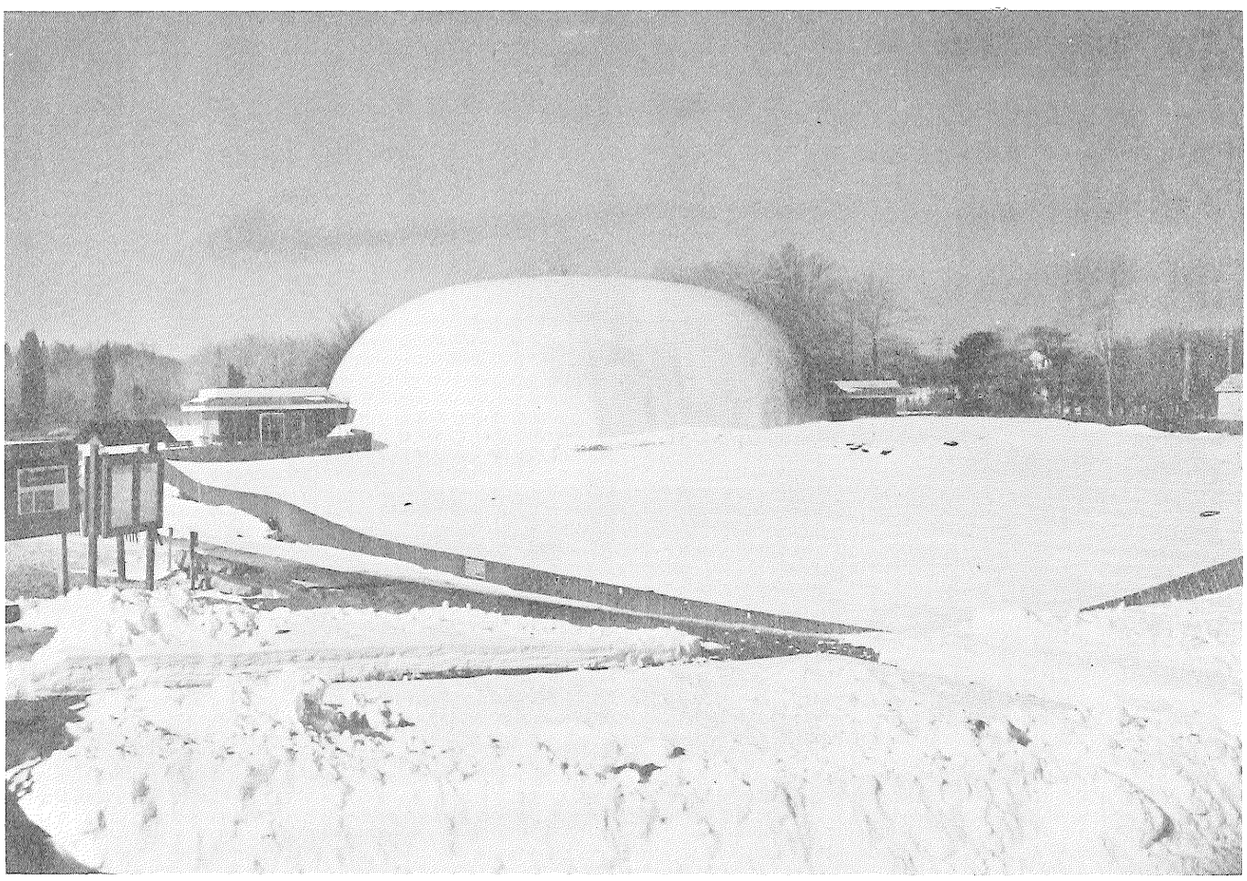

Plate 3. Inflatable exhibit building at Dinosaur State Park in Feb. 1969. Photo by Robert Arnold.

Plate 4. Bronze plaque presented by the National Park Service. Photo by Robert Arnold.

