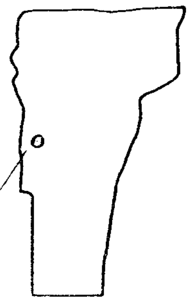
THE GREEN MOUNTAIN GEOLOGIST



QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

SPRING 1981 VOLUME 8 NUMBER 1

COME to the Spring Meeting of

THE VERMONT GEOLOGICAL SOCIETY

featuring the eighth annual

PRESENTATION OF STUDENT PAPERS

2 MAY, 1981 9:00 A.M.

ROOM 420 SCIENCE CENTER

→MIDDLEBURY COLLEGE

DIRECTIONS: Leave Route 7 and drive through the business section of Middlebury toward the college campus. The Science Center (a large modern stone building) is at the bottom of the hill to the left at the beginning of the campus. Parking can be found at the east side of the Science Center along Storrs Avenue.

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PRESIDENT'S LETTER

Dear members and particularly former members,

It was interesting and quite enlightening to review the Society's membership list last week and to find that although our membership has grown this year, there are former members who have not continued their affiliation with the society. The question is "why?".

As I looked more closely, it became obvious that some of those who have not continued their memberships had moved from Vermont to other parts of the country or world. They understandably have lost touch with what is going on in Vermont geology and have naturally acquired new interests. Others were formerly student members who also have departed from the state or have not yet matured through the transition from a student committment to a stronger professional committment to their profession. There are those who have retired from the professional life and we wish them "good fishin'" and a deserved rest. (I must add, however, that some of the so-called "retired" geologists are our most active members.) But the biggest mystery, by far, are those former members who are still active professionals, practicing in Vermont, who for some reason do not wish to continue to support the one local organization that supports and speaks for them, and provides a media for professional growth (related to the locale where they practice), unparalleled by any other organization.

Perhaps it is a simple case of being forgetful. If this is the category you fall into, a gentle reminder will be in your mailbox soon, and I hope you will continue your active support of the Society.

On the other hand, the reason may be that you feel the Society is not doing the kinds of things you feel it should be doing. In that case, you should, by all means, continue your membership and actively voice your interests. The Society is young, and remains very flexible. We continue to grow each year; come help us grow in the direction that will best complement your professional interests.

Most sincerely,

Charles A. Ratté

Charles A. Ratté
President

PROGRAM

MAY 2, 1981

ROOM 420, SCIENCE CENTER, MIDDLEBURY COLLEGE

Registration; Coffee and Donuts . . . 9:00

The Precambrian and its boundaries

1. Ricardo Presnell: A petrologic study of marble, anorthosite and amphibolite associations near Gore Mountain, Adirondack Mountains, New York . . 9:20
2. Bruce Davidson: A structural study of Brandon Gap, Vermont. 9:40
3. Valerie Kindred: Structural analysis of Cambrian sequence in the vicinity of Sucker Brook, East Middlebury, Vermont 10:00
4. Peter Tauvers: The geology of the Lincoln-South Lincoln area, Vermont 10:20

Coffee break

The ultramafic belt

5. Maureen Hill: Structure and petrology of the ultramafic body and surrounding country rocks near Ludlow, Vermont 11:00
6. Katherine Deregibus: Petrology of the ultramafic body at Ludlow, Vermont 11:20
7. Christopher Scholz: Petrography and field relationships of the Burbank Hill Breccia, Asbestos, Quebec 11:40
8. Dana Roy: Tectonic stratigraphy of the Cambrian-Ordovician sequence in the ultramafic belt near Troy, Vermont 12:00

Lunch (brown bag)

Cambrian and younger rocks east of the Green Mountains

9. Gerard Smith: Bedrock geology along the Baie Verte-Brompton Line of southern Quebec 1:20
10. Katherine Pound: Structure of the Ottauquechee Formation, and the Stowe-Ottauquechee contact near Rochester, central Vermont 1:40
11. Eric Weber: Tectonic and metamorphic relationships in the vicinity of the Stowe-Moretown contact, Braintree, Vermont 2:00
12. Daniel Bailey: Geochemistry of Brackett Member metabasalts, Braintree, Vermont 2:20
13. Michael Bailey: Geochemistry of the Braintree Complex, Vermont 2:40

Deep crustal structures

14. Teresa Walsh: Deep crustal structures of central Vermont: inferred from the COCORP seismic survey . 3:00
15. Bernadette Czuchra: Implications of seismic reflections studies in Vermont for deep crustal structure and origin of the Green Mountains . . . 3:20

Business Meeting 3:40

PRESENTATION OF AWARDS

ABSTRACTS

GEOCHEMISTRY OF BRACKETT MEMBER METABASALTS, BRAINTREE, VERMONT

Bailey, Daniel J., III, Department of Geology, Middlebury College, Middlebury, Vermont 05753

Major, trace and rare earth element analyses have been carried out on Brackett Member metabasalts of the Stowe Formation. Some metasediments of the Stowe and of the Moretown member of the Missisquoi Formation were also analyzed for major and trace elements in order to compare chemical trends along contacts.

The dominant mineral assemblage of the Brackett Member is albite-epidote-chlorite-actinolite, which is characteristic of greenschist facies metamorphism. Other common minerals include calcite, quartz, biotite and muscovite. Differences in petrography throughout the belts of greenstone are common, particularly near contacts with the pelitic schists of the Stowe and Moretown.

Major element analysis shows a range of SiO_2 from 46 to 54 (weight percent), but most samples are close to 50%, which is in the range of an oceanic basalt. However, since SiO_2 and most of the major elements are believed to have been mobilized due to metamorphism, interpretations are based on relative abundances of the immobile elements: Zr, Y, Nb, Ti, and the rare earths.

Chemical parameters of the immobile elements suggest that the Brackett Member greenstones were originally mid-ocean ridge basalts. All samples from the greenstone belts plot as ocean floor basalts in a Y-Ti-Zr diagram. Rare earth element data indicates LREE enrichment, which is also indicative of oceanic tholeiites.

GEOCHEMISTRY OF THE BRAINTREE COMPLEX, VERMONT

Bailey, Michael M., Department of Geology, Middlebury College, Middlebury, Vermont 05753

The Braintree Complex comprises two igneous intrusions, one of dioritic and the other of granitic composition. The presence of granitic dikes within the diorite body implies that the diorite intruded before the granite. Greenschist facies metamorphism is more pronounced in dioritic rocks than in granites, further suggesting an older age for the dioritic intrusion.

Chemical trends suggest that the two bodies were probably not cogenetic. Rocks originating from the same parent magma at different stages of fractionation would be expected to plot on a smooth line in chemical variation diagrams. This is not the case for the Braintree Complex. Plotted on an (Na_2O + K_2O), FeO, MgO (AFM) ternary diagram the diorites exhibit an initial Fe-enriching trend similar to that of mafic layered intrusions such as the Skaergaard intrusion. The granite, however, shows a strong iron depletion trend, as is common in the calc-alkaline series. Furthermore, graphs of (Na_2O + K_2O) versus SiO_2, FeO/MgO versus SiO_2, and TiO_2 versus Y/Nb have the diorites falling in the tholeiitic field. One notable exception is the plot of P_2O_5 versus Zr, in which the diorites plot entirely in the alkalic field. This is largely due to a

high (0.83 average weight percent) concentration of P_2O_5 in the diorites. Data for the granites, when applied to alkalic-tholeiitic field diagrams, are less consistent. The granites lie in the tholeiitic field for plots of (Na_2O + K_2O) versus SiO_2 and TiO_2 versus Y/Nb, but in the alkalic field for grapsh of FeO/MgO versus SiO_2 and P_2O_5 versus Zr. Evidence tends to indicate that the two intrusions originated from different magma sources.

IMPLICATIONS OF SEISMIC REFLECTION STUDIES IN VERMONT FOR DEEP CRUSTAL STRUCTURE AND ORIGIN OF THE GREEN MOUNTAINS

Czuchra, Bernadette L., Department of Geology, Middlebury College, Middlebury, Vermont 05753

Results of a seismic reflection survey conducted in Vermont during August 1980 by COCORP (Consortium for Continental Reflection Profiling) provide information about deep crustal structure and the origin of the Green Mountains. COCORP's data collection technique detects structural features on the scale of a kilometer. The main traverse, Line 3, runs west to east across the Green Mountains from Clarendon Springs to Windsor. A crossline, Line 5, extends sout to north on the east side of the Chester Dome. The final product of data processing is a seismic section display of reflectors with distance along the horizontal axis and two-way travel time increasing down the vertical axis.

Line 5 shows dipping seismic reflectors from 2 to 3 seconds (about 6.6 to 10 km) interpreted as the base of a large recumbent fold of Siluro-Devonian sediments. A diorite intrusion related to Mt. Ascutney disrupts penetration of seismic energy causing a semi-transparent zone on the Line 5 seismic section. Reflectors dipping east about 30 degrees under the Chester Dome on the main traverse, Line 3, may represent a major thrust fault and suture zone between the North American basement and an island arc collision during the Taconic orogeny. A band of reflectors at 4 seconds (12 km) on the crossline, Line 5, supports this interpretation. Other east-dipping reflection horizons beneath the Green Mountains on Line 3 appear to be thrust faults. There exist no interpretable reflections below 5 seconds on both lines.

A STRUCTURAL STUDY OF BRANDON GAP, VERMONT

Davidson, Bruce J., Department of Geology, Middlebury College, Middlebury, Vermont 05753

The Precambrian Mount Holly Complex crops out at the top of Brandon Gap. Other lithologies in the area, all Cambrian in age, are metasediments flanking the Mount Holly Complex -- the Pinnacle schists and overlying Underhill formation to the west, and the Hoosac schists to the east. The Underhill, outcropping in a small valley with Pinnacle on three sides, contains two members, the Forestdale marble and the Moosalamoo phyllite.

Field observations showed the Precambrian-Hoosac contact to be folded around an eastward dipping axial plane. This contact may be tectonic. Due to extensive cover, the location of the Mount Holly-Pinnacle and Pinnacle-Underhill contacts could only be approximated. The nature of these contacts is obscure.

Structural features observed in the area include traces of bedding, two cleavages, and small-scale folding. Bedding, when present, was seen to parallel schistosity (S_1). Both cleavages are predominantly eastward dipping, with S_1 folded around axial planes described by S_2. Small-scale folding to the west of the Mount Holly Complex was seen to be more highly variable in orientation than folding in the Hoosac. Due to the lack of intraformational stratigraphy, large-scale structures have been interpreted from microstructural data. Relationships between S_1 and S_2 suggest that the Cambrian metasediments have undergone large-scale folding that is overturned to the west.

The structure of this area appears to differ substantially from that to the north (Senior, 1980). She found evidence for at least three and perhaps four deformations to the west of the Mount Holly Complex, whereas this study finds only two definite deformations with a possibility of a third. Also, there is here no indication of greater deformation to the east of the Mount Holly Complex, though a higher degree of parallelism is evident.

PETROLOGY OF THE ULTRAMAFIC BODY AT LUDLOW, VERMONT

Deregibus, Katherine, Department of Geology, Middlebury College, Middlebury, Vermont 05753

The Ludlow body is a serpentinized alpine-type ultramafic mass, located in south-central Vermont. It is part of a belt of similar rocks which trends north-northeast throughout the state.

Thin-section study indicates the body is a partially serpentinized dunite, containing varying amounts of olivine and accessory chrome-spinel. Electron microprobe analysis of the olivine and chrome-spinel phases reveal compositional variations related to partial melting and subsequent metamorphism. Fo content of the olivine varies from Fo_{87} to Fo_{96}. The olivines in the range from Fo_{87} to Fo_{92} are similar to residual (igneous) olivines found in the tectonic zone of ophiolite suites. Those in the range Fo_{92} are comparable to high-temperature metamorphic olivines.

Chrome-spinel grains are ubiquitously rimmed by magnetite. Cr/(Cr + Al) and Mg/(Mg + Fe^{+2}) ratios show the cores are rich in chrome and magnesium, similar to spinels found in alpine peridotites.

It is tentatively concluded that this body was emplaced as a residual dunite, related to an ophiolite suite.

STRUCTURE AND PETROLOGY OF THE ULTRAMAFIC BODY AND SURROUNDING COUNTRY ROCKS NEAR LUDLOW, VERMONT

Hill, Maureen J., Department of Geology, Middlebury College, Middlebury, Vermont 05753

In Vermont, ultramafic rocks form a belt that lies east of the main axis of the Green Mountain anticlinorium. Near Ludlow there is a large body of ultramafics, approximately 6 km^2 in area, with a smaller body about 300 m to the west. These ultramafics are dominantly serpentinized dunite. Olivine and serpentine comprise a major proportion of most samples, along with minor amounts of chrome spinel, magnetite, actinolite and chlorite. This body is not concentrically zoned. Instead, most of the olivine is concentrated along the western margin while the remainder of the body is mainly serpentine, with talc and carbonates locally dominant.

The country rocks surrounding the ultramafic body are mainly Ordovician metapelites and metavolcanics of the Cram Hill Formation and Barnard volcanics. Some foliated hornblende amphibolites are locally found on the west and north boundary of the ultramafics. Although discontinuous, the occurrence of these rocks is significant. They are localized in the same position as the amphibolites associated with the ophiolites of Newfoundland (Williams and Smyth, 1973) and Thetford Mines (Laurent, 1975).

The ultramafics do not show chilled margins; instead, shearing is found at the margins of the body. The metamorphic country rocks exhibit decreasing intensity of deformationa way from the contact and have not been changed into hornfels facies at the contact. This evidence suggests that the ultramafic body was emplaced as a solid mass. Thus, ultramafics may have originally been part of an ophiolite suite, now largely dismembered.

STRUCTURAL ANALYSIS OF CAMBRIAN SEQUENCE IN THE VICINITY OF SUCKER BROOK, EAST MIDDLEBURY, VERMONT

Kindred, Valerie P., Department of Geology, Middlebury College, Middlebury, Vermont 05753

A traverse, east from Lake Dunmore, crosses the Green Mountain Front, which is the boundary between the Middlebury Synclinorium and the Green Mountain Anticlinorium. Along Sucker Brook the lithologic units are: Cheshire Quartzite, and the Forestdale, Moosalamoo, and basal members of the Pinnacle Formation. Structural features suggest that deformation increases eastward, perhaps due to the nature of the materials. The Cheshire consists of thin (10-25 cm) quartzite beds with 15 % phyllitic laminae, and 6 m sections of massive quartzite with occult bedding. In the west, thinner beds dip steeply west. To the east, the Cheshire dips 55 degrees west and has east-climbing minor folds. Within 30 m of the Forestdale contact the Cheshire is tightly folded, with schistosity formed in phyllitic interbeds. Cleavage in the phyllite remains almost vertical throughout the section and is axial planar to the folds.

The outcrop width of the Forestdale, a dolomitic marble, is about 500 m. Exposures are poor and exhibit few deformational features. However, along the margins of the Forestdale, an east-dipping foliation is observed. In thin section, relict bedding is discernable. In the Moosalamoo, a quartz-muscovite schist, there is field and thin section evidence of three deformational events. S_3 is a crenulation cleavage of S_2. S_2 is a 2-4 mm spaced foliation, which folds and shears S_1 -- the earliest cleavage. The basal member of the Pinnacle Formation is a pebbly quartz-muscovite schist. The fabric is highly contorted, with folds ranging from isoclinal to tight. Bedding is distinct.

This east-west sequence does not fit the accepted stratigraphy. The Moosalamoo should be present between the Cheshire and Forestdale, not between the Forestdale and basal member of the Pinnacle Formation. This probably is due to faulting, which is known in other places along the Green Mountain Front. In the study area, however, the outcrop of the Cheshire/Forestdale contact, which has been described by Osberg (1952) as an nondepositional unconformity, does not resemble a fault.

STRUCTURE OF THE OTTAUQUECHEE FORMATION, AND THE STOWE-OTTAUQUECHEE CONTACT NEAR ROCHESTER, CENTRAL VERMONT

Pound, Katherine S., Department of Geology, Middlebury College, Middlebury, Vermont 05753

The Cambro-Ordovician sequence on the east flank of the Green Mountain Anticlinorium forms part of a homoclinal sequence. This study is an examination of the structure and metamorphism of the Stowe and Ottauquechee formations within this sequence, in the vicinity of Rochester, central Vermont.

