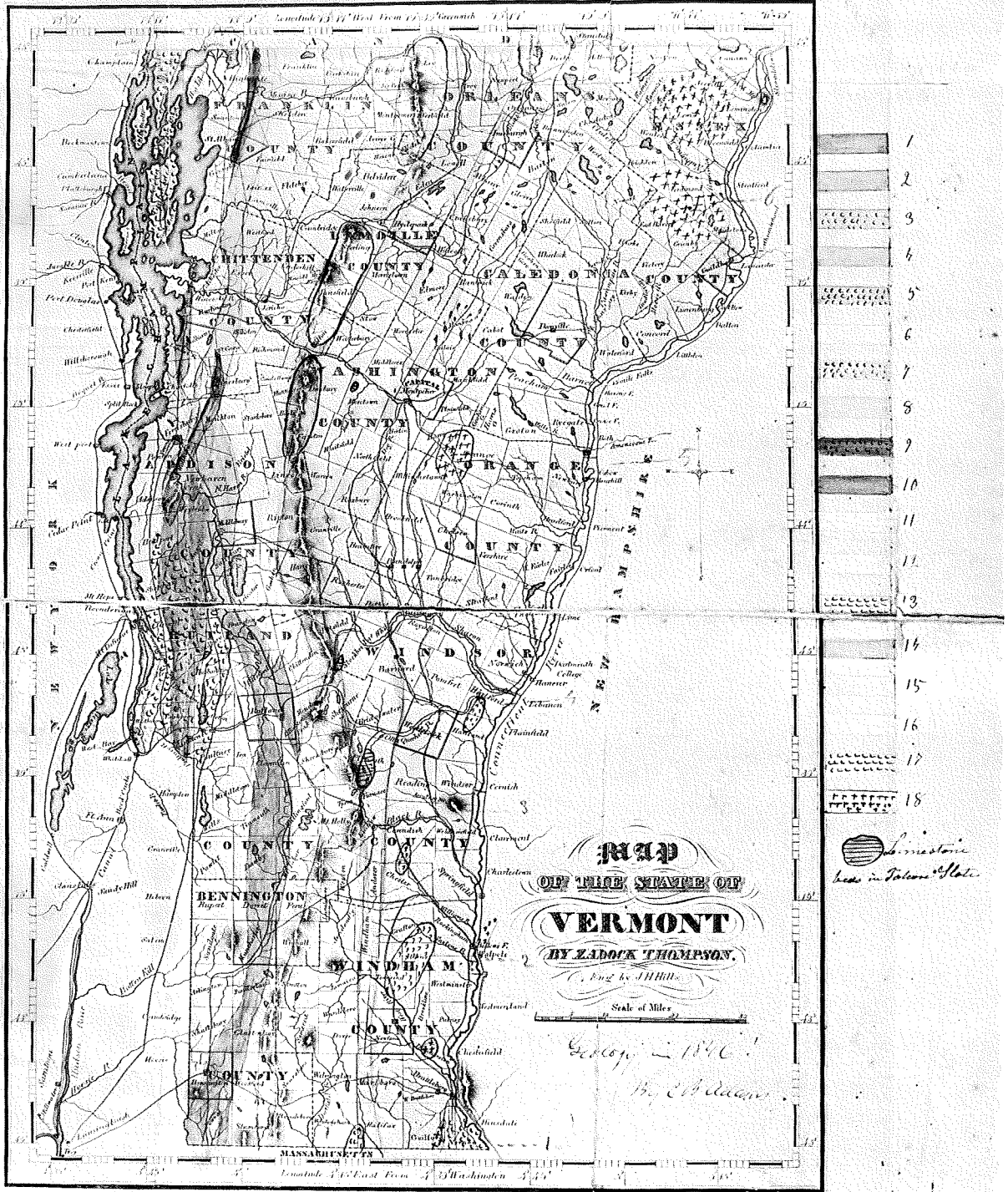


A HISTORY of the VERMONT GEOLOGICAL SURVEYS and STATE GEOLOGISTS

by T. D. Seymour Bassett



- | | | |
|---|--|--|
| <p>1. Red Sand rock</p> <p>2. Hudson Co. Gneiss</p> <p>3. Green Slate</p> <p>4. Devonian Limestone</p> <p>5. Siliceous Slate</p> <p>6. Siliceous Gneiss</p> | <p>7. Black & Jackson's Slate</p> <p>8. Devonian Slate</p> <p>9. Shaly Devonian</p> <p>10. Black Shale</p> <p>11. Siliceous Slate</p> <p>12. Limestone</p> | <p>13. Argillaceous Slate</p> <p>14. Talon</p> <p>15. Siliceous</p> <p>16. Greenish Shale</p> <p>17. Gneiss</p> <p>18. Granite</p> |
|---|--|--|
- best subterranean beds of Vermont*
- siliceous*
- with quartz veins*



Publications of the Vermont Geological Survey reach around the world, and teach with stories of Vermont strata. A steady demand for reports has continued for over 75 years; 19th century titles are out-of-print collectors' items.

Cover: Original hand colored map, the first attempt to show the bedrock geology of Vermont, by Charles B. Adams, projected on Zadock Thompson's 1842 map in the fall or winter of 1845/46.

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and
STATE GEOLOGISTS**

by
T. D. Seymour Bassett
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VERMONT GEOLOGICAL SURVEY
Charles G. Doll, State Geologist
1976

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FOREWORD

How Vermonters have treated their mineral and stone resources is an important story, and a central part of it is the role of state government in telling the world about these resources. Is our "buried treasure" understood as an endowment to bless many generations? Have seekers been finders? Have finders been keepers? How much has the state encouraged development? That is, how much have the surveys helped business? How well have we educated our citizens to appreciate what we have under our soil and what gives our landscape its profile? These are some of the questions that need to be asked. Where I have found answers I have told them.

One of the virtues of my story is that I know very little of what I am writing about. I was never exposed to the formal study of geology in the schools. Consequently I have had to make do with related subjects: biographical, social, economic, political and intellectual background. The bones of the account were put together by the late Harrison J. Conant, former State Librarian, who provided the Survey with a chronology of legislation about Vermont geological surveys and the state cabinet since 1836. When I stumbled over geological terms, many a geologist helped me out. Chief of these is Charles G. Doll. He wanted the history written, provided information, sources and editorial advice without imposing his opinions, and did all he could to accelerate the snail historian.

I am thankful for courteous service from librarians: the staffs of the Academy of Natural Sciences of Philadel-

phia, the Houghton Library of Harvard University and the Archives of the Smithsonian Institution; J. Richard Phillips, Special Collections Librarian, Amherst College Library; Archie Motley and Larry A. Viskochil of the Chicago Historical Society; Kenneth Cramer, Dartmouth College Archivist; Sidney G. Morse, Norwich University Archivist; Nina Mudge, Curator of the Sheldon Museum, Middlebury, Vt.; Laura Abbott, Lorimer S. Brigham and Reidun Nuquist of the Vermont Historical Society; Marlene B. Wallace, Editor of State Papers in the Office of the Vermont Secretary of State; the late Olney W. Hill, Vermont Public Records Director; and many on the staff of the University of Vermont, notably David J. Blow of the University Archives. I had many helpful conversations with Collamer M. Abbott of White River Junction, historian of Vermont and Appalachian copper. Robert S. Babcock and several other current legislators and state officials provided their recollections of particular bills. Margaret Gould Owens of Cavendish tried hard to find a picture of Albert D. Hager. The specific help of many others is acknowledged in the notes below.

T. D. Seymour Bassett

The University of Vermont
Burlington, Vt.
30 March 1976

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Early Interest in Vermont Geology

Vermonters are prone to look beneath the surface. Until they got beyond a hand-to-mouth existence, however, they were more concerned with removing the forest to get at the soil than in looking at the rocks under the soil.

Such superficial features of economic geology as water falls, soil, ore and stone beds were early discovered without benefit of science. Surveyors like Ethan and Ira Allen, spying out the land, could spot a workable water privilege and tell by the tree cover whether the soil would grow wheat. Immigrants familiar with bog iron and other small ore deposits in southern New England were able to locate iron and copper before 1800. Eben Judd had uncovered some marble to saw at Middlebury by 1802, and slate began to compete with marble for gravestones. Rude quarries were blasted from ledges to provide foundations and doorsteps. Grafton soapstone was valuable enough to go to court over by 1829. Beyond that, the only digging deeper than the plow was for wells and buried treasure.

The scientific mind of Samuel Williams attempted as early as December 1792 the triangulation of Killington Peak, and mused on the relations between physiography, climate, flora and fauna.¹ "As yet," wrote Ira Allen in 1798,

we have not discovered any gold or silver ore in this state, but . . . it contains iron, lead, copper, . . . red and yellow ochre . . . putty . . . I doubt not, when the naturalists and mineralogists explore those regions, that they will discover many treasures . . . highly estimable at this day in Europe in the materia medica, dying, building, ornament and use.²

Stone and ore are worth little per pound; therefore all this early use was local, or along Lake Champlain where boats could carry the heavy material. The first railroads had moved earth products, and by 1836 the first Vermont railroads were chartered with the expectation of carrying such exports to the seaboard or inland. On 19 October 1836, the first resolution to look into the matter of a geological survey was introduced into the new Vermont Senate by Zimri Howe of Castleton. The Committee on Education, to which the resolution was referred, reported on 7 November with all the favorable arguments more fully stated in 1837. It assumed, as with all scientific investigations, that beyond superficial deposits discovered by accident, you have to know the science of geology to find the resources. It felt that the state could probably not afford the estimated \$10,000 for a "thorough" survey, that anything less would be money wasted, and urged the governor to report a bill, if he thought it expedient, to the next General Assembly.³

By the end of 1836 a dozen other states, beginning with North Carolina in 1822, had made legislative motions for geological surveys, and before 1840, stimulated prin-

cipally by the example of Massachusetts in 1830, seven more had started.⁴ Every state from Maine to Georgia and from Michigan to Tennessee was going to see what subsurface resources it had. Canada, New Brunswick and Nova Scotia started too, by 1841. The motivation was from the federal surveys of the territories, the occupational interests of science professors, as demonstrated in the work of Amos Eaton on soils for Stephen Rensselaer or the right of way for the Erie Canal, and the avocations of other college-stimulated professionals. Perhaps, too, there was hope of financing surveys with funds distributed from the federal surplus received from the booming land sales in the West. In the hill country of Atlantic America, they hoped to uncover new resources to check emigration, for the forests, fish, game, soil and population showed signs of depletion. There was also the infectious fever of doing what the other states were doing.

Governor Silas H. Jenison's 1837 message, preoccupied with the local bank failures of recent months, did favor a survey as checking emigration by opening new opportunities for work in Vermont. Of the "scientific gentlemen" he wrote on 30 August, asking what professional staff would be needed and for how long, Professor George W. Benedict's reply was Exhibit A, spelling out the requirements. He prophetically recommended appointing two geologists of equal ability, so that the associate, "in case of the providential interruption of the labors of the principal, would be expected to succeed him." Also, at the back of his mind may have been the good politics of appointing a scientist from both rival Middlebury and Burlington colleges. Benedict specified that "every town must be visited; a geological map of the whole state laid down," and rock collections for the State and its principal educational institutions should remain as "vouchers" of work done. He distinguished between the geological and topographical surveys as two separate projects and emphasized the geological.⁵

John Johnson, also of Burlington, State Surveyor General, 1813-17, and leading civil engineer in northern Vermont, wrote an informative letter pointing out that some groundwork for a topographical survey had already been done, and that it would be a basic aid for internal improvements. James Stevens of Newport, R.I., supported his recommendation that an experienced civil engineer be appointed. Horace Eaton, Enosburg doctor, Governor, 1846-48, and Middlebury College professor, 1848-54, reported for the Senate Committee on Education for postponing the topographical survey. The geological survey "should be immediately undertaken" but unfortunately "no appropriation would be possible that session."⁶

Among the scientists Governor Jenison wrote were probably James Hall (in New York), Edward Hitchcock (Massachusetts) and Charles T. Jackson (Maine), the

geologists of neighboring states already engaged in surveys. The 9 October reply of James Gates Percival, state geologist of Connecticut, urged appropriation at the start of the total amount needed for a three-year survey, and this was eventually done. Fortunately the Vermonters did not accept Percival's politically unwise suggestion to separate the economic geology from the basic scientific investigation underlying it.⁷

Advocates for more than a century have rung the changes on the basic five arguments of 1837:

- 1) Use intelligence rather than blind trial and error to find resources.
- 2) Science can prevent the waste of money and effort digging in the wrong places.
- 3) Soil science will stimulate agriculture.
- 4) Improved geological knowledge improves the cultural level of the people.
- 5) Other states are doing it.

The trouble was that neither the colleges nor the college-trained nor anyone else in the country knew more than the first thing about geology. "Natural philosophy," as the physical sciences were called, had been taught at Dartmouth, Middlebury and the University of Vermont since the beginning of the century, and Alden Partridge's Academy started at Norwich in 1819 with an unusually strong emphasis on science. Professor Frederick Hall (at Middlebury, 1806-24) had published a *Catalogue of minerals found in . . . Vermont* (Hartford: 1824), just as he left to teach at Trinity College. Until Charles B. Adams and Alexander C. Twining came in the fall of 1838, however, science had taken a back seat at Middlebury. Nearly half of its 876 graduates during its first half century became ministers, and in those days orthodoxy feared that science was infidel. Adams valued the college's natural history books, three-quarters of which he claimed to have provided, at \$150 — perhaps 75 volumes.⁸

At the University of Vermont, trustees Royall Tyler and William Czar Bradley had recommended in 1811, "when the funds of the University or the benefactions of individuals will permit," the appointment (after classics and law professors) of "a professor of chemistry and mineralogy . . . to analyse at the charge of the institution, all fossils, minerals, &c. which may be discovered within the limits of this State, and who shall be accommodated with a laboratory within the College for that purpose."⁹ The Corporation of the Burlington College was considering itself a state university, intending to perform one of the continuing functions of a geological survey. It was also bidding to match Middlebury College's Frederick Hall, or steal him.

A year after George W. Benedict arrived as Professor of Mathematics and Natural Philosophy, he started a College of Natural History (1826-47) to teach biology and geology, and began collecting a cabinet of rocks. With his cousin, Farrand N. Benedict, who came in 1833 to teach Mathematics and Civil Engineering, he worked with Ebenezer Emmons on his Adirondack section of the New York geological survey in the late thirties. Since before 1834, G. W. Benedict's lectures in crystallography and mineralogy were scheduled for the summer term of the junior year.¹⁰ Professor Benedict entertained Charles Lyell, the English geologist, early in July 1842. He

showed Lyell fossil shells in loam, "the rocks of the neighborhood and at the Falls" of the Winooski, and presented to him some shells of species peculiar to Lake Champlain.¹¹

While the Vermont professors were in touch with the centers of science, there was not yet much in geology to be in touch with. The University's library, with close to 8,000 volumes, was unusually large and comprehensive for a college collection in 1836, but included only twenty titles on geology.¹² In such rudimentary state of the art, Governors Jenison and Paine prodded annually, but the Solons turned a deaf ear during the hard times of 1837-43. An 1840 bill was lost, 110-99. Horace Greeley's *New Yorker*¹³ chided the Vermont legislature for its penny wise and pound foolish policy. In 1841 an annual appropriation of \$2,000 for four years was defeated 100-97. A survey bill passed the 1842 Senate but lost in the House, 139-74. Governor Mattocks avoided the issue entirely in 1843.¹⁴

The Adams Survey, 1844-48.

By 1844, conditions were more favorable. Railroads, no longer a distant gleam of possibility, were actually approaching Vermont's borders, as Governor William Slade pointed out in his annual message of 1844. Half a dozen states had produced what were called "final reports," 1838-45, notably the two-volume work of Edward Hitchcock for Massachusetts (1841) and the impressive four-volume New York survey (1843-45).

Governor Slade not only recommended a survey with the usual arguments, but was also able on October 30, 1844, to sign a bill authorizing him to appoint a state geologist whose salary and expenses for three years, including assays and assistants, should not exceed \$2,000 annually. The bill had passed the House 96-92, a minimal endorsement which gave notice that performance would be closely scrutinized.

The last eastern state to authorize a geological survey, Vermont published its "final report"¹⁵ sixteen years after work started. Why did it take so long? The usual explanation is that Vermont was a poor, rural state whose legislators realized it could not enjoy the luxury of a scientific investigation. Vermont was comparatively poor, but the issues were more complicated.

Here was the first case in Vermont history where money was appropriated and the authority of the state supported the application of expert knowledge and skill to the development of the economy. The survey was by no means the first state aid to business, for through the employment of convict labor at Windsor State Prison, by state lotteries, a state bank, and in many other ways the state government had been helping business since 1777. The survey, however, was thought of as an extension of the state's normal function of promoting education at all levels. Hence the usual referral of survey proposals to the Committees on Education. The Democratic minority objected to spending in general, and for science in particular. The Whig majority, although reluctant to increase taxes, did not question whether the state should aid business, but only whether the professors *could* aid it.

Governor Slade had shown his preference for his fellow townsman, Charles B. Adams (1814-53), Professor of



Charles Baker Adams (1814-53), first State Geologist (1845-48), Burr Professor of Chemistry and Natural History at Middlebury College (1838-47) and a leading American conchologist. From the State Geologist's Report (1946), 4.

Chemistry and Natural History at Middlebury College, within five weeks of the enactment. "The Geol. survey of this State will give me work enough for some years to come," Adams wrote Samuel S. Haldeman, a Pennsylvania zoologist who had helped with his state's survey, on 4 December 1844.¹⁶ "If engaged in a Geol. Survey, as I expect, of course I shall consider it necessary to attend the meeting of Geologists, if leave of absence can be obtained." Slade did not announce his appointment until winter, effective March 1, 1845.

At thirty-one, Adams was full of energy and ambition. Coming from Boston, he had graduated at the top of his Amherst class in 1834, and worked with his mentor, Professor Edward Hitchcock, part of the summer of 1836 on the New York geological survey in Dutchess County. He had traveled to Missouri, and was enthusiastically collecting, corresponding and publishing in the fields of mollusks and insects. He hoped to earn the titles of conchologist and entomologist. In the previous winter and spring he had managed a collecting trip to Jamaica, and was devoting all his spare time to identifying and classifying the new specimens, and shipping duplicates to 22 other collectors. "During the last ten years," Zadock Thompson wrote of his "esteemed friend," "few have done more than he . . . for the advancement of the natural sciences."¹⁷

Hindsight suggests, as Whig editor E. P. Walton of the Montpelier *Watchman and State Journal* suggested at the

time, that Governor Slade should have gone outside the state for some one with more experience in the northeastern surveys. The highly qualified Charles T. Jackson, also of Boston but with Harvard instead of Yale-Amherst training, had applied for the job. While a Harvard medical student in 1828-29 he had made a geological tour of Nova Scotia and published the reports in Silliman's *American Journal of Science*. He continued geological studies along with medicine at the Sorbonne in Paris. From his European scientific contacts and Boston chemical laboratory came many suggestive discoveries, such as those leading to the invention of the magnetic telegraph and anesthesia.

His first professional job was as Maine state geologist, 1836-39. "The published results, considering the difficulties of transportation at that time and the non-existence of accurate maps, are interesting," wrote a latter-day expert.¹⁸ The summer of 1839 he spent collecting and examining the rocks of Rhode Island. His facile pen produced a substantial report, map, meteorological tables, plates, comments on the origins of the earth, the soils of Providence and the coal of Cranston. About the Rhode Island report the same geologist wrote, "Criticism on the basis of our present geologic knowledge should not be made of the work done at that time."¹⁹ New Hampshire next employed him from 10 September 1839 until June 1843, with a handsome, illustrated "final report" resulting.²⁰ Surely Jackson was the outstanding candidate

on paper.

But Middlebury College needed the patronage, in a decade when salaries were chronically in arrears. An un-decided story in the Middlebury *Northern Galaxy*,²¹ probably by its editor, Harvey Bell, who had been on the 1837 Senate Committee on Education considering a survey, explained why Jackson was not appointed. He had held out for more funds than Vermont could afford. This appeared to satisfy Walton, who must have decided not to wash party linen in public. Appropriations for Jackson's surveys in other states were roughly the same as in Vermont: \$2,000 a year (more at the start for the wilds of Maine; \$3,000 for the last year in New Hampshire).²² Jackson seems to have been dealing for the best bargain he could get when Slade cut him off on a technicality.

For lack of firmer evidence, I assume that the Governor told Adams he was first choice, but that he had to dispose of Jackson first and was writing Professor Hitchcock for a statement that the appropriation was adequate. According to the Middlebury paper, Hitchcock replied that with strict economy the funds could be stretched, and volunteered to direct the survey himself. On 16 December 1844 the Amherst faculty told the trustees of the near-bankrupt college that they would carry on if Professor Hitchcock were chosen President.²³ It seems likely that Hitchcock, on the eve of this proposal, was hedging against the collapse of the college, and helping Adams to a job, either as his assistant or, if he did not need it himself, as chief. In any case, he seems to have promised what he delivered, supervision of his protégé on vacation field trips.

If politics dictated the choice of a Vermonter, Adams looked like the best candidate, but he was not a good choice, even in that limited field. Burlington had three capable candidates, the Benedicts and Zadock Thompson. Thompson had just published his *History of Vermont: natural, civil and statistical*, which deliberately minimized the geological in his natural history on the expectation of a survey.²⁴ He had been roaming the mountains looking at nature for twenty-five years, and would have produced what Vermont wanted, for he was interested in nature as useful to man, more than in the niceties of taxonomy. But he was excessively modest and knew he had no apprenticeship in other geological surveys. Nevertheless, his omnivorous reading had already included Hitchcock's report on the Massachusetts geological survey, Samuel Robinson's Catalogue of American minerals, and Charles Lyell's two-volume treatise. He was also a regular reader of Silliman's *Journal of Science* and the publications of the Boston, New York and Philadelphia societies of natural history.²⁵

George W. Benedict knew at least as much as Adams about the science, but also had the mature administrative and political ability to meet deadlines and satisfy constituencies, trimming the ideal to the scale of the possible. Farrand N. Benedict was experienced in civil engineering, surveying and mapping.²⁶

There were several counts against Adams, relating to his personality, the state of popular ideas, and the political situation.

Governor Slade, a former Congressman (1831-43), had lost a bitter, mud-slinging senatorial fight to unseat

Senator Samuel S. Phelps of Middlebury after nine ballots on 24 October, in the joint assembly. The Democrats had for years voted against increased taxes, especially for schools, and on 28 October delivered nearly all of their votes (at least 57 of the 92 nays) to oppose the establishment of the survey. Except a dozen villages with Democratic majorities, like Danville and Montpelier, the bulk of the opposition came from small, backwoods, hill towns like Dover, Lincoln and Canaan, tending to feel that this was a college aristocrat's gravy train. They would be waiting to cut Adams down, the next time he needed money. Charles Linsley, a Middlebury Democratic lawyer, wrote cryptically that Adams was not "a whole man" and his appointment would be condemned.²⁷

His best friend knew his weaknesses as well as his strengths. Edward Hitchcock recalled after Adams's death that zoology was his all-consuming passion. As the President observed Adams at Amherst, he could not "direct his mind into a new channel" of astronomy,

But in Zoology he worked like a giant. I never knew a man who would do as much in collecting, arranging, and ticketing specimens as he. He gave his whole time to it, regardless of the laws of health, which with him was not the most vigorous. So economical was he of time, that in going from his cabinet to his meals he had learnt to move upon a trot [the first jogging geologist?] and I am afraid that too many midnight hours saw his lamp burning. He had two characteristics fully developed, which are indispensable to form the distinguished naturalist. The one was the power of giving a logical attention to minutiae, and the other the power of grasping great principles and using them for the arrangement of details.²⁸

Studying late and traveling far, to the neglect of his wife and children, Adams was intolerant of less rigidly methodical performance, and did not get along well with others. Hitchcock later reverted to the word "rigid" in defending Adams's "adherence to scientific accuracy in every other enterprise."²⁹ His scorn for uncultured Vermont and the local naturalists for their sloppy descriptions and improper claims to prior discovery is thinly veiled in his correspondence.³⁰

The short tenure of Adams's jobs — seven in his first thirteen years out of college — is symptomatic of a deep-seated malaise that drove him, as Hitchcock charitably put it, to "martyrdom in the cause of science."³¹

He died of yellow fever in 1853 on a collecting trip in the West Indies. President Hitchcock's daughter wrote her brother,

I am reminded . . . of a remark you made to me last winter . . . "What a merciful Providence it would be if Prof. Adams should be taken away, while he is gone to Jamaica." Providence *has* taken him this winter. Mother wrote that . . . "Prof. Haven expects to preach next Sab[bath] on the occasion." Mr. Bland came to Amherst to inform Mrs. Adams, and he told Father of it just before evening prayers and he went into College and announced it to the students. Mother says "It created quite a powerful sensation."³²

Adams was a passionate scholar whose specialization in an unspecialized society was not appreciated outside his field. He was a professional before his time.