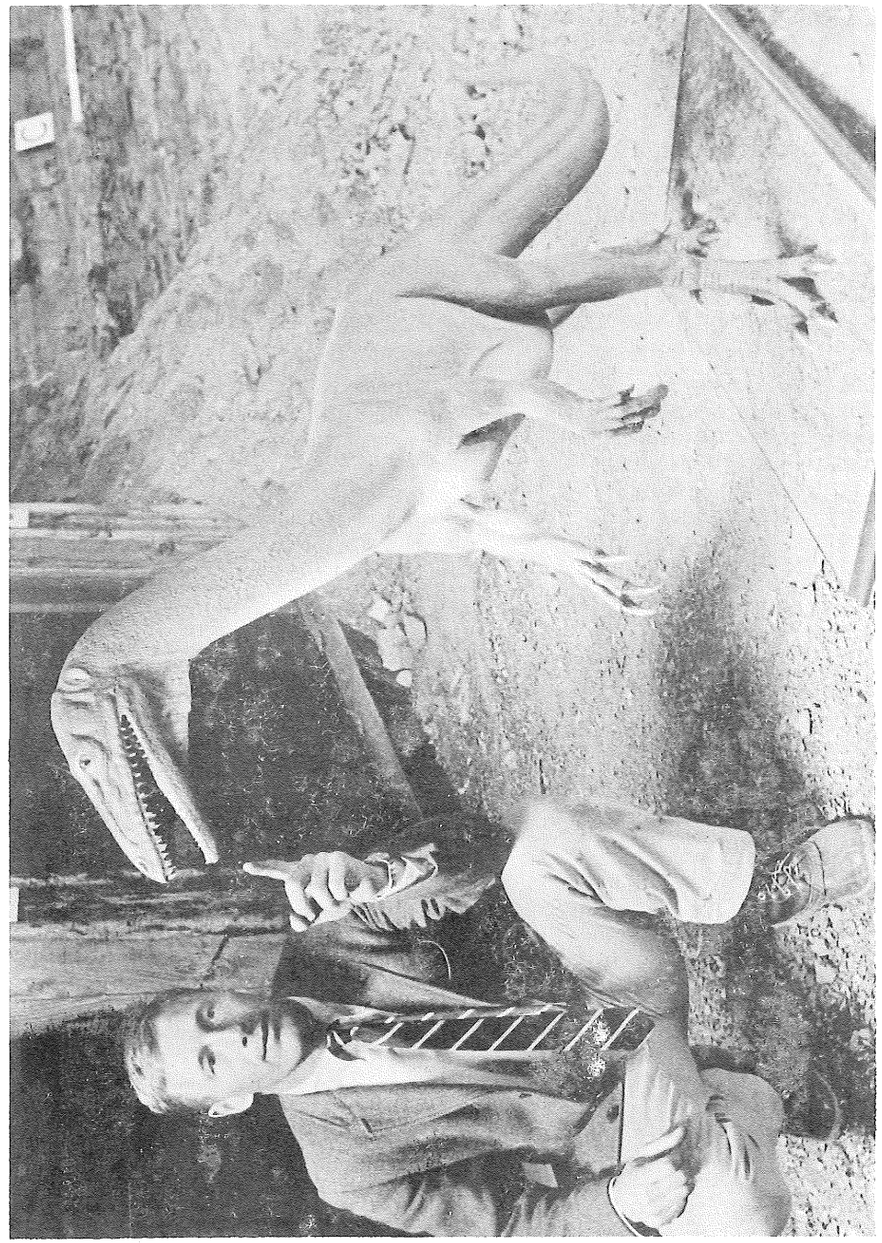

Plate 5. Survey geologist Sidney Quarrier with the full-scale model of the Triassic dinosaur *Coelophysis* at Dinosaur State Park. Hartford Courant photo by Arthur Warmsley.

The new exhibit facilities were an immediate success. The inflatable "balloon" building presents an unusual setting for the trackway. The contrast between the ultra modern, space age building and the 200 million year old dinosaur tracks inside is striking. Annual attendance at the Park for the past two years has been approximately 50,000 visitors per year, but with the new building open and daily attendance at a maximum of 2,000, the Park can expect 100,000 visitors this year. Pilot programs for schools are presently in operation and indicate a real potential for a significant contribution to the various schools.

Thus far our experience has shown that having trained guides on hand to talk with the visitors is a vitally important function. The signs and exhibits carry fundamental information to explain the geological features, but because of the range in age of the visitors and in their ability to understand the subject matter, the guides assume a large part of the interpretative function. In addition to full time Survey personnel, earth science teachers and natural history students have been used as part time guides.

New exhibits for the Park are in design and production stages, including a full scale reproduction of the Triassic dinosaur *Coelophysis* (plate 5). The Survey has recommended that at least a portion of the main trackway presently under the electric blanket be uncovered as soon as possible. Tests to determine the durability of this rock surface when exposed to the elements have been inconclusive, but exposure during the summer months is not apt to significantly damage the rock. This large area of tracks is the main resource of the Park and should be made available to the public.

Long range plans for the Park should include a permanent exhibit building, expanded parking facilities, land acquisition to the west for further excavations, and a full time staff. Dinosaur Park has served not only as an important educational and scientific site, but also as a significant tourist attraction in the State.

GEOLOGIC PROGRAM

Quadrangle mapping

During the past two years geologic mapping by quadrangle was vigorously prosecuted. Much of this work has been done by university personnel working part time for the Survey. In addition, U.S. Geological Survey personnel have been engaged in mapping under a cost sharing cooperative program. Index maps (figs. 1, 2) show the status of quadrangle mapping as of Jan. 1, 1969.

The geologic maps prepared are of two types, each using as a base a topographic quadrangle map and upon it showing in color pattern overprint the distribution of geological formations. The surficial map shows only the unconsolidated deposits of such materials as sand, clay, peat, and glacial till; the bedrock map shows the distribution and, by appropriate symbols, the structure of the rock formation as interpreted by the geologist. The primary basis for the interpretation is the examination of the rock outcrops in the field, but the geologist also makes laboratory studies and uses such bore hole records and geophysical data as are available.

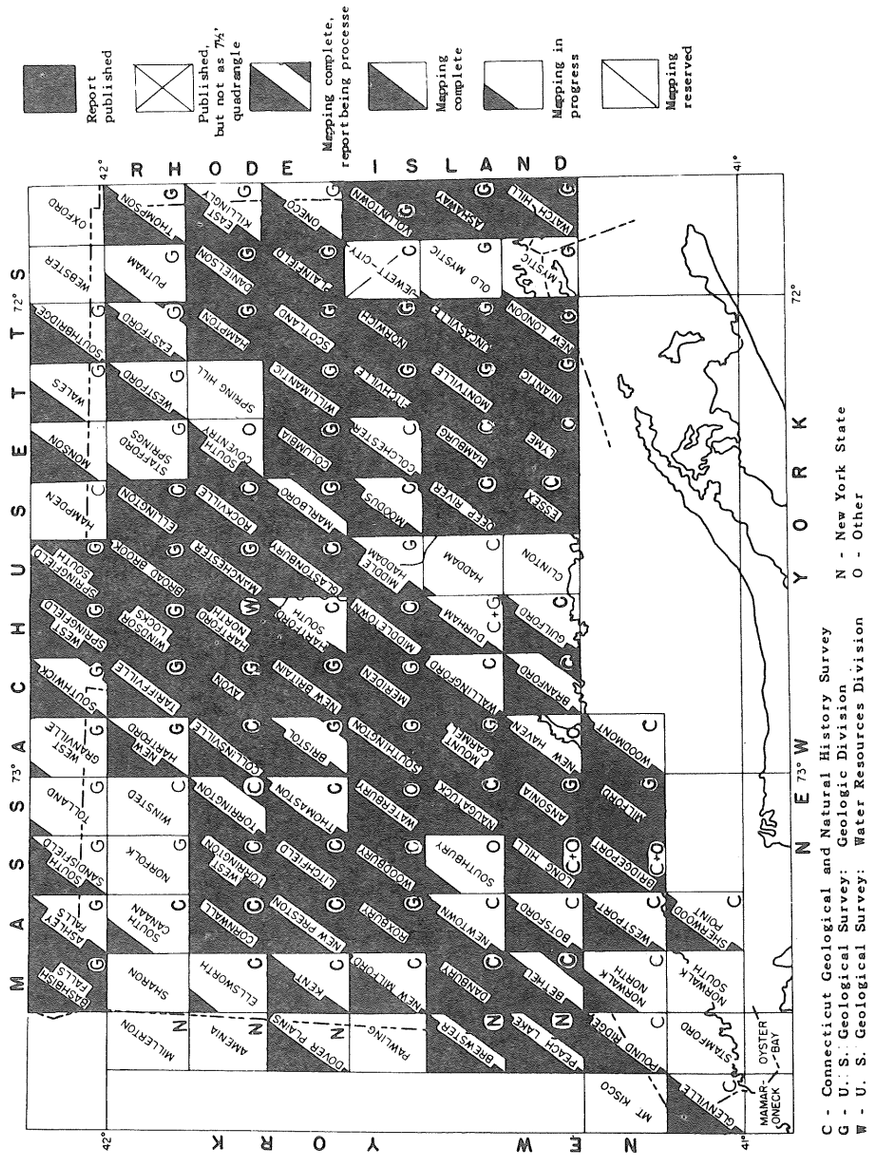

Fig. 1. Status of bedrock geologic mapping as of Jan. 1, 1969.