Outcrops of Stowe occur within the Ottauquechee, and several outcrops of Ottauquechee occur within the Pinney Hollow Formation to the west. These exposures represent doubly plunging anticlines (Osberg, 1952). Structural data taken on a traverse across the eastern portion of the Ottauquechee confirm Osberg's interpretation of that portion of the Ottauquechee as a south-plunging anticline within the homoclinal sequence.

A traverse across the eastern portion of the Ottauquechee shows it to vary from black quartzites to graphitic phyllitic schists and quartz-muscovite-sericite-albite schists within a small stratigraphic distance. This is in contrast to the type section of the Ottaquechee as described by Perry (1929), where black quartzites grade up through graphitic phyllitic schists and into quartz-muscovite sericite-albite schists adjacent to the contact with the Stowe.

The variation in lithology could represent a greater variation in depositional environment than observed in the type section. However, a series of ultramafic bodies trending north-south is found within the Ottauquechee, adjacent to the contact with the Stowe. Thus, the variation within the Ottauquechee lithologies could represent tectonic imbrication associated with the emplacement of the ultramafic bodies, prior to the development of the current structures within the homoclinal sequence.

A PETROLOGIC STUDY OF MARBLE, ANORTHOSITE, AND AMPHIBOLITE ASSOCIATIONS NEAR GORE MOUNTAIN, ADIRONDACK MOUNTAINS, N.Y.

Presnell, Ricardo D., Department of Geology, Middlebury College, Middlebury, Vermont 05753

A road cut along Rt. 28 north of Gore Mountain exposes calcitic marble, metanorthosite (An_{55}) and amphibolite. The outcrop is within DeWaard's (1969) hornblende-clinopyroxene-almandine subfacies of the granulite facies. From structural relations it appears that the anorthosite intruded the amphibolite; both were subsequently invaded by the more ductile marble.

Common primary minerals include calcite, ferrosalite, hornblende, scapolite, plagioclase, K-feldspar, sphene, ilmenite, pyrite, biotite, quartz, and garnet. Vesuvianite, zircon, apatite, muscovite, graphite, chalcopyrite, rutile, cordierite, magnetite, and hematite are less common. Representative samples and mineralogical zonations were analyzed to assess physical and chemical controls of metamorphism. Some mineral compositions were determined on the electron microprobe. Temperatures of metamorphism were determined from garnet-biotite and garnet-clinopyroxene pairs. Metamorphic reactions between the lithologies were modeled from textural relations and microprobe data.

TECTONIC STRATIGRAPHY OF THE CAMBRIAN-ORDOVICIAN SEQUENCE IN THE ULTRAMAFIC BELT NEAR TROY, VERMONT

Roy, Dana L., Department of Geology, University of Vermont, Burlington, Vermont 05405

Irregular and pod shaped ultramafic bodies comprise a linear yet narrow belt extending from the international border south, approximately 25 km to Lowell in north-central Vermont. Formational contacts between the Hazen's Notch, Ottauquechee, Stowe and Moretown member of the Missisquoi Formation were shown as parallel and conformable by Cady and others (1963).

Detailed field mapping at a scale of 1:10,000 however, has shown the contacts to be tectonic and enclose internally imbricated lithic packages of metasedimentary and metavolcanic rocks. Major thrust surfaces here designated (west to east) as the Belvidere Mountain Thrust, Missisquoi River Thrust and the East Hill Thrust, separate the major units as they appear on the geologic map of Vermont.

Five fold generations have been separated by superposed relations, with possible remnants of yet an earlier generation. F_1-F_3 folds are ubiquitous and also responsible for folded map contacts. Four generations of faults have been recognized on the basis of their folded relationship to the various fold generations. A preliminary fold-thrust chronology has been defined involving time and in part, spatial relationships between folding and thrusting.

Structurally deformed, intrusive metadiabases occur only in the western belt of Stowe and Moretown rocks within distinct thrust-bound sedimentary sequences. Their absence in Ottauquechee and Hazen's Notch rocks to the west suggest the dikes were intruded intoo a sedimentary sequence possibly deposited on ocean crust to the east of the North American continent, and subsequently thrust westward into the slope-rise sequence.

The three previously defined major thrust surfaces therefore, represent zones of polydeformation over a seemingly large expanse of time. The present position of the East Hill ultramafic body is the end result of repeated westward directed thrusts, and not emplacement by solid intrusion of mantle material as proposed by Chidester and others (1978). At least one of the thrust surfaces, the Belvidere Mountain Thrust, may contine southward along the western contact of the Ottauquechee Formation and join the Whitcomb Summit Thrust in western Massachusetts.

PETROGRAPHY AND FIELD RELATIONSHIPS OF THE BURBANK HILL BRECCIA, ASBESTOS, QUEBEC

Scholz, Christopher A., Department of Geology, University of Vermont, Burlington, Vermont 05405

Fractured gabbro, pillow volcanics and hypabyssal intrusives have been associated with the upper portions of northern Appalachian ophiolite stratigraphics. The ultramafic complex in and around Asbestos, Quebec represents one of the more complete rock suites of obducted ocean crust material in the Eastern Townships. Rocks of the Asbestos assemblage include amphibolite, peridotite, dunite, pyroxenite, harzburgite, gabbro, pillow volcanics, brecciated tholeiites, red shale, and wildflysch-type slate.

Resting stratigraphically and topographically above the ultramafic rocks is the Burbank Hill breccia. This supposed Ordovician unit contacts massive gabbro to the north and red shale and volcano-clastics to the south. Reconnaissance mapping indicates a conformable contact with the gabbroic rocks and a possible fault relationship with the bedded units. An abundance of coarse grained dikes intruding the gabbroic rocks, relict pillow textures and very similar outcrop appearances suggested a possible igneous origin for the breccia. Previous workers have termed these rocks brecciated tholeiites or gas breccias.

Petrography reveals a dark, extremely fine grained chloritic matrix material displaying no evidence of cumulate or rapidly crystallized phases. Clasts are dominantly igneous to metaigneous with no metasediments whatsoever.

The fragments are poorly sorted, angular with extremely varied composition including ophitic norite, hornblende gabbro, micrographic granite and cryptocrystalline basalt. Individual clasts have been metamorphosed as high as amphibolite facies but the breccia has recorded pressures and temperatures of chlorite grade only. Overall, the rock betrays no tectonic imprint.

The lack of crystalline features within the matrix strongly suggests a detrital origin for these rocks. Extremely poor sorting and angularity of clasts suggests rapid deposition and minimal transport. This menagerie may indicate what lithologies were subaerially exposed during assemblage emplacement.

BEDROCK GEOLOGY ALONG THE BAIE VERTE - BROMPTON LINE OF SOUTHERN QUEBEC

Smith, Gerard T., Department of Geology, University of Vermont, Burlington, Vermont 05405

The Miller Pond Formation of southern Quebec consists of a succession of metasedimentary and metaigneous rocks lying between the Ottauquechee Formation, to the west, and the Mt. Orford - Mt. Chagnon igneous complex to the east. The contacts between the metasedimentary and metaigneous rocks have previously been interpreted as conformable.

Mapping, at scales of 1:10,000 or better, has indicated that the Miller Pond Formation consists of three northeast trending linear belts. These belts contain discontinuous mafic and ultramafic metaigneous and metasedimentary units , including olistostromal black slates, separated by thick sequences of slightly metamorphosed graywacke.

The discontinuous units are mutually truncated above and below a series of mapped surfaces interpreted as thrust faults. Serpentinites along these surfaces are either brecciated or are characterized by shear polyhedra and glassy slickensided surfaces supporting the fault interpretation.

Serpentinites at the contact between the Ottauquechee and Miller Pond Formations are characterized by the presence of intrusive diorite breccias containing ophiolite clasts. Their absence in the metasediments indicates that they were intruded into oceanic crust, possibly as a result of the partial melting of the North American plate, east of their present location and have been subsequently imbricated with the adjacent metasediments forming a distinctive tectonic horizon that can be traced for at least six miles.

Four periods of deformation and one post deformational phase of intrusion are recognized in the field area. D_1 is pre to syn thrusting and results in a penetrative S_1 cleavage. D_2, D_3, and D_4 fold the earlier thrust surfaces although only D_3 is pervasive.

The intrusion of lamprophyre and nordmarkite dikes into the polydeformed thrust slices occurred during the Mesozoic and is related to the emplacement of the Monteregian intrusives.

THE GEOLOGY OF THE LINCOLN - SOUTH LINCOLN AREA, VERMONT

Tauvers, Peter R., Department of Geology, University of Vermont, Burlington, Vermont 05405

A 3-fold investigation of the geology of the Lincoln - South Lincoln area, Vermont, was begun during the 1980 field season. Preliminary results involve: 1) the mapping and structural analysis of the Grenville (Precambrian Y) age basement complex; 2) a lithologic study of the Eocambrian (Precambrian Z and Lower Cambrian) cover rocks, with emphasis on the basal Pinnacle Formation; and 3) a reexamination of the nature of lithologic contacts of units in both the basement complex and cover rocks.

The Mt. Holly Complex (MHC), of Precambrian Y age, consists predominantly of feldspar gneiss with interbedded massive amphibolites and minor schists and quartzites. Most outcrops exhibit the Paleozoic dominant schistosity, but may also show one older (Grenvillian) schistosity which is at high angles to the minor structures in the cover rocks. It is the younger deformation, however, which is largely responsible for the observed map pattern, as it folds both basement structures and the unconformity itself.

Field work thus far has demonstrated the depositional nature of the western contact of the MHC, and has delineated a basal fluvio-conglomerate at the base of the Pinnacle Formation. This unit is an important and definitive horizon marking the basement-cover unconformity, and may therefore be useful if recognized in other parts of the state. Previously mapped as MHC, detailed work has discerned its actual composite-paleochannel morphology.

Preliminary field work has also shown that the eastern margin of the MHC is a tectonic contact(s), mainly by the recognition of a major thrust fault at South Lincoln. There, a sliver of MHC mylonitic gneiss, overlain by basal Hoosac conglomerate, has been imbricated "upsection" as much as 100 feet into the Hoosac proper. This thrust zone is believed to continue to the north, forming the MHC - Underhill contact, and then passing through the Elder Hill area where it is defined by changes in lithology and minor structure-orientation across the fault. Future work may determine if this zone is continuous with the Hinesburg thrust to the north.

DEEP CRUSTAL STRUCTURES OF CENTRAL VERMONT: INFERRED FROM THE COCORP SEISMIC SURVEY

Walsh, Teresa A., Department of Geology, Middlebury College, Middlebury, Vermont 05753

The main west to east traverse of a deep crustal seismic reflection survey conducted by the Consortium for Continental Reflection Profiling (COCORP) runs from near Clarendon Springs, Vermont, to Windsor, Vermont. A western north-south crossline, Line 4, runs for approximately 18 km across Precambrian crystalline rock along the axis of the Green Mountains. An eastern crossline, Line 5, runs for approximately 26 km along the eastern side of the Chester Dome, across Mt. Ascutney and adjacent Cambrian through Ordovician metamorphosed sedimentary rock.

This paper focuses on interpretation of deep crustal structures indicated by reflection patterns of the main traverse, Line 3, near and to the west of its intersection with Line 4. Line 3 crosses two east-dipping thrust faults in this region -- the Pine Hill Thrust and a more eastern fault which is unlabeled (Doll and others, 1961). One interpretation would extend these two faults into crystalline basement beneath the Green Mountains. Reflection patterns indicate that the dips of these faults shallow to less than 15 degrees at a two-way travel time ranging between 1.4 and 1.6 seconds. This corresponds to a range of depths falling between 4.5 km and 5.2 km. This interpretation implies the occurrence of imbricate faulting involving basement rock of the Green Mountains. This interpretation and others are discussed.

COCORP data used for this paper was processed at Cornell University. The Vermont lines are also being interpreted by others at Cornell as a part of the set of seismic reflection surveys run in the New England area.

TECTONIC AND METAMORPHIC RELATIONSHIPS IN THE VICINITY OF THE STOWE-MORETOWN CONTACT, BRAINTREE, VERMONT

Weber, Eric F., Department of Geology, Middlebury College, Middlebury, Vermont 05753

Recent evidence in the metasedimentary sequence on the east flank of the Green Mountain Anticlinorium supports a tectonic relationship between lithologies in central Vermont. In light of this evidence work was done on the Stowe Formation, the adjacent Moretown Formation, and their relationship with the accompaning Brackett member of the Stowe. All the rocks studied are greenschist facies and fall within chlorite and biotite isograds. The Stowe formation is principally a quartz-muscovite-chlorite schist and is interbedded with the Brackett member, an

VERMONT GEOLOGICAL SOCIETY

CONSTITUTION

AND

BYLAWS

ADOPTED
FEBRUARY 1974

REVISED
OCTOBER 1976
OCTOBER 1977
SEPTEMBER 1979
OCTOBER 1980

CONSTITUTION AND BYLAWS
of the
VERMONT GEOLOGICAL SOCIETY, INC.

CONSTITUTION

Article I: NAME AND FORM

The name of this organization shall be the Vermont Geological Society, Inc., a non-profit, non capital stock corporation.

Article II: PURPOSE

The purpose of the Society shall be:

1. To advance the science and profession of geology and its related branches by encouraging education, research and service through the holding of meetings, maintaining communications and providing a common union of its members.
2. To contribute to the public education of the geology of Vermont and to promote the proper use and protection of its natural resources.
3. To advance the professional conduct of those engaged in the collection, interpretation and use of geologic data.

Article III: MEMBERSHIP

Membership in the Society shall consist of Members with full voting rights, and other membership categories not having voting rights in Society proceedings.

Article IV: MANAGEMENT

The affairs of the Society shall be managed by the officers and board of directors elected at regular intervals from the voting membership of the Society. The officers and board of directors constitute the executive committee.

Article V: ANNUAL CORPORATE MEETING

The annual corporate meeting of the Society for the election of officers and board of directors and for such other business as may properly come before the meeting shall be held at such time and place as the executive committee may from time to time prescribe.

Article VI: BYLAWS

Bylaws not inconsistent with this Constitution or with the Certificate of Incorporation shall be adopted at the time of adoption of this Constitution and may be amended as therein provided.

Article VII: AMENDMENTS

Amendments to this Constitution may be made at any annual corporate meeting of the Society by a two-thirds vote of the members voting, due notice having been given each member of such proposed amendment at least four weeks before the annual corporate meeting.

BYLAWS

Article I: MEMBERSHIP

A. Member
Membership shall be open to any person who has a degree in geology or is professionally engaged in geology and whose application, filed in the proper manner, has been approved by the executive committee.

B. Associate Member
Associate membership shall be open to any person or organization interested in geology and its related branches whose application, filed in the proper manner, has been approved by the executive committee. Associate members shall enjoy the same rights and privileges as full members, except that they shall have no vote in Society proceedings nor be eligible to serve as officers.

C. Student Member
Student membership shall be open to any student interested in geology, whose application, filed in the proper manner, has been approved by the executive committee. Student members shall enjoy the same rights and privileges as full members except that they have no vote in Society proceedings nor be eligible to serve as officers.

D. Lifetime Member
A lifetime membership may be bestowed by the executive committee upon an individual who has made a significant contribution in Vermont geology.

E. Honorary Non-Voting Member
An honorary membership may be bestowed by the executive committee on an individual who has made a significant contribution to the Society.

Article II: DUES

A. Dues for members and associate members shall be $8.00 for each fiscal year.

B. Dues for student members shall be $4.00 for each fiscal year.

C. Dues shall be due during the month of January.

D. Changes in dues shall be recommended by the executive committee, but shall not become effective until voted by the members of the Society.

E. Any member, associate member, or student member whose dues remain unpaid for a one year period and who fails to pay said dues within 30 days after written notification of said arrears shall be dropped from membership.

F. The fiscal year shall be divided into quarters and initial dues for new members reflect the period remaining in the fiscal year.

Article III: FISCAL YEAR

The fiscal year of the Vermont Geological Society shall be the same as the calendar year.