Adams accurately diagnosed the state of public opinion about science two years before his appointment.

They who are entirely ignorant of Zoology itself cannot see its relations to moral and intellectual culture and its claims to a high rank as an intellectual pursuit. This however would be of little consequence, if the minds of such were unoccupied & ready to receive instruction; but a groundless prejudice against these supposed trifling occupations, will otherwise close the minds, of students especially, against the subject.³³

What he applied to zoology had still more force with rural legislators when applied to geology, where he was less expert and less interested.

With moral support from Hitchcock, who reported 400-mile tours during the summers of 1845 and 1846, Adams produced what he and every one else considered to be progress reports.³⁴

The first, indeed, was only a sample of what Adams and his team could do. After the briefest introduction to the science, he spent nearly all the space on practical geology. His April circular (twenty questions), asking for help from all interested citizens, appears to have received the scant attention given most questionnaires, but he managed to elicit four letters reporting on the geology of Thetford, Pomfret, Pittsford and Chester.

Prophetic was his assertion "that our magnificent scenery may be made a source of profit," although our cool, summer air cannot be bottled and shipped like Congress water from Saratoga. If our scenery could be interestingly described and "amply illustrated by good engravings . . . travellers from abroad will more frequent our State," enjoy its beauty, restore their health, "give us the pleasure of their society and our landlords that of receiving their money."³⁵ When Hitchcock's *Geology of Vermont* appeared fifteen years later, it but demonstrated in its "Scenographical" section and lithographs, what Adams had in mind.

His 1846 report, had it been quarto instead of octavo, and embellished with his map, several lithographs and more wood cuts, would have compared favorably with C. T. Jackson's final (1844) report on the geology of New Hampshire. Excluding Jackson's padding — excursions into the history of the Canterbury Shakers and the maple sugar making process, his parading of impressive tables for calculating heights by barometer, and tables of results, we find only twenty or thirty thousand more words on New Hampshire geology than Adams's second report offered on Vermont's, and of roughly the same quality.

After a review of staff activities during the previous year, Adams provided a necessary exposition of elementary geology, pp. 19-82, which became the nucleus of a popular text published in collaboration with his Amherst classmate, Alonzo Gray, a successful writer of chemistry, physics and agriculture texts.³⁶ He added the first systematic essay on the geology of Vermont, pp. 120-169. In glaciation, then the focus of geological curiosity, Adams followed Hitchcock in attributing the drift scratches in the valleys to glaciers and those on mountaintops to icebergs.

Thinking of himself as a *Christian* scientist, he devoted pp. 106-108 to quieting the fears of the pious that the findings of geology would upset Genesis. He rejected the

idea that the six "days" of creation correspond to geological eras. The Bible taught belief in God the Creator, not science, he asserted. Its writers were not concerned how long it was from "the beginning" to the appearance of Adam, the first human. In other words, Adams could accept astronomical light years and geological eons, but ignored anthropological ages. Fossil evidence convinced him that death did not begin with the expulsion from Eden. He followed the English writer, John Pye Smith, in positing unusual volcanic action followed by Noah's Flood in the Middle East only. Adams's image of the pre-Adamite world was confusing to the common reader in all but one particular: he believed in the Bible *and* accepted evidence of long geological history.

Adams had not covered the state, except to accompany Hitchcock on his flying trips. The field work on Vermont north of Windsor and Rutland Counties was done by assistants Samuel Read Hall and Zadock Thompson. Denison Olmsted, Jr., Yale chemist, made the laboratory analyses until his death in August 1846, and was succeeded by T. Sterry Hunt, who also used the laboratory of Benjamin Silliman, Jr., in New Haven, and shortly after joined W. E. Logan's Canadian geological survey.

Hall produced a forty-page report on "Agricultural Geology," based on three months' exploration of the soils, crops and manures of 99 eastern Vermont towns. Adams had issued thirty instructions, to send sixty soil samples (removing stones larger than a pea) in quart bags to Middlebury, to measure soil depth, describe drainage, subsoil and adjacent bedrock, talk with farmers, collect rock specimens, and note muck and marl beds, trap dikes, drift scratches, claystones and infusoria. Adams sent Hall a copy of his new geological map for correction, and expected monthly reports and a final report by 10 September sharp. He added to Hall's report new data on minerals, building stone and highway geology — road location and materials. This practical information was what people expected because they were used to reading it in the reports of the U.S. Patent Office, and in the reports of the other state geological surveys.

Governor Slade directed Adams to assemble a collection of specimens for the State, and duplicates for Middlebury College, Norwich University, the University of Vermont, the two medical colleges at Castleton and Woodstock, and Troy Conference Academy at Poultney. Their value was understood to be both scientific and educational, "as vouchers for the statements to be made" in the Final Report, as samples to compare with rocks which citizens wanted to identify, and as illustrations for beginning students in geology.³⁷ Out of the 6,000 pieces collected the first year, and 7,000 the second, nearly a thousand were registered, labeled and ticketed for the capital.

By late summer of 1847 Adams had asked President Hitchcock for a place at Amherst, and Hitchcock made one in Zoology and Astronomy. Thompson stored the bulk of the collection in a small building near his cottage on the Burlington college green. Adams shipped all the fossils, the complete state collection, the minerals, maps and working papers, to Amherst. Then he took off to spend the winter collecting shells on the isthmus of

Panama.

All he had to show for his third year as state geologist were descriptions of existing developments observed on a few summer excursions. While consulting with President Hitchcock in Bennington County, he heard that Louis Agassiz was on a tour to the White Mountains and Niagara Falls. He dashed up to meet him in Burlington and show him some fossils and moraines in Bolton.³⁸ While noting that marble could be found from Dorset to beyond the Canadian border, he concentrated on Fisk's Isle La Motte and Swanton works. He emphasized the slate of Guilford and granite throughout eastern Vermont, mentioning half a dozen places including Barre. With sarcasm he confirmed the report of a Norwich resident on the existence of half a bushel of coal there, and elsewhere stated flatly, "no coal formation exists in Vermont." He pooh-poohed the existence of gold in commercial concentrations — a position that looked bad in the ensuing years, as returned Forty-niners, who had learned to pan in Placerville, found flakes and nuggets in the Deerfield, Black and White Rivers.³⁹

The legislature felt cheated. Although Governor Eaton and the House Committee on Education supported Adams's bid for an additional appropriation to complete the Final Report (nearly always capitalized by concerned contemporaries), the bill was defeated for second reading, without a roll call.⁴⁰

Adams's appointment expired in February 1848. The joint legislative committee that fall acknowledged that a Final Report must eventually be made, for the honor of Vermont, and as "a contribution to science which every enlightened state owes to the world." But it blasted Adams's performance: it was not "wise or just" of Adams to publish 'only a small fraction of the results obtained' (quoting from Adams's own report).⁴¹ He had proved undependable. In 1847 he had promised to finish by 1849 for \$3,400 more; in 1848 he said he needed \$1,250 a year for at least three more years. In 1836, Benedict, who was still around, and very much in Whig politics, had estimated that \$10,600 would cover everything. Adams had spent \$7,000 and wanted nearly \$4,000 more, not counting the cost of publishing the Final Report.

Adams also seemed to prove that a professor could not do the job and teach too. When we can afford it, the joint committee concluded, "and a competent person can be found to devote his whole service to the State," we shall approve completion. Meanwhile, it ordered all working materials delivered to the State Librarian.

We do not know why Adams fled from Vermont. He had written at the end of the second year, "I hope to get through with my Geol. affairs in due time; am almost as tired of them as I expected to be."⁴² Perhaps he kept antagonizing more and more people until it became uncomfortable to stay where he had so few supporters. For example, he kept a hundred copies of his 1846 report, to distribute to American and foreign scientists, and gave none to his assistants, if we can trust a Burlington paper apparently relying on what his assistant Thompson told it.⁴³ On the other hand, it may have been Adams's intuition as a scientist that there is no such thing as a "Final Report," a definitive survey which requires nothing more to be done. Because he was not primarily interested in geology, and not content to stay in Middlebury and roam

the hills unhonored and unsung, he left it for Perkins, half a century later, to persuade the State to maintain a continuing survey.

Zadock Thompson picks up the pieces

Zadock Thompson picked up the pieces — quite a tonnage as he reported to the 1849 legislature.⁴⁴ To save freight charges, he got Governor Coolidge's permission to leave what was in Burlington where it was, in its crude and partially unidentified state. No record has been found that the four other state institutions for whom rock collections were intended, either asked for or ever received their shares. The UVM collection was reworked with later accretions into the present exhibit in Perkins Hall. Middlebury's share, with its register, was transferred to the custody of the state geologist in the 1960's.

In his negotiations with Adams he had divided up the fossils because Adams claimed that Governor Slade had promised him part. He did not question Adams's argument in his third report that the collection Governor Slade had assigned to him should go to Amherst as an exhibit for outsiders. When Adams charged for storage in Amherst, he checked with Governor Coolidge and the bill was paid to close the case.

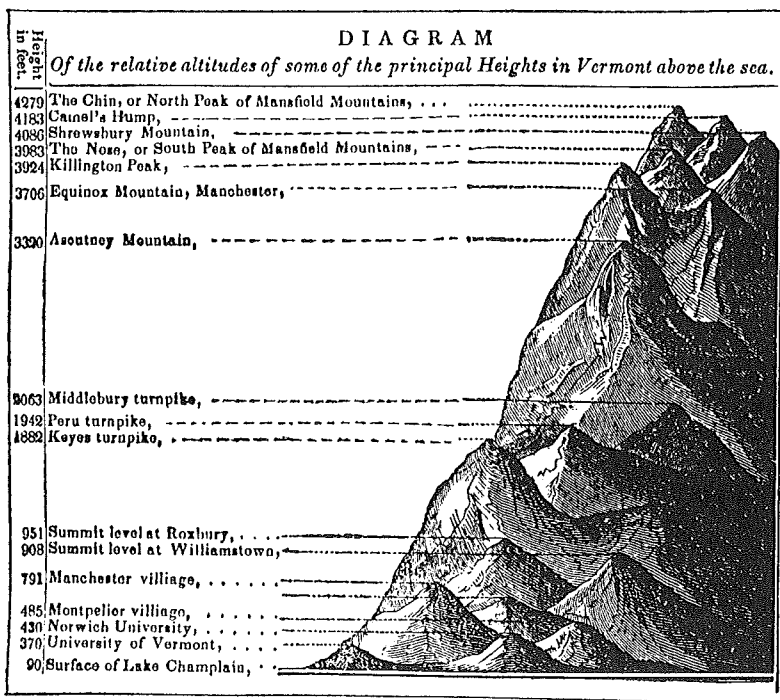
In the spring of 1849 a series of six articles appeared in the Woodstock *Vermont Mercury*, urging completion of the survey.⁴⁵ The author argued that Vermont had spent less than any other state, and a little more would make the whole worth while, not by discovering precious stones and minerals, but by directing labor away from useless diggings, toward workable deposits.

The second annual meeting of the American Association for the Advancement of Science sent a memorial to Vermont and other states with suspended surveys or without any, vouching for the value of a completed investigation. Louis Agassiz, Lewis C. Beck of Rutgers (formerly of Castleton Medical College), Joseph Henry of the Smithsonian Institution, Edward Hitchcock and Benjamin Silliman — scientists best known to Vermonters — were on the committee of fifteen signing the circular. Nevertheless, H. 140 introduced by Ezra S. Carr of Castleton, to complete the survey, was defeated without a roll call vote.⁴⁶

Vermont was only one of many states, notably Pennsylvania in 1842 and New York in 1849, where differences between scientists and Solons stopped the surveys. A new era of cooperation between colleges and government required many adjustments.

Thompson had made himself heir apparent by indefatigable study and thirty years' observation of the Green Mountain State. During the first year of the Adams survey he traveled with the Reverend Hall, keeping neat, daily field notes of their journeys through eight counties. The second year he made a detailed study of the trap dikes near Burlington, which Hitchcock retrieved from his papers and published entire, including his map.⁴⁷ He also prepared town maps and a table of altitudes. An accident on 26 August (a runaway horse?) ended the season for him.

After the suspension of the survey, he devoted most of his time to geology, expecting that eventually his merits would be recognized. But the construction of the



Zadock Thompson (1796-1856), State Naturalist, 1853-56, while assistant to the State Geologist, 1845-47, made special studies of Vermont mountain heights and Chittenden County trap dikes. His preliminary estimates appeared in his 1842 History of Vermont, p. 8. Portrait from an engraving by F. C. Buttre in the Wilbur Collection, UVM.

railroads brought him the attention he had long deserved. In August 1848, the tusks and other bones of a mastodon were unearthed in a Mount Holly swamp by Irishmen building the roadbed for the Rutland and Burlington Railroad. They were sent to Louis Agassiz at Harvard for identification, and then turned over to "professor" Thompson. A year later, the fossil bones of a fourteen-foot whale were found on the same railroad line in Charlotte. The overseer naturally had them brought to Thompson, who took them to Cambridge and spent two days with Agassiz studying them. He read a description before the Boston Society of Natural History on 5 December 1849.⁴⁸

In 1850 the Governor appointed five commissioners to represent Vermont at the London Exhibition of Science and the Arts the following summer, none of whom seem to have fulfilled their appointments.⁴⁹ But some anonymous angels, perhaps G. W. Benedict and John Wheeler, financed the trip for Zadock Thompson, and the publication of his observations.⁵⁰

To improve his entrée abroad, and because they hoped to raise an endowment for his chair, the Board of Trustees on 23 May unanimously elected Thompson Professor of Natural History and Chemistry, but without pay.⁵¹ UVM's College of Natural History had been abandoned when G. W. Benedict retired to build telegraph lines in 1847. Although he sold its collections to the college, no one replaced him until 9 September 1852, when the faculty appointed Thompson to lecture in Chemistry "and to aid the faculty otherwise in the instruction and discipline of College," on the tutor's salary of \$400.⁵² When the Medical Department reopened in the fall of 1853, Ezra S. Carr of Castleton took over the chemistry lectures and Thompson was reduced to Professor of Natural History and Curator of the Cabinet at \$300.⁵³

After eleven weeks abroad, seeing his book through the press and catching up on domestic affairs, he prepared a communication to the 1851 legislature. Perhaps not the "thorough statement from a long-time state employee" they had asked for in 1850, it claimed that completion could be cheap and sales could pay for publication. Samuel R. Hall, Thompson's colleague of 1845-46, had planned to lobby for him, but a painful accident kept him from Montpelier. The Committee on Education said "mañana" again.⁵⁴

Recognition by his alma mater, his state, and the community of scientists erased the excessive humility in Thompson's bearing when he sent a memorial through Burlington's town representative, Henry P. Hickok, to the 1852 session. He also wrote to Governor Fairbanks and to William C. Bradley of Westminster, an elder statesman again in the House, and sympathetic to science and the University of Vermont. The Reverend S. R. Hall urged Governor Fairbanks to mention the survey in his annual message (writing five days after the message was delivered) and expected to share a joint appointment with Thompson. Fairbanks had referred briefly to the survey, treating Thompson as the state expert who should advise on further publication.⁵⁵

Thompson's memorial asked the state to finance the preparation of a revised and enlarged edition of his 1842 natural history, to be expanded from 224 pages to four

volumes. "Three fourths of the descriptions are entirely original, and made from Vermont Animals, nearly all . . . captured expressly for the purpose." You have no idea, he continued, how much work it takes. And you can have my results free, if you will appoint me State Naturalist at only \$800 a year for three years. The sales of Volume I, Physical Geography, Scientific Geology and Mineralogy, at cost of printing, will provide basic information for citizens and schools, and a revolving fund for Volume II, Economical Geology, including Botany and Agriculture, &c., he optimistically predicted. Had the plan been accepted then, Thompson might have finished, but H. 205 was reported adversely and again the project was shelved.⁵⁶

Political conditions were abnormal in 1853. By various maneuvers capitalizing on hostilities aroused by the new prohibition law, the Free Soilers and Democrats had an unstable majority which elected Democrat John S. Robinson Governor and Free Soiler Lawrence Brainerd Senator. Robinson supported the survey: the state could afford it, he said, and *agriculture* (not industry) would benefit. In spite of the wails of die-hard Democrats like Erastus Plimpton of Wardsboro, who was against "every one of them [special] appropriations," and Charles K. Field of Newfane, who called the bill a plan "for the benefit of Burlington College," H. 271 sailed through, almost as Thompson had proposed it in 1852.⁵⁷

At this point Adams was dead and could not explain his shorthand field notes. Unlabeled specimens had been further disarranged in moving. Thompson had to start over. Perhaps to ward off an attempt to stop the survey in 1855, Thompson secured a committee room in the State House to show, for the first time, some of the specimens in the collection. Horatio N. White, Panton representative, did introduce a bill to repeal the survey's enabling act. After a brief sojourn in the Committee on Ways and Means, however, it was reported out adversely, and dismissed.⁵⁸

Thompson worked with enthusiasm. He corresponded with naturalists at home and abroad, persuaded James Hall of Albany, New York, to catalogue his fossils in 1855, and Henri Erni, the new UVM chemist, to analyze more specimens. Nevertheless, the second attempt to complete the survey failed for reasons opposite from those which defeated the first. Thompson's project was too vast, and he was too deeply interested in each phase of natural history, with its ecological ramifications, to concentrate on Volume I. Besides, the heart trouble of which he died in January 1856 had reduced his energies for several years.⁵⁹

In a summary of the history of Vermont geology, Henry M. Seely referred to Thompson as the principal early Vermont geologist, and virtually omitted Adams, whose memorial he wrote two years later.⁶⁰

The Hitchcock Survey, 1856-61.

Governor Stephen Royce appointed Augustus Young of St. Albans (1785-1857) as Thompson's successor on 29 February 1856, to hold office until the next session of the General Assembly. This would keep the survey in being, put the cabinet into an order that would encourage appropriations, and give a poor old politician a pittance. Young was an eccentric ex-Congressman who gained

notoriety in Washington by claiming to have squared the circle. He was too feeble to do anything except recapitulate the woes of the survey and reprint the obituary of his predecessor.⁶¹

On 18 November a new act required the governor to appoint a suitable person to start work as soon as possible, making new investigations where necessary and submitting a final report *first*.⁶² Then the legislature would decide whether to appropriate publication money. The total budget would be \$1,000 a year until otherwise ordered.

Fortunately, Edward Hitchcock, whose benign presence had been felt from the start, had retired from the presidency of Amherst in 1854 and saw a way to cut corners and finish. Had he not been available, the Panic of 1857 would have provided an excuse for saying, again, that the State could not afford it. Hitchcock remarked wryly that it was tempting fate to take the job after three predecessors had died before the work was done. When the Governor agreed to let him send his two sons to do the field work over again, and have his youngest son do the maps and sections, he consented to supervise the project.

Knowing that Vermont rock formations generally run the length of the state, and having no topographic maps, Hitchcock made thirteen traverses from Massachusetts to the Canadian line, in order to mark the boundaries of each formation and record the dips and strikes of the strata, as a basis for a geological map. The jinx seemed to follow the survey. On 23 May 1857, the sixty-four-year-old wrote his son Edward from Amherst, after his first field trip, "I have got completely upset by my jaunt last week. I never had so hard a time of it & am still quite unwell. The worst symptom is an irregular action of the heart. I rode two days all day in rain & snow."⁶³ The President had always been a hypochondriac, but on the same day Charles wrote Edward from Proctorsville,

Owing to the badness of the roads over the Green Mts we shall not attempt to cross them for a week, but shall prowl around Proctorsville in predatory excursions . . . Then it will be most proper for a new hand to come in as a fresh section will then be commenced . . .

The survey prospers finely — good success — good health of both of us [A. D. Hager and himself] — poor pay, but much gain to the Geological faculties — hard work — great need of patience & endurance . . . wasn't so much rain here and Father saw everything through colored specs because his health was so bad.⁶⁴

Hitchcock was an old fox with publicity, demonstrating in the Vermont press that his crew was early in the field, knew what it was doing, and was doing it in the quickest, cheapest way.⁶⁵ He put Young's assistant, Albert D. Hager, into the field to smooth public relations with farmers and quarriers. The President's sons might rub the locals the wrong way, but Hager would reassure them. Hager, a native, clever, self-taught, quick-learning, handy man, could be counted on to blow the horn as it ought to be blown for local products. "The stone used for the new Court House at Windsor," he wrote in the section on economic geology, "was found in New Hampshire, and transported over two railroads, while the beautifully mottled syenite and white granite of Ascutney lay un-

touched, almost in full view of the building."⁶⁶

Charles reported to his brother how he was getting along with Hager.

Hanover, N.H. June 27 [1857]

. . . We have taken refuge in N.H. & hope to pass the Sabbath here. Hager didn't want to come over here a bit, because he couldn't spread here as much as he could among the innocent inhabitants across the Conn. He came only because no one wd take him in Norwich. It is fun to see him tell all he knows to every person he meets — learned or ignorant. To day I learnt that he was obliged to see that your dips were all straight, but *previously* he hadn't looked after mine! Go it while you're young thought I. We came to a rock soon, where we were engaged in an animated discussion for 15 minutes as to whether the dip was South or 20° W of South, wherein I got the better of the argument & hope to be relieved in future. But I never trust to his measurements implicitly. If any great interest is at stake I see myself that all is right. Yesterday he called the strike of a soapstone bed N & S, when it was E & W. He is sure that the Bridg[e]water Gold mine will pay, because its external characters agree with some in N Carolina.