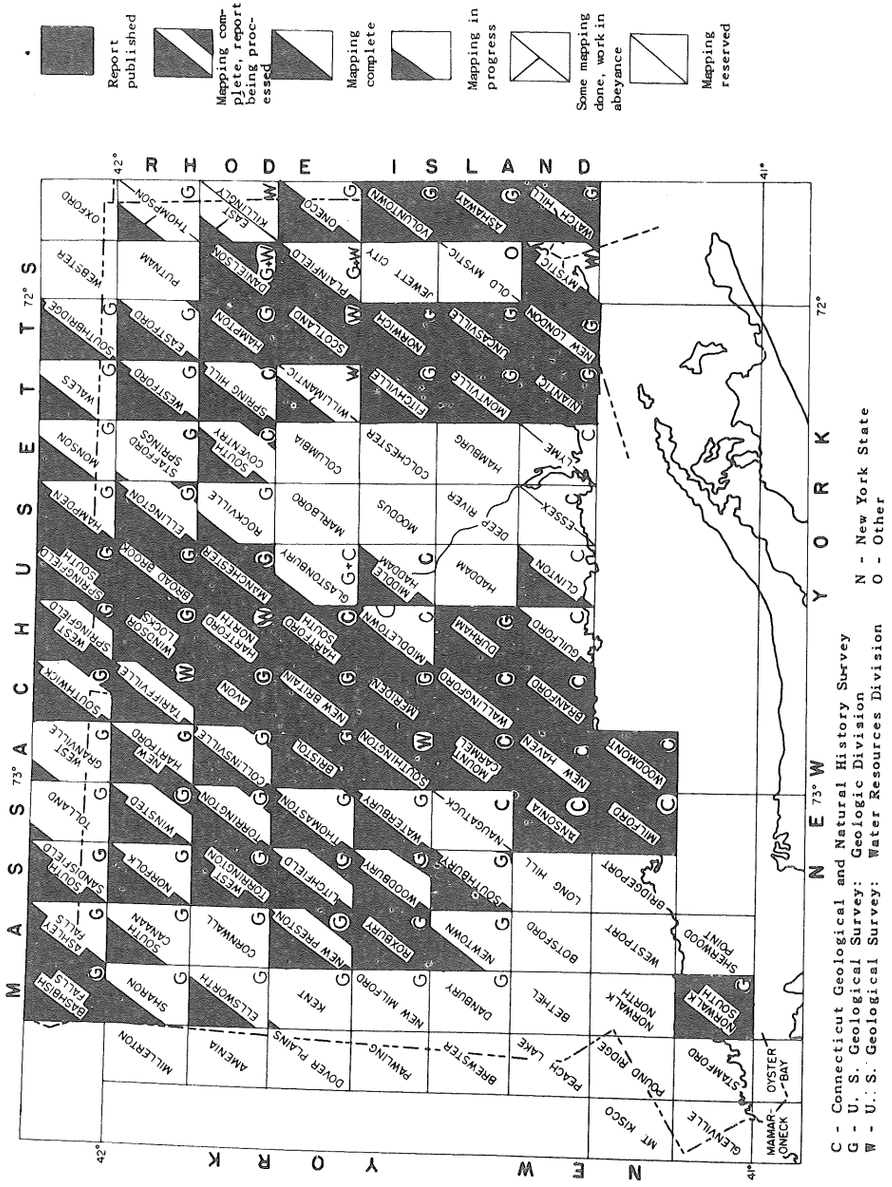

Fig. 2. Status of surficial geologic mapping as of Jan. 1, 1969.

Geologic maps are made at many scales. Mines are mapped at 100 feet to the inch, or 20 feet to the inch. Generalized geologic maps are made of countries and of continents. The scale of 1:24,000 or one inch on the map equals 2,000 feet in the field is about as large a scale as is used for geologic maps of general purpose in the United States. These maps have a wide variety of uses. They are used by various government agencies in considering appropriate land use, potential resources, locations of highways, reservoirs, and potential aquifers. They can be used by builders or developers in appraising subsurface conditions. Highway contractors find them useful in locating suitable fill. Their potential use in Connecticut has not been fully exploited since some possible users either do not know about them or how they can be used.

The most immediate use of these maps to date has been by the Highway Department in planning and building roads and in the study of the water resources of the State. There is a reciprocal relationship in both cases between map maker and map user. For example, the test drilling and material studies made by the Highway Department and the water well records and other data furnished by the hydrologists for the Water Commission are important sources of information for the geologist making quadrangle maps.

The quadrangles in which active field work has been done since Jan. 1, 1967 are shown in table 1. It is noteworthy that the geologists involved have been drawn from a number of colleges and universities.

Table 1. — Geologic field activity, 1967-69, Connecticut Geological and Natural History Survey

Quadrangle	*Type of Map*	*Geologist*	*University*
†Ansonia	Surficial	Flint	Yale University
†Botsford	Bedrock	Heyl	Univ. of N.Y. at New Paltz
*Clinton	Surficial	Flint	Yale University
†Durham	Bedrock	deBoer	Wesleyan University
†Glenville	Bedrock	Hall	Univ. of Massachusetts
*†Guilford	Surficial	Flint	Yale University
*Haddam	Bedrock	Quarrier	Wesleyan University
†Middle Haddam	Surficial	Tharin	Hope College
†Milford	Surficial	Flint	Yale University
†Newton	Bedrock	Stanley	Univ. of Vermont
*Norwalk North	Bedrock	Kroll	Syracuse University
*†Pound Ridge	Bedrock	Hall	Univ. of Massachusetts
*†Sherwood Point	Bedrock	Dieterich	Yale University
*Southbury	Bedrock	Scott	Florida State University
South Canaan	Bedrock	Gates	Univ. of Wisconsin
*†Spring Hill	Surficial	Rahn	Univ. of Connecticut
†Torrington	Bedrock	Martin	Earlham College
†Westport	Bedrock	Dieterich	Yale University

*Field work started since Jan. 1, 1967
†Field work completed

Table 2. — Status of geologic quadrangle maps and manuscripts as of January 1, 1969

