

REPORT
OF THE
VERMONT STATE GEOLOGIST

1946-1950

C. G. Doll

General Statement

When the Geologist came into office on July 1, 1947, he was engaged in mapping the Jay Peak quadrangle, a continuation of work begun the previous year. It was already late in the season to get new projects started, largely because geologists are rarely available during the field season. Completion of the Jay Peak quadrangle will require more field work, as the mountainous terrain is heavily wooded and the geology is very complex.

An exhibit of rocks and minerals of economic value, at the Eastern States Exposition in September, produced much favorable comment. The success of this exhibit has led to the installation in the spring of 1948 of a similar but permanent display in the Fleming Museum at the University of Vermont.

The summer field season of 1948 began about three weeks before the close of the fiscal year. At this time geological mapping was begun on the Rochester and East Middlebury quadrangles. Work on the Castleton quadrangle will be completed this fall.

The survey of ground water and lakes was also underway. In order to carry on the lake work efficiently the purchase of an outboard motor was necessary. This has facilitated the work greatly and made possible more accurate results than could otherwise have been obtained, since with it, drifting from a located contour point could be prevented. A 360-foot sounding line with lead constituted the other major item of equipment. After the technique of sounding was perfected and a suitable method of procedure developed, surveying of the lakes was begun. By the end of the three-months season it is anticipated that about 20 lakes in northeastern Vermont will have been completed, depending upon the division of this work with that on ground water.

Plans for the Cuttingsville project indicate an active summer for the Geologist at that locality.

During the past year some equipment necessary for geological surveying was purchased.

The Survey performs a service to the people of the State in identifying mineral and rock samples and reporting the results personally to the sender. Even though many of these samples prove to be valueless, some of them might be important guides to mineral deposits of commercial magnitude, and so the Survey continues to welcome the sending of specimens.

A Program of Mapping

With the release of the Burke Mountain quadrangle, which may be expected soon, the State will be completely mapped topographically on a scale of one mile to the inch. In recent years the topography has been remapped in some parts of the State on a scale of one mile to two inches. These maps are of great importance as a base in the geologic mapping of an area, and their availability makes possible a systematic program of rock and mineral exploration in conjunction with detailed map-

ping. Such a program, if consistently followed, would result in the completion of a geologic map of Vermont which would be widely used, as indicated by the numerous requests for one. In this connection it might be mentioned that, at the present time, the only geologic map of the State is the rather antiquated one published by Hitchcock in 1861. Geology has since made considerable progress and with competent personnel using modern geological methods a creditable geologic map can be made. It is quite impossible to make a geologic map of Vermont at the present time with the small amount of new data at hand.

Besides having a general interest, a geologic map of Vermont showing localities and rock formations of economic promise, would be valuable both to the existing and to any potential mineral industries. With regard to the latter, among the inquiries about mineral deposits are those received from industrial concerns outside of the State. Apparently due to the increasing shortage of marketable timber, some lumber companies have become interested in the geology of their properties with the idea of possible mineral exploitation, and are among those requesting maps. It is perhaps not sufficiently realized that as a structural material, lumber is in many ways being replaced by mineral products. With the demand for the latter growing it would appear that now is an opportune time to investigate our own mineral resources, and the most economical way to do this is by means of a methodical mapping program.

Recognizing the importance to the State of geologic mapping, the Geological Survey proposes a program of systematic mapping over a period of ten years which would in that time, possibly sooner, produce a complete geologic map of the State.

The normal time requirement for the completion of an area the size of a topographic quadrangle, is three years. The most economical cost to the State would be to engage geologists of graduate student grade during the summer months. These students would be under expert supervision, as the results of their field work would be incorporated in a thesis, an essential requirement for a higher degree at a university. Thus it may be seen that the benefits are mutual, as the State will be getting good quality geological mapping done relatively inexpensively and the student will gain experience from his field work.

The area still unmapped geologically is the equivalent of approximately 28 topographic quadrangles. The estimates tabulated below are based upon previous experience and show the one-man cost per quadrangle for a period of nine months in three years (the time normally necessary to map a quadrangle):

Wks.	Mos.	Yrs.				
	3	x	3	x	\$100 per mo. \$900 Salary	
4	x	3	x	3	x	\$ 25 per wk. \$900 Board & Lodging
			3	x	\$200 per season \$600 Travel Expenses	
					\$2400 Total	

Thus, the total expenditures for a program of 28 quadrangles comes to \$67,200. The distribution of this sum over a period of ten years will vary, of course, according to the plan adopted. The following plan which is preferable, has the advantage of keeping annual additions in personnel at a fairly constant, low figure, which reduces the danger of interruptions in the program during times of manpower shortage and permits better supervision of the work. Also, by staggering the program, a great influx of reports and thus a considerable burden on the printing fund at any one time is prevented. On the other hand, the annual expenditures vary considerably, although the grand total remains the same.