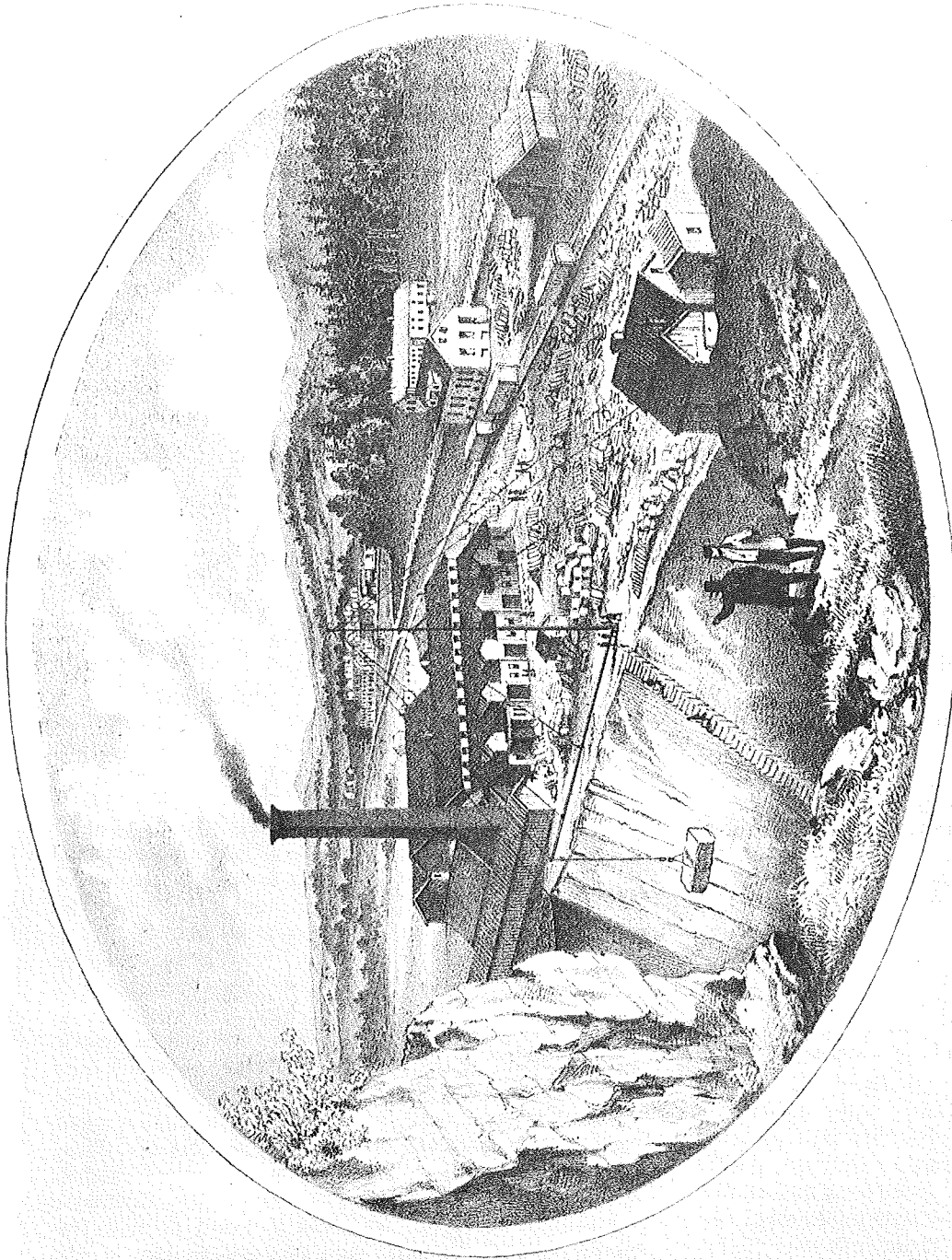
We have finished Section No 4, & on Wednesday hope to begin on No 5, commencing at Newbury & passing through Roxbury & Middlebury . . . I may spend Sunday . . . [in Roxbury] as Hager goes off on the 4th to celebrate his independence in an *old fashioned* way — probably in the use of fire crackers & peanuts.⁶⁷

Two months later, Mrs. Hitchcock wrote her son Edward that she had a pleasant trip to Montreal with his father and brother Charles, except that Edward, Sr., in St. Albans "had another of those unpleasant attacks of dizziness in the head." But they went on into the backwoods, headed for Lake Willoughby.⁶⁸

The next year, "Willoughby Lake . . . the boldest scenery in Vermont," attracted them again, on the way to Samuel R. Hall's in Brownington. "We are agoing to tramp around Orleans County a spell," Charles wrote Edward, "then go to Montpelier & haul over the rocks so carefully collected by Mr Hager & Co — go to Burlington, Quakers in Monkton, Plymouth, Ascutney & perhaps some other places if Pa don't give out before that time."⁶⁹

A comparison with his 1841 report for Massachusetts shows why the Hitchcock team was able to finish in four years what had not been finished in the previous twelve. The framework used in Massachusetts had proved successful. Good work on eastern New York and Massachusetts, and to a lesser extent on other nearby states, was available. As one of the most learned of American antebellum geologists, Hitchcock had only to fill in the blanks with the Vermont data his sons brought in. He concluded,

though obliged to close the work when only half done, because the legislature starved us out, we did bring out a report of nearly a thousand quarto pages, in two volumes, with thirty-eight plates and two hundred and eighty-nine wood cuts, and containing a vast amount of facts, so that in a review of the work in the "American Journal of Science" for



Sheldons & Slason's Marble Quarry.
West Rutland.

Pub. & Prop. by Geo. S. Stewart, N. Y.

H. F. WALLING, N. YORK.

The second largest marble business in 1860, Sheldons & Slason (pronounced Slawson) was in the late 1850's, when the Hitchcocks visited them, hiring 160 men and using many horses and oxen for teaming and powering the derricks which hoisted 70,000 cubic feet of blocks out of the quarry in 1859. A seventy horsepower steam sawmill converted these blocks into \$130,000

worth of inch-thick slabs according to the 1860 manuscript census of manufacturing, and produced the perpetual plume from its smokstack shown in this lithograph, Plate xxxvi in Hitchcock's Geology of Vermont, drawn by H. F. Walling; lithographed by Ferdinand Meyer.



Edward Hitchcock (1793-1864), State Geologist, 1856-61, and President of Amherst College, 1844-54, produced with his sons the first detailed study of Vermont geology, whose bedrock map served for a century. From the State Geologist's Report (1946), 18. No picture of Augustus Young (1785-1857), his predecessor for seven months of 1856, has been found.

May, 1862, by Mr. [Elkanah] Billings, paleontologist of the Canada survey, it is said: "Upon the whole, we look upon this Report as one of the best that has been published on this continent."⁷⁰

Following the pattern of earlier surveys, it was "a classification of minerals for the professional, a guidebook for prospectors, a textbook for the student, and a Baedeker for the tourist."⁷¹

Many contributed besides the survey team. Charles T. Jackson made a chemical comparison of American and European serpentines, and two other Boston chemists made analyses. Samuel Read Hall, "Report relating to the geology of northern Vermont," and Thompson's 1846 study of trap dikes found places.⁷² Although accepting the glacial origin of some scratches, Hitchcock clung to the iceberg theory for scratches found on mountaintops, because he could not conceive of an ice-cap a mile thick.⁷³ Charles G. Doll concluded, in his 1961 centennial address on the publication of the first geological map of Vermont, that a major achievement of Hitchcock's survey "was the discovery of the anticlinal structure of the Green Mountains."⁷⁴ Another major achievement was the creation of Hitchcock's "Geological Map of Vermont."⁷⁵

The geology of Vermont, with its maps, plates, wood cuts and extensive text, was a milestone. For the first four state geologists it was a monument. For most Vermonters it was the end of the survey. The work done before the

Civil War was seen through the press by the only local member of the survey crew, Albert D. Hager of Proctorsville, and appeared during the first months of the fighting. Of the thousand copies produced for \$7,724.25, close to four hundred were distributed free to the authors, Vermont towns, colleges and academies, national and state libraries. Any Vermont citizen who prepaid \$2.25 by 1 April could have a copy, but it was not out of print until about World War II.⁷⁶ Hager's second wife was a Goddard, probably related to E. L. and N. W. Goddard of the Claremont, N.H., Manufacturing Co., nineteen miles east of Hager's home, which did the printing. He dealt with H. F. Walling, who had published school wall maps of Vermont counties in the late 1850's, the engraver of the geological maps, and Ferdinand Meyer, lithographer of the plates.

Naturalists keep the State Cabinet, 1864-98

The only public responsibility which the legislature saw in this field for the next thirty-five years was to "keep" the cabinet and give some one the title of State Geologist as a point of reference. And they did not get around to doing this until late in 1864, probably because Hitchcock, although he had not worked on the Survey since 1860, was assumed to have the title, and died in February 1864.

This attitude was universal throughout the United States. In a few states, New York and Massachusetts especially, specific projects were consecutively approved,

so that scientists like James Hall and Edward Hitchcock were almost continuously employed. The federal government continued with separately authorized expeditions until the United States Geological Survey was founded in 1879. Canada meanwhile had maintained a continuous survey from 1841. No wonder that Vermont assumed that the job was done. Had the state felt the need to continue an active survey, several competent scientists were at hand.

Edward Hungerford, A. B. Yale, 1851, trained under the Sillimans and James D. Dana, came to Burlington as Professor of Chemistry in 1857, to teach in both the medical and classical departments. During his first year he gave a public lecture on "The theory of volcanic action."⁷⁷ Apparently a lion with the ladies — he captivated the Ladies Fair with *The migration of the fairies*,⁷⁸ a fantasy about Burlington as Titania's choice, and was captured by one of the most eligible, Maria Buell.⁷⁹

He was more of a mouse to President Calvin Pease. Oral tradition says that the President caught him going toward the lakeshore with his class, on a field trip. The Reverend Pease glowered at the young instructor and asked in an accusing tone, "Professor Hungerford, why are you down here wasting the students' time, when you should be in the classroom lecturing?"⁸⁰ The source of the legend may be the following uncorroborated item in the 9 October 1861 Burlington *Daily Free Press*:

A GEOLOGICAL EXCURSION

The entire senior class of the University sailed this morning in the sloop *Spaulding*, to investigate the interesting geological formations of Chazy and Isle La Motte, at the northern end of Lake Champlain, under the care and instructions of Prof. Hungerford. They carried an abundant supply of provisions, the various strata of which will divide attention with the limestone and fossils. If not captured by [Confederate] privateers, their return may be expected in something less than a week, and undoubtedly, barring the same contingency, they will have a fine time.

More impressive for his independent work on "the Taconic problem" and his steadfast efforts to reconcile science and religion, was the Rev. John Bulkley Perry (1827-72). He developed an interest in geology during his last two years at the University of Vermont, 1845-47, but trained for the ministry at Andover and spent a decade as Congregational pastor in Swanton, with a brief Civil War chaplaincy. Pastoral duties, with those of school superintendent piled on, did not prevent long, thoughtful walks, especially after his wife died in 1857, musing on the meaning of the rocks. They say as superintendent he examined scholars with a rock hammer sticking out of his satchel.⁸¹

When Jules Marcou came to America from Zurich in 1860, Joachim Barrande wrote him from Prague that he should check whether both sides of Lake Champlain had the same strata. A report of a Vermont state geologist assumed they did; Ebenezer Emmons of New York disagreed. A farmer in Georgia, Vermont, told Marcou to see Perry in Swanton, whom he found to agree with Emmons and Barrande. (There was no communication problem: Perry spent over three hours a day for many

years, studying French, German, Latin and Greek, and came to use a dozen languages.)

Recognition by a renowned European triggered a productive period for Perry. He wrote much for Abby Hemenway's history of Franklin County, and a series of geological articles, culminating in "The red sandstone of Vermont," before the Boston Society of Natural History, in December 1867. About the same time, Louis Agassiz offered him a job as curator of the paleontology collection at Harvard's Museum of Comparative Zoology. In less than four years he organized the paleolithic and tertiary fossils, with time out to lecture at the University of Vermont in 1869 and at Oberlin as "Professor of Science and Theology" for five months just before he died.

There were still others. S. R. Hall published *The alphabet of geology*, in 1868, a school text reprinted twice by 1878. Henry M. Seely (1828-1917), Middlebury College Professor of Chemistry and natural history, 1861-95, and lecturer in Chemistry to UVM medical students, 1860-67, had Yale and German scientific training, but did not publish on geology until 1885.⁸²

Augustus Wing (1808-76), a teacher 'overflowing with enthusiasm and kindling enthusiasm in others' became absorbed in geology.⁸³ In 1865 he decided to find out the age of the limestones, slates and quartzites of the Otter Valley. He built a clinometer to measure the dip, and examined 'every square rod of exposed rock' in the Valley, for ten years.

Finally he persuaded geologists James Dwight Dana of Yale, Frederick Prime and William P. Blake and mineral chemist F. A. Genth to test his theory of the Lower Silurian origin of the Otter Valley bedrock. The scientists met at Great Barrington on July 9, 1875, and traveled through the Hoosac Valley to the Canadian border, crossing the Green Mountains several times. Having convinced the great, Wing retired to live with relatives and died within six months, leaving only field notes, correspondence and unfinished papers. But Professor Dana thought enough of his originality to write him a memorial in the scientific literature, "An account of the discoveries in Vermont of the Rev. A. Wing."⁸⁴

Albert D. Hager

Neither Hungerford, Perry, Hall, Seely nor Wing, but Albert David Hager (1817-88), accepted appointment as State Geologist under the Act of 22 November 1864. It provided "that in no case and under no circumstances shall said geologist charge to or receive from the State anything for expenses, but in accepting such office it is understood that he looks to his employers for any compensation that he may reasonably deserve to have for professional services by him so rendered." The act further required the State Geologist to "keep a record of such new facts as shall come to his knowledge, and transmit a copy . . . to the Governor, when requested by him." No evidence has been found that Hager kept any such record, or that any governor asked for a copy. The law did speak of *continuing*, not *reviving*, the office, "to encourage the further development of" Vermont's underground resources.

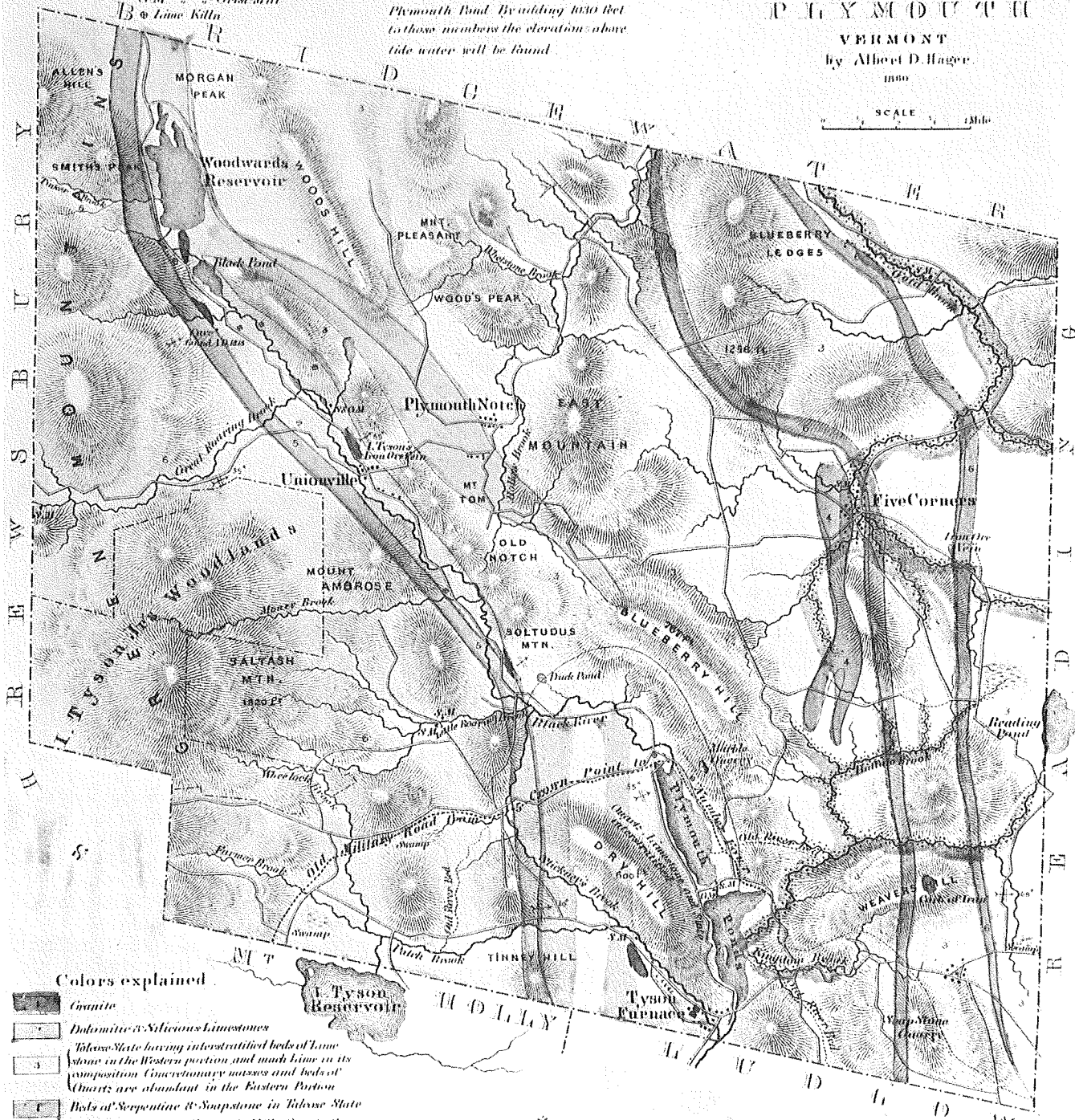
Hager was appointed, perhaps, because the public identified him as responsible for publishing the final

**GEOLOGICAL MAP OF
PLYMOUTH CO. VERMONT**
by Albert D. Hager
1880

EXPLANATIONS.
The figures on Mountains &c show the Elevation in Feet above the outlet of Plymouth Pond. By adding 1030 feet to those numbers the elevation above tide water will be found.

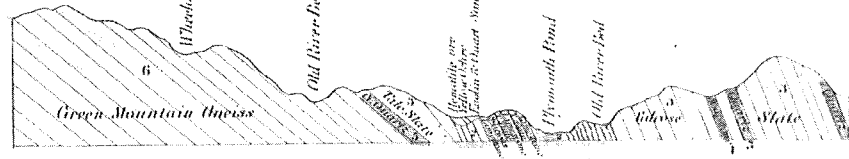
S.M. denotes Saw Mill
G.M. " " Grist Mill
B & L Lane Kill

SCALE 1/2 Mile



Colors explained

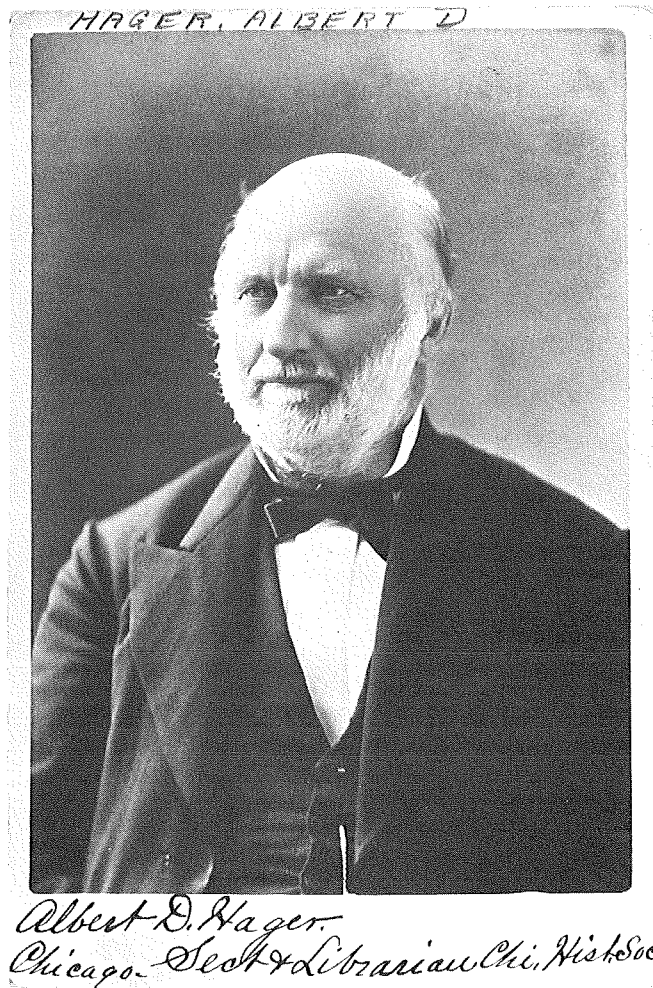
- 1 Granite
- 2 Dolomite & Silicious Limestones
- 3 Talcose Slate having interstratified beds of Laminar stone in the Western portion and much lime in its composition. Concretionary masses and beds of Quartz are abundant in the Eastern portion
- 4 Beds of Serpentine & Soapstone in Talcose State
- 5 Beds of Quartz. The Eastern is Milky Quartz; the middle bed Gray Quartz traversed by numerous White Veins and the Western bed is Crystalline Quartz often passing into a Slaty variety
- 6 Green Mountain Gneiss
- 7 Miscellaneous Gneiss of Iron
- 8 Carbonate of Iron (Spathose Ore)
- 9 Cold Deposits
- 10 Brown Hematite (Iron Ore)



Section of Rock one half mile north of the South line of Plymouth
SCALE 2 miles to an inch

While every word every state geologist has uttered in 130 years agrees there is no gold in Vermont worth exploiting commercially, Albert D. Hager's Plymouth map,

published as Plate xviii in Hitchcock's Geology of Vermont, encouraged panning if not digging.



Albert David Hager (1817-88), assistant to Hitchcock, Vermont State Geologist (1864-70), Missouri State Geologist (1870-71). Chicago Historical Society.

report. He had reprinted in 1862 the “Economical” and “Scenographical” sections he had written for Hitchcock — the parts the average Vermonter understood. There was little science but lots of useful information in those big pages. Hager could rattle on like a side show barker, making the dullest rocks interesting, and the views from mountaintops enticing.

A reporter’s 1886 portrait shows the enduring traits of the man who for fourteen years was devoted to Vermont earth science — among other things.

Just within the door the visitor will meet one of the queerest and quaintest specimens in the collection — a round-headed, white-haired old man, whose face is sure to wear a smile of welcome . . . and whose graciousness could not fail to charm the most indifferent into ease and expectancy. His name is Hager, and he is the Secretary of the Chicago Historical Society

The secretary is just like the building wherein he spends the days from early morn till late at night — plain and unpretentious outside, rich within, redolent of reminiscence, a storehouse of the past, a cyclopedia of the rare, quaint and ancient. He is at once a librarian, a historian, a geologist, antiquarian, ethnologist, genealogist, biographer, archaeologist, bibliographer, enthusiast. His devotion to method is only equaled by his industry, and his infallible memory is matched by his perennial humor. What he does not know about the history of Chicago and the men who made it is not

worth knowing. The tittle-tattle about men and things of bygone days which he has not on his tongue’s end would make but a short and dull story. Not one of the subjects of his discourse was ever more interestingly loquacious than himself, and in his office as connecting link between past and present he throws a glamour of romance over commonplaces which a more prosaic commentator would mention only with wearisomeness.

If nature in all her works ever made a man especially and wholly to fill the functions of secretary of a historical society she made him when she grew and ripened this quaint and lovable old man.⁸⁵

In the late 1860’s, Hager picked up consultant’s fees from about seventeen companies, several in Vermont. The work usually consisted of a trip to the quarry or mine, a few pages of optimistic generalities, with his title in the heading to impress investors. One Poultney quarry, he wrote, has forty-six acres “under every rod of which slate is found remarkably free from curves and joints it will prove *inexhaustible for the next fifty years* they do not fade the slate has not those brittle places in them remarkably fine and smooth Its freedom from hard spots and impurities renders it remarkably well suited for marbleizing.”⁸⁶

With apparently nothing more than an elementary education, Hager was willing to try anything and keep his commitments. His acquaintance with common people and sympathy with their untutored curiosity about nature

came from years of winter school and summer carpentering. His geological interest was evident as early as 1841, on his trip from Minerva, Kentucky, where he had taught since 1838, to his parents' home in Chester, Vermont, and back. At Woodstock Green he ran into James Robbins, "and with him I will have grand *Mineralogical* times," he wrote 22 October 1841. He took in a show at the Bowery Theater in New York the 9th of November, then saw the bones of a mammoth at Peale's Museum in Philadelphia the 11th, and noted the strata from the inclined railroad westward through the mountains.⁸⁷

His know-how in dealing with the map engraver came from peddling maps in the West, probably for Lewis Robinson of Reading, before he was old enough to vote. He was back in the Cavendish-Reading area by 1844, still plying his double trade, and serving as Cavendish's school superintendent by the late 1850's. He resigned this post in 1861 to produce the *Geology of Vermont*. By May 1862 he was running a land auction as receiver for the Black River Savings Bank.⁸⁸

Hager had built the show cases for the 1856 session and installed the specimens of natural history in the old State House. When the capitol burned the following January, the collection was rendered useless by the loss of identifying labels or explanatory manuscripts. To replace the loss and in belated recognition of Zadock Thompson's underpaid services to Vermont, the legislature gave his widow \$1,000 for his private collection. It was the oldest part of the State Museum until the flood of 1927 again destroyed the labor of generations.

Two new ideas came with the cabinet. The state geologist now had one small but continuing function, to care for the state collection of minerals and other specimens of natural history. "It will indeed demand a long time . . . to complete the cabinet," wrote President Hitchcock.⁸⁹ Furthermore, the state — not just private individuals or institutions — had begun to assume the responsibility for educating its citizens through a museum. Although the collection was nothing but neglected rock storage most of the time, when the legislature met the cabinet was supposed to be kept open. The Curator could hardly afford to spend the whole session in Montpelier, so his duty devolved upon the sergeant-at-arms or the janitor.