U.S. GEOLOGICAL SURVEY		*CONNECTICUT GEOLOGCIAL AND NATURAL HISTORY SURVEY*	
Bedrock	*Surficial*	*Bedrock*	*Surficial*
		Published	
(31)	(27)	(18)	(6)
GQ-121 Roxbury	GQ-119 New Britain	MS-3 Litchfield	QR-10 Wallingford
GQ-134 Avon	GQ-137 Windsor Locks	MS-5 New Preston	QR-12 Mt. Carmel
GQ-144 Norwich	GQ-138 Uncasville	QR-3 Woodbury	QR-14 Branford
GQ-199 Mt. Carmel	GQ-145 Bristol	QR-4 Ellington	QR-18 New Haven and Woodmont
GQ-200 Southington	GQ-146 Southington	QR-5 Glastonbury	*QR-20 Hartford South
GQ-223 Hartford North	GQ-147 Avon	QR-6 Rockville	*QR-23 Ansonia and Milford
GQ-335 Willimantic	GQ-148 Montville	QR-7 Danbury	
Bull. 1161-I Fitchville	GQ-150 Meriden	QR-8 Middletown	
GQ-370 Tariffville	GQ-165 Norwich	QR-9 Naugatuck	
GQ-388 Windsor Locks	GQ-176 New London	QR-11 Cornwall	
GQ-392 Scotland	GQ-223 Hartford North	QR-13 Deep River	
GQ-403 Ashaway	GQ-329 Niantic	QR-15 Essex	
GQ-426 Ansonia	GQ-392 Scotland	QR-16 Collinsville	
GQ-427 Milford	GQ-410 Watch Hill	QR-17 West Torrington	
GQ-433 Manchester	GQ-433 Manchester	QR-19 Hamburg	
GQ-434 Broad Brook	GQ-434 Broad Brook	*QR-21 Old Lyme	
GQ-436 Voluntown	GQ-468 Hampton	*QR-22 Waterbury	
GQ-468 Hampton	GQ-469 Voluntown	*QR-24 Long Hill and Bridgeport	
GQ-481 Plainfield	GQ-485 Fitchville		
GQ-494 New Britain	GQ-507 Bashbish Falls		
GQ-507 Bashbish Falls	*GQ-611 Roxbury		
GQ-537 West Springfield	*GQ-660 Danielson		
*GQ-574 New London	*GQ-678 Springfield South		
*GQ-575 Niantic	*GQ-712 Ashaway		
*GQ-576 Uncasville	*GQ-718 Norwalk South		
*GQ-592 Columbia	*GQ-727 West Torrington		
*GQ-609 Montville	*GQ-756 Durham		
*GQ-655 Watch Hill			
*GQ-678 Springfield South			
*GQ-696 Danielson			
*GQ-738 Meriden			
		In press	
(1)	(3)		
Marlborough	New Preston		
	Tariffville		
	Litchfield		
		In review	
(3)	(10)	(1)	(2)
Bristol	West Springfield	Torrington	South Coventry
Oneco	Southwick		Spring Hill
Eastford	Eastford		
	Torrington		
	Oneco		
	Woodbury		
	Southbury		
	Winsted		
	Collinsville		
	Thomaston		

* Published in the years 1967 and 1968

Table 3. — Summary of quadrangle geologic mapping in Connecticut (Connecticut Geological and Natural History Survey and U.S. Geological Survey)

	Bedrock		*Surficial*	
	1/1/67	1/1/69	1/1/67	1/1/69
Number of quadrangles covering the state	111	111	111	111
Quadrangle maps published	37 (33%)	50 (45%)	25 (22.5%)	35 (31%)
Quadrangle maps in press	13	1	4	3
Quadrangle maps in review	2	3	11	11
Quadrangle maps for which field work is completed	15	30	7	14
Quadrangles partly mapped	16	10	15	15
Total number of quadrangle maps completed at least through the field-work stage	68 (61%)	84 (76%)	47 (42%)	63 (57%)

State geologic maps

Some progress was made in the project of bedrock and surficial geologic maps of the state. Dr. Flint has compiled on the new 1:125,000 scale base the surficial geology as shown by 28 published maps. Dr. Rodgers compiled not only all the bedrock geology of the published quadrangles but also included the available unpublished material. It will be at least two years before a final compilation can be started with assurance of sufficient coverage for a good map. It is probable that gravity and magnetic maps of the state will be completed before the bedrock map. Certainly the gravity and magnetic data will be important tools in geologic interpretation of basic geology.

State topographic map

The 1965 Assembly appropriated $30,000 to be matched by the U.S. Geological Survey to make a topographic map of the State of Connecticut on the scale of 1:125,000. The cooperative funds paid only the compilation costs. The Federal Survey which printed the map paid for the printing cost. Three maps were printed in June, 1967. By an additional allotment of $2,000 in matching funds a shaded relief map was produced and printed in 1968. This very handsome map shows clearly by shading the configuration of the landscape. The four editions on sale at the State Library at the prices indicated, plus 3½% sales tax for Connecticut residents, are: planimetric, $1.00; topographic, $2.00; topographic with green overprint, $2.00; shaded relief, $2.00. These maps have proven to be very useful and have been in great demand. As of December, 1968 the State Library has sold about 2,300 maps.

The topographic map was printed from 11 separate plates. The Survey has purchased reproducibles of each which are kept in Hartford for the

use of any state agency in the preparation of special purpose maps. The State Development Commission has used this base to make a map of state owned property.

Aeromagnetic maps

The countours of an aeromagnetic map show variations in the earth's magetic field. The magnetic data is collected by low altitude airplane flights with special instruments that measure the magnetic field. Local variations in the magnetic field are often caused by concentrations of magnetic minerals in the rock formations. Sometimes these variations delineate ore deposits of magnetic minerals, but more often they show the characteristic pattern of a specific rock type. The latter permits geologists to "see through" the soil and surficial materials, to identify various types of rock, and to plot the areas underlain by these rocks. In many instances the aeromagnetic maps have helped to direct the activities of field geologists and have significantly increased the accuracy of the geologic maps and reduced the amount of field work required. For example, the basalt or traprock that forms the prominent north-south ridges in central Connecticut has a characteristic magnetic pattern and the aeromagnetic maps clearly show the presence of this rock even though it is covered by other materials.

The U.S. Geological Survey has completed the flying of the whole state and compilation of all quadrangles is in progress. Maps covering 45 quadrangles have been published and 14 more are to be published early in 1969. The first were done in a 100% Federal project; the forthcoming maps are the result of a cooperative program with the State. The status of preparation and publication of aeromagnetic maps on a quadrangle basis is shown on the index map in figure 3. As soon as the individual quadrangle maps are completed, compilation of a 1:125,000 scale map of the whole state will be started.