Article IV: OFFICERS

A. The officers of the Vermont Geological Society shall be a president, a vice-president, a secretary, and a treasurer. These officers, together with the board of directors, consisting of 3 members, shall constitute the executive committee.
B. The officers shall be elected for a term of one year each and two members of the board of directors for a term of two years each, one being elected each year at the annual meeting. The third member of the board of directors shall serve a term of one year and shall be the immediate past president of the Vermont Geological Society. If there is no immediate past president, the third member of the board of directors shall be elected at the annual meeting.
C. No person, with the exception of charter members, shall be eligible to serve as an officer or a member of the board of directors who has not been a member for at least one full year.

Article V: COMMITTEE ON NOMINATIONS

A. A committee on nominations, consisting of three members, shall be appointed annually by the executive committee at the regular meeting following the annual meeting and shall serve until the regular meeting following the next annual meeting.
B. The committee on nominations shall:
    1. Select one nominee for each office to be filled at the next annual meeting.
    2. Report to the executive committee one month after the spring meeting, the names of nominees, at which time additional nominations will be accepted from members submitted by prior mail addressed to the secretary.
    3. Mail a list of all nominees to all members not less than 30 days prior to the annual meeting.

Article VI: ELECTION OF OFFICERS AND DIRECTORS

A. Method of Election:
    1. Officers and directors shall be elected at the annual meeting.
    2. Voting shall be by ballot at the annual meeting.
    3. Those persons who will not be able to attend the annual meeting may request an absentee ballot from the secretary and shall return this ballot in the envelope provided so as to be received prior to the annual meeting.
    4. Officers and directors shall assume their duties at the close of the meeting at which they were elected.

B. Vacancies in Office:
1. A vacancy in any office shall be filled for the unexpired term by a person elected by the executive committee.
2. Voting shall be by ballot if there is more than one nominee for the office.
3. A two-thirds vote of the members of the executive committee shall constitute an election.

Article VII: DUTIES OF THE OFFICERS AND DIRECTORS

A. President:
The president shall:
1. Preside at meetings of the Society and the executive committee.
2. Be an ex-officio member of all committees except the nominating committee.
3. Determine the duties of the vice-president.
4. Coordinate the work of the officers and committees, in order that the objectives of the Society may be promoted.
5. Submit an annual report to the Society at the annual meeting.

B. Vice-president:
The vice-president shall perform the duties of the President in the absence of the ability of that officer to serve, and those duties assigned by the President.

C. Secretary:
The Secretary shall:
1. Record the minutes of all meetings of the Society and the executive committee.
2. Be responsible for mailing to each member of the executive committee a copy of the minutes of all meetings of the Society and the executive committee.
3. Conduct such correspondence as the Society, the officers or the board of directors may direct.
4. Notify officers and standing committee chairmen of their election.

D. Treasurer:
The Treasurer shall:
1. Be a member of the budget committee.
2. Collect and record funds in accordance with the approved budget and/or upon direction of the executive committee.
3. Present a financial statement at the annual meeting.
4. Disburse funds and pay all bills by check when approved by the president.
5. Present a financial statement at each meeting and at other times as requested by the President.
6. Close the books at the end of the fiscal year and submit them for audit to the budget committee.
7. Send dues notices to members one month prior to the date they are due.
8. The Treasurer shall be bonded in amounts determined by the executive committee. The expense of these bonds shall be paid for by the Society.

E. All Officers and Directors:
   All Officers and Directors shall:
   1. Perform the duties prescribed in the parliamentary authority in addition to those outlined in these bylaws and those assigned from time to time.
   2. Deliver to their successors all official material within fifteen (15) days following the close of the annual meeting at which their term of office expires.

Article VIII: REGULAR MEETINGS

A. Regular meetings shall be held three times a year. Normally these will be held during the academic year.
B. A special meeting may be called in lieu of or in addition to a regular meeting.
C. The date, time and place of each meeting shall be determined by the executive committee.

Article IX: ANNUAL MEETING

A. The annual meeting shall be held in the month of October and shall be considered a regular meeting.
B. The date, time and place of each annual meeting shall be determined by the executive committee.
C. The annual meeting shall be the governing body of the Society.

Article X: VOTING BODY

A. The voting body of the meetings shall consist of the members of the Society.
B. Each member shall have but one vote.
C. At the annual meeting, twenty-five percent (25%) of the membership shall constitute a quorum, two of whom shall be members of the executive committee. Business may be conducted at other duly warned meetings without a quorum. All meetings shall be warned no less than two weeks prior to the meeting.

Article XI: EXECUTIVE COMMITTEE

A. Membership:
   1. There shall be an executive committee comprised of the officers, two (2) members elected at large, and the immediate past President of the Society.
   2. The executive committee shall meet at the call of the President or upon written request of two of its members.
   3. A majority shall constitute a quorum.
B. Duties:
   The executive committee shall
   1. Perform the duties delegated to it here and also elsewhere under these bylaws.
   2. Transact business referred to it by the membership.
   3. Receive and pass upon plans of work of chairmen of standing committees and authorize and direct the work of each.

4. Select the time and place of all meetings, including the annual meeting.
5. Submit to the membership such recommendations as it deems advisable.
6. Determine the amount and authorize payment of fidelity bonds for the treasurer of the Society.
7. Take no action in conflict with that of the membership.

Article XII: COMMITTEES

A. Standing Committees
   1. Standing committees may be created or dissolved by the executive committee as deemed necessary to promote the purpose and carry out the work of the Society.
   2. Each standing committee shall consist of a chairman and such other persons as may be appointed by the executive committee.

B. Nominations for Chairman:
   1. Nominations for chairmen of standing committees shall be made by the committee on nominations, and shall be reported by the committee on nominations at the regular meeting prior to the annual meeting.
   2. Additional nominations may be made from the floor of this meeting.
   3. Only a member of the Society, whose consent has been secured, shall be eligible for nomination for chairman.

C. Election of Chairman:
   1. The election of chairman of standing committees shall be held at the annual meeting prior to the election of officers and directors.
   2. A majority of votes cast shall constitute an election.

D. Duties of Chairmen:
   The chairman of each standing committee shall submit a plan of work to the executive committee for approval.

E. Vacancies in Chairmanships:
   If a vacancy occurs in the chairmanship of a standing committee, the executive committee shall be empowered to fill such vacancies.

F. Special Committees:
   Special committees may be created and appointed by the President or by the executive committee.

G. President Ex-Officio:
   The President shall be an ex-officio member of all committees except the committee on nominations.

Article XIII: AMENDMENTS

These bylaws may be amended at any annual meeting of the Vermont Geological Society by two-thirds of the members voting, due notice having been given each member of such proposed amendment at least four weeks before the annual meeting.

The Vermont Geological Society was founded in 1974 for the purpose of:

1. advancing the science and profession of geology and its related branches by encouraging education, research and service through the holding of meetings, maintaining communications, and providing a common union of its members;
2. contributing to the public education of the geology of Vermont and promoting the proper use and protection of its natural resources; and
3. advancing the professional conduct of those engaged in the collection, interpretation and use of geologic data.

To these ends, in its 7 year history, the society has promoted a variety of field trips, an exposition on Vermont geology, presentations of papers by both professional and student researchers, teacher's workshops, a seminar on water quality, a soils workshop and a seismic workshop. The society was also active in lobbying for continuation of the State Survey in 1975 and in selecting a successor to the retiring state geologist at that time. Other position papers have been prepared in response to issues of land use, professionalism and uranium prospecting. Four yearly meetings have become established: an all day fall field trip (followed by a banquet and the annual meeting to elect officers), presentation of professional papers in the winter, and in the spring, presentation of student research papers, and a teacher's workshop and field trip.

The society has two publications. The Green Mountain Geologist, a newsletter containing announcements and short articles, has been published quarterly since spring 1974. In October 1980, we published the first volume of Vermont Geology, a bulletin containing six of the papers presented at our winter meeting in February 1980. Future issues of this yearly publication will be based on the papers presented at winter meetings, but may also include other manuscripts about Vermont geology submitted for publication only.

The tentative schedule of meetings for 1981 is:

April 25 Presentation of student papers at Middlebury
September Teacher's workshop and field trip led by Ballard and Sandria Ebbett of Lyndon State College.
October Fall field trip and annual meeting. Glacial geology in northeast Vermont led by the Ebbetts.

Information about meetings or publications may be obtained by writing to the address below.

The Vermont Geological Society welcomes as members, persons interested in geology. Membership categories include: member, associate member and student member. For further information write to:

Stewart Clark, Treasurer
Vermont Geological Society
Box 304
Montpelier, Vermont 05602

albite-epidote-chlorite-actinolite schist. The Moretown is primarily a quartz-muscovite schist.

In this area the Brackett member is in contact with the Moretown and runs in two linear belts parallel to the major structural fabric of the Stowe. In addition, monomineralic pockets of chlorite occur along the contact suggesting hydrous alteration along fractures. The pelitic Stowe schist is also seen as small slices at least 20 feet wide within the Brackett member.

The Stowe Formation records an initial schistosity with three subsequent folding events and foliations. The Moretown member of the Mississquoi Formation shows a much less complex tectonic and metamorphic history. It does not record the initial schistosity or first folding event seen in the Stowe.

The metamorphic and tectonic features of the Brackett member and the Stowe show different histories. The Brackett member records a strong brittle deformation compatible with the first foliation in the Moretown.

Evidence suggests that the Brackett member of the Stowe, the Stowe, and the Moretown have tectonic boundaries.

VGS BUSINESS & NEWS

NEW MEMBERS

Welcome to the following people and organization who were accepted as members by the Executive Committee since the last issue of GMG:

Spafford Ackerly	Burlington, Vermont
Bibliotek der Bundesanstalt für Geowissenschaften und Rohstoffe	Hannover, Federal Republic of Germany
William Bosworth	Hamilton, New York
Jon P. Broderick	Shelburne, Vermont
Frederick Crowley	Springfield, Vermont
John T. Humphrey	Reading, Massachusetts
Alan Liptak	Potsdam, New York
John Pratt	Rutland, Vermont
John S. Warren	Marlboro, Vermont

AD HOC COMMITTEE ON APPLIED GEOLOGY

A forum for discussing problems in applied geology was initiated on April 6, when fourteen persons met at Middlebury College. The group consisted largely of consultant geologists and those working for the State. The principal topic at this meeting was the forthcoming changes in state policy regarding direct and indirect discharges of "unnatural" waters.

There was agreement on the need to have this forum established on a continuing basis, and to seek status with the Vermont Geological Society. By phone, President Ratté gave his approval to the creation of an ad hoc committee. Lance Meade (P. O. Box 133, Pittsford, 05763) agreed to accept written suggestions for topics of future meetings. The next meeting will be on May 4 at 7:30 p.m. at Middlebury College (Science Center, Room 420). Interested individuals are invited to attend.

Submitted by Brewster Baldwin

1981 NOMINATIONS

Pursuant to a recent bylaw revision, the Nomination Committee is charged to "report to the Executive Committee one month after the spring meeting, at which time additional nominations will be accepted from members submitted by prior mail addressed to the secretary". Nominations presented for election at the annual Fall Meeting are for: President, Vice-President, Secretary, Treasurer, and a 2-year term on the Board of Directors. Nominees must have been Vermont Geological Society members for at least one full year and should have given prior consent to a nomination. Send nominations to: VGS Secretary, Box 304, Montpelier, Vermont 05602 and mark the envelope "nominations". The Executive Committee will meet not earlier than June 2 to receive the nominations.

CALL FOR PAPERS WINTER 1982

The next Winter Meeting is already being planned and this is the first call for papers. Focus of the 1982 meeting will be a "Ground Water and Surficial Geology Symposium". Speakers do not have to be members of the Vermont Geological Society in order to present papers (although some speakers have subsequently joined VGS). Papers about Vermont geology with topics unrelated to the symposium are also welcome. If you can present a paper or know of someone else who might be willing to, contact Charles Ratté, State Geologist, Agency of Environmental Conservation, Montpelier, Vermont 05602 (802-828-3357).

MEMBERSHIP LIST - ADDITIONS

The following are changes or additions to the membership list which was originally printed in the Spring 1980 issue and amended in the Summer 1980 and Winter 1981 issues of The Green Mountain Geologist:

Spafford Ackerly	180 No. Willard, Burlington, VT 05401
Bibliotek der Bundesanstalt für Geowissenschaften und Rohstoffe	Postf 510153 3000 Hanover 51 Federal Republic of Germany
William Bosworth	Colgate University, Hamilton, NY 13346
Jon Broderick	P.O. Box 560, Shelburne, VT 05482
Frederick Crowley	17 Birch Ct., Springfield, VT 05156
John Humphrey	195 West St., Reading, MA 01867
Alan Liptak	Rt.#4, Cedar Court Apt.#10, Potsdam,NY 13676
John Pratt	Soil Conservation Service, Federal Building, 151 West St., P.O. Box K, Rutland, VT 05701
Steve Solomom	c/o General Delivery, Canmore, Alberta, Canada T0L 0M0
John Warren	Marlboro College, Marlboro, VT 05344
Philip Winner	7835 Grow Lane, Houston, TX 77040

VERMONT GEOLOGY REPORT

Nine manuscripts have already been received and in turn mailed out to the reviewers. A tenth manuscript is definitely promised and, it is hoped that yet another paper will be forth-coming before the press deadline. Within a month, the editorial committee may be able to give final approval to some of the manuscripts so that the job of typing text and pasting up copy can proceed throughout the summer. This is an encouraging sign that Volume 2 of Vermont Geology will again be ready to go to press early in the fall.

Sales of Vermont Geology, Volume 1, have been steady but slow. By now at least 50 copies have been sold and perhaps we will have been able to advertise it at GSA Bangor before this GMG goes to press.

EXECUTIVE COMMITTEE MINUTES

Minutes of the meeting held on Saturday, February 21, 1981

The meeting was called to order at 4:15 PM by C.A. Rattè, President. Those present were: C.A. Rattè, Fred Larsen, Rolfe Stanley, Stewart Clark, Jeanne Detenbeck and Lance Meade.

New Business: The application of John Pratt was approved. Correspondence from Sanborn Partridge initiated a discussion as to the availability of life memberships. After discussion, this was tabled for future consideration with the idea being left that advance dues payment is possible by making out a check specifying the pre-payment of X number of years.

It was suggested by Stewart Clark and approved by the committee that the dues will be increased to $10.00 in 1982. It was also noted that the publication, Vermont Geology, volume 2, will not be distributed free of charge to the members, but will be available for purchase.

Old Business: Discussion of possible By-law revision was concluded with no particular action being taken. The concern of maintaining the continuity of the officers was felt to be adequately taken care of by the present situation as long as the Vice-President knowingly is slated to be President-Elect and the present President becomes a member of the Executive Committee.

Respectfully submitted, Lance Meade, Secretary

WINTER MEETING REPORT

This year's Winter meeting was spared the worry of being snowed out because Vermont was in the midst of one of the most unseasonable February warm spells on record! Both sessions were well attended, and head counts at mid-session revealed about 55 persons in the morning and nearly 50 in the afternoon. Because a number of those attending the afternoon session were not present in the morning, probably more than 60 people attended the meeting at some time during the day. The papers were well received and many discussions, initiated by the talks, had to be cut off for lack of time. Brian Fowler was unable to present his paper because of a bad throat, but his manuscript will be printed in Vermont Geology, Volume 2. Lance Meade, moderator for the afternoon session, introduced that symposium with some remarks about the diversity that exists among geologists between the extremes of academic research and commercial application. Exerpts from his comments are reprinted in this GMG issue.

MINERAL OF THE QUARTER

Chalcopyrite $CuFeS_2$

Crystal form: Tetragonal system; crystals resemble tetrahedrons, usually have somewhat uneven faces and tarnish readily to brilliant iridescent colors.
Color: Warm gold
Hardness: 3 1/2 to 4
Specific gravity: 4.2
Fracture: Uneven, brittle
Composition: 34.5% Copper, 30.5% Iron, 35.0% Sulfur

Chalcopyrite is the most widespread copper mineral and a very important ore of copper. It is commonly found with the other sulfide minerals, e.g. pyrite, sphalerite, galena and pyrrhotite, in hydrothermally deposited veins. It also occurs in contact metamorphic deposits.

This mineral has been found in many areas in Vermont, where it has been brought into the country rock by the penetration of hydrothermal solutions rich in copper and iron. Examples of this may be found in:

Old gold prospects in Bridgewater
S.W. Vermont slate quarries
With hematite in Jasper in dolomite in the Parrot Jasper mine in Colchester
With pyrite in talc at the talc mine near Johnson
In the serpentine rock at the Vermont Asbestos Corporation mine in Eden.