On the strength of his work with the Hitchcocks, Hager gave the 1858 annual address to the Vermont Historical Society during the legislative session.⁹⁰ As the field work neared its end, President Hitchcock expressed his appreciation by persuading the Amherst trustees to award Hager an honorary A.M. Hager protested that he scarcely deserved it since he could not even read the Latin on the diploma. Hitchcock replied that the honor was for making "such progress in science without a previous knowledge of Latin."⁹¹

Hager served usefully as Fish Commissioner, 1865-69, and titular representative of Vermont to the Paris "Expo '67." He could have continued as titular State Geologist until he eroded, but when the Missouri Mining Bureau passed over its competent state university geologist and invited Hager to continue their state survey *on salary*, he left Vermont for good in 1870.⁹² By 18 March 1871 he was removed from office (for not finding enough tin to suit

some confidence men, he said), issued an annual report⁹³ explaining the politics of the situation, and dropped out of sight.

We know he had three wives — one died, one divorced, one survived — and four children. We know he ran the Washingtonian Home in Chicago for alcoholics, 1873-74, and was Secretary-Librarian of the Chicago Historical Society, 1877-87. When late 19th century governors looked for a character to fill the virtually unpaid office of State Geologist and Curator of the State Cabinet, they had Hager's versatile traits in mind; curiosity and general knowledge of man and nature.

Hiram A. Cutting

Hiram Adolphus Cutting (1832-92), appointed Curator 5 November and State Geologist 22 November 1870,⁹⁴ answered this description better than any Vermont amateur geologists — Hall, Seely, Wing, or young George Perkins, the new naturalist at UVM. Cutting was a naturalist who wanted to show everybody the wonders of nature, and uplift humanity by applying close observation and accurate measurement to particular problems.⁹⁵

His central message, contained in the title of his remarks at a Woodstock farmers' meeting 13 January 1882, was "think more and work less."⁹⁶ He practiced only half what he preached, however, working harder on more things because he knew the short cuts. He had found so many ways of adding one cubit to his financial stature, that he wanted to share his good fortune and boast a little. By teaching from age sixteen, surveying and settling boundary disputes, he was making \$600 a year while still a teenager — double the income of farm hands or village parsons. He became a master mechanic, house carpenter, mill wright and bridge builder. At nineteen, he had made himself a telescope and a double microscope. With his skill at adjusting lenses, he brought extra business to his partner, D. H. Hill, an itinerant "dagareen," because his pictures were such sharp likenesses. In his "spare" time from work with Hill's "car" he sold subscriptions to *Sears Pictorial Histories*.

Having read that Napoleon got along on two hours' sleep, he tried it while studying medicine, and blamed the inevitable breakdown for his never going to college or medical school. Another reason was that he was too busy earning, learning and teaching. His medical credentials consisted of apprenticeship with Dr. George C. Wheeler of St. Johnsbury, long years of playing with his microscope, and study with Edward Elisha Phelps of Dartmouth. Finally, Phelps told him he had gone ahead of his teacher and should lecture at Dartmouth. He did, on techniques of microscopic examination in anatomy and pathology. Cutting wrote that the honorary M.D. Phelps procured him would "be of great value to me in my study of microscopy."⁹⁷ Henceforth north country doctors sent him specimens to analyze. At the 53rd annual meeting of the White Mountain Medical Society, 7 January 1874, he read "Observations on ozone, and its relation to disease," a combination of experimental reports and guesses.⁹⁸

Convalescent and of age, he bought a partnership in his uncle's dry goods business and opened a branch in Lunen-



Hiram Adolphus Cutting (1832-92), State Geologist, 1870-86, M.D., A.M., Ph.D., &c., a one-man extension service and walking encyclopedia about nature in Vermont. From Norwich University Archives.

burg in 1855. After a year's storekeeping experience he married Miranda E. Haskell of Lennoxville, in the Eastern Townships of Quebec near Sherbrooke. She minded the store and the post office (*he* was postmaster from 1863 until around her death) and made the profits. This freed him to read science, play with his museum and experiments, and travel all over the state as a one-man extension service. Having no children, they adopted a son and managed a gang of laborers and woman servants to tend their houses, livestock, hayfields, gristmill, shingle mill, cider mill, planing mill and butter tub factory.

Although "ill health" prevented active Civil War service, he recruited over a hundred men, administered induction physicals, handled family allotments out of soldiers' pay and profited as pension agent and long-time Examining Surgeon. The Lunenburg post office job required support from the local heavies in the Republican Party, and was a personal convenience because he boasted that half the incoming mail was addressed to him.

He was a moving spirit in Dr. J. M. Currier's *Archives of Science*, in 1870 as Corresponding Member from Essex County of the Orleans County Society of Natural History, and 1871-74 as Associate Editor. His only geological contribution was "Qualitative analysis of the mineral springs of Essex County, Vermont."⁹⁹ He expressed a healthy skepticism about the bad-tasting waters. The West Concord Saline Spring, he wrote,

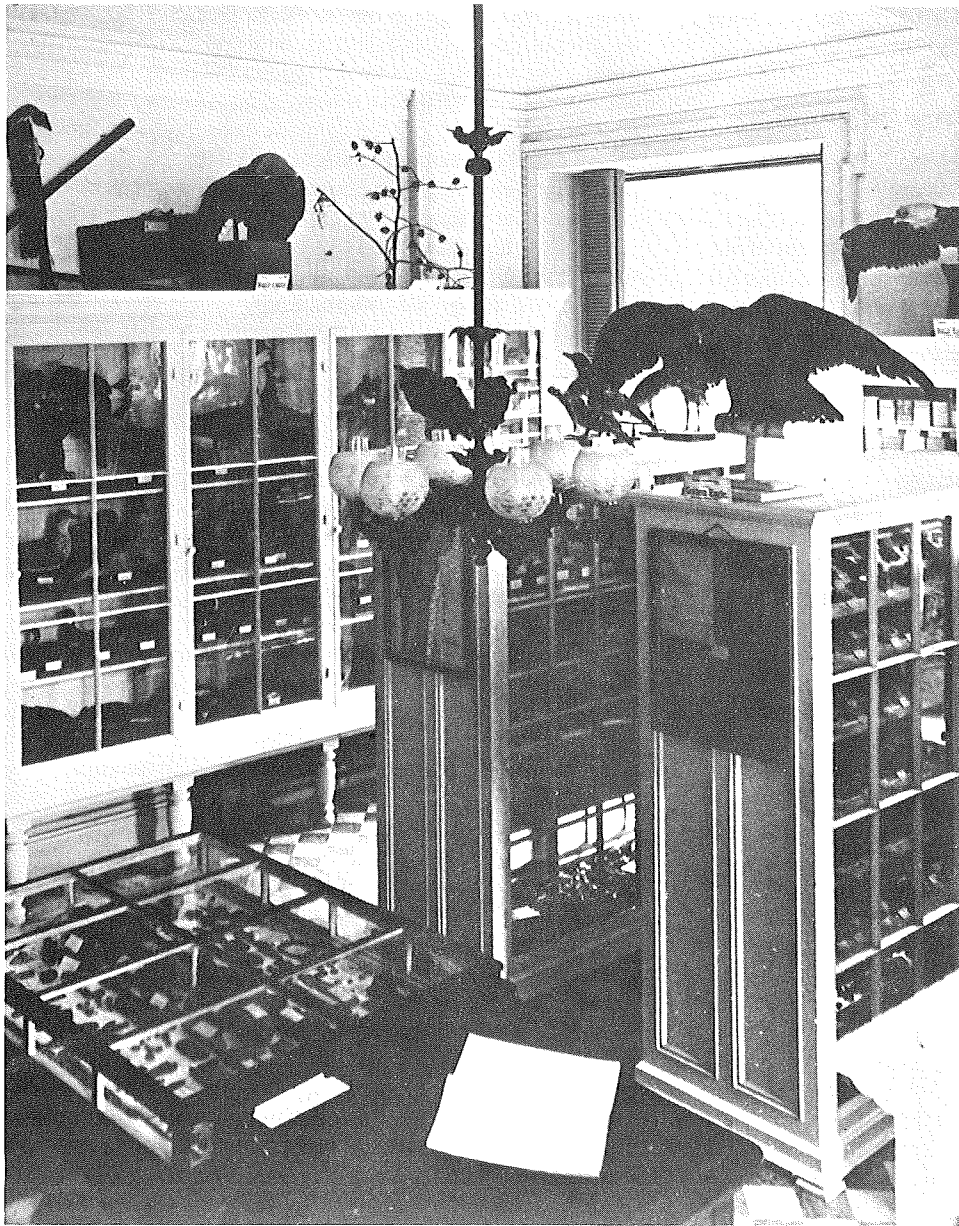
has a reputation in the neighborhood as a specific for kidney diseases, and . . . a regular use . . . might be advantageous in dyspepsia also . . . I feel that commodious and popular hotels for summer resort, do more to increase the popularity of mineral springs than the best ingredients ever prepared in

nature's laboratory, as it is necessary that an invalid be pleased in mind as well as cured in body.¹⁰⁰

One of the first Vermonters to own a microscope, he used it to study the scum of algae on pools, the dust brought in with a snow storm, fungus, merino wool, cattle diseases and trichinosis.¹⁰¹

He liked to be State Geologist because it gave him a letterhead with the state seal, to impress the Smithsonian Institution into sending him free instruments for his weather observations, continued since boyhood, or advising him whether corpses can petrify.¹⁰² He liked to get inquiries to answer, with specimens of ore to analyze. As Curator he liked to replace Thompson's moth-eaten bird skins, figure out the best ways to mount insects, advice contributors how to clean skulls, and appeal to collectors for more specimens, even though space was limited in the State House.¹⁰³

What Vermonters wanted was a man to be a clearing house, called "State Geologist," "State Naturalist," or "Secretary of the Board of Agriculture," spreading news of what is useful out of the good earth. This function Cutting amply filled for sixteen years. He disseminated "observations" on fleas and lice, clover, farming tools and buildings, building stones and Proctor marble in particular, how to forecast weather, the new vacuum process for making butter and cheese, sugaring, ensilage, and insects as friends and enemies. He thought little nitrogen was needed in a fertilizer. He betrayed mild rivalry with G. H. Perkins, coming out for the crow and against the robin, after Perkins had defended the cherry-eating robin and had his doubts about corn-eating crows. Cutting followed the professor's "Flora of Vermont" with "Wild flowers and noxious plants."¹⁰⁴



The state cabinet in the capitol, Montpelier, ca. 1870-75, from a stereo view by C. H. Freeman in the Vermont Historical Society. Hitchcock's 1861 bedrock map is framed at the end of a cabinet under the gas light.

The State Board of Agriculture, Manufacturing and Mining was the all-purpose sounding board directly descended from the first legislative appropriation to find out what more nature could provide for Vermonters. Like Hitchcock, Cutting did the work first and presented the bill afterwards. Henry Clark, Secretary of the Senate, failed to forward H. 375 for Governor Stewart's signature, so that he had no appropriation for the museum, but he improved the cabinet anyway. His theme in this and his next three biennial reports was that a geological survey should be continued, but since no expense had been authorized, he could report no progress.

He delighted in traveling the farmers' institute circuit, first as a free speaker on anything helpful, labeled "A.M., M.D., State Geologist." Later, as Secretary of the Board of Agriculture, 1881-86, he was responsible for arranging programs, and filling in when scheduled speakers failed to arrive through mud, drifts and derailments. At Burlington, 24 January 1872, he covered "Mining in

Vermont," reiterating earlier warnings, but citing many recent cases of finding a few dollars' worth and wasting thousands to find more gold, or gullible investors.¹⁰⁵ Six others spoke on geological subjects that year. In 1876, he discussed the White Mountains, and six others dealt with minerals and other stone-related topics.

Norwich University padded its faculty list with Cutting and gave him honorary degrees (M.A. 1868, Ph.D. 1879) in return for visiting lectures. When Governor Farnham appointed him Fish Commissioner, 1881-86, he surveyed unstocked streams, planted "many food-carp" and fought to protect them. In 1885 he was one of three delegates, including Redfield Proctor, to the American Forestry Congress in Boston, and the next year was named to attend the Agricultural Congress in St. Paul.¹⁰⁶

On 3 March 1886 his wife died, and he gave up. He resigned from all his boards and commissions, including the office of State Geologist, and died of apoplexy at home six years later, April 1892.¹⁰⁷ The Hatch Act (1886) establishing state agricultural experiment stations,

brought W. W. Cooke to UVM. He took over the farm science side of Cutting's work and did the fertilizer testing and licensing.¹⁰⁸

George W. Perry

To replace Hiram A. Cutting, Governor Ormsbee appointed forty-year-old George William Perry of Rutland, on 29 November 1886, "with the advice and consent of the Senate" — a new requirement.¹⁰⁹ Perry's function, like his predecessors', was adult education in natural history. Like them, too, he was a nature lover. Like Hitchcock and Cutting he was a popular lecturer. Like Thompson and Hitchcock he was a clergyman.¹¹⁰

He graduated from the theological school of what became St. Lawrence University at Canton, N.Y., in 1868, married Mary Alice Rice of Marlboro, Massachusetts, his childhood home, and started preaching in Universalist churches from Rhode Island to Auburn, Maine. In November 1884 the Perry's, now a family of eight, came to Rutland, Vermont, where he organized a new Universalist Society and built the marble St. Paul's Church at 46 West Street, next to his home.

Believing that the young can learn the life sciences better living outdoors and studying nature first hand, he took a few boys tenting at Queen City Park, South Burlington, 1886-88. The next year, tensions in the church led to his resignation.¹¹¹ With his brother Oscar, he started the Rutland English and Classical Institute, a private academy for boys and girls (1889-95) which became Rutland Business College. He taught the sciences and mathematics while Oscar covered the languages, history and bookkeeping. Because Universalists were not eligible for YMCA membership, Perry started a similar lyceum, the Disco Club (1885-93) for the boys of his church, with lectures and discussions.

As State Geologist, he had new instructions to spend up to \$150 assembling and publishing annual data on Vermont's mineral and stone industries. Consequently, during his twelve years' tenure, for the first time a systematic statistical series was called for and partly achieved for marble, granite, slate and less regularly for lime, soapstone, kaolin and brick, showing number of firms, capitalization, employees, wages, quantity and value of product. Perry noted new operations, casting doubt on some and encouraging others. Noting Hall's and Heroult's 1886 discoveries of electrolyzing aluminum, he suggested that the metal might be retrieved from slate mill dust.¹¹² He complained that he was expected to analyze specimens of talc sent in and inspect deposits in person, but no one would pay the costs. No good talc had yet been found, but it would be, he concluded in 1890. He noted that J. Seward Webb was drilling for natural gas at Shelburne, with not much chance of success.¹¹³

As Curator of the State Cabinet Perry was on hand when the Vermont Historical Society library was moved into the new State Library building after the 1888 session, and prevailed on the sergeant-at-arms to let him have "temporary" use for his museum. He had found Cutting's stuffed fish insect-ridden, and replaced them with a new set of 200 rock specimens. Out of his \$200 a year (increased to \$500 in 1888) he bought pesticides and equipment to war on vermin. In the larger space he added

birds and birds' eggs, a new collection of marbles, "nearly all the larger animals found wild in Vermont" (there having been only a few small species before), and a group of "Silurian" (Ordovician) fossils from Grand Isle.¹¹⁴ Yet in 1896, when he reported that the cases had been rebuilt, he was back singing the blues. "Not much further improvement can be made . . . until larger and better lighted rooms are provided."¹¹⁵

One result of his 1890 trip to Grand Isle to hunt fossils was his purchase of a thousand feet of lake front on South Hero's west shore. He opened Eagle Camp for boys there in 1891, with an early two-week period for girls beginning in 1892, and parents and teachers welcomed alongside. While unloading the Rutland Institute and moving to Chester Depot in 1895 Perry cut out the girls' session but instituted a Teachers' Camp. The diaries and reminiscences of former campers picture him as a benevolent despot, fun-loving, snapshooting and benign when stage center or stage manager, but making everybody except his wife jump to obey his (to him) reasonable rules. Although he made nature fascinating, the excursions were voluntary, and many a boy preferred to stay at camp and play ball or go boating. In later years, he used to say that when he was state geologist he had 'crawled over almost every inch of Grand Isle on hands and knees.'¹¹⁶

In 1893, for example, George and his sister Inez Perry conducted a class in geology and botany for an hour or so after lunch, unless there was a field trip to Cumberland Head or along the shore to see dikes. There was neither book-learning nor home work except to collect specimens for examination during the talks. At the end, the Perry's would quiz the group and tell them what kind of rock or plant to bring in for the next day. During the two weeks recorded by his sister-in-law, Perry covered the eons of the earth, the common minerals, iron, gypsum and fossils. The botanical lectures were illustrated not only with specimens, but also with large charcoal drawings of the principal parts of the flower, "made for George when he lived in Auburn, Me., to illustrate his lecture on plants."¹¹⁷ One night he showed the rings of Saturn through his telescope. Other evenings were devoted to games, readings, songs and dancing, recitations and stories. Pleasure and education were twinned.

This winning combination made Eagle Camp grow. He was also in popular demand as a lantern slide lecturer, so that his travels dovetailed with his summer work and helped recruitment. His stereopticon lecture on "Vermont's marble quarries" at the Burlington YMCA Hall was "often applauded," the *Free Press* reported.¹¹⁸ His repertory included slide talks on "The Moon," "Beautiful Vermont," "Insectivorous Plants," "Botany," and "Snowflakes." The last was based on glass plates magnified from Wilson A. Bentley's photographs.

We do not know what got into the 1896 legislature, when Governor Woodbury's retiring message recommended abolishing his office. "While I think that he [Perry] has accomplished as much as any other person could with the limited means at his disposal, I believe that the value of his work is not worth to the State what it costs."¹¹⁹ He therefore suggested that the Sergeant-at-arms have custody of the Cabinet and the annual statistics be abandoned. S. 83, abolishing the office introduced by



George William Perry (1846-1928), State Geologist, 1886-98, Universalist minister and founder of Eagle Camp, South Hero. Perry Family Archives, courtesy of Helen Perry Smith. Taken about 1895.

Lorenzo Hubbard of Lyndon, was reported unfavorably by Hiram Manchester (Pawlet) from the General Committee, and died. S. 82, on the other hand, "a bill to render the office more efficient," was reported out of the Committee of Manufactures by Henry M. Stone of Swanton, and passed. It answered his repeated prayers for more funds, just when the camp business was beginning to demand so much time. The \$1500 appropriation was for personal inspection of operating mines and quarries, and reports of deposits worth developing, especially with undeveloped waterpower nearby. The State Geologist must report the quality and quantity of our marble, granite, slate, soapstone, copper, and other minerals by the end of the biennium.¹²⁰

Perry spent at least \$700 of his \$1500 special appropriation, and the balance was transferred to his successor. Perkins wrote that Perry had collected "considerable material" for his report when "continued and serious illness" forced him to resign early in the summer of 1898.¹²¹ By then the Rutland Railroad was planning to build a line from Burlington through Grand Isle County which would leave campers at the South Hero depot, four miles from Eagle Camp. Until the trains arrived in 1900, the campers came and went from the Grand Isle steamer dock (now the ferry landing) to Burlington via Plattsburgh and Port Kent. Hindsight sees every prospect favorable for the future of Eagle Camp, but the Perry family could only worry about George's getting well, and redouble efforts to develop the summer business.

During the next decade he became president of the Vermont State Horticultural Society (1908-10).¹²² He

began going to Florida at the age of fifty-nine, and reopened a Universalist church at Tarpon Springs, which he served at least five winters. Although those who knew him frequently reported that he had to give something up because of ill health, he managed Eagle Camp until he died on the eve of its 38th season at the age of 81. He was the last of Vermont's amateur State Geologists.

The Continuing Program of Perkins and Jacobs, 1898-1947

George H. Perkins

George Henry Perkins, the first professional in the office, was appointed by Governor Josiah Grout 7 September 1898, and reappointed each biennium until he died in office 12 September 1933 at the age of 89.

He was a professional in training, teaching and research, although only a part-time geologist. He had graduate training as a natural scientist at the Sheffield Scientific School of Yale University. Like Charles B. Adams, the first state geologist, Perkins was a specialist in mollusks. His 1869 Ph.D. (the fifth ever granted by Yale) was accomplished with a thesis describing the snails and shell-fish of the New Haven area.¹²³ Since 1869 he had taught geology, along with other biological sciences, at the University of Vermont. He took the seniors on "geological" trips to Boston (1883) and New York (1884), and his geology class to Ausable Chasm.¹²⁴ He had published, up to his appointment in 1898, five articles in the realm of earth science. Three were on Winooski marble, one on Illinois geodes, and one, in a field

bordering meteorology and surficial geology, a short piece entitled "Notice of a recent landslide on Mount Passaconaway."¹²⁵

The method he followed in these observations was characteristic of his work for half a century. The avalanche of 4 October 1869 left a gash which Perkins could see forty miles away, when he was visiting his father's old home in Sanbornton, New Hampshire, two weeks later. He and a friend went straight over, picked up a third companion who knew the region, rode up the Waterville Valley, and walked in from there to view the destruction. The result of their on-the-spot observations was measured description: how far up their trunks the trees were bruised; the twisted course of the slide in relation to the stream; the syenite bedrock — accompanied by a drawing.

Judging by Perkins's many speeches and writings during his prime (1869-98), his abiding interest was in the original Indian inhabitants of Vermont. His chief role beyond teaching, however, was in public relations for the State Agricultural College. The dirt farmer is traditionally suspicious of "book-learnin'." Perkins steadily preached, at farmers' institutes all over the state and during the winter "short course" in agriculture on campus, that the science provided at UVM could help the farmer.

His first public lecture in May 1870 at Springfield, for example, dealt with natural history, mainly about the habits of birds, and the good and evil they do farmers. "The audience gave the closest attention, some gentlemen leaning forward at an angle of forty-five degrees as if otherwise they might lose a portion of his remarks. The professor spoke fluently and earnestly, and seemed to be an enthusiast and adept in his chosen field," the reporter wrote.¹²⁶

After ten years in Vermont, he ventured to meet the anti-intellectuals head-on:

I agree most heartily with the statement that "the field is a better place than some books to hunt for facts," but the books which I quoted were not of that sort. The facts I gave were given as published by those who had found them in the field. I do not know that facts determined by actual study in the field lose anything of their value when printed in books, and certainly none of us can hope to make very great progress in any branch of knowledge if we refuse to make use of the observations of others as well as our own.¹²⁷

Perkins concluded that every farmer and gardener should seek to learn the real value of Vermont animals. This takes a sharp eye and lots of patience, he wrote. What you learn from an hour's observation is true, but only a fragment of the truth. The whole truth comes from watching Vermont animals throughout their life cycle. Crop-eating birds, like the robin, he asserted, are primarily enemies of insects and eat fruit only for dessert, as men do. Perkins had succeeded to Zadock Thompson's role, that of the man who knows, when you bring him a strange specimen, what kind of beast, bird or fish it is before you can count to ten.¹²⁸

Besides being the first professional, Perkins established the Vermont geological survey as a continuing program

of state government. The act of 1886 initiated the practice of publishing annual summaries of answers to a questionnaire, but Perry had only minimal cooperation from quarry and mine operators and did not publish a complete series. The act of 1896 asked for only one report, in 1898. Perkins, however, by delivering a sixty-four-page report based on visits to seventy-five marble, granite and slate quarries in less than six weeks after his commission was signed, showed that he was the man to keep on that job.

No one could have found fault if, not having had the two years allowed for preparation, he had made only a token report, including a plan for the next biennium. Perry had already spent half the appropriation and Perkins could only hope to be reimbursed for his September tour of the quarries. In the eyes of most Vermonters, the title of State Geologist was honorific. No one deserved this honor more than Perkins, who had been interpreting popular science to rural Vermonters for a generation. His Middlebury friend, Henry Martyn Seely, had published more work in geology, but Seely had chosen to retire in 1895, and apparently was not interested.