Plan 1

1	2	3	4	5	6	7	8	9	10	Duration of program in years
3	3	3	3	4	4	4	4			New personnel—1st year of mapping
	3	3	3	3	4	4	4	4		Same personnel—2nd year mapping
		3	3	3	3	4	4	4	4	Completion of work—3rd year mapping
3	6	9	9	10	11	12	12	8	4	Number of men in field each year
\$2400	\$4800	\$7200	\$7200	\$8000	\$8800	\$9600	\$9600	\$6400	\$3200	Annual expenditures
\$7200		\$14,400		\$16,800		\$19,200		\$9600		Biennial appropriations

Another procedure in which the annual expenditures are uniform, appears in the plan below. However, it might be extremely difficult to locate the number of men required at the beginning of each three-year period, as shown in the plan.

Plan 2

1	2	3	4	5	6	7	8	9	10	Duration of program in years
10			10			8				Number of men in field during each 3-year period
\$24,000			\$24,000			\$19,200				Expenditures for each 3-year period.

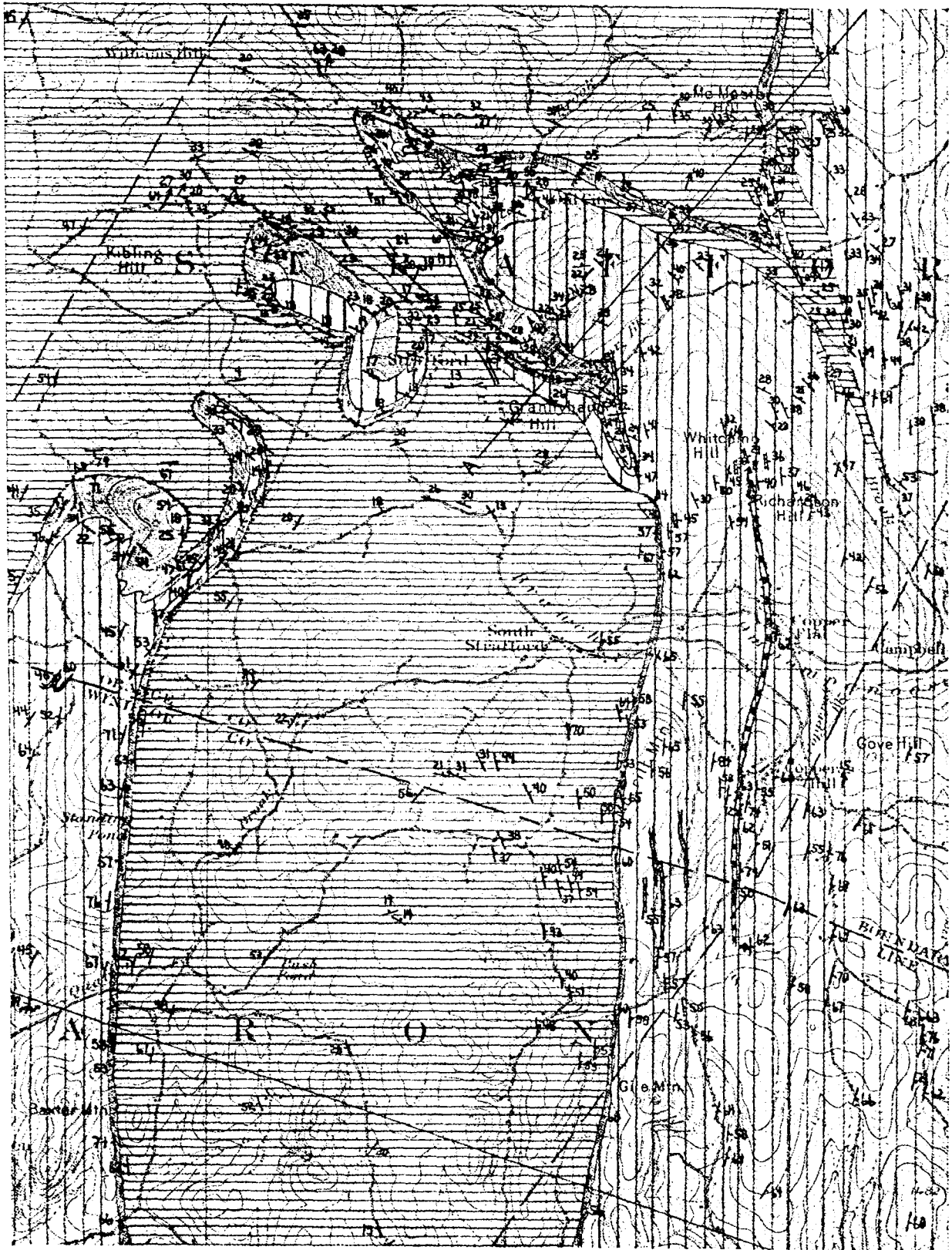
It is earnestly hoped that the Geological Survey will be favored with the funds necessary to pursue this planned mapping program. Among the New England states possessing geological surveys, Vermont ranks fourth in the amount appropriated for geological work, according to figures compiled for 1947 by the secretary of the Association of American State Geologists. The exploited mineral wealth in Vermont far exceeds that of any other New England state, the total annual production amounting to more than \$20,000,000. The State of Vermont spends one-fiftieth of one percent of this sum for the work of the Geological Survey at the present time. Some of our mineral industries are expanding their operations, due either to increased business or to new discoveries resulting from exploratory work.