Economic deposits were worked in the Connecticut River valley at the Ely mine near South Vershire and the Elizabeth mine in South Strafford.

An interesting new location where this mineral can be found is in the last road cut on the south side of Route 2 before it crosses the Lamoille River. Here the blasting which created the road cut has exposed fresh dolomite rock which varies from dark rose to buff in color. In some of the lighter colored dolomite, veins of chalcopyrite can be found. A clue often is the greenish color of the secondary mineral, malachite, which colors the rock around the sulfide ore. Good, small specimens of bright chalcopyrite golden masses and crystals can be found here.

Submitted by Ethel Schuele

THE APPLIED GEOLOGIST - A POINT OF VIEW

The diversity of papers that were presented in the afternoon session of the winter meeting of the Vermont Geological Society rather aptly shows the divergence of specialization that has occurred in the geological fields during the past 2 decades. Prior to the 1960's most geological scientists applied their knowledge in either mineral resources or to a lesser extent to engineering or hydrogeological problems. Recent legislation both on the Federal and State levels has created more of a demand for answers to geological problems in the areas of water supply and waste disposal than what had been needed in the past.

There are many different groups today needing answers to geological problems: engineers, accountants, managers (both business and government) and elected politicians (that set policy). These various groups hopefully seek out answers to their geological questions from geologists working in the field. If these practicing geologists can't supply the answers, then in the decision-making process, conclusions are drawn from insufficient data. Many times though, the geologist isn't able to adequately interject his answers into the decision-making process, and again, conclusions are drawn from insufficient data input.

Most all of the authors in the afternoon session are people who have been trained as geologists, and who have adapted themselves into the world of applied geology by becoming staff geologists, quarry and production supervisors or managers. The world that they travel is mostly outside of the world of academia, yet they must draw upon current geological concepts if they are going to adequately supply the answers to the questions that are being or should be asked.

The afternoon forum is hopefully going to be on-going in the VGS as it will give both the academic and applied geologists a chance to share ideas and understand the working environment that each group has to function in. One of the problems will be to keep the attention of each group. Many practicing geologists who have been out of touch with G.S.A. publications are out of step with a lot of current geological thought; as well as, many academic geologists are only slightly aware of the fact that there are other geological societies (ie. AIME) that have data banks of information in their publication divisions that may be applicable to their areas of study.

Another point, is that many practicing geologists - particularly in Industry - don't feel very comfortable writing a paper that conforms to academic standards - either in research or format. Many practicing geologists have had to concern themselves for too many years with other things (ie. management of men and machines) to keep up with academic research - yet they usually have had a lot of exposure to some real interesting geological phenomenon that the academic community should be aware of (ie. detailed mapping of fold structures in alpine type talc deposits).

We, in Vermont, through the VGS have a rather unique situation with both a small group of practicing geologists and academic/research geologists to keep the lines of communication open.

Excerpted & Paraphrased from Introductory
Comments to the Afternoon Session of
Applied Geology - by Lance Meade

PUBLICATIONS REVIEW

Occasionally the Green Mountain Geologist has printed information about new publications that might be interesting to members of VGS, and it will continue to do so when they come to our attention. However, there are a number of older publications about Vermont geology whose sources may not be familiar to some of our members new to Vermont. Many of these publications are listed in the new Bibliography of Vermont Geology (1980), which should be the first reference source for the serious student. To the best of my knowledge, all publications named below are still in print, and the prices are the most recent.

The greatest number of Vermont geology publications has been published by the Vermont Geological Survey, and they are available from: Vermont Department of Libraries, Geological Documents Section, 111 State Street, Montpelier, Vermont 05602. A complete listing, which includes quadrangle reports, economic geology reports and maps can be obtained from this address. A few interesting titles are:

Bibliography of Vermont Geology, 1980	$4.00
Welby, C.W., Paleontology of the Champlain Basin in Vermont, 1962	$3.00
Grant, R.W., Mineral Collecting in Vermont, 1968	$3.00
Bassett, T.D.S., A History of Vermont Geological Surveys and State Geologists, 1976	$3.00
Centennial Geologic Map of Vermont, 1961, scale 1:250,000	$4.00
Surficial Geologic Map of Vermont, 1970, Scale 1:250,000	$4.00

Please include payment with your order. Vermonters should add 3% sales tax.

The New England River Basins Commission's Lake Champlain Basin Study produced 36 reports, 30 of which are available from NTIS. A complete listing of these can be obtained from the VGS Editor or the Lake Champlain Basin Study, 177 Battery Street, Ice House, Burlington, Vermont 05401. Titles (and their NTIS numbers) which may be most interesting to geologists are:

PB293420/AS	Shoreline Erosion, Lake Champlain.	$4.00
PB293427/AS	A Lake Champlain Trophic Classification System	$5.25
PB293443/AS	Bibliography of Environmental Studies on Lake Champlain	$5.25
PB295612/AS	Limnology of Lake Champlain	$22.00

Prices are for papercopies which can be ordered from: National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161, or call 703-557-4650 and charge it with a credit card.

There are still some guidebooks left from the last New England Intercollegiate Geological Conference (NEIGC) held in Vermont in 1972 in Burlington. Copies at $6.00 a piece can be ordered from: Department of Geology, Perkins Hall, University of Vermont, Burlington, Vermont 05405.

Also from UVM is a booklet, University of Vermont Natural Areas by Louis Borie, 1977, available for $1.00 from: Environmental Program, The Bittersweet, 153 South Prospect, University of Vermont, Burlington, Vermont 05405. Ten natural areas (including a geologist's favorite, Red Stone Quarry), managed by UVM, are portrayed through location maps, pictures and text.

Vermont is included in two different regional geologic maps. The colorful Tectonic Lithofacies Map of the Appalachian Orogen, 1978, 1:1,000,000, compiled by Harold Williams is available from: Department of Geology, Memorial University, St. John's, Newfoundland, Canada for $20.00. Checks should be made payable to the Appalachian Research Fund. This map helps the student to develop a picture of the plate tectonic movements which have occurred in the Appalachians. An uncolored version is available for student development projects at $10.00.

Vermont is one of 9 states on the geological highway map of the Northeastern Region, which is map number 10 in the U.S. Geological Highway Map Series of the AAPG. Besides a geological map superposed on the road map, the map sheet contains charts of time and rock units, geological cross sections, a short geological history of the region by John Rodgers, physiographic, tectonic and glacial deposit maps, fossil and mineral localities and places of geologic interest. All this for $4.00 each from: The American Association of Petroleum Geologists, P.O. Box 979, Tulsa, Oklahoma 74101. There are 12 regional maps in this series.

Although no single volume contains an up-to-date geologic history of Vermont, Several available books partially fulfill this requirement. For nostalgic geologists, Zadock Thompson's 1853 edition of Natural History of Vermont,was reprinted in 1971 by C.E. Tuttle Co., Rutland, Vermont.

A Guide to New England's Landscape by Neil Jorgensen, originally published in 1970, was reprinted in 1977 by The Globe Pequot Press, Old Chester Road, Chester, Connecticut 06412. A paperback copy costs $5.95. Half of the book describes bedrock and glacial geology in so far as they have shaped the landscape. Following the discussion of each natural feature or process is a list of places to visit. The second half of the book describes the vegetation zones of New England.

The Nature of Vermont, by Charles Johnson, State Naturalist, was published in 1980 by University Press of New England, P.O. Box 979, Hanover, New Hampshire 03755 and costs $7.50 in paperback. Two chapters of this book contain a cursory geologic history and a description of the physiographic regions of Vermont. An appendix provides an extensive list of areas to visit. The remainder of the book is an engaging description of the natural communities of Vermont. (That includes the greenery that covers so much of the outcrops and is the bane of many field geologists!)

Northeastern Geology, a recently established journal reporting about research in our region, may sometimes contain Vermont articles. Two volumes have been published to date, volume 1, 1979 and volume 2 (2 issues), 1980. The combined cost of these two volumes is $13.00. Subscription to volume 3, 1981, scheduled to contain 4 issues, is now available for $15.00. Volume 3, number 1, already in print, contains proceedings of a symposium about The History of Geology in the Northeast. Publication of a symposium issue, Coastal and Nearshore Processes of the Northeast, will occur later this year. Orders should be sent to: Northeastern Geology, P.O. Box 746, Troy, New York 12180.

Our coevals in New England, The Geological Society of Maine, published their first issue of Maine Geology in 1979, and copies are still available for $2.85 from John R. Rand, Cundy's Harbor, RD 2 - Box 210A, Brunswick, Maine 04011. A second volume is scheduled for publication in October 1981 and will be announced in the GMG.

The Appalachian Journal and the Appalachian Bulletin also occasionally carry articles about the geology of Vermont. In fact, the June 1981 issue of the Journal will carry one by Chuck Ratté. These are publications of the Appalachian Mountain Club, 5 Joy Street, Boston, Massachusetts 02108.

Last, but not least, the VGS publications should be mentioned. Copies of Vermont Geology, volume 1, 1980, are still available for $4.00. Back issues of the Green Mountain Geologist can be purchased for $.50 an issue or $2.00 per volume. The Second Spring Field Trip Guide (the Champlain Thrust, 1978) is available from the VGS Editor. Cost to cover copying and postage is $1.50. The Third Spring Field Trip Guide (Lake Willoughby and Miller Run Valley, 1979 and 1980) can be obtained from Ballard and Sandria Ebbett, Lyndon State College, Lyndonville, Vermont 05851 and $1.25 should cover its costs. The 1980 Fall Field Trip Guide (Fred Larsen's Central Vermont glacial trip) will be available in the near future, but the cost is unknown at this time.

Finally, just for fun, there is a free brochure, "Outdoors on Lake Champlain", which is available from the Lake Champlain Basin Study (cited previously). This well-documented map of the lake locates recreation sites along both shores-beaches, boating accesses, campgrounds, bike routes and wild-life management areas. Monty Fischer was one of those responsible for this fine aid to recreation in the Champlain Valley.

Suggestions for additions to this list will be appreciated. Brief reviews of new publications which you would like to share with the Society will find their way immediately into the GMG.

The State Geologist's Report, which follows, lists publications and USGS open file reports that have become available during the past year.

Submitted by Jeanne C. Detenbeck, editor

STATE GEOLOGIST'S REPORT

For those members who might be interested, the following publications and open-file reports of the U.S. Geological Survey (covering Vermont) have become available during the past year. They are listed by sources. Please note that payment must accompany orders.

National Technical Information Service
U.S. Department of Commerce
Springfield, Virginia 22161

PB-80 145 295 Water resources data for New Hampshire and Vermont water year 1979. $13.00

PB-289 541 Water resources data for Massachusetts, New Hampshire, Vermont water year 1972. $13.25

PB-289 542 Water resources data for Massachusetts, New Hampshire, Vermont water year 1973. $14.50

PB-289 276 Water resources data for Massachusetts, New Hampshire, Vermont water year 1974. $15.50

Branch of Distribution
U.S. Geological Survey
1200 S. Eads Street
Arlington, Virginia 22202

Topographic map, metric conversion, scale 1:25,000 Northfield, Mass., N.H., Vermont. $1.25

GQ-1440 Geologic Quadrangle Map. Surficial Geologic map of the Northfield, Mass., N.H., Vermont quadrangle, by K.J. Campbell and J.H. Hartshorn. $1.75

GP-928 Aeromagnetic map of Conn., Mass, N.H., R.I., Vt. and part of N.Y. by Isidore Zietz, F.P. Gilbert and J.R. Kirby. Scale 1:1,000,000. $1.50

L-185 Land use and land cover, 1972, Glens Falls, N.Y., N.H., Vt. NTMS $1^o \times 2^o$, scale 1:250,000. $1.25

MF-1262 Seismicity map of the state of Vermont by C.W. Stover, L.M. Barnhard, B.G. Reagor and S.T. Algermissen, 1980. Scale 1:100,000. $0.50

Topographic map 7 1/2 minute, contours in feet, scale 1:24,000, Northfield, Vt. 1980. $1.25

Open-file Service Section
Branch of Distribution
U.S. Geological Survey
Box 25425
Federal Center
Denver, Colorado 80225

Open-file 80-978 Geology of the Belvidere Mountain Complex, Eden and Lowell, Vt. by M.H. Gale, 179p. Map scale 1:20,000. $46.25

Open-file 79-873 Bouguer gravity map of Lewiston, 1° x 2° quadrangle, Me., N.H., Vt. by W.A. Bothner, R.W. Simpson and R.P. Kucks. $2.50

Open-file 79-957 Bouguer gravity map of the Glens Falls 1° x 2° quadrangle N.Y., Vt., N.H. by R.W. Simpson, W.A. Bothner and R.P. Kucks. $2.50

Open-file 79-958 Bouguer gravity map of the Lake Champlain 1° x 2° quadrangle N.Y., Vt., N.H. by R.W. Simpson, W.A. Bothner and R.P. Kucks. $2.50

Open-file 79-970 Bouguer gravity map of the Albany 1° x 2° quadrangle N.Y., Vt., N.H. by R.W. Simpson, W.A. Bothner and R.P. Kucks. $2.50

Open-file 79-1524 Stress-relief borehole measurements before and after quarrying a block of Barre granite at Barre, Vermont by D.R. Miller and G.E. Brethauer $5.50

U.S.G.S. Eastern Mapping Center
(NCIC-E)
M.S. 536
12201 Sunrise Valley Dr.
Reston, Virginia 22092

78-417 Land use and land cover and associated maps for Lewiston, Me., N.H., Vt. NTMS 1° x 2°, 1:250,000 $1.25 per map.

79-976 Land use and land cover and associated maps for Albany, N.Y., Conn., Ma., N.H. 1° x 2°, scale scale 1:250,000, 4 maps. $1.25 per map.

State Geologist's Office
State Office Building Post Office
Montpelier, Vermont 05602

Radioactivity Map of Vermont, 1980 (includes a brief summary report, anomaly and occurrence map at scale 1:250,000, bibliography and analytical data sheets). $3.00

Charles Ratté
State Geologist

AT GSA - BANGOR

Over Maine seafood dinners, Chuck Ratté met for the first time with members of the advisory board to the State Geologist which was established in 1977 (see the Winter 1977 issue of GMG). Present were Fred Larsen, Rolfe Stanley, Lincoln Page, Christopher Hepburn and James Thompson. Chuck described the direction that the State Geologist job has taken under his guidance and the financial status of the office. Suggestions from the advisors concerned the necessity for resuming publications from the State Geologist's Office. VGS members should appreciate that our GMG has been the vehicle for reports from the State Geologist since Chuck took over the job.

The Geological Society of America will be 100 years old in 1988 and it has designated 1980-1989 as the Decade of North American Geology (DNAG). During this time, an ambitious project is underway to produce 23 volumes of regional synthesis of the geology of the North American plate. At Bangor, an open workshop was held to inform all members of the planning process for volumes pertaining to the Northeast and to discuss the problems involved. Three volumes were outlined - the Appalachian/Ouchitas region, the Precambrian and the Continental Interior. One problem which was almost immediately obvious was the possibility for overlap between volumes, but the organizers are more concerned, at present, with leaving out important information. Project leaders will engage the best experts to write each chapter, but each volume will not be just a collection of papers. Rather, a volume will be a collection of integrated chapters based on an outline, which it is hoped will serve as a model for future syntheses. Each volume is meant to be used as a workbook which will have the best information about North American geology, presented in an understandable way. In order to make this information available to the greatest number of geologists, GSA hopes to subsidize the cost through its newly formed GSA Foundation so that each volume will cost about $20.00.

MEETINGS

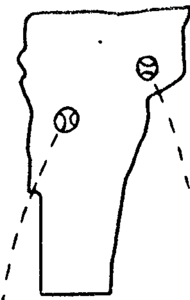
May 2	VGS Spring Meeting - details in this issue.
May 25-29	American Geophysical Union meeting in Baltimore, Md.
June	VGS Executive Committee receives nominations - see note in this issue.
June 5	Deadline for GSA Cincinnati papers - see details below.
Aug 1-2	Geological Society of Maine field trip. Don Newberg will conduct a trip in the Gardiner quadrangle and Dave Westerman will show Norumbega faulting in the Brooks area.
Nov 2-5	Annual meeting of the Geological Society of America and associated societies in Cincinnati, Ohio. NOTICE: VGS has received a stack of announcements and special abstract forms for this meeting. Abstracts are due in Boulder, Colorado by June 5, 1981. If you would like a set of these forms, contact the GMG editor, J.C. Detenbeck (Perkins Geology Hall, UVM, 802-656-3396).