The first report was a tour de force and a work of art. Perkins made it clear that it was all his own work; he had "no access to his [Perry's] considerable material" collected for the report. Although he had no new arguments for a survey, he also made it clear that if the state were to benefit from investments in its earth resources, a new *scientific* survey was a must. Hitchcock's report of 1861, although containing much useful data, really contained "much that is not very valuable . . . it does not give such information as any one who is seeking to make profitable investments would require."¹²⁹ And since 1861, he wrote, no Vermont geological report had been authorized or published. By showing that he knew major from minor and by featuring current information about the stone industry which enabled Vermonters to be proud of it, he insured his reappointment by Governor Smith.

He may have used all summer to get ready. An undated petition to "the Governor," suggesting Perkins for State Geologist as "a man most eminently fitted by character, profession, and training, could not have been circulated without his knowledge and consent. Over 150 signatures, representing half the towns, and all the counties and principal villages of Vermont, had been gathered at some Republican meeting, to be given to Governor Grout, perhaps by the time he received an honorary degree at UVM's July Commencement. On the other hand, perhaps the Governor had told Perkins at Commencement that he would appoint him if state-wide support could be shown, and was assured of this without seeing the petition.¹³⁰ Supporters included such men as General William W. Wells and Judge Seneca Haselton of Burlington, knitting mill owner A. B. Valentine of Bennington, and diplomat Austin T. Foster of Derby. Not speaking geologically, some one had left no stone unturned to secure the post for Perkins.

But why would the professor want the job? When Hager left Vermont in 1870, Perkins was still on his first year's temporary appointment and not well known. When Cutting resigned in 1886, it may have seemed impolitic for



George Henry Perkins (1844-1933), State Geologist, 1898-1933, about ten years before his first appointment. UVM Archives, gift of Geraldine Andrews.

UVM to grab another office, when the question of whether the Agricultural College should stay in Burlington was not yet permanently settled. Besides, its new Professor of Agriculture, Wells Woodbridge Cooke, was succeeding Cutting as Secretary of the State Board of Agriculture. The full life of a teacher of all parts of natural history, including physiology and hygiene to the entire freshman class, left little surplus time and energy. To the scrupulous Congregationalist, it would be impossible to fulfill the requirement of attending the sessions of the legislature every other year, in the middle of the fall term of classes, as Curator of the State Cabinet. He was supposed, for the \$3 per diem of a town representative, to keep the room open and provide guided tours to see a few rocks and stuffed beasts tucked away in a dark corner of the capitol. Proof is absent that any curator literally met the stipulation while it lasted, but it bothered Perkins.¹³¹

In 1898, when he was in his 55th year, he was getting "old." On the UVM faculty only President Buckham and Professors Barbour, Goodrich and Torrey were older or had longer service. Retirement at 65 is an idea not applied at UVM until about 1945. In 1898, there was no such thing as retirement, except for ill health or to pursue a different activity. There were no pensions for non-veterans, and Perkins had been in college during the Civil War. The cushion of a part time office would be very welcome for a superannuated naturalist, and he might be well into his sixties before the next opportunity came.

In the summer of 1899, the off year when no biennial report was due, George Perkins and his wife took a trip to

Alaska. They traveled by Canadian Pacific Railroad from Montreal to Vancouver and by steamer from Victoria up the inner passage to the Muir Glacier and Sitka. Stopping "to spend the Sabbath" at Lake Louise, Mary Farnham Perkins wrote her sister, explaining why they were prolonging the trip:

It is becoming more and more evident that if George is to hold a College position now, at his increasing age, and in this day of specializing, he must add to his equipment in the ways which are open to him. I see quite a difference between his enthusiasm for these things now, and when we first began to see mountains together. Not that he is less appreciative, but more cautious and deliberate. He has kept up wonderfully in his departments of study, considering the pressure which his *work* keeps on him all the time. And so long as he is to hold a place in College he *must* keep up . . . any letting down . . . will mean *retirement*, and they do not *pension* old teachers in this country. I sometimes suggest that he should lay up every spare dollar, . . . but . . . these investments . . . in tours for field work and study are keeping him equipped for further work — or storing his mind . . .¹³²

Earlier, in 1883, his wanderlust had sent the Professor to the American Association for the Advancement of Science in Minneapolis, and on to visit Yellowstone Park.¹³³ Receiving the standard maximum faculty salary plus compensation as curator of the college museum, he could begin to afford more frequent, longer trips.¹³⁴ The spacious brick house he had built in 1884 at 205 South Prospect Street, a block south of the campus, he must



Black Bess G.H.P. Mary
 Eagle Camp July 25, 1901.
 Photo by Mrs. Sumner.

George H. Perkins, with his wife Mary, at Eagle Camp, South Hero, run by his predecessor G. W. Perry, in the

summer of 1901. Perkins Family Archives, courtesy of Anne Perkins Wollaston.

have nearly paid for by 1899. His father had died in his care in 1893. His only surviving child, Harry, had graduated from the University of Vermont in July 1898 and was studying Zoology at Johns Hopkins University. He had no other dependents except his wife, who died in 1904.

Of all the faculty during his sixty-four years' tenure at UVM, Perkins had least to worry about old age. He was an approved teacher, so popular that juniors could both praise him and poke fun at him in their 1897 year book: "an abridgement of all that was pleasant in man"; "In short in matters vegetable, animal, and mineral, I am the very model of a soft snap."¹³⁵

From 1887 an entomologist for the new Experiment Station, Perkins advised horticulturists what to do about apple borers, and residents about elm leaf beetles. His familiar name among Vermont farmers must have won crucial votes in the legislative fight of 1890 to remove the

College of Agriculture from Burlington. In 1898 he had been singled out with three others to share the administrative burden of President Buckham's last years, as Dean of the Department of Natural Science, and he was Dean of the College of Arts and Sciences, 1907-31. Although "publish or perish" had never been heard of at UVM, his publications by 1892, in every field of natural history as well as anthropology, make a volume 8cm. thick.

Mary Farnham Perkins was a wifely worrier. To see the Canadian Rockies and a live glacier was indeed valuable for the geologist of a glaciated region, but this was the way George's conscience rationalized the luxury of travel.

His next trip, however, was as a widower in his sixties, viewing the buildings and art of Europe, in 1907. The climax of his life, perhaps, was his trip around the world in 1910. Although never losing his Greek curiosity about and tolerance of each new thing, he could thenceforth in-

dulge his primary interest in man. His last twenty-three years, graced by substantial geological volumes issued every two years, were a dignified denouement of musings, with a few, fortunate student listeners, on the nature of man.

In the 1920's you were sure of a B if you regularly attended "My trip around the world," as Perkins's Anthropology I was called, with an A for any noticeable effort, but only honors students were admitted. For some it justified the ways of God to the 20th century young, as Paley's *Evidences of Christianity* had done for college students a century before. For most, it synthesized the life sciences in relation to man, and they considered it one of their most valuable college experiences.¹³⁶

This was the kind of man the State of Vermont kept in the post of State Geologist until his death in the month of his 89th birthday. What happened to the Survey under his aegis? Neither the State, the University, nor his family has preserved his once voluminous correspondence. From his publications, a letter here and there in the papers of others, official proceedings of bodies where his voice was heard, and fragments treasured by his heirs, the general outlines of his work are revealed.

Participants, being close to their own efforts, inevitably see them large. In cumulative sciences they tend to apply the standards of their own day to older work done with cruder equipment. So Perkins persuaded himself and others that the Vermont Geological Survey really began in 1898. Judged by more sophisticated standards half a century later, his scientific contributions dwindle, like an object on a receding shore.

Take, for example, his articles on Forestdale lignite.¹³⁷ Elso S. Barghoorn, Harvard paleobotanist, began investigations at Forestdale in 1947 and, after a season of trying to relocate the deposit, has for thirty years, with colleagues and graduate students, scrutinized its fossil flora. "The kindest thing that can be said for Perkins's work," Barghoorn concluded, "is that it introduced photographs of the Brandon fruits and seeds into the scientific literature and thereby brought renewed attention to an important fossil locality. From the botanical viewpoint, the venture was virtually valueless. Almost every minor variation . . . was named as a 'new species.'"¹³⁸ But this geological brokerage did not amount to much, since no one studied the deposit or its fossils between Perkins and Barghoorn.

The State Geologist did conceive of a systematic survey, and started one without special appropriations.¹³⁹ The completion of 1:62,500 or "fifteen minute" (one inch to the mile) topographic maps of most of southern Vermont and the Lake Champlain strip by 1900, and most of the Champlain Valley by 1920, encouraged work on the west side. Whether from a decline in his rock-climbing ability, a decline of interest, or the availability of better work by younger men on scattered locations, he gave up the series.¹⁴⁰

His mind was the center for the study of Vermont geology, and he put a good deal of this stored information into his reports. A detailed, seventy-page, chronological summary of previous work, his third bibliography, appeared in his 1922 *Report*.¹⁴¹ This shows which of his special studies appeared in the *Bulletins* of the United States Geological Survey and in the learned journals. It

also shows that both in quantity and quality the Vermont State Geologist's *Report* was the primary outlet for Vermont studies. Each report continued and expanded Perry's annual summaries of stone and mineral workings, referred to the testing of hundreds of ore samples, and to "the very large correspondence which [prevents] . . . the office from being a sinecure."¹⁴²

Soon after the germ theory of disease spread from Europe in the 1880's, Dr. C. S. Caverly's Vermont Board of Public Health pioneered in raising public consciousness of the dangers of water pollution. To this movement Dean Perkins contributed a landmark study, "The drinking waters of Vermont."¹⁴³

Stream gauging in Vermont, started in 1912 for the benefit of mills and hydroelectric developments, was never part of the State Geologist's duties. Instituted by an agreement between Governor Allen Fletcher and the U.S. Geological Survey, Vermont hydrometric work long subsisted on federal money, plus an annual State appropriation of \$1,200, under frequent threat of discontinuance. The flood of 1927 highlighted the significance of water resources surveying. Five stream gauging stations in 1927 had increased to twenty-two by the end of fiscal 1929, with the Army Corps of Engineers and the Vermont Flood Control Commission carrying out their own activities in the same broad field. Expansion of work on water resources in the 1960's reflected the importance of ground water for development as well as dairying.¹⁴⁴

Geology was never the center of Perkins's interest. Some memorialists have assumed that it was, because he was responsible for two feet of geological reports and was "State Geologist." Others, guessing from his early and continued publication on Vermont Indians, and from the course he taught longest (1890-1933)¹⁴⁵ were nearer right in calling him an anthropologist. The only surviving syllabus of his full complement of courses for over sixty years is a twenty-one-page, interleaved booklet with the cover title, "Anthropology," used by Elizabeth Richmond in 1898-99.¹⁴⁶ He had always done what seemed necessary at the moment, if it meant preparing four widely different courses, being helpful in answering letters, encouraging a boy curious about a rock, or gently promoting the theory of evolution. As his burdens were lifted, he became what he always wanted to be, a religious philosopher.

A letter from his father, a Congregational minister, reveals a career aim in 1864 which never left him.¹⁴⁷ He had explained to the Reverend Frederick Trenck Perkins why he could not prepare for the ministry. Presumably the ideas he had acquired from the study of science were still unpalatable to the orthodox, five years after Darwin published his *Origin of Species*, and he did not want to get into a theological fight. As a teacher, at least at the University of Vermont, he could reconcile science and religion and avoid the wrath of the righteous.

He was a peace-loving man, preeminently a conciliator, a giver of approval. One professor who had known him on the faculty for twenty-eight years wrote in the memorial issue of the *Alumni Weekly*¹⁴⁸ that in all that time he had only once or twice heard Dean Perkins speak a word of adverse criticism, and then in the gentlest tone of voice. One does not remove such a man from office, who has found so much good in so many. Then there is an

old Vermont custom of keeping a man, in whom many have confidence, in office until he dies.

One may wonder how the benign George Perkins survived as a dean, when a prime requisite of deaning is to say no. His function from 1898 until Elijah Swift assumed the day-to-day office work in 1922 was mainly that of faculty spokesman and expeditor of presidential decisions. Where he was able, he gave approval, and let department heads hew the line. A testimonial of June 1911, signed by thirty faculty, thanked their "Senior Professor" for his "whole-hearted dedication of self to new responsibilities" of leadership as a result of the death of President Buckham 29 November 1910.¹⁴⁹ The faculty again congratulated him on his seventieth birthday in 1914. This verbal bouquet was also a silent testimonial to the genteel Buckham tradition by those unhappy with the breezy, Middlewestern President Benton. As symbol of this New England tradition, Perkins was chosen Acting President after Benton was forced into war work in 1918.

At seventy, Perkins began to consider retirement. On the resignation of Nathan F. Merrill, head of the Chemistry Department, the deans considered whether to appoint Elbridge C. Jacobs his successor. Merrill favored Jacobs, who had taught physical and industrial chemistry and mineralogy under him for fifteen years. Perkins pointed out that Jacobs was finishing an M.A. in Geology at Columbia that spring, with the hope, in which Perkins concurred, of succeeding the Dean as sole Geology teacher and State Geologist.¹⁵⁰ Perkins gave up teaching geology in 1924, yet for several months he was wondering whether to take it back again! He was not ready to relinquish the office of State Geologist.

From about 1908 on, the State Geologist tried to attend the meetings of the Geological Society of America, the Geological Section of the American Association for the Advancement of Science, and the Association of American State Geologists, whenever they were near enough for his small budget to stand the expense. He attended at least five meetings of the AASG, 1912-21, all in the Northeast. As one of the senior geologists in the United States, he presided at the Christmas 1918 meeting of AAAS geologists in New York City, in the absence of the president.¹⁵¹

Perkins's eighteen biennial reports were bound in covers of marble, for his first and last reports glorify the Vermont Marble Company, the producer most cooperative with the State Geologist. His 1933 report on marble is an imposing volume of nearly four hundred pages. One might wonder how a man laid up with rheumatism, lecturing to his students from his easy chair in the sun room, could have made the necessary investigations. It appears, however, to be his own compilation, up-dating the section of his first report by fitting together all the work of thirty-five years.

Just as it was going to press the research geologist for the Vermont Marble Company, favored with an advance copy, reported to Governor Wilson that some of the tables of chemical analysis were too full of errors to tolerate. Perkins acknowledged the errors; they stopped the binding machine; Harold Ladd Smith supplied the corrections from Company data; Perkins paid for reprinting the erroneous section.¹⁵²

Instead of retiring, the Professor spoke of the work of

Schuchert of Yale and Howell of Princeton on the geology of northwestern Vermont, to comprise "the greater part of the next [1933-34] Vermont Report." He expected to resign after that work was published. By August, as the fan mail rolled in, he wrote the Governor that he would never again have as much trouble with a report as with that one. A month later he died.¹⁵³

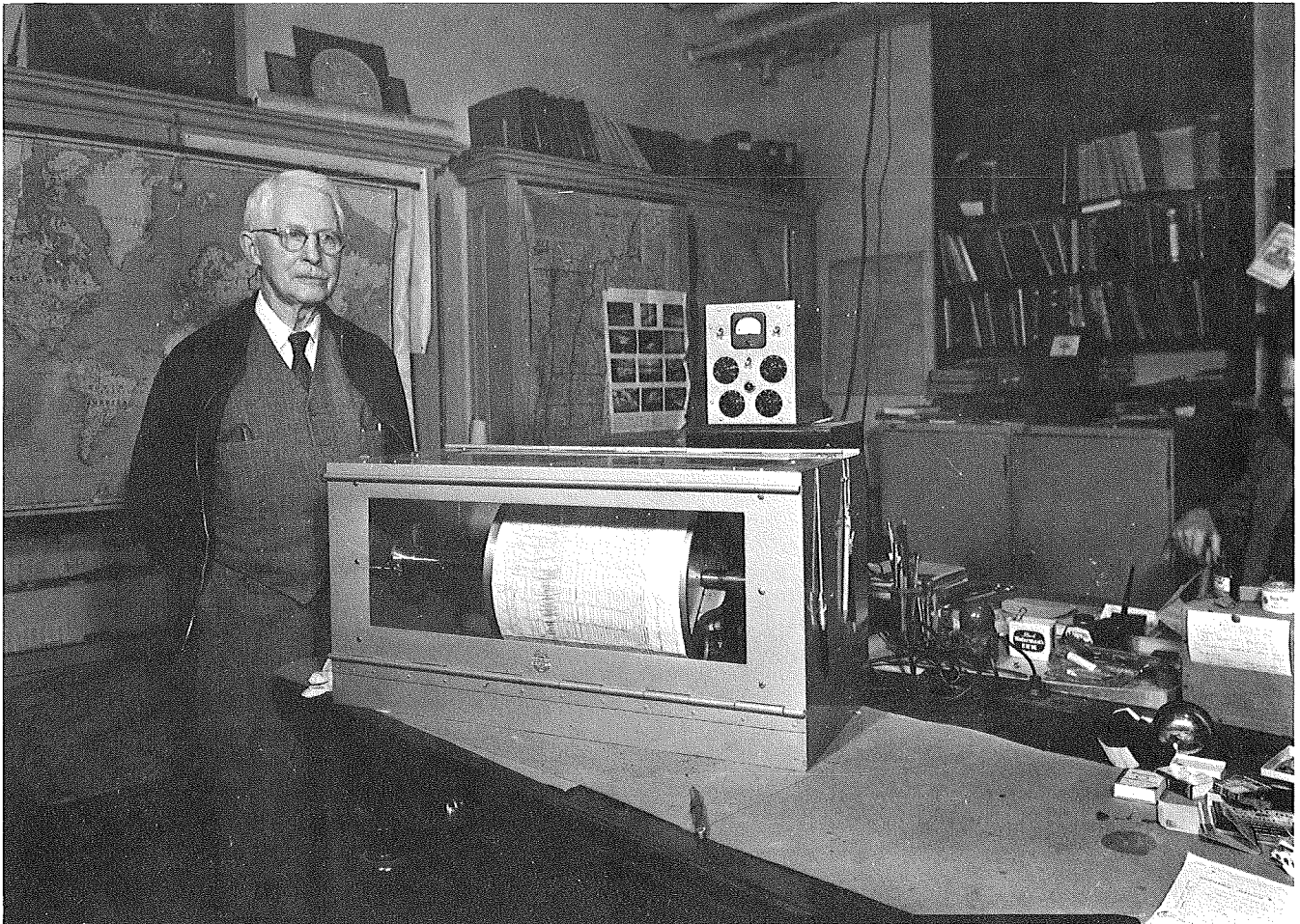
Elbridge C. Jacobs

Twenty years earlier, Professor Jacobs began staking out a claim to the succession, not only by earning an advanced degree in geology, but also by contributing to the biennial report.¹⁵⁴ In 1912, when Perkins began to list his contributors as staff, Jacobs appeared near the bottom of the list as Mineralogist and Petrographer. In 1916 he had become Field Geologist. In 1920 and thereafter he was second-ranked as Assistant State Geologist. Thirty-five years' association of the office with the University of Vermont made it seem natural to continue with its well-qualified Professor of Geology. Jacobs already held a federal appointment as consultant, appointed 25 July 1929, to the U.S. Army Corps of Engineers, investigating flood control and water power development in the Winooski Valley.¹⁵⁵ Governor Wilson, perhaps stimulated by H. F. Perkins's letter of 19 September, pointing out that there was a great deal of his father's correspondence to deal with, appointed Jacobs on the 23rd.¹⁵⁶

Where Perkins had dealt with sedimentary and metamorphic stratigraphy and the problems of paleontology and glaciation, Jacobs interested himself in petrology and especially igneous formations — dikes, vulcanism, and earthquakes. In 1926 he observed the Hawaiian volcanoes. On that or a subsequent sabbatical he toured the West and hoped to observe an eruption, but Mauna Loa started flowing as he was about to board his ship for San Francisco. He gave up his passage and returned to see the eruption.¹⁵⁷

As Curator of the State Cabinet, Jacobs inherited a crowded, poorly lit collection of rocks and always deteriorating Vermont zoological specimens, adjacent to the Historical Society on the main floor of the Supreme Court and State Library Building. Perkins's basement office and store room had been flooded in November 1927. The Income Tax Division took over the space and removed the dilapidated cabinets to a nearby garage. The rocks, worthless with their labels washed off, were disposed of to Professor Charles H. Richardson of Syracuse University, who had collected most of them in the first place.¹⁵⁸

With the discouraging prospects for a Montpelier museum, Jacobs had planned in 1930 a substitute in the geological section of UVM's new Fleming Museum. A scale model of the Grand Canyon and a mural of the Rock Point overthrust by Raymond S. Pease¹⁵⁹ lined the corridor leading to the geological hall. In the center of the room was a relief map of Vermont half the scale of the topographical maps upon which it was based, with a four to one exaggeration.¹⁶⁰ The surrounding cases showed fossils, commercially produced rocks and minerals of Vermont, a case of volcanic rocks Jacobs had collected in Hawaii in 1926, drill cores of European rocks, and a



Elbridge Churchill Jacobs (1873-1957), State Geologist, 1933-47, with his seismograph, in his basement office,

Robert Hull Fleming Museum, 1940's. UVM Archives.

mineralogy alcove. At the east end a tunnel led to a 10' x 12' x 10' vault of reinforced concrete holding two Milne-Shaw horizontal component seismographs, resting on piers on hardpan and supposedly insulated from surface tremors.

The Professor of Geology was very proud of his title of seismologist, which he kept until his death, and his membership in the Seismological Society of America. He had won a National Research Council grant of about \$2,200 in 1931 to buy these instruments, and persuaded President Bailey to spend another \$2,800 to house them.¹⁶¹ He soon had trouble with his equipment, however, and although these were replaced with a vertical Benioff seismograph in 1935, recordings continued to be distorted by nearby traffic and the humidity of the vault. After Harvard experts visited the site in response to his importunities, they washed their hands of his project. He failed partly because UVM would not spend more for proper installation, but also because of his over-frequent complaints. Originally one of four stations in the East reporting to the U. S. Coast and Geodetic Survey, it provided much publicity for UVM and its Geology Department.¹⁶² It was dismantled at Jacobs's death. Professor C. G. Doll in 1958 proposed a \$150,000 geology building with a state minerals research laboratory and a seismograph in an open well for visitors to see in connec-

tion with the geological museum. The Vermont Development Commission showed interest, but the project lacked both priority and private donors. Middlebury College established a station in the 1960's.

A depression casualty was the separate budget for state printing, from which Perkins had drawn roughly \$1,500 in addition to per diem and other expenses. Jacobs was allowed only his biennial account of state mineral production, required by law, one 50,000-word summary of current knowledge about Vermont geology (1936), and a few short articles by him and his colleague since 1927, Charles G. Doll. Perkins appears to have received money almost without argument. Jacobs pleaded his cause every two years and could not increase his \$1,200 total including publication.¹⁶³

The defense boom of 1939-41 raised the price of copper beyond the threshold for working Orange County deposits. A group, including ex-Governor Wilson, George A. and Edward A. Ellis, bought the Eureka and Union mines in Corinth, not worked since World War I, the Ely mine in Vershire, virtually closed in 1883, and the Elizabeth mine in Strafford. They incorporated the Vermont Copper Company soon after Pearl Harbor, secured a federal contract for 16,500,000 pounds of copper, and had the Elizabeth in production by October 1943. Doll was released from teaching mapping to



Elbridge C. Jacobs (second from left) with members of the Vermont Board of Conservation and Development, ca. 1943-47, at the main adit entrance of the Elizabeth Mine, Vermont Copper Company, South Strafford. UVM Archives.



In the main adit of the Elizabeth Mine. Left to right: Hector M. Kingsbury, Vermont Copper Company geologist, Governor William H. Wills, George Adams Ellis, President, and another Copper Company official. UVM Archives.

military personnel at UVM in order to prepare a geological map of the Strafford quadrangle.¹⁶⁴ Owners of low grade deposits, seeing the Elizabeth making money again, called for Jacobs's evaluation of their holdings. The reply was as it always had been for copper, lead, silver, and gold in Vermont: "Not rich enough to work."

War conditions threatened the continuance of the office of State Geologist; H. 117 as originally drafted provided no appropriations for him. A memorandum of 16 February 1943,¹⁶⁵ however, successfully argued for continuing the \$1,200 a year. For a hundredth of one per cent of the 1939 value of Vermont mineral products, Jacobs claimed the State got plenty of widely circulated information. State librarians kept affirming that more copies of the State Geologist's report were distributed than any other state publication.