Gravity map

Measurements of surface variations of the earth's gravity field have furnished geologists with another tool to interpret subsurface geology. The gravimeter is used to measure vary small variations in the gravity field produced by the difference in density of underlying rocks. A U.S. Geological Survey field party in 1967 completed a gravity survey of the southern half of Connecticut. In 1968 R. W. Bromery of the University of Massachusetts continued this study in northern Connecticut for the Connecticut Survey. He will finish the field survey in the summer of 1969 after which he plans to compile a gravity map of the state using the topographic map on a scale of 1:125,000 as a base. The state-wide gravity and aeromagnetic maps will enable geologists to more accurately predict and interpret subsurface data. Past experience has shown that this kind of data has become more important as the scale of urbanization and construction projects increases.

Mineral resources

Sand and gravel, and stone products account for 90 percent of the value of the mineral production of the state. For five years the value of the

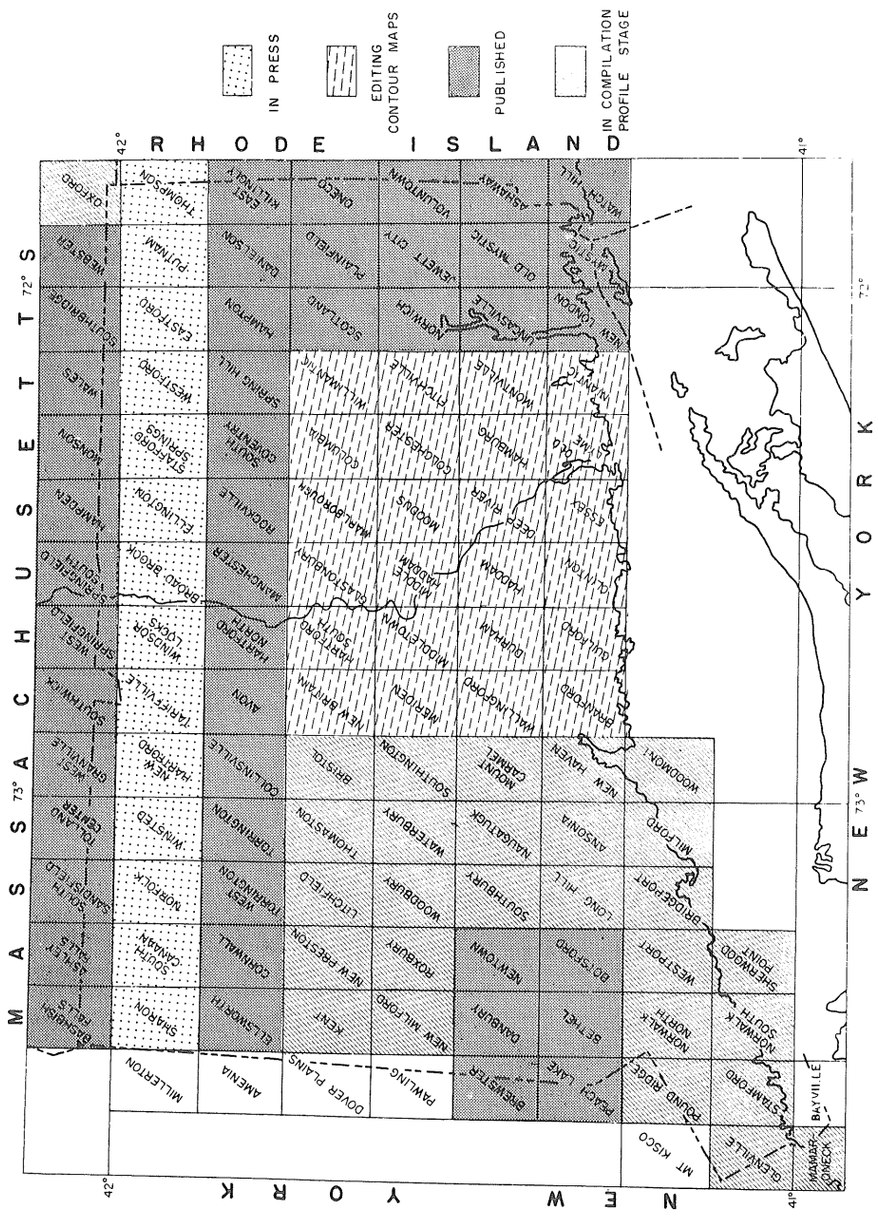

Fig. 3. Status of aeromagnetic surveys as of Jan. 1, 1969.

mineral production has remained at about $21,000,000 per year. In 1968 the reported value is estimated at nearly $28,000,000, a forty percent increase from 1967. As Connecticut's population grows, the production of bulky products of low unit cost such as sand, gravel, and crushed stone will have to increase even though the competing uses of land will create major problems for new sourses of supply. In many areas this situation has already become acute.

During 1968 the U.S. Geological Survey published a report on the submarine sand and gravel deposits off the New England coast. In the near future it is quite probable that attempts will be made to utilize these underwater deposits in Long Island Sound. It would be desirable first of all to know something of the distribution of these deposits and the possible adverse effects this action might have on marine life so that any mining can be done with a minimum of damage to the environment.

Cooperation with other agencies and with universities

The Survey has maintained close contact with geologists working on the groundwater problems of the state in the cooperative program between the State Water Resources Commission and the U.S. Geological Survey. A strenuous effort has been made to get surficial mapping completed in time for it to be used by the groundwater geologist in the inventory program. Surficial mapping has been pressed in western Connecticut to provide data to be used in water resources studies underway in the Housatonic and Naugautck river basins. Surficial mapping has already been completed in the upper Connecticut and Farmington river basins where groundwater studies are in an early stage. It is hoped that surficial mapping in the lower Connecticut River basin can be completed by 1971 when the water inventory studies will begin there.

The groundwater geologists, as a by-product of their own program, have produced some surficial maps to be published in the GQ series of the U.S. Geological Survey. The Surficial Geology of the Tariffville Quadrangle by Allan Randall (in press) is an example.

WORK ON CONNECTICUT GEOLOGY IN UNIVERSITIES

In addition to the university personnel engaged in mapping for the Survey, other research on geologic problems in Connecticut is being carried on at a number of places. Our information is far from complete; however, some of the projects known are as follows:

University of Connecticut staff:

Aitken, J.

1) Study of small scale fold structures in northeastern Connecticut.
2) The relation of bedrock fracture systems to groundwater supplies.
3) Bedrock geology of the South Coventry and Spring Hill quadrangles.

Frankel, L.