GREEN MOUNTAIN GEOLOGIST
VERMONT GEOLOGICAL SOCIETY
BOX 304
MONTPELIER, VERMONT 05602

The GREEN MOUNTAIN GEOLOGIST is published quarterly by the Vermont Geological Society, a non-profit educational corporation.

FIRST CLASS

THE GREEN MOUNTAIN GEOLOGIST



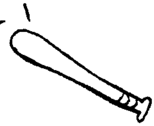
QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

SUMMER 1981 VOLUME 8 NUMBER 2

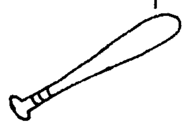
Don't miss the VGS

LATE-SUMMER DOUBLEHEADER

AUGUST 24 · APPLIED GEOLOGY FIELD TRIP



SEPTEMBER 18 · TEACHER'S WORKSHOP and FIELD TRIP



Read pages 3 & 4 for complete announcements

CONTENTS PAGE

PRESIDENT'S LETTER

Dear Members,

At a recent meeting of the executive committee of the society (July 22, 1981), the topic of establishing quality standards and evaluation criteria for papers published in our new Vermont Geology was the focus of our attention.

Through this letter I would like to introduce the results of the committee's deliberations and seek your comments and suggestions. Beyond the desire to have a quality production and a media in which all professional earth scientists working on Vermont or Vermont-related geological studies would be proud to have their work published, no specific standards were set. However, the following criteria were established for the purpose of evaluating papers which are submitted to the editorial committee for publication:

1.) The major context of the paper must relate to an accepted earth science discipline, and must involve Vermont geology but not necessarily restricted to Vermont geographical borders.

2. The paper must present some element of new information gathered either through research or observation and experience, or must be a compilation of information from a variety of sources presented in a creative fashion using new analytical and interpretive procedures.

3. Papers must be written in a clear, concise and well-organized style, and must show literary integrity and honesty through proper credit-giving and referencing techniques.

The executive committee appreciates your ideas and response.

Sincerely yours,

Charles A. Ratté

VGS SUMMER FIELD TRIP

TOPIC: BRISTOL-EAST MIDDLEBURY GRAVEL BENCH AND MIDDLEBURY AQUIFER

LEADERS: Robert Cushman, Hydrologist, Middlebury, and Brewster Baldwin, Middlebury College

DATE: Monday, August 24, 1981

PLACE: Mt. Abrahams High School, Bristol, VT. drive around on north side to parking lot on west side.

SPONSOR: VGS Ad Hoc Committee of Applied Geology

SCHEDULE: 9:00 A.M., briefing
9:30 A.M., depart
Morning will be spent looking at two or three gravel pits around the Bristol terrace and then driving south on VT 116 to vicinity of Palmer Springs, looking at one or two additional gravel pits. The purpose of this part of the trip will be to assess the probable origins of the gravels that make up the bench between Bristol and East Middlebury.

Afternoon will be spent in vicinity of Palmer Springs, looking at some gravel deposits, boulder deposits, possible sources of pollution of Middlebury aquifer, observation wells. The purpose of this part is to review the hydrogeology of the Middlebury Aquifer.

Trip will end about 3:30 P.M.

MAPS: Field trip stops will be within the area of the Bristol, South Mountain, and East Middlebury quadrangles.

LUNCH: Participants are responsible for their own lunches. We will have lunch in a gravel pit near the Abbey Pond trail. Those who wish can drive south and then east into Middlebury; there is an AW root beer stand south of town on U.S. 7. Meet after lunch at the East Middlebury airport (south of Palmer Springs, east of VT 116) at 1 pm, to continue the trip.

VGS TEACHERS' WORKSHOP

FIFTH ANNUAL VGS TEACHERS' WORKSHOP

The Vermont Geological Society Teachers' Workshop will be held at Lyndon State College, Lyndonville, Vermont 05851 on Friday, September 18, 1981 from 9:00 A.M. to 4:00 P.M. If you plan to attend, please send a note to:

Ballard and Sandria Ebbett
Lyndon State College

or phone:

802-626-9371 or 802-626-9769.

These are the days of computer models for the analysis of missle control systems or nuclear power plant automation. Perhaps students, and even the general public, would be more patient with the problems of constructing such models by looking into something more concrete - gravel pits between Lake Willoughby and Lyndonville, Vermont. The 1981 Teachers' Workshop will attempt to apply to this region several conflicting models that purport to describe the manner in which the last ice sheet retreated.

This is a list of models that various researchers in New England, New York and Quebec have found useful.

1) Pulsating retreat of an active ice margin.
2) Pulsating retreat of an ice margin where the active ice is separated from the ice margin by a half kilometer or more wide zone of stagnating ice.
3) Continuous retreat of an ice margin where the ice margin occasionally encounters valleys parallel to it that become temporary basins for glacial sediment.
4) Rapid retreat of an ice margin where it calves into a glacial lake followed by a temporary halt where the ice margin becomes grounded.
5) Thinning ice sheet over entire region separates into blocks as barriers to glacial flow are uncovered.
6) Stagnating ice sheet over entire region separates into blocks with the last blocks to completely melt concentrated in the major valleys.

Perhaps there would be less misunderstanding in the world if more of us appreciated how well all these models seem to work in at least parts of this region. Can they all be true? The best model will best predict the nature of the subsurface - an important matter for those interested in construction, farming, polution, land-use planning, water resources and gravel.

Submitted by Ballard Ebbett

VGS BUSINESS & NEWS

NOMINATION'S COMMITTEE REPORT

The nominations committee presents the following slate of officers for election at the fall 1981 annual meeting:

President	Fred Larsen
Vice-president	Chris White
Secretary	Larry Becker
Treasurer	Stewart Clark
Director - 2 years	Lance Meade

Names of chairmen of the standing committees are also presented:

Education	Ballard and Sandria Ebbett
Budget	Roger Thompson
Publications	Jeanne Detenbeck

Respectfully submitted,

Jeanne Detenbeck, Chairman
Philip Wagner
Bruce Watson

The Secretary received no additional names by mail.

SPRING MEETING REPORT

A wide variety of bedrock field studies was presented at the spring meeting by Middlebury College and University of Vermont students. The exchange during the question periods was lively, especially at the conclusion of the afternoon session when the audience had the opportunity to "help" interpret the COCORP seismic reflection data from southern Vermont. (Proposed were deep extension of the Champlain Thrust, extensive overthrusting of the carbonate as well as other wishful handwaving!) Brewster Baldwin and Barry Doolan presided over the sessions, while Sanborn Partridge, Fred Larsen, Chris White and Chuck Ratté served as judges. This years' winners were Valerie Kindred, a Middlebury College undergraduate, and Peter Tauvers, a graduate student from the University of Vermont. About 40 people attended the sessions throughout the day.

NEW MEMBERS

Welcome to the following people who were accepted as members by the Executive Committee since the last issue of GMG:

Shirley G. Knowlton	South Londonderry, Vermont
Dinah O'Sullivan Shumway	North Springfield, Vermont
Robert J. Dineen	Albany, New York

EXECUTIVE COMMITTEE REPORT

The committee met at noon on May 2, 1981 at Middlebury College. Present were C. Ratté, R. Stanley, F. Larsen, J. Detenbeck and S. Partridge.

Applications for full membership from Shirley Knowlton and Dinah O'Sullivan Shumway were approved.

C. Ratté expressed his concern about members who have not paid up their dues. He suggested sending a two-part card when dues are solicited. One part would be kept as a membership card, the other returned with the dues payment or returned with the request to have the name dropped from membership. S. Partridge suggested that the two-part card be enclosed with a return envelope. He further suggested that the year through which dues have been paid be printed on each address label. This date would provide a ready reminder for those whose dues are delinquent. It would also indicate the year through which dues have been paid should members choose to pay dues for several years ahead.

A review was made for the record of the committees that currently exist.

Standing committees are:
- Publications Committee which includes the Editorial Committee
- Education Committee
- Budget Committee

Appointed Committees:
- Nominations Committee

Ad hoc Committees:
- Professional Committee
- Ground Water Protection Watchdog Committee
- Applied Geology Committee

The process of nominating officers under the new bylaws was discussed. C. Ratté will mail the list of nominees from the nomination committee plus any write-in candidates to the members of the executive committee after June 2 for their approval. The list will be published in the summer GMG, the nomination committee selections separately from write-in candidates.

J.Detenbeck reported that 9 papers for Vermont Geology have been received, sent out to review, and some have been returned. The editorial committee should be able to meet to discuss them before the end of May. We may only print 300 copies of volume 2, because it has been learned that Northeastern Geology prints that number, and we probably will not sell any more than they will. We will have to charge VGS members for volume 2, probably cost plus postage.

It was suggested that the winter 1982 meeting be held in the Pavilion Auditorium in Montpelier. C. Rattè agreed to organize the meeting with the help of F. Larsen. R. Stanley suggested that we might obtain a keynote speaker. F. Larsen suggested that we put together information about preparing audio-visual materials for future speakers.

The Executive Committee met at 1 P.M., July 22, 1981 in Montpelier. Present were C. Rattè, F. Larsen, L. Meade and J. Detenbeck.

The two-part membership card (to be mailed when yearly dues are requested) which C. Rattè had designed was approved and he will order 400 for future use starting in 1982.

Guidelines for criteria to evaluate manuscripts submitted for publication in Vermont Geology were discussed. Chuck read comments he had received in response to a letter mailed to the executive committee in June. Those present hammered out the wording for a set of guidelines which are published in the President's Letter in this issue of the GMG. Please take time to read them.

The Geological Society of America, as part of its Decade of North American Geology program, is initiating a project to prepare field guides to outcrops known to local geologists in each of the GSA regions. Since a number of VGS members are interested in establishing a set of Vermont guidebooks, Jeanne Detenbeck is going to investigate the possiblility of VGS cooperation with GSA.

GEOLOGIC PROJECTS IN VERMONT

If you or anyone you know are (or intend to be) engaged in any geologic work (research, investigations, consulting, etc.) in the State of Vermont or directly related to the State, I would appreciate it if you would complete the following questionnaire for each project being conducted. Please return to:

Dr. Charles A. Ratté, State Geologist
Agency of Environmental Conservation
Montpelier, Vermont 05602

NAME & AFFILIATION: ____________________

ADDRESS: ____________________ PHONE: __________

COWORKERS & THEIR AFFILIATION: ____________________

ADDRESS: ____________________ PHONE: __________

TITLE & BRIEF DESCRIPTION OF PROJECT: ____________________

____

STARTING DATE: __________ COMPLETION DATE: __________

LOCATION OF PROJECT:

LOCATION OF PROJECT: ____________________

WHERE WILL THE RESULTS OF THIS WORK BE AVAILABLE?: ____________________

____

WILL YOU KEEP FIELD NOTES ON FILE?: ____________________

DO YOU INTEND TO PUBLISH THE WORK?: ______ WHERE?: ____________________

WOULD YOU MAKE A COPY AVAILABLE FOR THE FILES OF THE VERMONT STATE GEOLOGIST AT OUR EXPENSE?: ____________________

HOW WOULD YOU CATEGORIZE THIS WORK? (CHECK APPROPRIATE CATEGORY)

- [ ] Economic Geology
- [ ] Engineering Geology
- [ ] Environmental Geology
- [ ] Igneous Geology
- [ ] Metamorphic Geology
- [ ] Structural Geology
- [ ] Other (Specify) ____________________
- [ ] Hydrology, Geohydrology, Hydrogeology
- [ ] Mineralogy, Geochemistry
- [ ] Geophysics
- [ ] Glacial, Surficial, Geomorphology
- [ ] Paleontology, Historical Geology
- [ ] Sedimentary Geology, Stratigraphy

Please provide me with an address or forward this questionnaire to anyone you know who is conducting geologic work in Vermont.

Thank you,

Charles A. Ratté, State Geologist

STATE GEOLOGIST'S REPORT

For your information I present the following list of geologic work and research being conducted in the state, which has recently come to my attention. The list is by no means complete. If you know of any geologic work being conducted in Vermont, please have the project leader or researcher return the questionnaire stapled in the center of this copy of the GMG to my office.

Federal Government:

U.S.G.S.

- CUSMAP project (Conterminous U.S. Mineral Assessment Program) Lewiston 1° x 2° quadrangle, R. Moench, project chief.
- Postglacial uplift in the northeastern U.S.A., C. Koteff, project chief.
- Tectonics of New England States, W. Hamilton, project chief.
- CUSMAP project, Glens Falls 1° x 2° quadrangle, E. Brown, project chief (start October 1981).
- Rare II and Wilderness Area Mineral Resource Assessments, J. Slack, project chief.
- Vermont ultramafic belt, Rolfe Stanley, project chief.
- Geology of the Lewiston 1° x 2° quadrangle, Norman Hatch, project chief.
- Massive sulfides of New England, J. Slack, project chief.

Colleges and Universities:

- Comparative metamorphic and tectonic history of the Berkshire massif and the Green Mountain massif, Ohio State University, S.B.Mukasa.
- Structure, stratigraphy and metamorphism of the Jamaica area, Johns Hopkins University, P. Karabinos.
- Stratigraphy and structure of the Western Taconic Allochthon, SUNY Albany, W.S.F. Kidd.
- Trace element (REE) study of the Standing Pond volcanics, Boston College, J.C. Hepburn.
- Structural and lithologic interpretation of the bedrock geology in the vicinity of Montpelier, SUNY Albany, T.Ray.
- Petrologic and diagenetic aspects of the Dunham Formation, Rensselaer Polytechnic Institute, G. Greiner.
- Petrologic analysis of high grade metamorphism associated with massive sulfides of Orange County, University of Cincinnati, M.Annis.
- Mesozoic features of New England, Purdue University, J. Gregory McHone.

Submitted by Charles Ratté
State Geologist

STUDENT ABSTRACTS

Several students were unable to present the results of their Senior research at our annual spring meeting. For your information, we are pleased to present abstracts of their work at this time.

FACTORS AFFECTING SHORELINE EROSION OF SOUTHERN LAKE CHAMPLAIN

Davis, Christopher W., Department of Geology, Middlebury College, Middlebury, Vermont 05753

Ten sites on the Vermont shoreline of southern Lake Champlain were examined to determine the major geologic and physical factors affecting erosion. Severe shoreline erosion is a combination of lake and land-related processes. Wind driven waves during seasonal periods of high levels is the major cause of lake-related erosion. The land-related processes of freeze thaw, overland wash, and ground water saturation are the major causes of bank erosion and failure. Soil creep, sheet sliding, and slump failure of unconsolidated shoreline material are the most severe forms of bank recession. Unconsolidated clay sediments are the most vulnerable shoreline materials to erosion processes. Low-lying wetland areas, and steep bedrock slopes are the most resistant to erosion processes. The amount and type of bank vegetation has a significant effect on increases or reductions of shoreline erosion.

The estimated rate of bank recession in the southern lake is 2 to 5 feet per year (maximum 15 feet per year). Slope angles of unaffected banks range between 0 and 35 degrees. Banks undergoing bank recession and erosion have slope angles between 45 and 55 degrees. Shoreline erosion in the southern lake was found to exceed previous estimates of bank recession rates.

SEDIMENTOLOGY OF SELECTED OUTCROPS OF THE POTSDAM SANDSTONE, EASTERN NEW YORK STATE

Luneau, Barbara A., Department of Geology, University of Vermont, Burlington, Vermont 05405

The Upper Cambrian Potsdam Sandstone is a basal sedimentary deposit on the surface of the Adirondack dome. Field studies of selected eastern New York State exposures suggest that the Potsdam Sandstone was deposited in a diverse number of depositional environments ranging from fluvial coastal plain to marginal marine intertidal and subtidal.

Samples from two outcrops of the Potsdam Sandstone were subjected to detailed petrographic studies. Application of bivariate and multivariate analysis to the petrographic data indicates that it is possible to identify and segregate these depositional environments where they are characterized by depositional processes which vary significantly in rate and intensity.