With the funds requested made available for this program, the Geological Survey will be in a position to continue its work more effectively.

The Ground Water and Lakes Survey

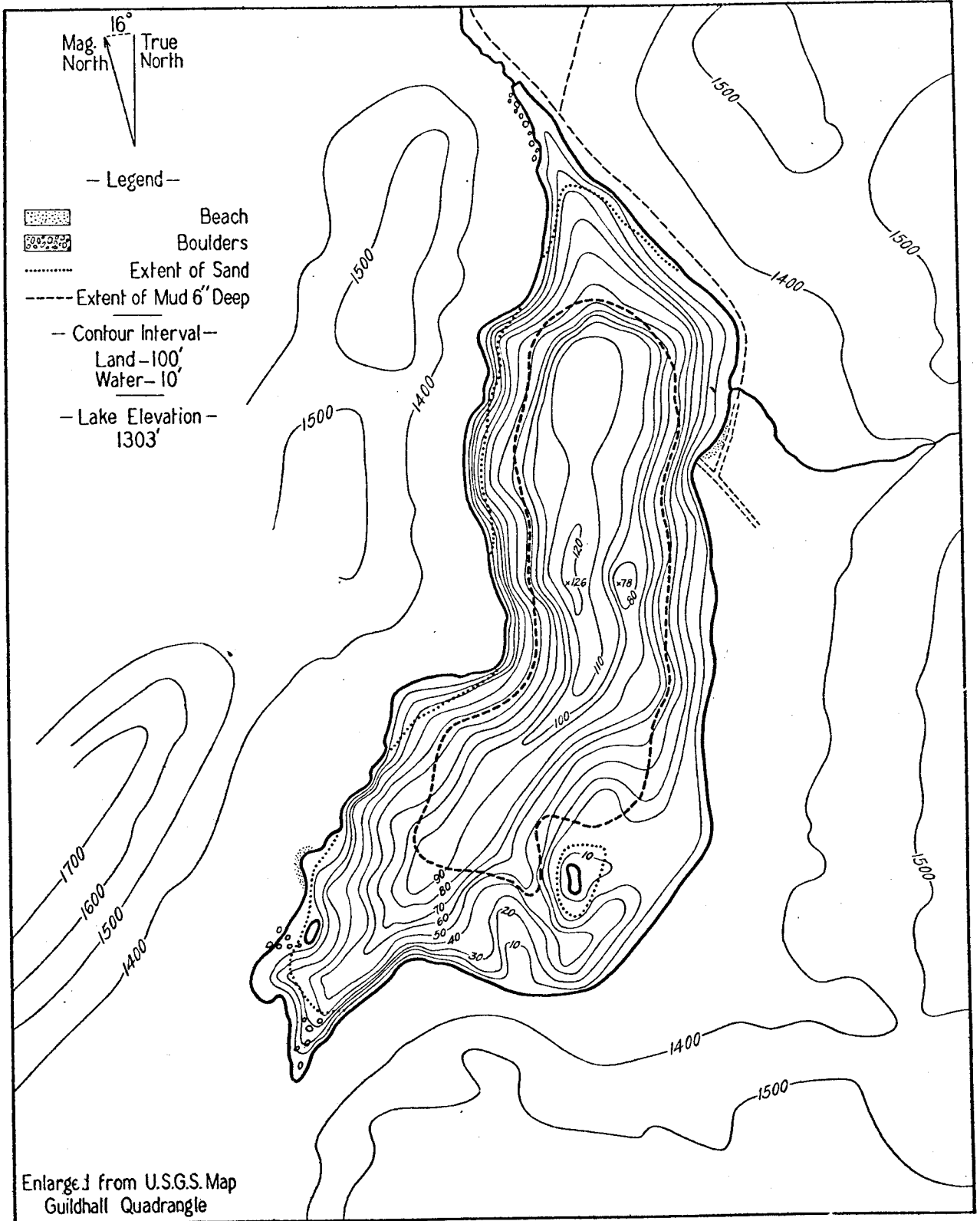
In the spring of 1948 the Development Commission appropriated the special sum of \$1800 for the purpose of compiling data on and making a study of our ground water supply during three months of this summer. Ground water is a very important resource which is used daily by urban and rural industrial plants and inhabitants of the State. The increased use of ground water for industrial and domestic purposes in recent years has caused some Vermont communities to augment their present water-supply systems and, in so doing, they have been forced to tap new ground water sources with varying success. Water is a vital necessity on every farm and plays an important part in the daily activities.