1) Study of foraminifera ecology in Long Island Sound.
2) Surficial geology of the South Coventry quadrangle.

Frankel, L. and Thomas, H., Effect of induced infiltration on water supply at an experimental well field at Lee Farm.

Liese, H., Continuing studies on feldspars in New England granites, and, with Aitken (above) on granitoid bodies in the South Coventry and Spring Hill quadrangles.

Thomas, H., Sediment deposition of suspended material in the Mystic Estuary.

University of Connecticut graduate students:

Byrnes — Triassic sedimentation in the Dinosaur Park and adjacent area.

Dorrler — Induced infiltration of wells near the Naugatuck River in the Waterbury area.

Frankfort — Study of talus slopes on the basalt ridges in the Meriden and New Haven areas.

Ronavne — Compositions and associations of garnets from selected areas in northeast Connecticut.

Earlham College undergraduates:

Cohen, J. — A study of the limestone in the South Canaan quadrangle.

University of Rochester staff:

Lundgren, L. and Ebblin, C. (Ph.D. candidate), Structural studies of the rock units along the Honey Hill Fault Zone.

University of Rochester graduate students:

Guu — Sulfide mineralogy of rock units in the coastal area of southeastern Connecticut (Master's essay).

Wesleyan University staff:

deBoer, J. — Paleomagnetic differentiation and correlation of the Late Triassic volcanic rocks in the central Appalachians (with special reference to the Connecticut Valley). (G.S.A. Bul., v. 79, p. 609-626, May 1968)

Wesleyan University graduate students:

Chang, C. — A gravity study of the Triassic Valley in southern Connecticut. (Master's thesis, 1968)

Graf, A. — An integrated study of the old cobalt prospects in Cobalt, Connecticut, using geological, geochemical, and geophysical data.

Wesleyan University undergraduates:

Laine, E. — A geophysical study of a buried river channel in the Jobs Pond area of Portland, Connecticut.

Western Connecticut State College staff:

Groff, D. — Pollution indices in the Still River in Brookfield, Connecticut.

University of Wisconsin staff:

Gates, R. — A study of the petrology of the Waterbury Formation in the Waterbury quadrangle.

University of Wisconsin graduate students:

Brauner, M. — A study of the geochemistry of the Housatonic Highlands gneiss complex in the South Canaan quadrangle.

Yale University graduate students:

Vidale, R. — Calc-silicate bands and metasomatism in a chemical gradient. (Ph.D. thesis, 1968)

Yale University undergraduates:

Besancon, J.

1) Whole rock potassium-argon dating of basalts from the Triassic of eastern North America.
2) Whole rock rubidium-strontium dating of the Nonewaug Granite.

COOPERATION WITH THE STATE HIGHWAY DEPARTMENT

The Highway Department has always been a user of the published geologic maps and in turn has furnished valuable drilling data and physical tests of earth materials. More recently the Highway Department has started an inventory of the sand and gravel resources of Connecticut. A report was prepared by Donald Spalding on the sand and gravel availability in District IV and Rino Vitali, now with the Survey, completed the field work on the sand and gravel of District II. Plans are being made to prepare these reports for publication by the Connecticut Survey to make them available to the public. A knowledge of the distribution of sand and gravel deposits is very important for highway and general construction, water supply, waste disposal, regional planning and intelligent land use. This work with the Highway Department is rated as a very important project.

COOPERATION WITH THE STATE PARK AND FOREST COMMISSION

The cooperative project at Dinosaur State Park has already been discussed. Plans are being made for a series of guidebooks for state parks describing both the geology and natural history. Dr. Lawrence Lundgren who has mapped a number of quadrangles in southern Connecticut has agreed to prepare geological material for a guide to Gillette Castle State Park. S. Bates of the Park and Forest Commission will prepare the natural history section. Other guidebooks are in the discussion stage in addition to the one being prepared for the Dinosaur State Park.

CONFERENCE ON CONNECTICUT GEOLOGY

The annual Conference on Connecticut Geology serves several useful purposes. Originally it was set up to provide an informal setting for the interchange of ideas between geologists working in the State. It has provided a unique opportunity for these people to get together to discuss mutual problems. Recently the Survey has made a determined effort to

encourage the participation of earth scientists in related fields and particularly organizations that use geological data.

On July 11 and 12, 1968, the ninth annual conference was held and discussion on both days was directed towards recent state-wide compilations of the bedrock and surficial geology. These discussions focused attention on unmapped areas and pointed out the increasing need for the cooperation of all the various agencies working with these data. There is a greater need for a free flow of information between the organizations that produce geological data and those who use it.

Current plans

Briefly summarized the immediate plans in the geologic program are: (1) to continue the U.S. Geological Survey cooperative program of geologic mapping which would include complete bedrock and surficial mapping of all the quadrangles along the Massachusetts and Rhode Island boundaries, completion of the surficial mapping of the Housatonic Valley, completion of the surficial mapping of the quadrangles east of the central lowland, start of the bedrock mapping in the Mystic, Old Mystic and Jewett City quadrangles, and pressure for completion and publication of the quadrangles already mapped; (2) to continue the mapping by part time state personnel to complete the bedrock geology of the Southbury, Norwalk North, and South Canaan quadrangles, and to begin the Winsted quadrangle, to continue surficial mapping in the lower Connecticut River area, to start bedrock mapping in the Clinton quadrangle, to compile a gravity map, and to continue use of geophysics to aid in mapping.

NATURAL HISTORY PROGRAM

Bulletin 101, "Freshwater Fishes of Connecticut," by Walter R. Whitworth, Peter L. Berrien, and Walter T. Keller, was a major contribution in 1968. Another bulletin, on molluscs, is ready for editing and bulletins on salt water fishes and amphibia are in preparation.

Entomology

For a number of years Dr. Charles L. Remington has planned and edited the distinguished series of entomology bulletins. Recently Dr. Philip Garman has submitted a revision of Bulletin 39 on dragonflies of Connecticut which has long been out of print.

Ecology

The program of studying the vegetation pattern in the natural areas of the state was described in the Thirty-first Biennial Report. The third report of the planned series was published in 1967. Drs. Niering and Egler have been occupied with other projects and have not been able to complete any other manuscripts. Plans are being made to complete the studies as outlined in the last Biennial Report as soon as personnel is available.

FINANCES

The appropriations for fiscal years 1956 to 1969 are shown in table 4. In the 1966 fiscal year a special appropriation of $30,000 was available for matching federal funds to produce a topographic map of the State on the scale of 1:125,000 with fifty foot contours. By use of the balance and the transfer of $2,000 from the 1967 regular appropriation to match with $2,000 of federal funds, a shaded relief version of the map was produced. A financial statement for the period from July 1, 1966 to June 30, 1968 is given in table 5.