The results of field, petrologic and petrographic studies can be used to make some general assertions about tectonic conditions during the deposition of the Potsdam Sandstone.

POST-GLACIAL SEDIMENTS ALONG SOUTHERN LAKE CHAMPLAIN

Potter, William G., Department of Geology, Middlebury College, Middlebury, Vermont 05753

Seven sites along the Vermont shore of southern Lake Champlain were examined for sediment stratigraphy, grain size, and microfossil content. The predominant lithology at five sites was laminar varved clay, which was deposited in quiet, deep Lake Vermont waters. All sites contained ice-rafted stones at various levels. Four sites exhibited silt beds very low in the section which were contorted as a result of post-Lake Vermont slumping, and the less cohesive nature of the silt. These beds were deposited in very early Lake Vermont time, when the lake was small. Two sites had layers of sand alternating with clay beds, a result of proximity to small mountains on the New York side of the lake. One site contained a layer of unsorted material, possibly from a minor glacial readvance. No microfossils were found, thus no marine sediments could be positively identified. The lack of microfossils is due to the low salinity of the extreme southern end of the Champlain Sea.

ROCK OF THE QUARTER

Slate

Slate is a metamorphic rock (one changed by the effects of heat and pressure) in which the clay minerals have been transformed into small mica flakes. These flakes give the now-hardened slate rock a luster quite different from the original shale from which it formed. These mica flakes, interlocked by quartz or chlorite, align themselves in parallel positions at right angles to the direction of the pressure exerted by mountain-building forces in the earth's crust. This parallelism of the mica flakes is responsible for the tendancy of the slates to split easily in a single direction. This property of slate is known as "slaty" cleavage. Slate is the only building stone which can be made into large pieces with a naturally cleaved surface. This property early led to its use for roofing and floor tile and flagging, as well as blackboards. Today, it is also used for billiard table bases, window sills and architectural panels. Crushed slate is used in making asphalt roofing tile aggregate, tennis court surfaces and road construction.

According to the Study of Slate Mining Industry of Vermont/New York published by Arthur Little Company in October 1980, the slate belt in these two states is an area 8 to 10 miles wide and about 25 miles long. The slate deposits vary from Cambrian to Ordovician in age, and are found in klippen (bodies of rock completely surrounded by a fault) in the Taconic range. The operating quarries are found in a band 1 1/2 miles wide extending from Fairhaven to West Pawlet along the Vermont-New York border. This region is unique in the US slate industry in that it alone produces green, purple, mottled and red slate. The red slate is found only on the New York side of the slate belt. Much of the slate is quarried in Vermont and processed in New York. The report indicates that descendants of the Welsh slate makers, who came to furnish the skills and manpower to begin the industry in 1892 and later, are still the owners and operators of these quarries. It is a depressed industry today for various reasons. It suffers from lack of capital, competition for labor and competition for markets. At present, the industry accounts for 5 percent of Vermont's total value of manufacture for the stone industry (marble, granite, talc, slate, etc.). The purpose of the Arthur Little study was to recommend ways to improve the profitability of the slate industry. Several suggestions were made, among them: increasing the use of modern technology in the quarrying process in order to improve the yield from 15 to 24 percent, cooperative marketing, and the formation of a slate manufacturer's association.

A large number of the quarries are bounded by the triangle formed by routes 30, 4 and 22A, between Fairhaven, Castleton Corners and Poultney. The quarries can be seen from route 30 because they have large wooden derricks, and they can be reached by various dirt roads. They are interesting to visit, and it is no problem to collect a specimen from their extensive waste piles. As always, care should be taken to stay away from quarry walls.

Submitted by Ethel Schuele

A Summer Amusement

The following abstract was the collective project of some University of Vermont graduate students, written during end-of-semester madness in spring 1981 and presented to VGS. Names of the authors have been changed to protect their future professional reputations. VGS (and the UVM Geology Department for that matter) takes no responsibility for the observations and conclusions presented herein. Enjoy!

THE NATURE OF THE SWEETSBURG-BONSECOURS CONTACT IN SOUTHERN QUEBEC

E. (Everest) Rupta and R. Sadmirth

An area of one square mile has been mapped in detail in southern Quebec over the last three years. Although outcrop control was poor, this area has been shown to be an extension of the Brevard zone of the southern Appalachians.

The area consists of a complex of magnetiferous greywackes, black phyllites and quartzites, and intercalated carbonates of the Ottauquechee-Sweetsburg-Bonsecours sequence, along with several ultramafic bodies.

Detailed petrography and SEM studies have demonstrated the similarity between the ultramafics here and the Belvedere Mountain amphibolite. Furthermore, preliminary field evidence indicates that the ultramafics are intrusive, thus demanding a similar origin for their correlative rock types in Vermont.

A multivariant discriminant function analysis, along with mapping of the vertical and lateral lithofacies arrangement, has been performed on the area's severely metamorphosed metasediments to determine their petrogenesis. Several important results follow.

With broad-reaching implications for Vermont and Mexico, a new Permian crinoid fossil locality has been found in carbonates of the Ottauquechee Formation, which previously had been believed to be unfossiliferous (R. Stanley, pers. comm., 1958). Interestingly, footprints of a deep-water reptile believed to be an ancestor of Champ, the Lake Champlain monster (A. Hunt, pers. comm., 1982), were located in the same horizon as the crinoids. These findings suggest previous workers may have been wrong in their original stratigraphic correlations. Furthermore, petrographic evidence conclusively proves that these carbonates are actually primary dolomites.

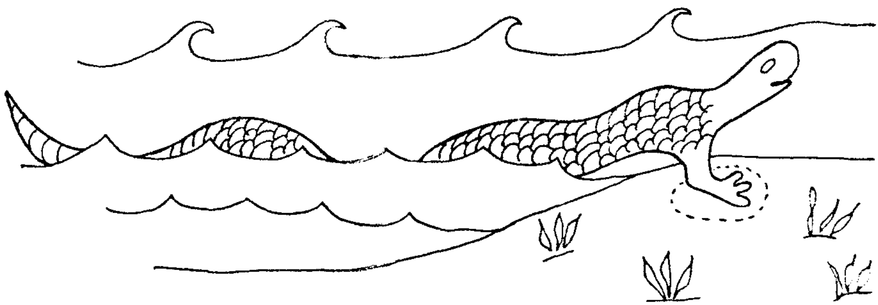
Preliminary field evidence and a detailed structural analysis (done over the last three years) have revealed no fold generations. Indeed, all foliations are mimetic.

Combined petrographic and field evidence, along with preliminary radiometric age data, indicate that what were formerly thought to be Mesozoic dikes are actually Pleistocene kimberlites and can in rare instances be seen cutting till deposits.

Airborne input EM, flown two weeks ago by Pete Sainsbury, has disclosed an undiscovered massive tetrahedrite deposit astride the fault zone.

It is therefore concluded that the Baie-Verte-Brompton-Brevard lineament is a major transcurrent fault bringing rocks of the Yucatán Penninsula into juxtaposition with the Permian carbonate bank of North America.

The authors recognize the paramount importance of this work in modifying current plate models of the Appalachian mobil belt.



MEETINGS

AUG 24 Monday — VGS Summer Field Trip to Bristol - East Middlebury gravel bench and Middlebury Aquifer. Meet at 9:00 A.M. in parking lot of Mt. Abrahams High School Bristol, Vt. Sponsored by the VGS Ad Hoc Committee of Applied Geology. See page 3 of this issue of GMG for details.

SEPT 18 Friday — Fifth Annual VGS Teachers' Workshop. Models of ice sheet retreat illustrated in gravel pits between Lake Willoughby and Lyndonville, Vt. Trip leaders are Ballard and Sandria Ebbett of Lyndon State College. Workshop runs from 9:00 A.M. to 4:00 P.M. See page 4 of this issue of GMG for details.

*** R.S.V.P. ***

SEPT 18-20 — New York State Geological Association, 53rd Annual Meeting at SUNY Binghamton. Ten field trips. For information contact: Donald Coates, NYSGA, Dept. of Geological Sciences, SUNY, Binghamton, N.Y. 13901 (607)-798-2453.

OCTOBER — VGS FALL FIELD TRIP AND ANNUAL MEETING
Time and place to be announced in Fall GMG

NOV 2-5 — Annual meeting of the Geological Society of America and associated societies in Cincinnati, Ohio.

GREEN MOUNTAIN GEOLOGIST
VERMONT GEOLOGICAL SOCIETY
BOX 304
MONTPELIER, VERMONT 05602

The GREEN MOUNTAIN GEOLOGIST is published quarterly by the Vermont Geological Society, a non-profit educational corporation.

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Charles A. Ratte
10 Independence Green
Montpelier, VT 05602

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THE
GREEN MOUNTAIN GEOLOGIST

QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

FALL 1981 VOLUME 8 NUMBER 3

ANNOUNCING

SATURDAY, OCTOBER 24, 1981

THE FALL FIELD TRIP

(Landforms SE of Willoughby Lake)

&

DINNER & ANNUAL MEETING

(Cutter Inn at Burke Mountain)

turn to page 3 for details

CONTENTS PAGE

PRESIDENT'S LETTER

Dear VGS members,

It is interesting to read the newspapers these days and learn about all those frightening things that are going to happen to the environment now that Ronald Reagan is President and is cutting budgets and trimming the federal (and state) bureaucracies, and now that James Watt is secretary of the Department of the Interior (and claimed to be an anti-environmentalist), who, in my estimation, apparently recognizes a need to strike a balance between environmental issues and real national needs (which by the way does not mean an end to environmental protection). People seem to forget that we still live in a democracy. With all of the dire forecasts of impending irreversible degradation of the environment made by intelligent people in our land, one wonders who it was and why it was that anyone voted for Ronald Reagan in the first place? The majority of the American people did, that's who! WHY may be more difficult to analyze but the answer may be in what the WHO's are saying to those concerned with environmental protection (and lord knows most geologists are basically concerned with the proper use of the environment). To me what is being said is that maybe, just maybe the environmental movement of the 70's got carried away with its own momentum. And perhaps, just perhaps overstepped some real legitimate bounds. For instance, the persistent efforts to tie up huge acreages of Alaskan and conterminous U.S. federal lands for single purpose, Wilderness category use in a nation fraught with dealing with OPEC nations' oil prices and a nation seeking independence in the production of energy and other strategic mineral resources, doesn't make much sense. The time, energy and money spent on this one issue by the U.S. Congress must have soured many legislators, and quite likely the continued pressures by environmental preservationists may have been the proverbial "straw". History is also beginning to raise some eyebrows, for instance the construction and existence of the Alaskan Oil Pipeline appears not to be turning out as an environmental disaster as was predicted. So what is it all about, do the actions of the Reagan administration signal doom to programs dealing with rational and real environmental issues and problems? I think not. Are we seeing the beginning of an environmental protection "backlash"? Perhaps, if we're not careful. However, I believe President Reagan, Secretary Watt and others are saying that no government can or should be expected to do everything for all people, and further that that which government does attempt to do is often the least effective and efficient way to do it. Furthermore I think they are also saying "let's slow down and take another look at things and come back reinforced in a new com-

(continued page 4)

VGS FALL FIELD TRIP
AND ANNUAL MEETING

TOPIC: Landforms southeast of Willoughby Lake suggest to the field trip leaders a <u>complete</u> morphosequence (see Larsen, *Green Mountain Geologist*, Fall 1980, pg. 4-5 or Koteff and Pessl, *U.S.G.S. Prof. Paper 1179*, 1981, 20 p.) that formed when the surface of a late Wisconsin ice sheet was well below the present cliffs.
Note: Bedrock at Willoughby will be hard to ignore.

LEADERS: Ballard & Sandria Ebbett

DATE: Saturday, October 24, 1981

PLACE: Lyndon State College. Follow signs from the post office in downtown Lyndonville.

SCHEDULE:

- 9:00 A.M. Refreshments available in Geology Room, Science Wing, Lyndon State College.
- 9:30 A.M. Depart for Willoughby by bus or car.
- 12:30 P.M. Bring your own lunch. We will eat at the south end of Willoughby Lake.
- 5:00 P.M. Cutter Inn at Burke Mountain Bar opens.
- 6:00 P.M. Dinner
  Menu: Scrod $11.25
  Pot roast or roast duck $12.50
  Coq au Vin $10.75
  (Prices include complete dinner, tip and state tax.)
- 7:00 P.M. (about): Annual Meeting

RESERVATIONS: Fill out the form in the center of this issue and mail with your check payable to "Vermont Geological Society" to:

The Ebbetts
Lyndon State College
Lyndonville, Vermont 05851

mitment to those issues that are really important to the national effort". In other words it's a way of saying "put your money where your mouth is". And unless you were not listening during the last presidential campaign, you should have known what Reagan's mouth was saying. So I look on these anticipated "tougher times" as a new challenge, a real test for those who claim to be concerned about their environment. Do you only act if Uncle Sam has a few easy bucks to hand out or do you get busy on your own? For a change, look no farther than to yourself and your own actions for some of the solutions. Evaluate environmental issues with perspective and rational thought, and then use the democratic system to make it work. After all our presidents and their administrations only reflect the national majority's desires and historically have proven to be quite ephemeral. If the environment is worth protecting, it will be protected, just hang in there and do your part.

Respectfully yours,

Charles A. Ritte

VGS BUSINESS & NEWS

VOTING INFORMATION

Members present at the annual meeting will be asked to approve the slate of officers for 1981-1982 and also chairmen of the standing committees. In addition, your approval of an increase in yearly dues from $8 to $10 will be requested. The upcoming postal increase, as well as other recent ones, have been cause of consternation to out treasurer. If you will not be able to attend the annual meeting, please mail in you absentee ballot which is enclosed in the center of this issue of GMG.

NEW MEMBERS

We welcome those who were accepted as members by the Executive Committee since the last issue of GMG:

James Hall	Randolph, Vermont
Nancy Jannik	Waltham, Massachusetts
Jeffrey Pelton	Springfield, Vermont
Preston Turner	Berlin, Massachusetts

MEMBERSHIP

The treasurer reports that so far in 1981, VGS has admitted 21 new members. Our mailing list now includes a total of 113 individuals and organizations.

REPORT OF THE LATE SUMMER FIELD TRIPS

The applied geology field trip on August 24th was a great success with at least 20 in attnedance. Carl Koteff, a glacial geologist for the U.S.G.S. joined us for the day, and a number of representatives of the Village of Middlebury attended the afternoon session. The group assembled on the Bristol Delta and proceeded to a pit on the west side where lake bottom sediments were exposed. Strong evidence was seen for the presence of retreating ice in the valley below Bristol as well as remnants of melting ice in the mountains to the east. During the day we saw several exposures of ice contact landforms, including a spectacular exposure of ice-contact-stratified drift east of the Middlebury airport. At the end of the afternoon, Larry Becker discussed his study to determine aquifer protection areas for the Palmer Springs and East Middlebury wells.

The teacher's workshop on September 18 was treated to clear weather, and although attendance was small, the Ebbetts report that the trip went well.

FROM THE EDITOR

Late this August, in a flurry of activity, I was offered and accepted a full-time position as instructor of geology at Norwich University in Northfield, Vermont. I am delighted to be professionally employed again and to be working with Fred Larsen here. Those of you who teach will understand that in the first month I have found little extra time to work on Vermont Geology. I have not changed my committment to its publication, however, and I can now find some free time to assemble the manuscripts for publication. Volume 2 of Vermont Geology will be published this fall. It appears that it will again contain six papers.

As always, I solicit your comments and contributions to GMG. Please direct correspondence to:

Jeanne Detenbeck
Earth Science Department
Norwich University
Northfield, Vermont 05663

THE ORIGIN OF QUECHEE GORGE

Quechee Gorge in Hartford, Vermont is a spectacular chasm almost half a mile long and 140 feet deep. The gorge is notable for its straightness and north-south orientation, unusual features for Vermont streams. Like many other river gorges in the Northeast, Quechee Gorge is likely to be a post-glacial feature, perhaps cut back from a "hanging valley".