The ground water program consists of gathering data on existing wells from drillers' logs,—locations, depths, rates of flow, levels of water, types of aquifer, etc. This information



Example of a portion of a modern geologic map showing complexity of rock formations and structures in the copper belt of eastern Vermont.

MAIDSTONE LAKE



Enlarge J from U.S.G.S. Map
Guildhall Quadrangle

Vermont Geological Survey
Charles G. Doll, Director

Water Survey Division
John R. Mills, Surveyor

accompanied by a ground water map will make the search for subsequent water sources more economical and will permit predictions of depth and yield. In this new branch the Geological Survey welcomes cooperation with well drillers active in the State; such cooperation should be to mutual advantage. An occasional visit by a well driller is indicative of the water problems encountered in uncharted ground.

In order to facilitate progress and enlarge the scope of this work, a cooperative project has been discussed with a representative of the United States Geological Survey. As with the existing cooperative topographic survey, the amount contributed by the Vermont Geological Survey is matched by the United States Geological Survey.

The cooperative work will consist largely in studying water level fluctuations in selected observation wells in different parts of the State. The data collected is important, as it discloses the conditions in an aquifer during pumping operations and permits estimation of the level below which water should not be taken.

In discussing a cooperative project with the District Geologist of the United States Geological Survey it was found that at least \$6000 would be necessary to carry on the work satisfactorily, \$3000 to be contributed by each party.

The lakes survey is a project concerned with contouring the bottoms of our major lakes with the purpose of determining their geological nature, depths, and the types and distribution of sediments on their bottoms. These maps have aroused considerable interest already and should prove useful in fields other than geology. The accompanying figure, page 26, an underwater map of Maidstone Lake (original on a scale of 5 inches to the mile) is a sample of the type of work this survey is doing.

The Cuttingsville Project

A gift of \$15,000 to the State by Mr. George A. Ellis and designated for exploratory work on metallic deposits in the State, has been made available to the Geological Survey. After an examination of the old mine workings at Cuttingsville and on the basis of a recommendation made in a report on the locality by Mr. H. M. Kingsbury, Consulting Mining Geologist, and formerly with the Vermont Copper Company at South Strafford, it was decided to explore this ground by means of a small amount of diamond drilling either to confirm or disprove the presence of minable ore.

Work has been started on this project in preparation for the drilling operations which are expected to begin some time in August. An important part of the preparatory work will be the plane table mapping of the locality on a scale of 50 feet to the inch. This will permit drafting of the geologic structures on a workable scale and the placing of drill-hole sites with greater accuracy.

Topographic Mapping

A cooperative project with the United States Geological Survey has been in existence for some time. The appropriation on the part of the State continues to be \$2000 on the dollar-for-dollar basis. As stated elsewhere in this report, certain areas in the State are now being remapped on a scale of two inches to a mile. Vermont is now about 98 percent mapped by quadrangles on the scale of one mile to the inch, and the issuance of the one remaining quadrangle is not far off.