PLANS FOR THE FUTURE

Geological program

The program of quadrangle mapping will continue to be pressed both by part time state personnel and by the cooperative program with the U.S. Geological Survey. These maps are basic to an understanding of the regional geology and for most applied geology. It is anticipated that they will be used continually by the groundwater hydrologists, highway geologists, and construction engineers. The completion of the aeromagnetic maps will also be pressed for they represent an important tool in the interpretation of the geology.

Within a few years Connecticut should have the following maps of the state on the scale of 1:125,000: gravity map, aeromagnetic map, surficial geologic map, bedrock geologic map. Other special purpose maps may also be produced. These maps represent important contributions to the basic

Table 4. — Appropriations 1956-1969 (Fiscal Year)

Year[1]	*Appropriation*	*Cooperative State Funds*	*Cooperative Federal Funds*
1956	$23,930	$20,000	$20,000
1957	16,535	20,000	20,000
1958	30,250	40,000	40,000
1959	32,250	40,000	40,000
1960	30,208	40,000	40,000
1961	27,513	40,000	40,000
1962	22,012	40,000	40,000
1963	22,114	40,000	40,000
1964	30,520	40,000	40,000
1965	28,645	40,800	40,800
1966	56,130	76,000	76,000
		30,000[2]	30,000[2]
1967	63,401	75,000	75,000
1968	65,434	75,000	75,000
1969	94,703	75,000	75,000

[1]Ending July 1

[2]Appropriation for state topographic map

Table 5. — Financial statement, biennial period, July 1, 1966 to June 30, 1968

Income	*Expenditure*	
	1966-1967	
Appropriation, $63,401	Salaries	$ 8,121
Cooperative with U.S. Geological Survey, $75,000	Fees	9,866
	Printing	14,883
Capital expenditure, $1247	Dues	91
	General repairs	91
	Travel	5,452
	Sundry	2,255
	Office expenses	824
	Maps	3,466
	Total	$45,006
	Reimbursement from sales	1,885
	Total expenditure	$43,121
	1967-1968	
Appropriation, $65,434	Salaries	$16,801
Cooperative with U.S. Geological Survey, $75,000	Fees	15,960
	Printing	16,007
Capital expenditure, $227	General repairs	201
	Travel	5,846
	Sundry	4,185
	Office expenses	434
	Maps	3,328
	Total	$62,762
	Reimbursement from sales	4,023
	Total expenditure	$58,739
	1968-1969	
Appropriation, $94,703		
Cooperative with U.S. Geological Survey, $75,000		

geology of the state, but to fulfill their potential value they must be followed by special studies — economic studies, educational bulletins, and particularly cooperative studies with other agencies involved in soils, geology, and hydrology of the urban areas. An engineering geologist has been requested for this work. After June 30, 1971, it is expected that the

cooperative mapping program with the U.S.G.S. can be reduced and applied geology expanded either with state personnel or a changed cooperative program oriented more in this direction.

Dinosaur Park

The Survey has been operating the educational facilities at Dinosaur Park, and in the future a more complete utilization of this site is anticipated. A "school package" is planned for the Park in September of 1969 that will include a lecture for a class at a school followed by a guided tour of the Park where the Survey will continue to provide full time guides. In order to best serve the growing number of visitors and to realize the full potential of Dinosaur Park, expanded facilities must be planned and constructed. There is a need to protect the Park by the acquisition of adjacent land to the west, and additional personnel will be required to direct and operate the educational program. The Survey has been working closely with Wesleyan University, Peabody Museum, the University of Connecticut and others in the development and implementation of this program.

Educational publications are planned for the following: geology and natural history of selected state parks, topographic and geologic maps, and specific areas such as Dinosaur Park.

Natural history

It has long been apparent that the natural history program of the Survey needed to be expanded. The three Commissioners whose professional fields are biology or botany met in the fall of 1967 and recommended among other things that the Survey support in part a working museum at Storrs where collections could be made by specialists which would permit preparation of bulletins on groups such as birds, amphibia, reptiles, etcetera. The published bulletins on these groups are out of print and badly in need of revision. The support by the Survey of a director of such a museum and of appropriate assistants would permit important progress in the natural history field.

Dr. Remington and others have urged the need of ecological studies. The effects of pesticides, thermal pollution, and air pollution on the flora and fauna (including man) are too little known. Such studies are recommended when funds and personnel are available.

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 administrative 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 conditions of the survey, together with such other information as they deem useful or as the general assembly requires. The regular and special report 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 Geological and Natural History Survey, Jan. 1, 1967 to Jan. 1, 1969

PUBLISHED

Bulletin series

Bulletin 100. Thirty-second Biennial Report of the Commissioners of the State Geological and Natural History Survey

Bulletin 101. Freshwater Fishes of Connecticut, by Walter R. Whitworth, Peter L. Berrien, and Walter T. Keller

Bulletin 77. (Reprint) Connecticut Minerals, by Julian A. Sohon

Bulletin 84. (Reprint) Preliminary Geological Map of Connecticut

Quadrangle maps and reports

QR 20. The Surficial Geology of the Hartford South Quadrangle, by R. E. Deane

QR 21. The Bedrock Geology of the Old Lyme Quadrangle, by Lawrence Lundgren, Jr.

QR 22. The Bedrock Geology of the Waterbury Quadrangle, by Robert M. Gates

QR 23. The Surficial Geology of the Ansonia and Milford Quadrangles, by Richard F. Flint

QR 24. The Bedrock Geology of the Long Hill and Bridgeport Quadrangles, by William P. Crowley

Guidebooks

2. Guidebook for Fieldtrips in Connecticut, New England Intercollegiate Geological Conference, 1968, edited by Philip M. Orville

The Vegetation of Connecticut Natural Areas

3. The Natural Areas of the McLean Game Refuge, by Frank E. Egler and William A. Niering

List of Publications 1967

List of Publications 1968

Report of Investigations series

RI 4. Stratigraphy and Structure of the Western Part of the New Haven Quadrangle, Connecticut, by Henry R. Burger

IN PRESS

Bulletin series

Bulletin 102. Thirty-third Biennial Report of the Commissioners of the State Geological and Natural History Survey

Bulletin 84. (Reprint) Explanatory Text for Preliminary Geological Map of Connecticut, by John Rodgers, Robert M. Gates and John L. Rosenfeld

Reprints on Connecticut Geology

Amphibolites: Syntectonic Intrusives? (a reprint from American Journal of Science) by Robert M. Gates