On 20 October 1944, Jacobs asked Governor Wills for an enlarged budget, in order to renew the geological survey. He had made virtually the same case for a continuing survey ten years before. On a pittance, spending part time and depending on out-of-state scholars attracted to particular problems,

the work completed has of necessity been fragmentary . . . and it will be many years before the whole state is covered.

And furthermore, there is no finality to science. As long as the human mind progresses, bringing new methods to bear on old as well as new problems, and new interpretations on old facts, so long will the science of geology, or any science for that matter, need to be studied and recorded.¹⁶⁶

He now pointed out that all but four states had surveys with wartime budgets averaging over \$40,000. Even the three small New England states of Connecticut, Maine, and New Hampshire averaged more than the \$4,000 he was asking. "If Vermont is to maintain her standing," he concluded, "a systematic geological survey of her unexplored regions should be begun. One or more field parties should be at work every summer and, eventually, a geological map, which most states have and for which there are many requests, should be produced." In order to find minerals, discover ground water tables, etc., "there should be adequate, continuing appropriations." Governor Wills forwarded the budget to State Treasurer Levi R. Kelley and replied that the office of State Geologist should either have enough "to do a good job . . . or it should be abandoned."¹⁶⁷

In November 1944, Mortimer R. Proctor was elected Governor. The Proctors of the Vermont Marble Company had been friends of the Survey since Perry's incumbency. Proctor's inaugural quoted Jacobs's memorandum verbatim and recommended the increase "in the hope that men may be obtained to start such a survey." Two years later he pointed out that this increase, approved by the legislature, was "one of several efforts we have initiated to increase the income of Vermonters," and deserved continuance.¹⁶⁸ Signs of the new affluence were Jacobs's purchase of a \$185 Geiger counter, and a trip to Boston Christmas week 1946 to present a paper on the Vermont Geological Survey to the American Association for the Advancement of Science — probably the only time he ever traveled out of Vermont on his State Geologist's budget.¹⁶⁹

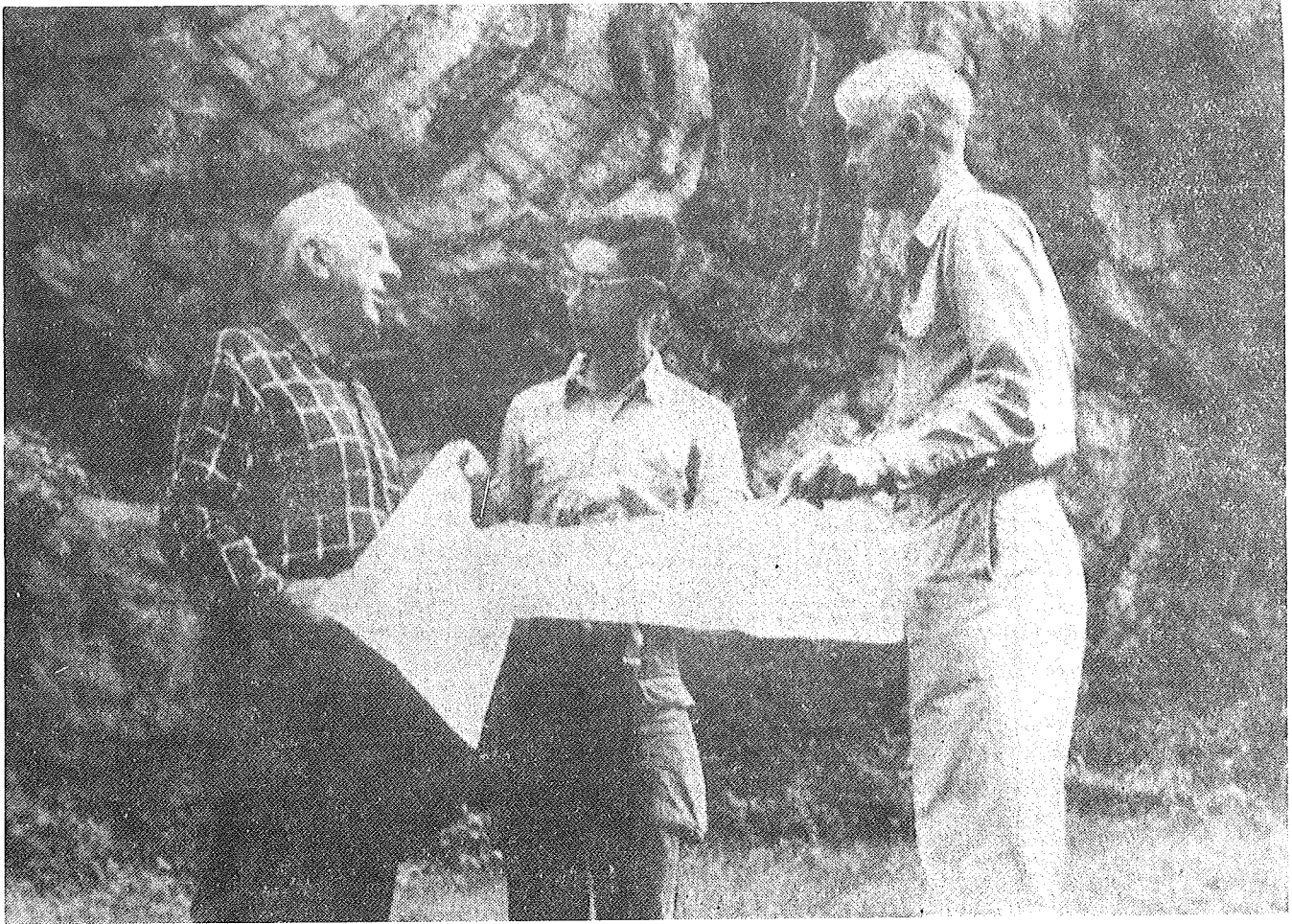
Professor Jacobs probably expected to continue, like Perkins, until his death. In June 1944, in his 72nd year, he was rudely retired by economy-minded President John S. Millis, with a group of outraged heads of departments and other senior professors over 65. As long as the war continued, they were allowed to teach the curriculum prescribed for armed forces personnel on government salaries. But after Hiroshima, geology was dropped for 1945-46, until Charles G. Doll returned from doctoral studies at Columbia and started teaching as head and sole instructor of geology. He was not, however, increased in rank and salary to Associate Professor until 1950 (when he also became a member of the new Graduate Council) or to Professor until 1952.

After Ernest W. Gibson's surprising defeat of Governor Proctor in the September 1946 primaries, Jacobs still expected to continue in his state position under the new Vermont Development Commission. However, on recommendations of George A. Ellis of the Vermont Copper Company, John M. Thomas, ex-President of Norwich University and a member of the Commission, and President Millis, the Commission gave Professor Doll an indefinite, that is a continuing, appointment, effective the first of July, 1947. Thus the job was still held by the chairman of UVM's Geology Department.¹⁷⁰ Jacobs's most useful publication, *Physical Features of Vermont*, was prepared after his retirement and has gone through several printings.¹⁷¹ He also wrote a sketch of the history of the Vermont iron industry.¹⁷²

Doll's Modern Survey and Centennial Map, 1947-76

For the first time, the Vermont State Geologist was a man who had chosen the profession of geologist at the start of his career. He was also at his appointment the youngest Vermont State Geologist since Perry. A New Englander like all his predecessors, Doll was born in Providence, Rhode Island, in 1898, and majored in Geology at Brown University. He would rather roam the hills of Vermont following a geological problem than take a vacation — in fact, to the date of this writing he has never taken a day of annual or sick leave. Although normally carrying a heavy teaching load with many preparations and field trips, and after 1947 the increasing administrative burden of the Survey, he has always liked to write. His reports of geological studies, both popular and scientific, have shown an inquisitive, wide-ranging and well-trained mind.¹⁷³

George Ellis was ready to re-invest some of the money he made in Vermont copper to find more minerals. On 8 April 1947 he transferred \$100,000 to a trust run by himself, his brother and his Bennington lawyer W. C. Holden. Three months later, after Doll had taken office, these trustees agreed with Governor Gibson on an \$85,000 grant to the State, to be spent at UVM on the perfection of an electrolytic process for the commercial production of pure powdered iron and copper. Ellis supervised the operation under the umbrella of the Development Commission, and Eric H. Konrad ran the experiments in the frame building west of the University Farm, until the end of 1948. A \$15,000 grant for a mineral survey by the Vermont Copper Company geologist H. M.



Gov. Joseph B. Johnson (1893-), E-an Zen and Charles G. Doll (1898-), *State Geologist*, 1947-76,

near Glen Lake, West Castleton. From clipping of *Rutland Herald*, 27 August 1958.

Kingsbury turned into a drilling project at the Cuttingsville pyrrhotite deposit, on lands owned chiefly by Pratt Institute. Doll began supervising this operation in August 1948 and completed the work late in the fall of 1949. He sampled and analyzed five pits opened in the 19th century and eventually reported in the Survey's *Economic Geology Series*, No. 4 (1969).^{173a}

The new State Geologist had outlined his long-range program at the 8th of July meeting on the use of the Ellis Fund. The Survey would prepare a state geological map within a decade; describe bedrock geology as fast as funds would allow; produce a state map of surficial geology and studies in environmental geology.

To show more clearly the progress of the Survey, Doll published its monographs and maps in a separate series of *Bulletins* and used his section of the reports of the Vermont Development Commission (published separately, 1954 to date) as reports of progress. The bedrock survey started slowly, with only six *Bulletins* published during the first eight years.^{173b}

Still hoping to complete a state geological map in time to celebrate the centennial of Hitchcock's map in 1961, Doll asked for double his \$10,000 appropriation at the budget hearings in the fall of 1954. Governor Joseph B. Johnson recalls that when he proposed \$35,000 for "the whole ball of wax," Doll almost fell out of his chair. The

Johnson administration was meeting budget pressure by increasing the personal income tax and was proposing, for the first time, a bond issue for highways. Consequently Johnson had more funds to work with than the governors before him. He accordingly proposed in his inaugural, "It is time that we stepped up our activity on research of Vermont's resources and I therefore recommend that the basic geology mapping program be accelerated in both mineral and water resources." The Survey ultimately received \$43,200 for 1955-57 and \$92,000 for 1957-59.¹⁷⁴

Johnson was careful to show the public it was getting its money's worth. "I want to go into the field," he told the State Geologist at the governor's reception. Each year, with Neal Joseph Houston, his Secretary for Civil and Military Affairs, Doll, and a reporter, he spent a day at an interesting site. First they inspected the East Barre quadrangle, being studied by Varanasi Rama Murthy, a graduate of the Indian School of Mines and Yale doctoral candidate. The following year they visited in the slate belt of Rutland County, where E-an Zen, an Oriental student from Harvard, was working. In August 1958 they walked into Lewis from Island Pond (the Governor had been in every Vermont town except Lewis) and Bruce Goodwin of Lehigh University, the field geologist showed where granite made contact with metamorphic rocks.¹⁷⁵



Charles G. Doll and John G. Dennis, field geologist, examining field map on south shore of Lake Willoughby

The appropriation bill is usually one of the last to pass both houses, some time in April, but in order to prepare for the summer's field work, appointments had to be made during the winter. With the assurance and help of Governor Johnson and his Secretary of Civil and Military Affairs Robert S. Babcock, Doll was able to secure professors at Cornell, Harvard, the University of Massachusetts, Boston College, Miami and Princeton Universities, as well as advanced graduate students from these institutions and Columbia, Middlebury, Dartmouth, Lehigh, Yale, and the Universities of Cincinnati and Tulsa. Doll did not pad the payroll with UVM students, although some were used as assistants; he negotiated for the best geologists he could interest in Vermont projects. Each usually picked an undergraduate majoring in Geology or a beginning graduate student as his own assistant. Doll's 1955 budget was approved, and by mid-summer a dozen teams were in the field.

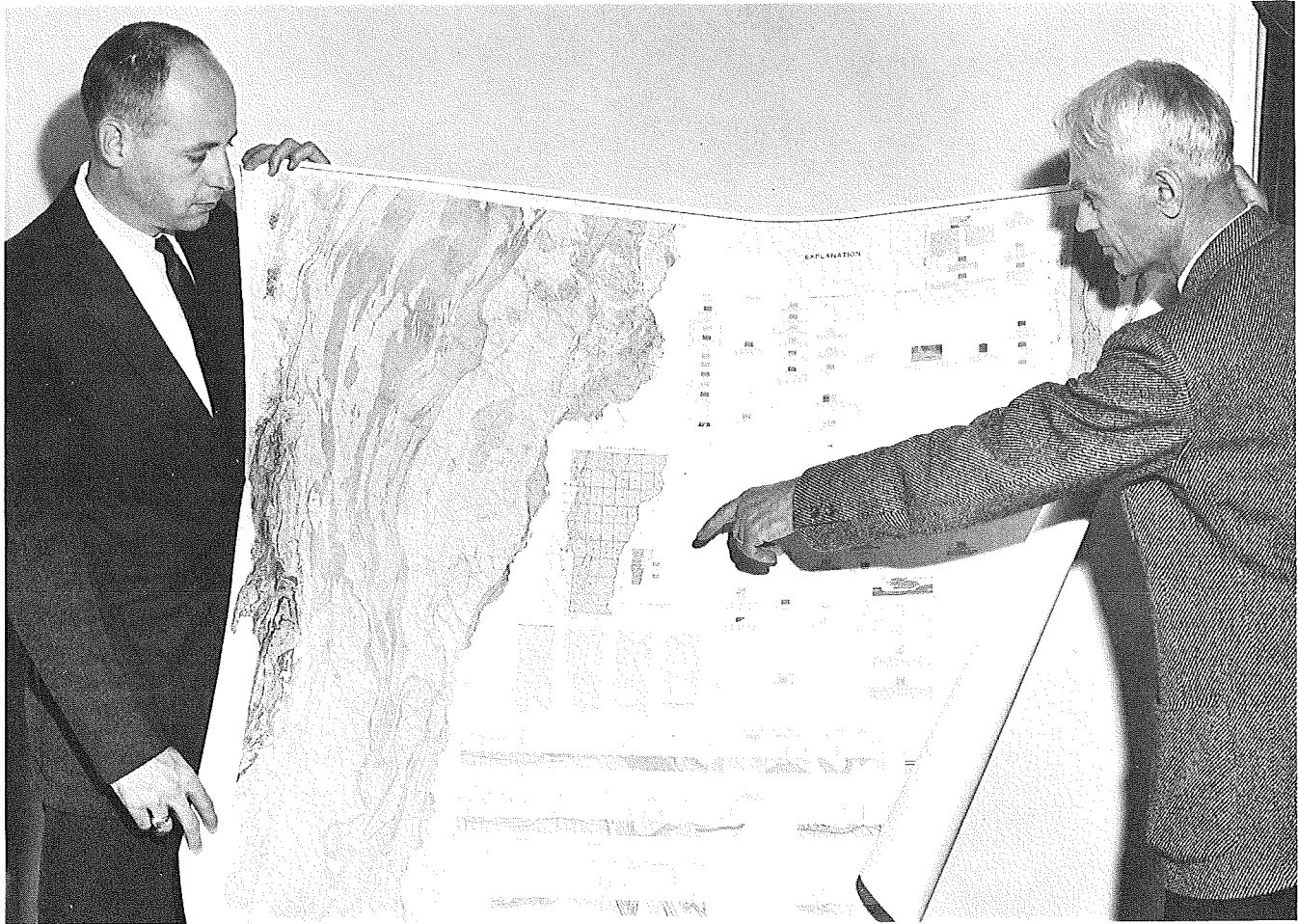
The principal surveyor was paid about \$200 a month for three months, plus \$25 a week living expenses and six cents a mile for travel within his quadrangle. In return for guaranteed publication, the field worker contracted to deliver in three years a completed typescript for his topographical quadrangle, with accompanying geologic map and structure sections. "We welcome more emphasis

by Mt. Pisgah, ca. 1956. UVM Archives.

on economic geology," and allow the inclusion of special problems, Doll wrote the candidates.¹⁷⁶

The Survey supplied aerial photographs, first secured from the U.S. Geological Survey, the Army or the Brown Paper Company, but by the 1960's from a new survey to which it contributed funds. These were used with stereoscopes made in the UVM carpenter shop at a great saving over the price of the commercial product. Field workers supplied Brunton compasses (which correct from magnetic to true north), their own vehicles, topographic maps and enlargements, and found their own lodgings to which they sometimes brought wives and children. The more experienced geologists in the field supervised the students nearby, and the State Geologist kept in touch by site visits throughout the summer and by annual progress reports.¹⁷⁷

In January 1956, a meeting with Governor Johnson decided to start as many quadrangles as possible the following season, in order to finish by 1960 and allow time for drafting the centennial map. At least two dozen were in the field that summer, and 33 field workers were on the payroll in the summer of 1958, although the peak of expenditures for a single fiscal year, \$49,000, was reached in 1957. Doll attracted, by a firm program with firm commitments, able scientists who needed a publication record, and able graduate students who needed support for their Ph.D. research. A dozen *Bulletins* (Nos. 7-19,



Gov. F. Ray Keyser (1927-) and Charles G. Doll examine 1961 Centennial Geologic Map of Vermont in

the Governor's office, State House. Vermont Development Department photo by Norman MacIver.

including David P. Stewart's "Glacial Geology of Vermont," No. 19) appeared by 1961, when the centennial geological map was published on time. Doll took a sabbatical, 1960-61, to supervise work on the map. On the week-end of 13-15 October, 1961, some 350 New England Intercollegiate Geological Conference members came to Montpelier for their annual meeting and field trips. Although Governor Johnson had been unable to attend any of the regular proceedings, by a special effort he made a surprise appearance at the opening session and addressed the Conference.¹⁷⁸

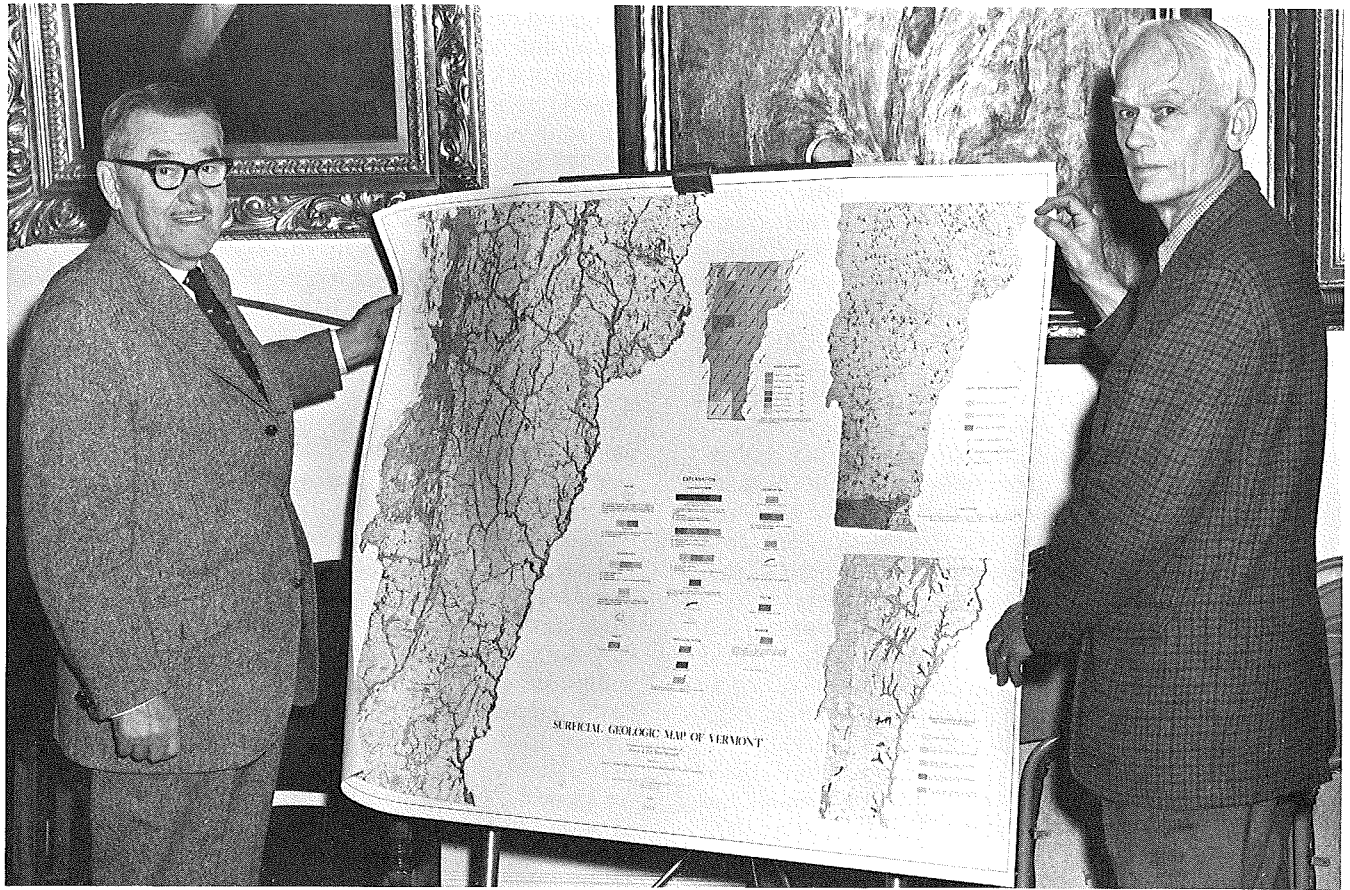
The climax of Doll's work as State Geologist was the completion of the centennial map of Vermont bedrock geology. A joint resolution of special celebration on its publication called for a committee to promote its distribution as "an aid in the development of Vermont's untapped resources and to spread valuable information about Vermont."¹⁷⁹ Flora Coutts, Olin Gay, and Sanborn Partridge were instrumental in its passage. Professionals everywhere have recognized this outstanding achievement as a quality product.

Doll has won several battles since. *Bulletins* 20-30 were published, 1963-67, and in 1970, a surficial geologic map begun in 1956 by David P. Stewart of Miami University, Ohio, and Paul MacClintock of Princeton. The funds for this effort came from the released time of Professor

Stewart, amounting to over \$10,000 in professional aid, by Miami University, from the Vermont State Highway Department, and the Vermont Geological Survey.¹⁸⁰

In 1962-63, Doll prepared materials for moving the Geology Department into the 1891 Engineering Building from East Hall, which it had used since World War II. The Department spent a year back in the Williams Science Hall after East Hall was razed to build Votey and allow the College of Technology to vacate what became the Perkins Geology Building. He was not to enjoy the responsibility for the new space, however, as he retired from teaching on 30 June 1964, less than two months before his 66th birthday. He continued as State Geologist, however, so that for the first time since 1898 the office was separated from the chairmanship of UVM's Geology Department. Doll's office, files, library, and workroom as State Geologist, along with the geological exhibit, were transferred at the same time from the Fleming Museum, now entirely devoted to art, to Perkins Geology Hall. The exhibit of Vermont mineral industries was sent to the Fairbanks Museum in St. Johnsbury.

The Geological Museum in Perkins also incorporated the Montpelier "state cabinet" in the sixties. In practice, the state exhibit had for a generation or more been tended by the adjacent Vermont Historical Society staff or the custodian of state documents or the janitor. As new space



Governor Deane C. Davis (1900-) and Charles G. Doll with Surficial Geologic Map of Vermont, at the

State Capitol, 24 March 1970. Vermont Department of Highways photo by Woody Grimes.

was long awaited and partly realized for state offices, the museum had too low a priority to win any. On the contrary, Doll's collections, which he relabeled on his return from Columbia in the spring of 1946, kept being crowded into less and less space. A visitor's register, which documented how popular the museum was with school children, has disappeared along with the printed catalogs prepared by Perkins. Before the establishment of the historical museum in the new Pavilion Building after 1970, the fossils and minerals, including Zadock Thompson's fossil whale and mastodon tusk, had enhanced the University's public exhibits or expanded its stored research collections.¹⁸¹ In the seventies, Professor Brewster Baldwin of Middlebury College transferred on behalf of his institution C. B. Adams's original 1846 collection of Vermont rocks, one of the oldest in the United States, to the office of the State Geologist.