Survey Publications

The publication of the series of biennial reports of the State Geologist has been discontinued. Instead, separate bulletins will be published for the Geological Survey by the Development Commission. This new arrangement has the advantage in that



Drilling at Cuttingsville

material can be published whenever ready and not be required to wait until the end of the next biennium.

No bulletins have as yet been published, but a report on the geology of an area in the eastern part of the State is in process and is expected to appear during the coming winter. Other reports will follow in the next year. All work performed under the auspices of the Geological Survey will appear in these bulletins. The demand for geological information of the State is quite appreciable and might be expected to increase with the publication of new bulletins.

Budget Requested

The following budget has been requested for the next biennium, July 1, 1949 to June 30, 1951:

	July 1, 1949 to June 30, 1950	July 1, 1950 to June 30, 1951
Geological Mapping, Plan 1 (p. 24)	\$2400	\$4800
Plan 2 (p. 24)	8000	8000
Ground Water Survey-cooperative	3000	3000
Lakes Survey	1800	1800
Equipment and Supplies	300	300
Salary and Expenses of State Geologist	2625	2625
(Including Plan 1)	\$10125	\$12525
(Including Plan 2)	\$15725	\$15725

Motion Pictures 6017.68

Sportsmen's Shows:

Equipment for Exhibits, etc. 2913.59
 Catalogs 432.84
 Telephone, Express 198.14
 Electricity 45.83
 Art Work, Photography. 118.24
 Travel 853.38

Eastern States Exhibition 4018.41

Total Disbursements \$210,818.58

EASTERN STATES EXPOSITION BUILDING

July 1, 1947-June 30, 1948

RECEIPTS:

Appropriations for Fiscal Year 1948:
 For Building Management \$5,000.00
 For Building Repairs, etc. 3,678.17 \$8,678.17

Transfer of Funds from Development Commission 2,643.37

Transfer of Funds from:
 Fish & Game Commission 1,256.60
 State Forestry 1,256.60 2,513.20

Refund—Miscellaneous 5.60

Total Receipts \$13,840.34
 Total Disbursements 12,734.53

Balance \$1,105.81

DISBURSEMENTS:

Travel \$ 824.15
 Salaries 556.50
 Painting 3,463.00
 Plumbing 2,581.83
 Carpentry. 4,023.11
 Insurance 114.42
 Equipment, Supplies, etc. 144.23
 Trucking, Telephone, Telegraph 148.66
 Photography. 100.00
 Planting 628.63
 Miscellaneous 150.00

Total Disbursements \$12,734.53



STATE GEOLOGIST

July 1, 1947-June 30, 1948

RECEIPTS:

Appropriation Fiscal Year 1948 \$4,000.00
 Total Disbursements 3,667.13

Balance \$ 332.87

DISBURSEMENTS:

Salaries \$1,799.15
 Travel 749.51
 Telephone, Telegraph, etc. 7.07
 Equipment 883.03
 Printing 36.00
 Exhibit at Eastern States. 58.93
 Photography 50.00
 Miscellaneous for Analyses service, etc. 83.44

Total Disbursements \$3,667.13

FINANCIAL STATEMENT

July 1, 1946-June 30, 1947

RECEIPTS

Development Commission

Total Appropriations \$30,000.00

\$30,000.00

Publicity Service

Balance brought forward 10,322.22
 Total Appropriations 55,100.00

65,422.22

Total Receipts \$95,422.22

EXPENDITURES

Development Commission

Salaries of Director & Employees. \$20,163.64
 Expenses of Director & Employees 962.48
 Per Diem & Expenses of Commission 908.96
 Office Equipment. 1,228.31
 Miscellaneous Expense 765.36
 Water Conservation Board Report 775.00
 Stream Gauging 4,653.94

29,457.69

Publicity Service

Salaries of Director & Employees \$9,466.93
 Advertising 11,098.01
 Printing 9,809.46
 Photos & Movies 1,149.45
 Information Services 3,925.00
 Hotel & Tourist Home Survey 580.55
 Miscellaneous Expense 1,108.72
 "Vermont Life" Magazine Expense 27,721.91

64,860.03

Total Expenditures \$94,317.72

tracted films and to provide additional motion picture and television prints of existing films, as well as to defray costs of film servicing, shipment and booking.