Stratigraphy and Primary Sedimentary Structures of Fine-Grained, Well-Bedded Strata, Inferred Lake Deposits, Upper Triassic, Central and Southern Connecticut (reprint from Geological Society of America, Inc.) by John E. Sanders

Isotopic Age Study of Metamorphism and Intrusion in Western Connecticut and Southern New York (a reprint from American Journal of Science) by George S. Clark and J. Laurence Kulp

Publications of the U.S. Geological Survey in Cooperative Program with the Connecticut Geological and Natural History Survey, Jan. 1, 1967 to Jan. 1, 1969

PUBLISHED

Connecticut State Map, scale 1:125,000

Four editions: planimetric, topographic, topographic with green overprint, shaded relief

Geologic Quadrangle series

GQ-574. Bedrock Geology of the New London Quadrangle, by Richard Goldsmith

GQ-575. Bedrock Geology of the Niantic Quadrangle, by Richard Goldsmith

GQ-576. Bedrock Geology of the Uncasville Quadrangle, by Richard Goldsmith

GQ-592. Bedrock Geology of the Columbia Quadrangle, by George L. Snyder

GQ-609. Bedrock Geology of the Montville Quadrangle, by Richard Goldsmith

GQ-611. Surficial Geology of the Roxbury Quadrangle, by Harold E. Malde

GQ-655. Bedrock Geology of the Watch Hill Quadrangle, by George E. Moore, Jr.

GQ-660. Surficial Geology of the Danielson Quadrangle, by A. D. Randall and Fred Pessl, Jr.

GQ-678. Geology of the Springfield South Quadrangle, by Joseph Hartshorn and Carl Koteff

GQ-696. Bedrock Geology of the Danielson Quadrangle, by H. Roberta Dixon

GQ-712. Surficial Geology of the Ashaway Quadrangle, by J. P. Schafer

GQ-718. Surficial Geology of the Norwalk South Quadrangle, by Harold E. Malde

GQ-727. Surficial Geology of the West Torrington Quadrangle, by Roger B. Colton

GQ-738. Bedrock Geology of the Meriden Quadrangle, by Penelope M. Hanshaw

GQ-756. Surficial Geology of the Durham Quadrangle, by Howard E. Simpson

IN PRESS

Geologic Quadrangle series

GQ-782. Surficial Geology of the New Preston Quadrangle, by Roger B. Colton

GQ-791. Bedrock Geology of the Marlborough Quadrangle, by George Snyder

GQ-798. Surficial Geology of the Tariffville Quadrangle, by A. D. Randall

GQ-848. Surficial Geology of the Litchfield Quadrangle, by C. R. Warren

U.S. Geological Survey publications not part of the Cooperative Program, but dealing with Connecticut geology, Jan. 1, 1967 to Jan. 1, 1969

PUBLISHED

Geophysical Investigations

GP-629. Aeromagnetic Map of Hampden Quadrangle

GP-630. Aeromagnetic Map of the Monson Quadrangle

GP-631. Aeromagnetic Map of the Southbridge Quadrangle

GP-632. Aeromagnetic Map of the Springfield South Quadrangle

GP-633. Aeromagnetic Map of the Wales Quadrangle

GP-634. Aeromagnetic Map of the Webster Quadrangle

GP-635. Aeromagnetic Map of the West Springfield Quadrangle and Part of the Southwick Quadrangle

Miscellaneous Geological Investigations

Map I-514. Engineering Geology of the Northeast Corridor Washington, D.C. to Boston, Massachusetts: (A) Bedrock Geology; (B) Coastal Plain and Surficial Deposits; (C) Earthquake Epicenters, Geothermal Gradients and Excavations and Borings

Hydrologic Investigations

Atlas HA-249 Ground-Water Favorability of the Connecticut River Basin New England States, by D. J. Cederstrom and Arthur L. Hodges, Jr.

IN PRESS

Geophysical Investigations

GP-640. Aeromagnetic Map of the Sharon Quadrangle and Part of the Ellsworth and Bashbish Falls Quadrangles

GP-641. Aeromagnetic Map of the South Canaan Quadrangle and Parts of the Cornwall and Ashley Falls Quadrangles

GP-642. Aeromagnetic Map of the Norfolk Quadrangle

GP-643. Aeromagnetic Map of the Winsted Quadrangle and Parts of the Torrington and Tolland Center Quadrangles

GP-644. Aeromagnetic Map of the New Hartford Quadrangle

GP-645. Aeromagnetic Map of the Tariffville Quadrangle

GP-646. Aeromagnetic Map of the Windsor Locks Quadrangle and Part of the Hartford North Quadrangle

GP-647. Aeromagnetic Map of the Broad Brook Quadrangle and Part of the Manchester Quadrangle

GP-648. Aeromagnetic Map of the Ellington Quadrangle

GP-649. Aeromagnetic Map of the Stafford Springs Quadrangle and Part of the South Coventry Quadrangle

GP-650. Aeromagnetic Map of the Westford Quadrangle and Part of the Spring Hill Quadrangle

GP-651. Aeromagnetic Map of the Westford Quadrangle and Part of the Spring Hill Quadrangle

GP-651. Aeromagnetic Map of the Eastford Quadrangle

GP-652. Aeromagnetic Map of the Putnam Quadrangle

GP-653. Aeromagnetic Map of the Thompson Quadrangle and Part of the East Killingly Quadrangle

Publications of the Connecticut Water Resources Commission, Jan. 1, 1967 to Jan. 1, 1969

PUBLISHED

Bulletin 11. Water Resources Inventory of Connecticut, Part 2, Shetucket River Basin, by M. P. Thomas, G. A. Bednar, C. E. Thomas, Jr., and W. E. Wilson

Bulletin 12. Hydrogeologic Data for the Shetucket River Basin, Connecticut, by C. E. Thomas, Jr., G. A. Bernar, M. P. Thomas, and W. E. Wilson

Bulletin 13. Ground-water Levels in Connecticut, 1965-1966, by R. L. Meikle

Bulletin 14. Ground-water Resources of the Hamden-Wallingford Area, Connecticut, by A. M. La Sala, Jr.

Bulletin 16. Hydrogeologic Data for the Lower Thames and Southeastern Coastal River Basins, Connecticut, by M. A. Cervione, Jr., I. G. Grossman, and C. E. Thomas, Jr.

Other Publications on Connecticut Geology

Thomas, C. E., Jr., The Quality of Connecticut's Surface Waters: Institute of Water Resources, University of Connecticut, Rept. No. 6