The most important battle the State Geologist has won in the past fifteen years was fought in the winter of 1969 to preserve the integrity of an independent Geological Survey from a take-over by the Highway Department. A modern state survey has many functions, involved in acquiring ever more accurate knowledge of subsurface resources: determining the water supply; pollution prevention and architectural bases for industrial and urban development; an aid to civil engineering, soil conservation and agriculture; enriching the educational programs of schools and colleges; the planning of highways. The first geologist assigned directly to the

Vermont Highway Department, Frank J. Lanza, came from the Elizabeth copper mine in 1958 as it was closing. Part of the time the Highway Department helped finance the surficial geology mapping program, which located, among other things, sand and gravel deposits for road construction. Communication sometimes broke down, as in the case of expensive misplacement of a bridge pier just north of Shelburne on U.S. 7, "which geological reconnaissance could have prevented."¹⁸²

House Bill 25 was introduced early in January, 1969, to transfer the State Geological Survey from the Water Resources Department, where it had been since 1965, to the Highway Department. Doll had no inkling of this political move in the guise of saving money until just before the bill was introduced.

In none of the 48 states with surveys then was the part running the whole — was any highway department in command of a geological survey. Doll, perforce turned lobbyist, appealed successfully to the members of the Association of American State Geologists, the U.S. Geological Survey staff, his former field workers and other professors and industrial geologists, mine and quarry managers, ex-Governor Johnson, and the Vermont Natural Resources Council, as well as many other friends near and far. They persuaded the House Committee on Natural Resources; the bill never reached the floor.¹⁸³

It is easy to show what broad services the State Geologist performs beyond the needs of roadbuilding

from a sampling of letters of inquiry he receives, amounting to about a dozen a week in recent years. In 1974 there were inquiries from technical and scientific editors sending questionnaires, from industries, libraries, college professors, engineers, high school teachers of earth sciences and environmental studies, a sixth grade project, Cub Scouts, Boy Scouts, Girl Scouts, tourists and others planning vacations, real estate agents, commercial photographers, sculptors looking for stone to carve, visitors panning gold as a hobby, fossil hunters and rock hounds. For many of these amateur geologists, special reports were published. Harry W. Dodge prepared *Geology of Button Bay State Park* in time to distribute much of the 5,000-copy edition to Girl Scouts assembled at the Park in July 1962. That year, C. W. Welby came out with *Paleontology of the Champlain Basin*, useful for fossil collectors. The popular geology of seven other state parks and forests was made available to campers and hikers by 1969; also Ray W. Grant's *Mineral Collecting in Vermont* (1968) for gem and mineral club members.

At various times, extra honors and duties have been laid on Dr. Doll. He served as co-chairman of the Mineral Resources Committee of the New York-Vermont Interstate Commission on the Champlain Basin. In 1953 he was appointed Vermont Chairman of the Interstate Oil Compact Commission's Committee to study underground storage of oil and oil products. From time to time he has served as expert trial witness. In May 1972 he was elected Historian of the Association of American State Geologists, to succeed George F. Hanson of Wisconsin, and in 1973 proposed that each member commission a history of his survey, or compile its basic facts, as well as keep track of necrology and news. The UVM Geology Department's *Guidebook for field trips* of the 64th annual meeting of the New England Intercollegiate Geological Conference in Burlington, 13-15 October 1972, was dedicated to Doll, "in deepest appreciation of his devotion and contributions to the understanding of Vermont geology." With the completion of twenty-nine years' service in 1976, he shared with Leo W. Hough of Louisiana the longest tenure of its fifty members.

He has had only the most indirect connection with the Topographic Mapping Division of the U.S. Geological Survey, although dependent on its product, even after aerial photographs became available. Its mapping sequence was originally determined by the Director of the U.S. Geological Survey, with some input from the Governor and informal communication from the State Geologist. Recently, Doll has drafted a priority list upon which the federal survey has acted.

Because state matching funds were for such a long time minimal, fifteen-minute topographical quadrangles for the whole state were not completed until 1951. As late as 1942, with 94% of the State done, Vermont was contributing only \$2,000 a year, the minimum agreed upon in 1912.¹⁸⁴ In 1967-69, however, the State assumed a quarter of the \$140,000 cost of a re-survey of base points, and in fiscal 1971 the U.S. Geological Survey spent \$187,500 in Vermont, with a similar matching percentage.¹⁸⁵ The projection of long-term re-mapping of the whole state on a seven and a half minute scale (1:24,000) will provide a more detailed topographical base for geological work.

Appropriations for the Survey have declined since completion of the centennial bedrock map in 1961. They reached rock bottom when the House Appropriations Committee in 1976 proposed to "continue" the Survey with only a token dollar. The appropriation was raised to \$15,000 by the Senate, half of what it had been the year before, primarily through the insistence of Sanborn Partridge of Proctor, and survived conference.¹⁸⁶ Why this lowering evaluation by the legislature? Underlying each reduction was the worsening problem of coping with the state budget during a depression, when it had been expanding since World War II, especially in the booming sixties.

The latest attack arose from several considerations. Some votes came from those who felt that this tactic would persuade the 77-year-old dean of American state geologists to resign. Personalities of the officers involved, and their chief supporters, affected attitudes. As an independent official in all but accounting and clerical matters, Doll had no departmental chief concerned to defend his program. Add to this the Survey's early introduction, compared with other states, of the study of environmental resources, to determine the geological conditions for recreation, water supply and sewage disposal, especially in mountain resort areas. This thrust seemed to duplicate the soil reconnaissance of the U.S. Soil Conservation Service, part of the background work for the land capability plan. Also, there were inevitably persons, during Doll's three-decade incumbency, who believed they were entitled to more help than he felt he could legally give about subsurface resources.

The State Geologist had the support of his national professional associations, as in 1969. The Vermont Geological Society, formed in the winter of 1974 and with about seventy-five state, industrial and academic professionals, lobbied for a reorganization of work performed by some ten geologists attached to various state departments. They argued that a full-time state geologist could coordinate services and establish priorities for research. They saw his primary job as advising the many state offices, and in the present state of public finances, to use the excellent body of basic knowledge already accumulated. They said more expensive field parties should await funding as needs warrant. They could point out that Maine and the southern New England states now have full-time state geologists, and throughout the country, the small number who are part-time is declining.¹⁸⁷

Fundamental to the recurring fight for funding were basic questions. What is the modern role of a geological survey in a small state? Does it have a continuing role? If so, how does the public understand this role? When the office of state geologist was instituted in 1844 there were less than twenty state officials, paid a few hundred dollars each, all part-time except the five supreme court judges. In the broad field of education the state university, the state librarian, the state superintendent of common schools and the state geologist were all embryonic in public duties and powers. The geologist was expected to produce a final report and disappear. The office was "continued" in 1864 "to encourage . . . further development," but A. D. Hager was paid nothing to answer inquiries and care for the rock collection. The freeze to one above zero proposed by the 1976 House would have carried the

Survey back to 1864.

The reasons for continuing a state survey have usually been urged by the geologist mainly in terms of economic development of minerals and commercial stone. Naturally, in a period of emphasis on checking excessive development, agencies supposed to accelerate it are pruned. But the role of a geological survey in this kind of development is an indirect and long range one: discoveries and economic benefits occur in the context of basic geological knowledge built by the whole community of earth scientists. An even more fundamental justification for maintaining a geological survey has not

changed since the House referred the first 1836 proposal to the Committee on Education. It is the accumulation and dissemination of useful knowledge, in packages ready for the consumer, especially the offices of state government. This has immediate relevance for short-term development, as the geological function of locating water supplies and arranging waste disposal provides necessary conditions for development. New needs and the refinement of new instruments and techniques will require what each twentieth century Vermont State Geologist has reiterated, the permanent support of a scientific and practical state geological survey.

Notes

- ¹ *History of Vermont* (Walpole, N.H.: 1794), 22, 17-132.
- ² *History of Vermont* (3 ed.; Rutland: Charles E. Tuttle Co., 1969), 166, 161.
- ³ Vermont Senate *Journal* (1836), 26, 72; report of Winslow C. Watson of Manchester, 124-126.
- ⁴ For the development of other state surveys, see Walter B. Hendrickson, "Nineteenth century state geological surveys: early government support of science," *Isis*, 52:357-371 (Sept. 1961), and Dirk J. Struik, "The surveys," in *Yankee science in the making* (Boston: 1948), 181-201.
- ⁵ Vermont House *Journal* (1837), 15-19; Senate *Journal* (1837), 95-104. William Maclure (1817), Amos Eaton (1830) and Ebenezer Emmons (1842) mapped parts of western Vermont in connection with their New York surveys. See State Geologist, *Report* (1923), 14-16.
- ⁶ Senate *Journal* (1837), 94, 104-108.
- ⁷ Harry R. Warfel, ed., *Uncollected letters of James Gates Percival, poet and geologist, 1795-1856*. Gainesville, Fla.: [c1959], 39-40. University of Florida Monographs, Humanities, No. 1.
- ⁸ Adams to Samuel S. Haldeman, 30 June 1842, MS. Collection 73 in the Library of the Academy of Natural Sciences of Philadelphia.
- ⁹ Trustees, *Minutes*, 1:146-147 (3 Jan. 1811).
- ¹⁰ Notes of Benedict's lectures by Albert H. Bailey and Charles B. Welles, both of the Class of 1843, are in the University of Vermont (hereafter UVM) Archives.
- ¹¹ Charles Lyell, *Travels in North America, with geological observations on the United States, Canada, and Nova Scotia* (London: 1845; 2v.), 1:156-159.
- ¹² *Catalogue of the books belonging to the library of the University of Vermont* (Burlington: 1836), 36-40. The 3,500 volumes of the literary societies had seven more by 1852.
- ¹³ 10:276 (16 Jan. 1841), probably written by Henry J. Raymond, University of Vermont A.B. 1840.
- ¹⁴ House *Journal* (1838), 34; Senate *Journal* (1839), 46; references to H. 4 and S. 36 in House and Senate *Journals* (1840); to S. 20 in 1841 and S. 69 in 1842.
- ¹⁵ *Report on the geology of Vermont: descriptive, theoretical, economical, and scenographical*; by Edward Hitchcock and others (Claremont, N.H.: 1861, 2v.).
- ¹⁶ In MS. Collection 73, Library of the Academy of Natural Sciences of Philadelphia.
- ¹⁷ *History of Vermont* (Burlington: 1853), appendix, 41n. See also his letters to Augustus A. Gould of Boston, 1837-50, in the Houghton Library, Harvard University, and to Samuel S. Haldeman in the Library of the Academy of Natural Sciences of Philadelphia; Henry A. Pilsbry in the *Dictionary of American Biography*, and Henry M. Seely, "Sketch of the life and work of Charles Baker Adams," *The American Geologist*, 32:1-12 (July 1903). The National Union Catalog lists 15 titles by Adams, 1839-53.
- ¹⁸ C. W. Hayes, *State geological surveys of the United States*. U.S. Geological Survey Bulletin 465 (1911), 63.
- ¹⁹ *Ibid.*, 130-131.
- ²⁰ The University of Vermont copy was a present from the author to President John Wheeler in February 1845. Did Governor Slade also receive a copy?
- ²¹ 13 January 1846. Edward Searl first called my attention to the article he found in Zadock Thompson's scrapbook in the Vermont Historical Society.
- ²² The introductory pages of Jackson's reports, checked for me by Margaret Whalen, Maine State Archives, William N. Copeley, New Hampshire Historical Society, and Nancy Chudacoff, Rhode Island Historical Society, quote the enabling acts, with appropriations.
- ²³ Claude M. Fuess, *Amherst; the story of a New England college* (Boston: 1935), 124-125.
- ²⁴ "Geology and mineralogy of Vermont" (Burlington: 1842; 3 pts. in 1), 1:222-223.
- ²⁵ *Faculty library loans (1839-41), Library record: faculty and others (1844-55)*, in the UVM Archives.
- ²⁶ F. N. Benedict, "Barometrical measurements in Essex County," *Natural history of New York; Division 4, Geology* (Albany: 1842), 2:195-212.
- ²⁷ To Charles G. Eastman, 27 March [1845], in Eastman Papers, Vermont Historical Society. His fellow Democrat, Charles K. Field of Newfane, recalled Adams as "a man of little head, little hands, and little feet, who went about looking at soils and precipices, &c., and had discovered nothing new" (Burlington *Free Press*, 6 Dec. 1853).
- ²⁸ *Reminiscences of Amherst College* (Northampton: 1863), 92-93. Adams wrote A. A. Gould, 2 July 1841, that he had stayed up all night reading Gould's report (Gould Papers in Houghton Library, Harvard University).
- ²⁹ *Ibid.*, 96; *Preliminary report on the geology of Vermont* (Montpelier: 1859), 10.
- ³⁰ See, for example, his letters of 27 Feb., 23 July 1841, 29 Oct. and 20 Dec. 1842, to S. S. Haldeman in the Library of the Academy of Natural Sciences of Philadelphia, MS. Collection 73, and a long series to Augustus A. Gould, Boston conchologist, 4 April 1837-1 April 1850 in The Houghton Library, Harvard University. His "Invertebrate animals of Vermont. I. Mollusca," in Zadock Thompson, *History of Vermont*, 1:151-169, is pure description.
- ³¹ *Reminiscences*, 97.
- ³² J. E. [Hitchcock], Lawrence, [Mass.], 2 February 1853, to Ed[ward Hitchcock, Jr.], MS. in the Amherst College Library.
- ³³ To S. S. Haldeman, 16 Feb. 1843 in The Library of The Academy of Natural Sciences of Philadelphia, MS. Collection 73.
- ³⁴ *First annual report on the geology of the state of Vermont* (Burlington: 1845; 92p.) embellished with the map in Zadock Thompson's 1842 *History of Vermont*; *Second annual report* (Burlington: 1846; 265p.); *Third annual report* (Burlington: 1847; 32p.); *Fourth annual report* (Burlington: 1848; 8p.).
- ³⁵ *First annual report*, 59.
- ³⁶ *Elements of geology* (New York: 1853). Harper reprinted it seven times in the next decade.
- ³⁷ *Second annual report*, 16; *Third annual report*, 10.
- ³⁸ *Ibid.*, 13, 21.
- ³⁹ See clippings in Zadock Thompson's scrapbook, in the Vermont Historical Society, 4-5, 22.
- ⁴⁰ House *Journal* (1847), 28, 171. Zadock Thompson's "Preliminary remarks" in his Appendix to his *History of Vermont*, dated 9 April 1853, wrote that the failure to publish the final report

- "has been occasioned, by this penny wise and pound foolish policy of the legislature" when "a very small additional appropriation in 1847, would have secured" it.
- 41 House *Journal* (1848), 97-99, 191, 233, 313-314 (report of the joint committee); Vermont *Laws* (1848), 36.
 - 42 To S. S. Haldeman, 17 December 1846, in Library of the Academy of Natural Sciences of Philadelphia. MS. Collection 73.
 - 43 Unidentified clipping in Zadock Thompson's scrapbook, 4, in the Vermont Historical Society.
 - 44 House *Journal* (1849), 316-317.
 - 45 Copied in the Burlington Daily *Free Press*, 16, 25 April, 2, 7, 16, 23 May 1849, and signed "C. R.," which the *Free Press* assumed to be former Williams Professor Chester Dewey, then of Rochester, New York.
 - 46 House *Journal* (1849), 14, 56, 59, 108, 133, 223, 345-348 (memorial). Senate *Journal* (1849), 161, listed expenses of \$6,970.74 to date.
 - 47 "The dikes of Chittenden County," *Geology of Vermont*, 2:579-583, Plate XIV (IX in Hager's reprint of 1862).
 - 48 "On fossil cetacean bones," in its *Proceedings*, 3:205-206. Thompson described both finds in "An account of some fossil bones found in Vermont in making excavations for the Rutland and Burlington Railroad," *American Journal of Science and Arts*, 9:256-263 (March 1850). See also the 1853 Appendix to Thompson's *History of Vermont*, 15-18. These fossils are in the geological museum of Perkins Geology Hall at the University of Vermont.
 - 49 Executive Department Commissions, 1:15, MS. Vermont State Papers.
 - 50 *Journal of a trip to London, Paris, and the Great Exhibition, in 1851* (Burlington: 1852).
 - 51 Trustees *Minutes*, 3:123.
 - 52 Faculty *Minutes*, 1:262-263; Ledger B (1844-53), 3.
 - 53 Trustees *Minutes*, 3:140, 143-144.
 - 54 House *Journal* (1850), 154, 160, 163, 169, 372; (1851), 228, 315, 411; S. R. Hall, Craftsbury, to Gov. Erastus Fairbanks, 22 Oct. 1852, MS. Vermont State Papers, 71:91.
 - 55 Zadock Thompson to Erastus Fairbanks, 6, 12, 21 Oct. 1852; Samuel R. Hall to Fairbanks, 22 Oct. 1852, MS. Vermont State Papers, 71:91; House *Journal* (1852), 33.
 - 56 House *Journal* (1852, 15, 41, 179, 245; Thompson's memorial, 329-331).
 - 57 House *Journal* (1853), Vermont *Laws* (1853), report of "Third House" dated Montpelier, 5 December 1853, in Burlington Daily *Free Press*, 6 December 1853.
 - 58 Senate *Journal* (1855), 49; House *Journal* (1855), 172, 188, 223, 338. Governor Royce ignored the survey in his annual message (*ibid.*, 28-33).
 - 59 Obituaries in Senate *Journal* (1856), 399, Burlington Daily *Free Press*, 21 January 1856, and in Augustus Young, *Preliminary report on the natural history of the State of Vermont* (Burlington: 1856), 24, 37-47, first published in the St. Albans *Franklin County Journal*.
 - 60 "The geology of Vermont," *Vermont*, 5:53-67 (Feb. 1901); sketch and portrait of Adams in *American Geologist*, 32:1-12 (July 1903).
 - 61 *Unity of purpose, or rational analysis: being a treatise designed to disclose physical truths, and to detect and expose popular errors* (Boston: 1846; 292 p.). Originally delivered as poorly attended lectures to the Burlington Mechanics' Institute. An unsigned review in the Burlington *Free Press*, 30 April 1847, possibly by F. N. Benedict, Professor of Mathematics at the University of Vermont, patiently disagreed 'that the ratio of the diameter to the circumference is commensurable in the third powers and roots of infinite numbers.' Young replied in the *Free Press*, 7 October 1847.
 - 62 Vermont *Laws* (1856), 60-61.
 - 63 MS. in Amherst College Library.
 - 64 *Ibid.*
 - 65 E.g., Burlington Daily *Free Press*, 23 March, 1 June 1857, 17 July 1858, 12 January 1859 on Hager's address to the Vermont Historical Society, 21 June quoting the Springfield *Republican* and 9 August 1859 quoting the Boston *Advertiser* on Brandon's frozen well.
 - 66 *Geology of Vermont*, 2:741.
 - 67 MS. in Amherst College Library.
 - 68 Orra White Hitchcock, Amherst, 27 August 1857; MS. in Amherst College Library.
 - 69 C. H. Hitchcock, Brownington, 17 August [1858]; MS. in Amherst College Library.
 - 70 *Reminiscences*, 367.
 - 71 Dirk Struik, *Yankee science in the making*, 186.
 - 72 *Geology of Vermont*, 1:547-552, 2:719-730, 2:579-583.
 - 73 *Ibid.*, 1:56-92.
 - 74 MS. draft, 9, in UVM Archives.
 - 75 Folded following 2:988, 1:400,000, with Charles H. Hitchcock's "Map of the Surface Geology of Vermont" on the same scale.
 - 76 Vermont *Laws* (1860), 49-50; Auditor of Accounts, *Report* (1862), xxi; State Geologist, *Report* (1936), 25.
 - 77 Burlington Daily *Free Press*, 24 February 1858.
 - 78 Burlington: 1859.
 - 79 Burlington Daily *Free Press*, 1 September 1859.
 - 80 Cited in Julian I. Lindsay, *Tradition looks forward* (Burlington: 1954), 221. The story applies equally well to Zadock Thompson, who had learned about field trips from Bishop Hopkins's Institute.
 - 81 Obituary in the *Congregational Quarterly* (April 1873), quoted in full in A. M. Hemenway, *Vermont Historical Gazetteer* (Burlington: 1867-91; 5v.), 4:983-988; M. D. Gilman, *Bibliography of Vermont*, 199. The Perry MSS. in the Wilbur Collection at the University of Vermont partially document his pioneer attempt to accommodate science and theology.
 - 82 George H. Perkins, "Memorial of Henry Martyn Seely," Geological Society of America *Bulletin*, 29:64-69, read at its St. Louis meeting, 27-29 December 1917.
 - 83 H. M. Seely, "Sketch of the life and work of Augustus Wing," *The American Geologist*, 28:1-8 (July 1901).
 - 84 *American Journal of Science and the Arts*, 3d ser., 13:342-405, 14:36 (1887).
 - 85 Copied from the Chicago *Herald*, 20 June 1886, by Paul Angle, in *The Chicago Historical Society 1856-1956; an unconventional chronicle* (Chicago: Rand McNally, 1956), 118-119.
 - 86 *The Green Mountain Slate and Tile Company, reports* (Boston: 1865), 8-9. M. D. Gilman, *Bibliography of Vermont*, 111. *Geological surveys and reports on the property of the Tyson Iron Company, Plymouth, Vermont* (Boston: 1864), has a report by C. T. Jackson, 8-10, but merely quotes Hager from the *Geology of Vermont*, 731.
 - 87 MS. diary in Vermont Historical Society, donated by his grandson, Harold Goddard Rugg. Called to my attention by Lorimer S. Brigham.
 - 88 Rutland *Herald* advertisement, 24 May 1862.
 - 89 *Geology of Vermont*, 1:9.
 - 90 *The marbles of Vermont* (Burlington: 1858).
 - 91 M. D. Gilman, *Bibliography of Vermont*, 111.
 - 92 G. P. Merrill, *The first 100 years of American geology* (New Haven: 1924), 459-460.
 - 93 Jefferson City, Mo.: 1870; 23p.
 - 94 Executive Department Commissions, 1:293, 297. I have found no earlier geologists entered in this register.
 - 95 His fullest biography, obviously based on information from the subject, is in the *Biographical Encyclopedia of Vermont of the Nineteenth Century* (Boston: 1885), 320-327. A. M. Hemenway, *Vermont Historical Gazetteer*, 1:1020, 1039, M. D. Gilman, *Bibliography of Vermont*, 67, and Hamilton Child, *Gazetteer of Caledonia and Essex Counties, Vt., 1764-1887* (Syracuse, N.Y.: 1887), 470-472, add details. Child shows an undated photograph of his 1866 home, store, museum, library, weather station and observatory. Because commercial biographical dictionaries depended on persons included for sales, Cutting disappeared from these "mug books" after his death in 1892, except for the *National Cyclopaedia of American Biography* (New York: 1900), 10:204, and William A. Ellis, *History of Norwich University*, 3:79-80 with portrait, 604.
 - 96 State Board of Agriculture, *Report* (1881), 12.
 - 97 To President Asa D. Smith, 28 July 1870. MS. in Dartmouth College Archives.
 - 98 Newport, Vt., *Archives of Science*, 1:225-231 (April 1874).
 - 99 *Ibid.*, 1:17-20 (October 1870), 149-152 (July 1871).
 - 100 *Ibid.*, 151.
 - 101 E.g., in his articles, "New mounting for microscopic objects," *Archives of Science*, 1:43-44 (October 1870); "Dust storm in Vermont, Feb. 12, 1870," *ibid.*, 1:81-85 (January 1871), read before the Dartmouth Microscopic Club during its semiannual meeting,