I recently visited the gorge to look for some lamprophyre dikes mentioned in an 1894 paper by J.F. Kemp. Having scrambled down to the river from the west path north of Rte. 4, it became apparent that a large mafic dike runs down most of the length of the gorge, along its west wall and partially under the river. The dike is oriented around 5 to 10 degrees east of north, dipping easterly about 62 degrees, and is up to 220 cm wide. The phyllitic cleavage of the country rock strikes nearly the same direction but is not so steeply dipping to the east.

Although covered with pale-green lichens, the dike is well exposed along the west wall of the gorge under the Rte. 4 bridge. It is also easily seen from the picnic area on the east side of the gorge north of Rte. 4. The dike is a variety of augite camptonite, and is probably a member of the Early Cretaceous New England-Quebec magma province.

The gorge has certainly formed by the rapid erosion of the dike, with the west wall following the dike and the east wall a more vertical river-cut cliff. A famous example of another gorge formed by dike erosion is The Flume in the White Mountains of New Hampshire. There are several other streams in Vermont which follow mafic dikes. The Lewis Brook gorge north of Poultney is one of the more interesting, although smaller than Quechee Gorge. I hope to do some work in the future on the geomorphic expressions of Mesozoic features in northern New England. Please contact me if you know of other examples.

Submitted by
J. Gregory McHone
Geology Dept., I.U.P.U.I.
Indianapolis, Indiana
46202

A

Absentee Ballot

OFFICERS
(vote for one for each office)

President	Fred Larsen	____
Vice President	Chris White	____
Secretary	Larry Becker	____
Treasurer	Stewart Clark	____
Director-2 yrs.	Lance Meade	____

Chairmen of standing committees

Education	Ballard & Sandria Ebbett	____
Budget	Roger Thompson	____
Publications	Jeanne Detenbeck	____

Do you approve the increase of dues to $10.00 per year?

____ yes ____ no

Please return in an envelope with the word "ballot" in the lower left hand corner and your name and address on the upper left corner. Mail it to:

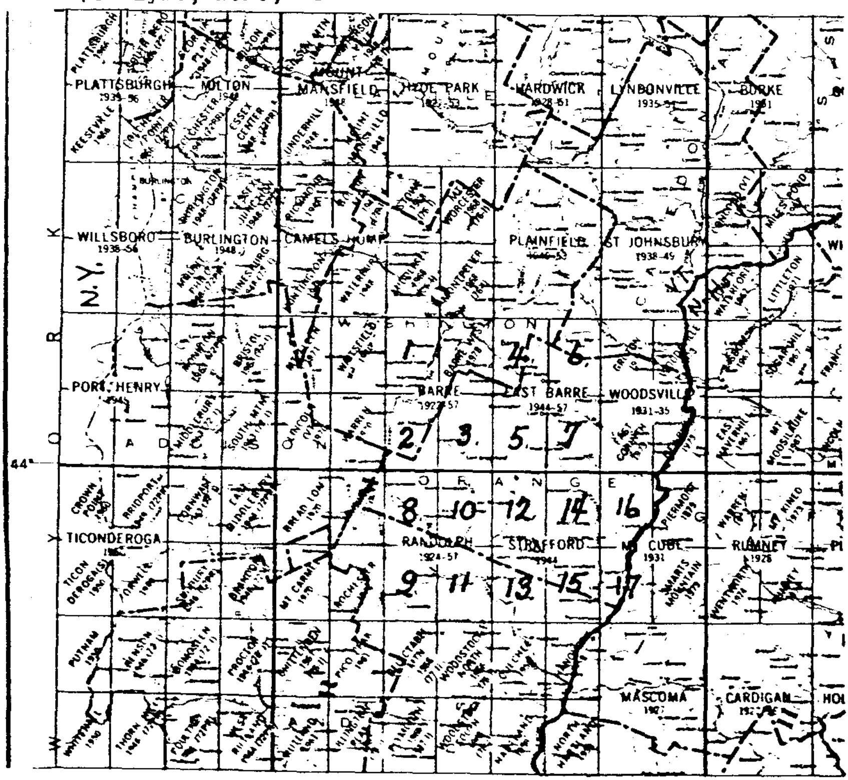
Vermont Geological Society
Box 304
Montpelier, VT 05602

before October 23, 1981.

STATE GEOLOGIST'S REPORT

The following 7 1/2 minute, U.S.G.S. topographic quadrangles have recently been published and are available for sale from U.S.G.S., the State Geologist's Office, or private vendors (see index sheet).

1. Northfield, VT (note there is also a Northfield Mass., Vt., N.H. quad)
2. Roxbury, VT
3. Brookfield, VT
4. Barre East, VT
5. Washington, VT
6. Knox Mountain, VT
7. West Topsham, VT
8. Randolph, VT
9. Bethel, VT
10. Randolph Center, VT
11. South Royalton, VT
12. Chelsea, VT
13. Sharon, VT
14. Vershire, VT
15. South Strafford, VT
16. Fairlee, VT
17. Lyme, N.H., VT



LEGISLATION - FRAGILE AREAS

The following list of fragile areas have been nominated initially to the Agency of Environmental Conservation by the Fragile Areas Committee (of which Chuck Ratte' is a member). The areas have been approved by the Secretary, Brendan Whittaker, and have been sent for final approval to the Legislative Committee on Administrative Procedures. Comments should be addressed to this committee at the State Capitol, Montpelier.

AREAS WITH COMBINED FEATURES
(see site description for classification categories)

A. <u>Combined Features</u>
1. Mt. Mansfield Alpine Area
2. Camel's Hump Natural Area
3. Lake Willoughby Natural Area
4. Smugglers Notch
5. Missisquoi River Delta
6. Moose Bog

PHYSICAL FEATURES

B. <u>Bedrock Features</u>
1. Lone Rock Point
2. Chazyan Coral Reef
3. Quechee Gorge
4. Texas Falls
5. Weybridge Cave

C. <u>Surficial Features</u>
1. Miller Brook Cirque

D. <u>Aquatic Features</u>
1. Shelburne Pond

BIOLOGICAL FEATURES

<u>Flora</u>

E. <u>Alpine Communities</u>
1. Mt. Mansfield Alpine Area (A1)
2. Camel's Hump Natural Area (A2)
3. Lake Willoughby Natural Area (A3)
4. Smugglers Notch (A4)

F. Forest Communities
1. Cambridge Pines
2. Canfield-Fisher Memorial Pines
3. Lord's Hill Northern Hardwoods
4. Gifford Woods
5. Maynard Miller (Vernon) Black Gum Swamps

G. Marshes
1. Little Otter Creek Marsh
2. Barton River Marsh

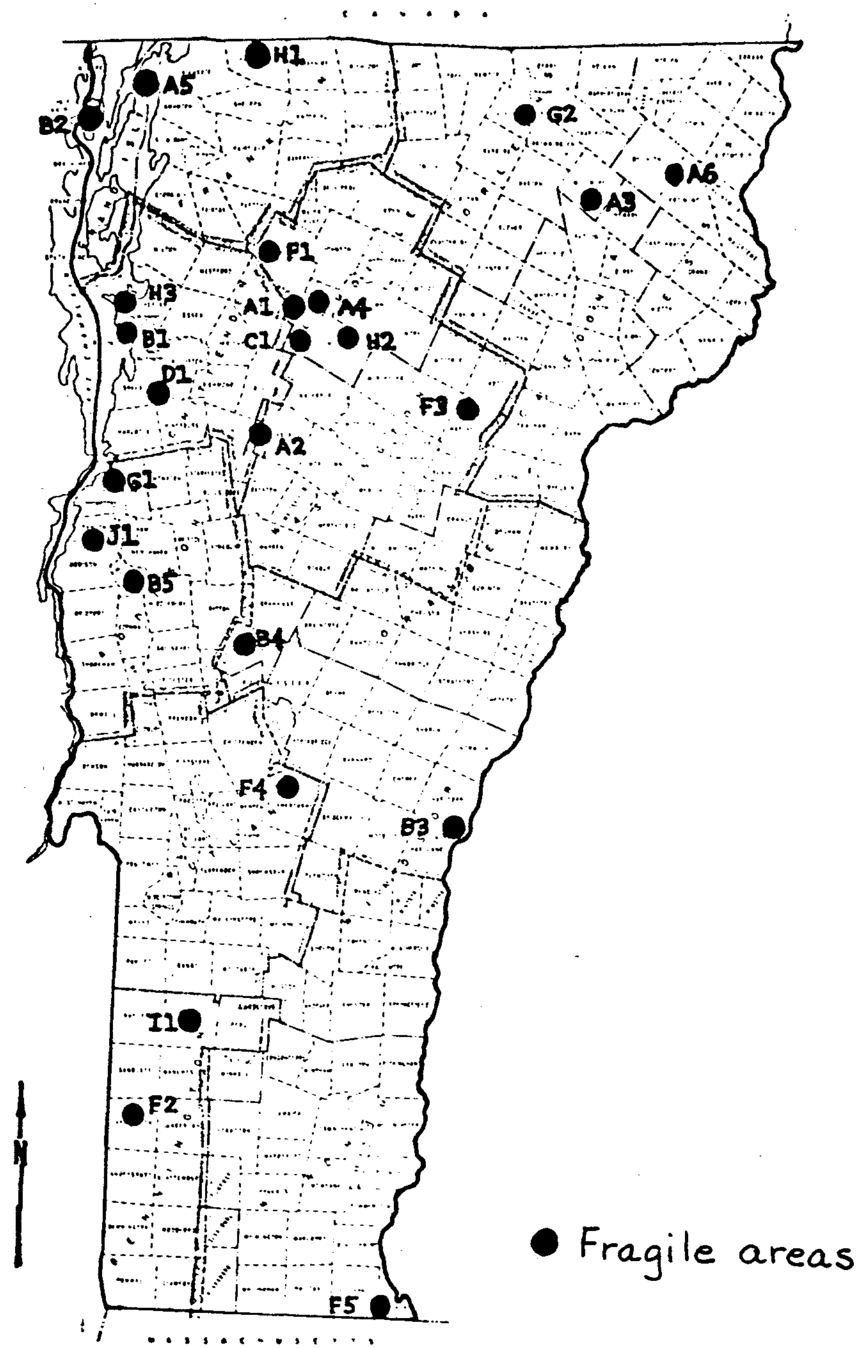
H. Peatlands
1. Franklin Bog
2. Molly Bog
3. Colchester Bog

Fauna

I. Habitats for Endangered Species
1. Dorset Bat Cave (Green Peak Cave)

J. Critical Habitats for Restricted Species
1. Dead Creek Waterfowl Area

See page 10
for location map


H1
A5
B2
G2
A6
A3
F1
H3
A1
A4
B1
C1
H2
D1
F3
A2
G1
J1
B5
B4
F4
B3
I1
F2
F5
N
Fragile areas

PUBLICATION

Proceedings: The Caledonides in the USA, 1980, David Wones, editor, Virginia Polytechnical Institute and State University, Memoir 2 is available for $22 ($20 prepaid). Send order to:

Department of Geological Sciences
4044 Derring Hall
VPI & SU
Blacksburg, Virginia 24061

MEETINGS

Oct. 16-18 NEIGC 73rd Annual Meeting at University of Rhode Island, Kinston R.I. 02881. (At this late date call 401-792-2170 for information about registration.)

Oct. 24 VGS Fall Field Trip and Annual Meeting - see page 3 of this issue for details.

Nov. 2-5 GSA Annual Meeting, Cincinnati, Ohio

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THE GREEN MOUNTAIN GEOLOGIST

QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

WINTER 1981 VOLUME 7 NUMBER 4

FOURTH ANNUAL WINTER MEETING OF THE VERMONT GEOLOGICAL SOCIETY

— TWO SYMPOSIA —

THE TACONIC OROGENY – NEW THOUGHTS ON AN OLD PROBLEM

and

APPLIED GEOLOGY IN VERMONT

DATE: Saturday, February 21, 1981
TIME: 8:30 A.M. Registration and coffee
PLACE: Angell Lecture Center, University of Vermont, Burlington, Vermont

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CONTENTS PAGE

PRESIDENT'S LETTER

Vermont faces a very critical year of decision making regarding the management and protection of its ground water resources. The Vermont Geological Society can and must play an active role in helping to guide these programs in the direction best suited to the requirements of Vermonters, the protection of their health and welfare, and with a vision to the future.

Vermont's ground water environments are very fragile and a clear understanding of specific ground water environments does not exist. However, there are some very basic things we do know that should guide us in any effort made to manage and protect ground water:

1) The basic ground water environments in Vermont consist of two fundamental geologic domains:

   a) porous, permeable glacial sediments,and;

   b) fracture porosity and permeability in crystalline metamorphic and igneous bedrock.

2) Recharge for Vermont's aquifers is from both local and distant sources.

3) There are two totally incompatible activities which are vying for the use of Vermont's subsurface environment;

   a) production of potable ground water;

   b) disposal of all types of waste.

4) There is an intimate and direct relationship between Vermont's ground water and surface water.

With the knowledge of these basic fundamentals in mind, it is the responsibility of our knowledgeable, professional community to become involved, and to insist on decision making that is based on the best possible scientific and technical knowledge available.

As your president during this critical year of 1981, I seek your help and guidance, and dedicate this year as the Society's GROUNDWATER YEAR.

Charles A. Ratté

President

FROM THE EDITOR

This GMG issue is literally bulging with information- the Winter meeting program with abstracts, short articles, reports, VGS business and news, and for members, an updated version of the Constitution and Bylaws. Members have responded generously to my requests for articles and I am obliged to them. As always, I solicite news, articles, reports or letters to the editor from all members. Items concerning the protection and management of Vermont's ground waters will be especially appropriate. Deadline for the Spring issue of the GMG is April 6, 1981.

Jeanne C. Detenbeck
Perkins Geology Hall
University of Vermont
Burlington, Vermont 05405

VGS BUSINESS & NEWS

1981 VGS CALENDAR PLANNED

Meetings have been planned for the remainder of this year. The winter meeting at UVM on Saturday, February 21 is described in this issue. The Spring meeting, featuring presentation of student research papers, will be held Saturday, April 25 at Middlebury College. In May, (date to be announced, if possible, in the Spring GMG) the Executive Committee will meet to accept the nomination of officers.

This year, the teacher's workshop and field trip will be held during September instead of May. Ballard and Sandria Ebbett of Lyndon State College will conduct this meeting for the third consecutive year. Notice of this meeting will be forthcoming in the Summer GMG.

The Society's Fall field trip and annual meeting will occur in early October when the Ebbetts will lead the trip to glacial sites in northeast Vermont. The Fall GMG will contain this notice.

If you have questions about any of these meetings, contact Chuck Rattè at 802-828-3357 or write to VGS at Box 304 Montpelier, Vermont 05602.

NEW MEMBERS

Welcome to the following people who were accepted as members by the Executive Committee since the last issue of GMG:

Donald K. Balmer	Tacoma, Washington
Dwight C. Bradley	Albany, New York
Herbert Hawkes	Orleans, Vermont
Leah Haworth	Niagara Falls, New York
David Rowley	Albany, New York
David Stoner	Starksboro, Vermont
Sandra Thiel	Warren, Vermont
Michael D. Wurth	Warren, Vermont

BYLAW AMENDMENTS SUGGESTED

Suggestions for two bylaw amendments have emerged recently. They will be discussed at future executive committee meetings before any formal recommendations are made. Comments or opinions from the members are, as always, welcomed.

Rolfe Stanley, past president and Chuck Rattè, present president have both expressed the opinion, from experience, that a one year presential term is not long enough to develop consistency in the Society's program of activities. Because meetings must be planned at least six months in advance, each president must make decisions which lock his successor into about 50 percent of the year's activities.

A member has inquired about lifetime membership in the Society. The bylaws do not include such a category and, indeed, it may never have been addressed!

CALL FOR PAPERS - SPRING MEETING

This is the first call for student papers to be presented during the VGS eighth annual Spring meeting at Middlebury College on Saturday, April 25. Undergraduate and graduate students who wish to participate should submit their abstracts no later than April 7, 1981 to:

Dr. Brewster Baldwin
Science Center - Geology
Middlebury College
Middlebury Vermont 05753

Abstracts should be limited to 300 words. Fifteen minutes will be allotted for each talk, followed by a five minute question period. The Society awards a prize to each of the best undergraduate and graduate student papers. Students from any college or university who are doing research in Vermont geology are encouraged to participate.