PUBLICITY SERVICE—Promotional activities have centered in three major classifications—space advertising, circulation of a variety of publications and information services. Each bears a relationship to the other two.

Newspaper and magazine advertising bring a demand for booklets and, in many cases, for detailed information on vacations, industries and agriculture. The spring campaign covers places for sale, spring fishing and summer vacations. A winter campaign, a fall foliage schedule, industrial sites advertising and miscellaneous agricultural ads have been carried on.

Hundreds of thousands of pieces of literature have been printed and distributed directly to interested people and through widely scattered travel centers. Heavy correspondence of the office has been supplemented by informational service of chambers of commerce, booths and the aid of interested Vermonters and organizations.

Trends of business have been studied and surveys of advertising results and the vacation business in general have been conducted by the research and planning division co-operating with the publicity staff.

Rising costs are causing curtailment of plans for advertising and printing. More space in magazines and newspapers should be used and some of the publications should be improved to meet the steadily rising competition of other states and areas.

VERMONT LIFE—Publication started with the Autumn issue of 1946 and by July 1 of 1948 circulation had increased to 50,000 copies per issue, including 14,000 paid subscriptions, two-thirds of these to out-of-state residents, 1200 copies distributed free to Vermont public schools, and the balance sold on newsstands.

In its first eight issues *Vermont Life* carried 86 articles on 19 general subjects. Thirteen were on places to visit, ten on sports and recreation, and seven each essays on Vermont and on winter sports.

Operating on a flat sum *Vermont Life* was forced to cut

the numbers of copies printed below the sales demand. Continuing without the use of revenues from the sales of the magazine and continuing the policy of no advertising it is estimated that revenues might equal costs when the circulation per issue reaches the neighborhood of 100,000 copies.

If *Vermont Life* is to expand to supply copies to meet the present and potential demand, it must secure an augmented appropriation or the use of receipts plus an appropriation.

GEOLOGICAL SURVEY—Activities of the Survey during the biennium included installation of a Vermont rock and mineral display at the Fleming Museum, University of Vermont as a permanent exhibit. A special rock identification service was maintained by the Survey.

In the process of completion are: geological mapping of the Jay Peak quadrangle, geological mapping of the Castleton quadrangle, publication of the Burke Mountain topographical quadrangle, publication of a report on the geology of a section of eastern Vermont, and bottom contour mapping of 20 northeastern Vermont lakes.

Work was begun by the Survey on: geological mapping of the Rochester and East Middlebury quadrangles, on ground water surveys, and exploratory drilling at Cuttingsville under the \$15,000 gift by George A. Ellis.

The Burke Mountain quadrangle will complete the Vermont topographic mapping on a one inch to one mile scale. The last Vermont geological map was published in 1861. It is recommended that \$67,200 be expended over the next 10 years to complete geological mapping of 28 quadrangles. An adequate ground water survey will cost \$3000 in state funds, \$2200 more than now available.

CONCLUSION—If Vermont is to maintain its favored position in the tourist and recreation business the pressure of serious competition makes it necessary to carry on a well-rounded publicity and promotion program. This situation also is true of Vermont's role in industrial development and in agricultural planning, as these functions become increasingly important in the economy of Vermont.

A major concern of the staff at present is the increase of news stand sales, since the subscription price of \$1.00 per year is below cost. No less important is the fact that news stand sales mean operating capital while moneys from subscriptions are tied up in the reserve fund.

CAN VERMONT LIFE PAY ITS OWN WAY?—While it is too early to make a definite forecast it seems reasonable to expect that the magazine will be self-supporting in the not too distant future. Circulation of the Winter 1950 issue was upwards of 52,000 copies, the first time the 50,000 figure had been achieved and bettered. The print order on the Spring issue of 60,000 was a realistic estimate of expected sales but full returns are not in as this is written. Further plans for 1950-51 include increased, intensive promotion. The least costly method is fortunately the most effective, namely, to get sample copies into the hands of as many people as possible. *Vermont Life* sells on sight and no sales talk or advertising surpasses a glimpse of the publication itself.

It is estimated that, barring an unforeseen rise in costs, a circulation of 80,000 would support the magazine. This circulation is now within reach.

VERMONT BUILDING

Eastern States Exposition

The Vermont Building at Eastern States Exposition is by statute under the management of the Development Commission. A separate appropriation is set up by legislative act with a definite allocation each year of the biennium. For the past two years the appropriation has been based on estimated minimum operating and maintenance expenses. It has not included an allowance for major maintenance or repairs.