- 26 October 1870; "Notes on nostochiniae," *ibid.*, 1:190-192 (January-April 1873); "Microscopic revelations: fungi — rust, smut, mildew and mould. Animalcules — water mites, sugar mites, and trichina spiralis. An address delivered at Albany, Vt., at a meeting of the Vermont Board of Agriculture . . . , in its *Report* (1878), 184-208, and reprinted (Montpelier: 1878); a report of his microscopic measurement of a hundred Vermont merino wool fibers, in the *Burlington Daily Free Press* (morning ed.), 16 October 1880, and "Diseases of cattle," *ibid.*, 20 April 1885, and in *State Board of Agriculture Report* (1886), 361-368.
- ¹⁰² Cutting to Joseph Henry, 21 July 1866, 8 May 1867, and other correspondence in the Smithsonian Institution Archives, xerox in Wilbur Collection.
- ¹⁰³ See his first report in the 1872 *Report* of the State Board of Agriculture, Manufacturing and Mining, 713-721.
- ¹⁰⁴ State Board of Agriculture *Report* (1882), 93-139 (Perkins), 224-231 (Cutting); (1884), 211-229, (1886), 22-23. These reports are sprinkled with evidence that although Cutting was a stammerer until ten and could neither read nor recite aloud, he made up for lost time in outpourings on the platform and in the press, e.g., "Weather probabilities, or popular weather prognostics," *ibid.* (1884), 382-405; *Notes on building stones* (Montpelier: 1880).
- ¹⁰⁵ *Ibid.* (1872), 682-695.
- ¹⁰⁶ Executive Department Commissions, 2:96, 190. MS. Vermont State Papers.
- ¹⁰⁷ *St. Johnsbury Caledonian*, 21, 28 April 1892.
- ¹⁰⁸ See *Reports* of the State Board of Agriculture (1888), 90, 92.
- ¹⁰⁹ Executive Commissions, 2:202, MS. Vermont State Papers; *Vermont Laws* (1886), 71.
- ¹¹⁰ Biographical information comes from his grandchildren, George R. Perry of Bristol, Ct., and Helen Perry Smith of Ruxton, Md., who kindly provided copies of the diary of Perry's sister-in-law, Viola Rice, while she was at Eagle Camp, 11-26 July 1893, of Katharine J. Middleton's 3,000-word typescript, "George W. Perry, Vermonter" (July 1949), and Margaret G. Brown's "Early history of Eagle Camp," a ditto'd three-page summary, 14 May 1965, for the 75th anniversary. Edith Fox MacDonald has also contributed liberally from her history of the Vermont Universalist churches, *Rebellion in the Mountains* (Concord, N.H., 1976).
- ¹¹¹ *Burlington Daily Free Press*, 7 January 1889.
- ¹¹² *House Journal* (1888), 554.
- ¹¹³ *Ibid.* (1890), 433-434.
- ¹¹⁴ *House Journal* (1888), 555-557; (1890), 435-436.
- ¹¹⁵ *Report* (1896), 8.
- ¹¹⁶ Katharine J. Middleton, "George W. Perry," 3.
- ¹¹⁷ Viola Rice's diary, 15 July 1893.
- ¹¹⁸ 14 November 1892.
- ¹¹⁹ *House Journal* (1896), 336.
- ¹²⁰ *Vermont Laws* (1896), 7.
- ¹²¹ *State Geologist, Report* (1898), 5-6.
- ¹²² See his numerous contributions in its *Proceedings*, 1905-13.
- ¹²³ "Molluscan fauna of New Haven; a critical review of all the marine, freshwater and land mollusca of the region, with descriptions of many of the living animals and of two new species," *Boston Society of Natural History Proceedings*, 8:109-136, 139-163 (Oct.-Nov. 1870).
- ¹²⁴ *University Cynic*, 7 November 1883, 12 November 1884, 26 June 1890.
- ¹²⁵ *American Journal of Science*, 49:158-161 (March 1870).
- ¹²⁶ Unidentified clipping pasted in front of his *Miscellaneous Papers*, a bound set of Perkins's publications to 1892, the gift of the Perkins family, in the UVM Archives.
- ¹²⁷ Undated clipping, about 1878, from *Montpelier Green Mountain Freeman*, in Perkins's *Miscellaneous Papers*, 336.
- ¹²⁸ See, for example, his series of fifteen articles on Vermont flora in the *Burlington Free Press*, April-September 1883 (*ibid.*, 519-574), and nine articles in the *Green Mountain Freeman*, 1878-83 (*ibid.*, 336-338, 381-393, 397-399).
- ¹²⁹ *Report* (1898), 6.
- ¹³⁰ The original is in the Perkins Family Papers, rather than the addressee's. Without corroborative evidence one cannot tell whether Governor Grout (or Governor E. C. Smith during the 1898 session) ever saw the petition, or whether it was returned by the recipient to the Perkins family.
- ¹³¹ G. H. Perkins to his son, H. F. Perkins, Baltimore, 11 February 1917 (Perkins Family Papers), hoping that Governor Gates's plan to abolish the requirement would pass.
- ¹³² *Ibid.*
- ¹³³ *University Cynic*, 1:57 (26 September 1883).
- ¹³⁴ 1870-81, \$1,500 salary; 1881-1905, \$1,850; beginning 1907, \$3,000 (from the Treasurer's ledgers, UVM Archives). In addition, Perkins received a federal stipend as entomologist of the Experiment Station, and free tuition at UVM for his son.
- ¹³⁵ *Ariel*, 217, 218.
- ¹³⁶ Conversations with Irene E. Allen, Ph.B. 1925, and Alfred F. Whiting, B.S. 1933.
- ¹³⁷ "On the lignite or brown coal of Brandon and its fossils," *Report* (1904), 153-162; "Description of species found in the tertiary lignite of Brandon, Vermont," *ibid.*, 174-212; "The lignite or brown coal of Brandon," *ibid.* (1906), 188-194; "Fossils of the lignite," *ibid.*, 202-230; "Tertiary lignite of Brandon, Vermont, and its fossils," *Geological Society of America Bulletin*, 16:499-516 (1905).
- ¹³⁸ Elso S. Barghoorn and Richard H. Eyde, "Morphological and paleobotanical studies of the Nyssaceae, II; the fossil record," *Journal of the Arnold Arboretum*, 44:328-370 (July 1963), 343. See also Barghoorn, "The Brandon lignite," *Vermont Botanical and Bird Clubs Joint Bulletin* No. 18 (June 1950), 28.
- ¹³⁹ "The geology of Grand Isle," *Report* (1902), 102-173, "intended as a beginning of a complete geological survey of the whole State" (viii).
- ¹⁴⁰ "A preliminary report on the geology of Chittenden County," *ibid.* (1908), 221-264, was the third and last county survey published.
- ¹⁴¹ See also *ibid.* (1901), 14-21; (1904), 16-21.
- ¹⁴² *Ibid.* (1902), viii.
- ¹⁴³ *Report* (1906), 254-344.
- ¹⁴⁴ Governor's correspondence, mainly with the Water Resources Branch, U.S. Geological Survey, e.g., Allen M. Fletcher Papers (1912-15), notably the contract of 17 December 1912, Redfield Proctor Papers (1923), John E. Weeks Papers (1927-31), and W. H. Wills Papers (1942-44) (Public Records Service microfilm).
- ¹⁴⁵ See William A. Haviland and Louise A. Basa, "Anthropology and the academy: George H. Perkins and the nineteenth century," *Man in the Northeast*, No. 8:120-125 (Fall 1974).
- ¹⁴⁶ Gift of Alfred F. Whiting to the UVM Archives.
- ¹⁴⁷ F. T. Perkins, Galesburg, Illinois, to G. H. Perkins, 13 November 1864 (Perkins Family Papers).
- ¹⁴⁸ (4 October 1933), 10.
- ¹⁴⁹ Perkins Family Papers, dated by internal evidence.
- ¹⁵⁰ Minutes of Meeting of Deans, 27 May 1914, in UVM Archives.
- ¹⁵¹ Charles G. Doll, Historian of the AASG, founded in 1906, reports that its partial records show Perkins's attendance at New Haven, 27 December 1912; at the first annual summer meeting in Michigan, 27 August-1 September 1914 (indicated intention of coming); Washington, D.C., 27 December 1918; Amherst, Mass., 28-30 December 1921. No attendance records kept for many other years.
- ¹⁵² Sixteen letters in the microfilmed Papers of Governor S. C. Wilson in the Public Records Service, 28 February-28 April 1933.
- ¹⁵³ On 12 September 1933. G. H. Perkins to S. C. Wilson, 4 April, 8 August 1933, *ibid.*
- ¹⁵⁴ Out of his M.A. thesis, *The talc deposits of Vermont* (Columbia University, 1914; 60p., prepared under James Furman Kemp; copy in UVM Archives), he published "Talc and the talc deposits of Vermont," *Report* (1914), 382-429; "The talc and verd antique deposits of Vermont," *ibid.* (1916), 232-280; "Progress in talc production," *ibid.* (1918), 148-157; "Progress in talc production" (1920), 101-114. He also published in the *Report*, "Copper mining in Vermont" (1916), 192-199; "Progress in copper mining" (1918), 141-147; "The lime industry in Vermont" (1918), 158-164; "The geology of Lake Willoughby" (1920), 280-298; "The clay deposits and clay industries of Vermont" (1920), 191-221; and "The geology of Westmore, Brownington, and Charleston (Orleans County)" (1922), 93-108; and elsewhere, "Flood erosion in Cavendish, Vermont," *Science*, 66:653-654 (30 December 1927), and "Cases of flood erosion in Vermont," *Geological Society of America Bulletin*, 40:109-110 (abstract, 1929).
- ¹⁵⁵ Robert K. Doten, "Memorial of Elbridge Churchill Jacobs," *American Mineralogist*, 44(3-4):377-379 (March-April 1959), with portrait.
- ¹⁵⁶ Executive Department Commissions, 20:119, MS. Vermont State Papers.

- 157 *Vermont Alumni Weekly*, 7:394 (2 May 1928), noting a slide lecture to the Ethan Allen Club.
- 158 E. C. Jacobs to Governor S. C. Wilson, 21 May, Wilson to Jacobs, 24 May 1934 (Public Records Service microfilm).
- 159 Completed June 1934; reproduced in Earle W. Newton, *The Vermont Story* (Montpelier: 1949), [9]; transferred with the geological museum to Perkins Hall in 1964.
- 160 Made by Ward's Natural Science Establishment, Rochester, N.Y., for \$100. See *Rural Vermont; a program for the future, by two hundred Vermonters* (Burlington: 1931), 34-36.
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- 162 E. C. Jacobs, "Concerning earthquakes and the University seismographs," *Vermont Alumni Weekly*, 12:231-232 (15 March 1933); N. H. Heck, "University helps trail Vermont earthquakes," *ibid.*, 14:167 (30 January 1935). The Jacobs Papers document his futile efforts to get a working seismograph.
- 163 Correspondence with Governor Stanley C. Wilson, especially 16 October 1933, 21 November 1934, and with Governor William H. Wills, 17 August 1942, 4, 10 June 1943, 23 October 1944 (Public Records Service microfilm).
- 164 Doll's report and map, based on field work in the summers of 1942-44, with Jacobs's description of the Company's operations and the petrography of Strafford, are in Jacobs's *Report* (1944). See also E. C. Jacobs, "The reopening of the Vermont copper mines," *Report* (1942), 1-16; Hugh E. McKinstry and Aimo K. Mikkola, "The Elizabeth Mine, Vermont," *Economic Geology*, 49:1-30 (January-February 1954), and Peter F. Howard, "The geology of the Elizabeth Mine, Vermont," Vermont Geological Survey, *Economic Geology*, No. 5.
- 165 Copy in Jacobs Papers, UVM Archives.
- 166 "University has played important part in Vermont Geological Survey," *Vermont Alumni Weekly*, 14:163, 167-168 (30 January 1935), 168.
- 167 Memorandum, n.d. but dated by internal evidence, and Wills to Jacobs, 23 October 1944 (Public Records Service microfilm).
- 168 Mortimer R. Proctor, *Inaugural address . . . January 4, 1945* [Montpelier: 1945], 6; "Building a better Vermont," *retiring message . . . January 9, 1947* [Montpelier: 1947], 21-22.
- 169 Esther C. Marsh to Proctor, 13 April 1946; Jacobs to Proctor, 8 December 1946; H. C. Sylvester to Jacobs, 10 December 1946 (Public Records Service microfilm).
- 170 Undated memorandum by "M" to Robert C. Lane, Managing Director, Vermont Development Commission, assuming that Jacobs would be reappointed; G. A. Ellis to Gibson, 21 April 1947 (Public Records Service microfilm); interview with C. G. Doll, 14 November 1972, on his learning that Thomas and Millis were recommending him.
- 171 Montpelier: 1950; 169 p. with folding relief map.
- 172 "Iron in Vermont — a glance at its story," *Vermont Quarterly*, 21:128-131 (April 1953).
- 173 Ph.B. Brown, 1924; A.M. Brown, 1926, unpublished thesis on the Narragansett Basin; A.M. Harvard, 1931; Ph.D. Columbia, 1951, thesis published as VGS Bulletin No. 3, "The geology of the Memphremagog quadrangle and the southeastern portion of the Irasburg quadrangle" (1951). His articles and monographs outside his biennial reports of progress to governors include: "Notes on the mineral localities of Rhode Island," *American Mineralogist* 12:427-436 (December 1927); "Geology in relation to some Vermont scenery," *Vermont Alumni Weekly*, 12:352-353 (7 June 1933); "A glacial pothole on the ridge of the Green Mountains near Fayston, Vermont," *VGS Report* (1936), 145-151; "Watch your step!" *Vermont Alumni Weekly*, 16:291-292 (5 May 1937); "Fossil rains," *Vermont Alumnus*, 17:267-268 (May 1938); "The geology of Clay Point, Colchester, Vermont," *VGS Report* (1938), 74-83; "The hurricane passes," *Vermont Alumnus*, 18:84-85 (January 1939); "Finds only recorded meteorite in New England," *ibid.*, 22:7 (October 1942); "Fossils and fossilization," WCAX Monday Evening Broadcast No. 5 (copy of text in C. G. Doll Papers, UVM Archives); "An abandoned valley at West Charleston, Vermont," *VGS Report* (1942), 20-25; "A paleozoic revision in Vermont," *American Journal of Science*, 241:57-64 (January 1943); "A brachiopod from mica schist, South Strafford, Vermont," *American Journal of Science*, 241:676-679 (October 1943); "A preliminary report on the geology of the Strafford quadrangle," *VGS Report* (1944), 14-28; "The Vermont State Geological Survey in education," MS. of paper read as President of the New England Section, National Association of Geology Teachers; n.p., n.d.; in UVM Archives.
- 173a Contracts of 8 July, 15 November 1947 and 9 September 1948 in Doll Papers, UVM Archives.
- 173b By the end of fiscal 1976 the Survey had published 31 *Bulletins*, eight in its Economic Geology Series, six in its Environmental Geology Series with a seventh ready for the press, and several special publications.
- 174 Interview with ex-Governor Johnson, Springfield, Vermont, 15 September 1971; *Inaugural address, January 6, 1955* [Montpelier: 1955]; *Vermont Laws* (1955), 84, 258, (1957), 230-231.
- 175 Interview with C. G. Doll, 26 March 1973 (Typescript in Doll Papers, UVM Archives); Frank B. Follett, "Governor accompanies Geological Survey team mapping mineral resources in Orange County," *Barre Daily Times*, 18 September 1956; Burton H. Wolfe, "Governor inspects State Geological Survey," *Burlington Free Press*, 6 September 1957; *Rutland Herald*, 27 August 1958. Doll appointed a committee of Wallace M. Cady of the U.S.G.S., James B. Thompson, Jr. and Marland P. Billings of Harvard University to help plan the map.
- 176 Seven studies in the *Economic Geology* series were published, 1966-70, on ferromagnesian minerals, kaolin, copper, Doll's Cuttingsville borings, and Ray W. Grant's *Geo-chemical investigations in Essex and Caledonia Counties* (No. 7, 1970). The quotation is from a letter from Doll to Varanasi Rama Murthy, 27 February 1955 (Doll Papers, UVM Archives).
- 177 Doll Papers in the UVM Archives.
- 178 N.E. Intercollegiate Geological Conference. Vermont Geologic Map Centennial. *Guidebook, fifty-third annual meeting* (Charles G. Doll, ed.; Montpelier: 1961); Richard E. Stoiber, "New Vermont geologic map," *GeoTimes*, 6:19 (April 1962).
- 179 *Vermont Laws* (1961), 311-312.
- 180 Elizabeth Kirkness, "State's new surficial geologic map is eye-catcher," *Burlington Free Press*, 3 April 1970, 12; supported by VGS *Bulletin* 31, "The surficial geology and pleistocene history of Vermont," by David P. Stewart and Paul MacClintock (1969). See also such articles as Erlene Laviolette, "Geologists believe Caspian Lake once 50 feet above shoreline," *Barre-Montpelier Times-Argus*, 11 July 1963.
- 181 Sergeant-at-arms to E. C. Jacobs, 26 January 1944 (Public Records Service microfilm); interview with Allen S. Hunt, Curator of Fossils in the Geology Museum, 26 February 1975 (typescript in UVM Archives).
- 182 Robert B. Erwin to Governor Deane C. Davis, 11 February 1969, copy in Doll Papers, UVM Archives.
- 183 "H25," a report by C. G. Doll to the May 1969 meeting of the Association of American State Geologists at Rolla, Mo.; 11 p., summarizing a large file of copies of letters of support sent to the Committee on Natural Resources and Governor Davis, in the Doll Papers, UVM Archives.
- 184 Governor Allen M. Fletcher's agreement with the U.S. Geological Survey of 17 December 1912; B. B. Marshall to Fletcher's Secretary, Warner A. Graham, 23 April 1914 (Public Records Service microfilm). David Cobb, *Vermont maps prior to 1900; an annotated cartobibliography* (Montpelier: 1971), 272-297, describes, lists and maps the early series.
- 185 *Burlington Free Press*, 13 October 1969, 30 January 1971.
- 186 The act passed 27 March 1976, with a humorous resolution of appreciation for Doll's services, also provided for the appointment of the State Geologist by the Secretary of Environmental Conservation, with the advice of the Vermont Geological Society.
- 187 See *Geology and public service in Vermont; a position paper of the Vermont Geological Society, February 20, 1976*, a twelve-page report of its Ad Hoc Committee on the Vermont Geological Survey, W. Philip Wagner, Chair, and its *Newsletter*.

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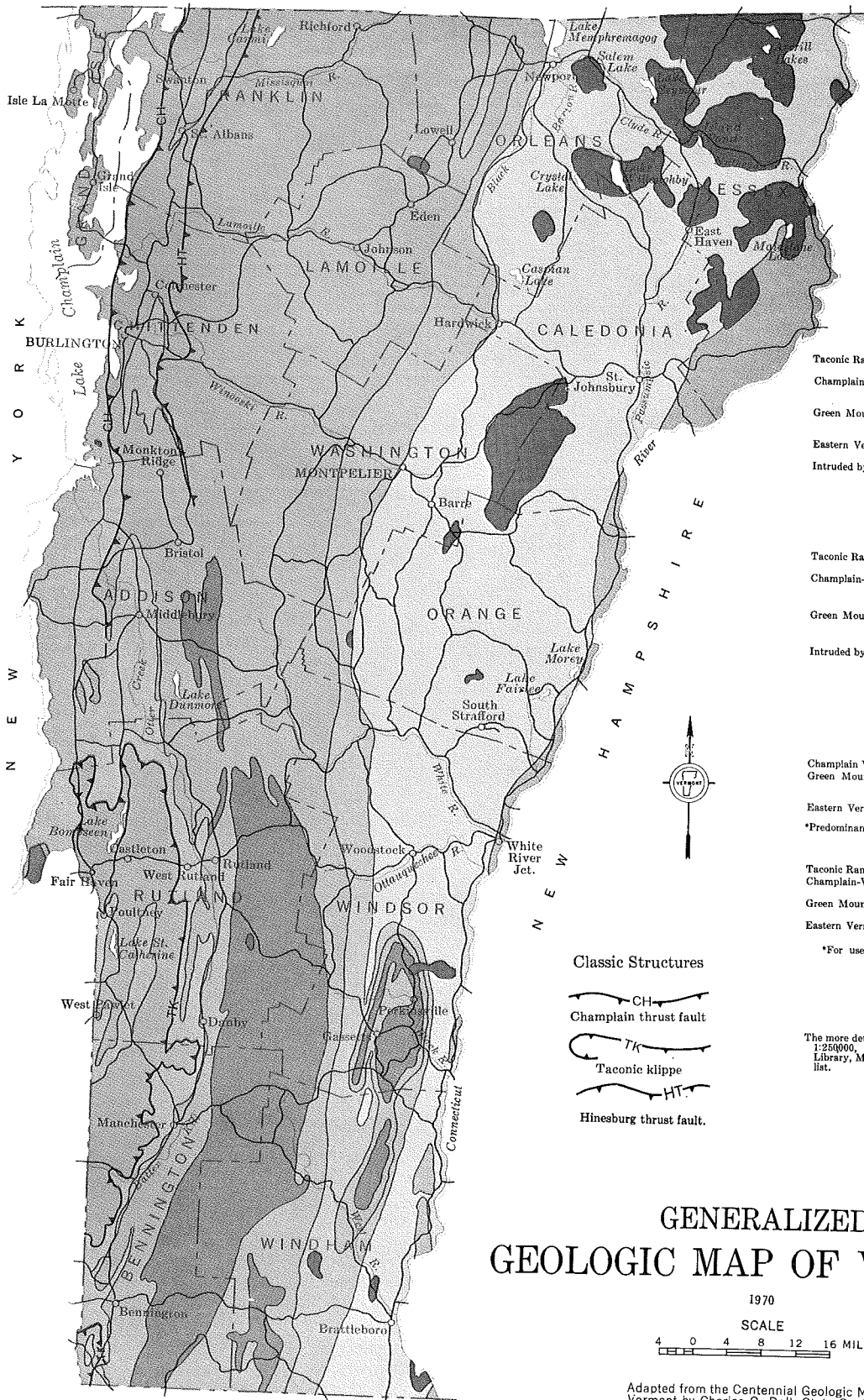
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



EXPLANATION

 Igneous Rocks*
Granite, syenite, basalt, dunite, peridotite, serpentinite.

 Silurian-Devonian
Slate, phyllite, limestone, quartzite, conglomerate, greenstone, schist, amphibolite. Intruded by granite and syenite.

 Ordovician
Taconic Range—Slate, graywacke, quartzite, limestone, conglomerate, marble.
Champlain-Vermont valleys—Slate, dolomite, limestone, quartzite, phyllite, slate, sandstone, conglomerate, marble.
Green Mountains—Phyllite, schist, quartzite, greenstone, slate, graywacke, gneiss, conglomerate, amphibolite.
Eastern Vermont—Phyllite, quartzite, greenstone, schist, gneiss, slate, amphibolite.
Intruded by granite, syenite, basalt, ultrabasic rocks.

 Cambrian
Taconic Range—Slate, graywacke, quartzite, limestone, phyllite, sandstone, marble, dolomite.
Champlain-Vermont valleys—Quartzite, dolomite, slate, phyllite, sandstone, shale, limestone, conglomerate, marble.
Green Mountains—Schist, phyllite, quartzite, graywacke, conglomerate, greenstone, dolomite, limestone, gneiss, amphibolite.
Intruded by ultrabasic rocks, basalt.

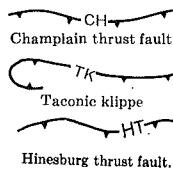
 Precambrian
Champlain Valley (small area)—Gneiss, quartzite, granite.
Green Mountains—Schist, gneiss, metagraywacke, quartzite, calcite and dolomite marbles, amphibolite.
Eastern Vermont—Gneiss, schist, quartzite, calcite, and dolomite marble, amphibolite.
*Predominant and important rocks in italics.

Earth Materials*
Taconic Range—Slate, marble.
Champlain-Vermont valleys Limestone, marble, clay, kaolin, roadstone.
Green Mountains—Talc, asbestos, verd antique marble, roadstone.
Eastern Vermont—Granite, talc, roadstone, copper (now inactive).

*For uses consult *The Mineral Industry of Vermont*, U. S. Bureau of Mines, Preprint, obtainable from Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402

Also, use information available from the mineral industries.
The more detailed Centennial Geologic Map of Vermont, scale 1:250,000, available from State Librarian, Vermont State Library, Montpelier, Vermont 05602. Write for publication list.

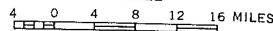
Classic Structures



**GENERALIZED
GEOLOGIC MAP OF VERMONT**

1970

SCALE



Adapted from the Centennial Geologic Map of Vermont by Charles G. Doll, State Geologist, Vermont Geological Survey