The building was painted in 1948 and should be painted inside and out in 1951. This will require a larger budget than allocated in 1949 or 1950. Due to the changed conditions since 1929 when the building was opened it has been found necessary the past two years to install a second transformer in order to meet the demand of the exhibitors for lights and power. In order to avoid costly installation charges each year a supplemental power transformer should be purchased and installed and the wiring within the building changed over to insure trouble-free operation during the exposition.

In 1948 and 1949 the exhibitors were about evenly divided on space allocations among industrial, agricultural and recreational interests. Of necessity the latter two are predominantly represented by state departments and the first by cooperating industrial concerns. No charges are made for space and no sales are allowed except by agricultural organizations whose profits from sales are used to promote general use and increased sales of their products.

Under this arrangement the Vermont Maple Sugar Makers Association and the Vermont Beekeepers Association have been able to realize substantial amounts for promotional purposes.

State departments that have exhibited during the biennium are: Department of Agriculture, Fish and Game Service, Forestry Service, Arts and Crafts Division of the Department of Education, and the Development Commission.

Individual concerns that have exhibited are: Vermont Marble Company, Green View Tissue Co., C. F. Orvis Co., Vermont Hotel Association, Minshall-Estey Company, Lecuyer Brothers, Vermont Winter Sports Council, Vermont Plastics, Inc., Maltex Company, S. Ballard Company, Vermont Coppercrafters, and Vermont Tubbs, Inc.

Planned for the 1950 exhibit are several repeaters from the above list and the following concerns: Howe Scale, Inc., C. E. Bradley, Inc., Beecher Falls Manufacturing Co., Vermont Turkey Growers Association, and several individual craftsmen who represent the best in Vermont craft work.

In 1948, building maintenance cost was over \$3,600 and total operating costs were in excess of \$6,300. In 1949 it was possible to keep within the \$4,000 appropriation only by cutting out the painting expense and holding all other costs to a minimum. In 1950 with an appropriation of \$3,000, it was impossible to do any painting or major repair work. This will have to be done before 1951 in order to protect the building and make it presentable to the thousands of people who visit the exhibits.

To best serve its purpose of advertising and promoting Vermont the building should be operated on a basis of independence from subsidy by private interests. This means an adequate budget to allow for completely free choice of exhibitors and to provide sufficient financing to maintain high standards of overall appearance. Other states have found that when lack of finances makes it necessary to depend upon private interests to provide operating costs, the overall purpose of state promotion is subjugated to those interests. In order to avoid this contingency it appears necessary that an increased budget be allocated in the next biennium.

In 1949 the general reaction of Exposition visitors and officials was that the Vermont Building offered more of general interest than any other state building. This was due mainly to the fact that most of the exhibitors' booths presented some form of action demonstration. Without doubt this is the answer to crowd appeal. Attendance checks during the Exposition varied. The highest count showed 7,400 persons entering the building per hour and the lowest count during the week showed more than 1,900 persons per hour. The satisfying factor was that all visitors stayed longer in the Vermont Building than in any other state building.

It is estimated that between 250,000 and 300,000 people visit the Vermont Building during the Exposition. It is our thought that this opportunity to sell Vermont should be promoted to the greatest extent possible. The Development Commission believes that the building should be used for state promotional purposes for longer periods during the year. Preliminary discussions have been held with Exposition officials looking forward to keeping the building open during the summer months if some plan can be arranged that will be self-liquidating financially.

GEOLOGICAL SURVEY

CHARLES G. DOLL, *State Geologist*

GEOLOGIC MAPPING—The importance of geologic mapping cannot be overemphasized. Only by efficient, methodical mapping can the geology of Vermont be accurately and satisfactorily portrayed. In this way the systematic un-

raveling of the stratigraphic, structural, and metamorphic geology of an area will reveal the presence of deposits of possible commercial character. The areal geologic map will serve as a base for further and more detailed investigations of a restricted area showing favorable indications. The Geological Survey makes the results of its mapping programs available to the public in the form of published reports.

Consistent accumulation of map data will contribute timely information toward the construction of a geologic map of Vermont. Numerous requests for a geologic map of the State have come from interested persons and industries, largely from outside of the State. Such a map would rank high among State publications as a medium of publicity.

FIELD WORK COMPLETED—Mapping of the Castleton quadrangle was completed at the close of the field season in 1949. Considerable importance is attached to this area because it lies in the marble and slate belts of the Taconic Mountains, in which the sequence and structure of the rock formations have long been a problem. This report is in press.

During the summer of 1948 the Geological Survey carried on, as its Lakes Survey project, studies of 15 lakes in northeastern Vermont. These studies included the distribution and kinds of sediments, and the sounding and consequent contouring of the lake bottoms. The manuscript and accompanying maps were submitted to the Geological Survey and are ready for the printer.

Diamond core drilling in the area of the old sulphide mine workings at Cuttingsville, begun in the summer of 1948, was resumed in the summer of 1949 and brought to a conclusion late that fall. Logging of the cores has been completed, the drill-hole data platted, and a geologic map made. The results of this investigation should be ready for publication in the late fall of 1950. This project was made possible through a gift of \$15,000 by Mr. George Adams Ellis for exploratory work on metallic deposits.

FIELD WORK IN PROGRESS—Field work on the geology of the Rochester and East Middlebury quadrangles will be completed in September, 1950. This study will give a better understanding of the complex rocks in the central part of the Green Mountains and will show their relationship to known formations on the eastern side of the Champlain Valley. The type of rock sometimes carrying talc and verde antique, has been located in this area. This report is expected to be ready for publication in 1951.

Mapping of the Irasburg quadrangle has been resumed and, together with some remaining work in the Jay Peak quadrangle, will be completed during the field season of 1951. The belt of rocks with which asbestos is associated, traverses the western side of the Irasburg quadrangle. Located along the International Boundary, the Jay Peak and Irasburg quadrangles and, in addition, the Memphremagog quadrangle on the east, afford an important geologic section of the rocks in the northern Green Mountains eastward across the formations of the Memphremagog Basin. These border quadrangles permit direct correlations of Vermont formations with those of Canada. The manuscript covering the detailed geology of the Memphremagog quadrangle, will be published in the fall of 1950.

In the summer of 1950 field studies were begun in the Rutland quadrangle. The location of this quadrangle adjacent, on the east, to the Castleton quadrangle embracing significant sections of the marble and slate belts, is important from a standpoint of regional geology. The position of the Rutland quadrangle directly north of the Cuttingsville sulphide locality, is noteworthy.

GROUND WATER PROJECT—This project is aimed at the collecting of deep well data from water well drillers mainly, with the purpose ultimately of placing the assembled information on a map showing the locations of deep water wells in the State. Such a map should be of interest to persons intending to have a well drilled and to water well drillers wishing to know what the deep ground water conditions are in a particular area, before beginning drilling operations. Inquiries concerning ground water conditions in various parts of the State and visits by water well drillers, indicate the existence of ground water problems in the State. The cooperation of water well drillers in this program is appreciated by the Geological Survey.

PUBLICATIONS IN CIRCULATION—Biennial Report of the State Geologist in the Biennial Report of the Vermont Development Commission, 1946-48, pp. 23-27.

The Physical Features of Vermont, by Elbridge Churchill Jacobs.

Bulletin No. 1 (1950) Geology of the Bradford-Thetford Area, Orange County, Vermont, by Jarvis B. Hadley.

PUBLICATIONS IN PRESS—Bulletin No. 2 (1950) Stratigraphy and Structure of the Castleton Area, Vermont, by Philip Fowler.

PUBLICATIONS READY FOR THE PRESS—A Study of Lakes in Northeastern Vermont, by John Ross Mills.
Geology of the Memphremagog Quadrangle and the South-eastern Portion of the Irasburg Quadrangle, Vermont, by Charles G. Doll.

PUBLICATION IN PREPARATION—The Cuttingsville Metallic Project, by Charles G. Doll.

SERVICES—The following services are rendered by the Vermont Geological Survey.

1. Detailed investigations of mineral deposits and of the geology of designated areas, and the issuance of reports descriptive of them.

2. Trips to mineral localities at the request of residents of the State. Advice rendered on these visits has probably prevented useless expenditures.

3. Identification of mineral and rock samples forwarded by residents of Vermont and other states. Specimens for examination have been received from Canada.

4. Answering correspondence pertaining to general and economic geology. Consulting with persons calling at the office with problems of a geological nature.

5. Cooperation with other agencies. Cooperative topographic mapping program with the U. S. Geological Survey. Cooperation with State departments having problems concerning geology.