ANNUAL TREASURER'S REPORT

An audit of the Society's books has been performed by Charles Rattè, John Malter and David Butterfield, and they found the books to be acceptable in accordance with standard geological accounting practices.

The 1980 membership roll records 10 new members, 2 members who renewed their active status, 2 members who withdrew and 5 who stopped communicating. There were 90 active memberships for the year.

The response to the request for 1981 dues was the best ever seen, i.e. about everyone has paid.

The following is the financial condition of the Vermont Geological Society January 1, 1980 through December 31, 1980.

Cash on hand December 31, 1979.		$1027.32
Checking	$659.54	
Savings	367.78	
Total	1027.32	
Income.		868.93
Dues	574.00	
Interest	38.13	
Sale of Stapler	18.80	
Sale of Vt. Geol.	100.00	
Fall trip	138.00	
Total	868.93	
Expenses.		1568.81
Dues refund	14.00	
Typing	44.00	
Office supply	62.78	
Office equipment	29.72	
Awards	75.00	
Bank charges	3.00	
-Publication expense	125.56	
120.35: Vt. Geol.		
5.21: GMG		
-Printing	816.74	
610.83: Vt. Geol.		
205.91: GMG		
-Postage	157.61	
45.58: Vt. Geol.		
82.03: GMG		
30.00: General		
Advertizing Vt. Geol.	86.40	
Post Office Box	16.00	
Fall trip	138.00	
Total	1568.81	
Balance for 1980.		-699.88
Expenditures	1568.81	
Income	868.93	
Net	-699.88	
Cash on hand January 1, 1981.		327.44
Cash on hand December 31, 1979	1027.32	
Income	868.93	
Total Credits	1896.25	
Total Debits	1568.81	
Balance	327.44	

Vermont National Bank NOW Account
Balance 327.44

Submitted by: [signature]

PROFESSIONALISM COMMITTEE

In response to concern expressed at the annual meeting, the president has created "a special ad hoc committee to investigate the need and desirability for a Professional Registration or Certification of Geologists and/or Geological Specialities in the State of Vermont". Members of the committee are Eric Slavin, chairman, David Stoner, Jim Ashley, Jeff Noyes, Winslow Ladue and Brian Fowler.

The president charged the committee to investigate, but not be limited to, the following topics:

1. Consider professional registration and/or speciality certification.

2. How many practicing geologists are there in the state? What is the breakdown?
   A. Private consulting-engineering firms.
   B. Government.
   C. Academia.
   D. Other.

3. Is there evidence that unprofessional, poor quality geological work is being conducted in the state? By whom?

4. Who is currently doing most of the geological work in the state? In-state or out-of-state firms?

5. Are there in-state firms now capable of doing all the geological work that is required to be done in the state? Consider all disciplines.

6. Consider the evidence that indicates registration has been effective in other states.

7. Would current practitioners (and others) be grandfathered, or should all be required to qualify? Who takes on the responsibility of establishing standards, tests and measurements of professional qualifications?

The committee is charged to report its findings to the Society at the Spring meeting, and to prepare a written report for the Society record by the annual Fall 1981 meeting.

The committee held its first meeting November 8, 1980, discussed the issues point by point, and assigned topics for further investigation.

GROUND WATER WATCHDOG COMMITTEE FORMED

Progress in the development of a Vermont Ground Water Strategy (details of which start on page 27 of this issue) will be reviewed for the Society by a committee being assembled by Chuck Ratté. Chris White will serve as chairman.

FALL MEETING REPORT

Again, Vermont geologists and their friends proved that they are a hardy lot. In spite of rain early in the day, the 1980 fall field trip was well attended; at least 40 people gathered 'round at the first trip stop. The variety of ages and interests of the company was unprecedented. The rain very quickly yielded to an occasional sprinkle and eventually to sunshine before the day was over.

Fred Larsen provided us with an excellent field trip guide, and previewed the trip with a slide show over coffee and donuts. Then he took us out to sites of some magnificent glacial deposits. Fred's running account in the lead van translated the rollercoaster road along a narrow valley into so many outwash fans. Deference to the hard rock contingent was shown at the drainage divide in Roxbury which is marked by a large piece of well-brecciated verde antique (Old ocean crust?), quarried locally. At lunch time, we squeezed into grade school desks and enjoyed the warmth and hospitality of the Lower Branch School in Braintree. A pictorial report of the trip can be found on pages 13 and 24.

At the annual meeting, 21 voting members were present, and 5 members sent in absentee ballots. The slate of officers was approved, as well as the proposed bylaw amendments.

Chuck Ratté, the newly elected president, promised to devote his year to ground water geology and plan a ground water symposium for the 1982 winter meeting.

Jeanne Detenbeck thanked the authors of *Vermont Geology* papers who were present and acknowledged omission of two names from the list of reviewers, Jeffrey Noyes and Bruce Watson. Her request for suggestions of people and organizations to whom we might send brochures about *Vermont Geology* produced a flood of ideas. The members, in general, agreed that some charge to members for future issues of *Vermont Geology* was reasonable, should sales of our first issue be slow.

NEWS OF MEMBERS

The "North Carolina" Thompsons are back in New England. Peter is working toward his PhD at University of Massachusetts, Amherst and Thelma is working in the admissions office at Hampshire College.

Charles Fox is now living in Connecticut where he has a part time consulting job.

Rolfe Stanley traveled to Taiwan between semesters to attend a seminar on plate tectonics and metamorphism. He presented a paper about his sabbatical research in Taiwan and led a field trip. The meeting was sponsored by the NSF and the National Research Council of The Republic of China. Participants were invited from the United States, Japan, Korea, France and the Republic of China.

MEMBERSHIP LIST - ADDITIONS

The following list contains additions and changes to the membership list as it occurs in the Spring and Summer issues of the Green Mountain Geologist:

Donald Balmer	Robinson, Noble and Carr, Inc., 5915 Orchard St. W., Tacoma, WASH. 98467
Peter Beblowski	1090 Western Avenue, Albany, New York 12203
Dwight Bradley	Dept. of Geological Sciences, SUNYA, 1400 Washington Ave., Albany, N.Y. 12222
Barry Doolan	Dept. of Geology, University of Vermont, Burlington, VT 05405
Charles Fox	26 Westmoreland Drive, W. Hartford, CONN 06117
Peter Garrity	%J. Nessel, RD 3, Montpelier, VT 05602
Herbert Hawkes	RFD 2 Box 162-5, Orleans, VT 05860 Winter:6120 Santa Valera, Tuscon, AZ 85718
Leah Haworth	1221 Garfield Ave., Niagara Falls, N.Y. 14305
George Holman	Elmore Mountain Road, Morrisville, VT 05661
Allen Hunt	Dept. of Geology, University of Vermont, Burlington, VT 05405
Jeffery Limoge	Rural Route #2, Morrisville, VT 05661
Ronald Marcotte	Box 71, Bakersfield, VT 05441
John Oski	P.O. Box 191, Fair Haven, VT 05743
David Rowley	Dept. of Geological Sciences, ES 215, SUNYA, 1400 Washington Ave., Albany, N.Y. 12222
Shelley Snyder	72 Blacklantern Lane, So. Burlington, VT 05401
Byron Stone	National Center MS 928, U.S. Geological Survey, Reston, VA 22092
David Stoner	RFD 1 Box 2160, Starksboro, VT 05481
Sandra Thiel	RR 1 Box 115, Airport Rd., Warren, VT 05674
Peter Thompson	67 West Street, Hadley, MASS 01035
Thelma Thompson	67 West Street, Hadley, MASS 01035
Michael Wurth	Box 96B, Warren, VT 05674

CONSTITUTION AND BYLAWS

An updated copy of the constitution had been prepared as an insert for this issue of the GMG. However, a last minute article (which will fill this issue to just short of 2 ounces) makes it more economical to wait until the Spring issue comes out to include the Constitution and Bylaws update. Members who would like a copy sooner, can write to the editor or ask for a copy at the Winter meeting.

NUCLEAR WASTE DISPOSAL

An Open Letter to the Geological Community
(and other interested parties)

I recently made a statement to a reporter for the Burlington Free Press indicating that I did not feel that Vermont's bedrock geology would prove to be amenable to the construction of safe repositories for high level nuclear waste.

It is unfortunate but true that reporters only report portions of what one tells them. These are the portions that they feel the public wishes to hear. Qualifying statements are invariably omitted. Furthermore, you should also know that the person who provides headlines is not the reporter who writes the article, and often times headlines distort the truth. Finally, I find reporters to be unbelievably ill informed as to science in general and geology in particular. Most try to editorialize to the point of making what seems to be a rather simple, straightforward statement lose its meaning entirely.

First of all, as presently conceived, a geologic repository will be constructed at a depth of 2000-3000 feet below the surface, the subsurface excavation may occupy an area of one mile radius (2,000 acres), with a surface control area of 3 miles radius (16,000 acres). Immediately, this places everyone in the same box, i.e., we have no physical evidence or information regarding the actual characteristics of bedrock at these depths in Vermont. We are all forced to conjecture, but the information available to us in my estimation points in one direction. That direction leads to the conclusion that Vermont's bedrock will be unsuitable for construction of a deep geologic repository for storing high level nuclear waste.

TECTONIC EVIDENCE. Since Paleozoic time, Vermont's bedrock has been subjected to several mountain building events. Precambrian, Cambrian and Ordovician rocks which occupy two-thirds of Vermont have been affected by at least three tectonic events and probably more. These are (1) the Mid-Late Ordovician Taconic orogeny; (2) Late Devonian Acadian orogeny; (3) Late Triassic-Early Jurassic Palisades orogeny. Also, there is growing evidence for major crustal disturbance in Vermont during Late Jurassic-Early Cretaceous time (Stanley, 1980). Quarried granitic bodies of the New Hampshire plutonic series in Vermont display prolific jointing and some faulting (Murthy, 1957; Kruger and Linehan, 1941; Meyers, 1964; personal observations).

With the exception of the small intrusives at Mt. Ascutney, Mt. Monadnock, Cuttingsville and Charlotte and numerous dikes of Jurassic-Cretaceous age (McHone and Corneille, 1980; Paul et al, 1963), the remaining two-thirds of Vermont's bedrock is Silurian-Devonian in age and has been influenced by all but the earliest Cambro-Ordovician tectonic events.

As anyone who has conducted geological work in any capacity in Vermont's bedrock geology, they are quite aware of the complexity of the folding, faulting, jointing, etc. displayed at the surface. THERE IS ABSOLUTELY EVERY REASON TO BELIEVE THAT SUCH COMPLEXITY CONTINUES TO PERSIST AT DEPTH.

SUBSURFACE EVIDENCE. Actual physical evidence of the nature of Vermont's subsurface bedrock environment does exist. Admittedly this evidence does not come from depths of 2000 to 3000 feet below the surface in every instance, and records of some of the deepest penetrations of Vermont's subsurface are not as sophisticated as one would hope for when attempting interpretations related to structural integrity and deep ground water hydrology. However, the following examples are enlightening and NO EXAMPLE PROVIDES A COMFORTABLE FEELING REGARDING THE SAFE DISPOSAL OF HIGH LEVEL RADIOACTIVE WASTE IN VERMONT'S BEDROCK.

The deepest mine in Vermont is at the Eastern Magnesia Talc Co. in Johnson. The mining operation continues to intersect water-bearing seams and joints at a depth of 950 feet below the surface (personal observations, personal communication with Howard Schaefer, mine superintendent).

Water well records in the files of the Vermont Department of Water Resources indicate that many of the deepest water wells in the state produce substantial amounts of water at depths of more than 1000 feet below the surface in marble and other crystalline rocks. A well in Brunswick produces over 200 gpm from fractured granite at a depth of 500 feet. The granite was absolutely dry until this major fracture was encountered.

In the early 1960's several "wildcat" oil wells were drilled in northwestern Vermont. The log for the Hazelett well in Colchester indicates water was encountered at depths of 1400 and 1645 feet below the surface. The E. S. Baker #1 well on Grand Isle was abandoned at a depth of 3500 feet largely because the bailing operation could not keep up with the rapid influx of water (personal communication with E. F. Taylor, geological consultant for the Cambrian Corp.).

The deepest water well in Vermont (partially drilled to test new drilling equipment) penetrates a depth of 1545 feet. The well was drilled in the notoriously "dry" Littleton formation (phyllite) in Putney, Vermont. Yet the tight seams in this rock do "weep" a small amount of water so that in time the well has filled with water.

Water well drillers in Vermont are quite proud of their high rate of success. The "dry" holes that are drilled each year are low in number and probably for the most part are not truly dry but are incapable of producing quantities of water sufficient to sustain household needs.

The best conclusion one can reach from this subsurface information is that faults and fractures do persist at depth in Vermont's crystalline bedrock and that in a significant number of examples, fractures are sufficiently "open" to allow the movement of ground water at the greatest depths so far penetrated.

CLIMATE CONSIDERATIONS. At least since the last retreat of the continental ice sheet, Vermont has been influenced by a temperate climate which has consistently "drenched" our rocky terrain with 40+ inches of precipitation for thousands of years. It is doubtful that any area of the state has been spared from this soaking. Relative to geographic regions of the U. S. with much drier climates where it is much less likely to encounter a saturated subsurface bedrock environment, Vermont does not, in my estimation, rate too high as a "favorable site for nuclear waste disposal."

GLACIAL DOWNWARP AND POST GLACIAL UPWARP CONSIDERATIONS. Crustal yo-yoing during the Pleistocene ice age may have been as much as several thousand feet at the ice accumulation center and perhaps a few hundred feet in the vicinity of Vermont (Lougee, 1953; Gutenberg, 1941). Such bending of a brittle and fractured crust undoubtedly reactivated movement along ancient fractures, perhaps extending some, opening (and closing) others. In any case, this activity undoubtedly provided greater access for ground water penetration to greater depths in Vermont's brittle crystalline bedrock. Crustal movement related to this phenomenon and other neotectonism may persist to this day (Barnett and Isachsen, 1980).

GEOPHYSICAL EVIDENCE. The 1961 Centennial Geologic map of Vermont illustrates in cross-section an interpretation of major east to west thrusting involving much of Vermont's crystalline bedrock. A deep seismic profile line was run across the central Green Mountains in the summer of 1980 by the COCORP project (Consortium for Continental Reflection Profiling). Results of this seismic work may prove or disprove the extension of the so-called eastern overthrust belt into Vermont's Green Mountains. Such major thrusting undoubtedly would have numerous associated "thrust slices." New interpretations of Vermont's ultramafic belt suggest that serpentinite bodies are parts of imbricate thrust slices rather than intrusive igneous bodies (personal communication with Rolfe Stanley, Barry Dalan and others).

Seismic studies in western New Hampshire indicate some of the crystalline intrusive bodies of the New Hampshire plutonic series are floored, in some cases at depths of less than 3000 feet below the surface. At least in one instance, although the depth is shallow (200 feet), ground water was found to be present in the schist which forms the floor of the intrusive crystalline rock (Kruger and Linehan, 1941). Most of the granitic plutons in northeastern Vermont are related to those in western New Hampshire. The inference is that they too may be relatively shallow and floored.

In the final analysis, I can only say that the armchair, of course, is no substitute for the drill.

Charles A. Ratte'

Charles A. Ratte'
State Geologist

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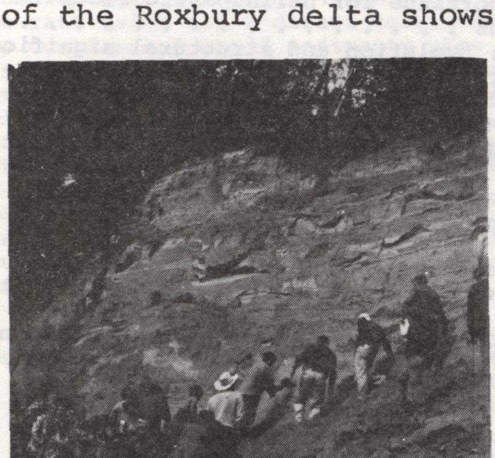
CANDIDLY SPEAKING - THE FALL FIELD TRIP

Faulting due to ice collapse at the margin of the Roxbury delta shows clearly.



Everyone scrambled up the bank to see the seven, one meter varves.

(More photos on page 24)

VGS WINTER MEETING PROGRAM

Registration (no fee); coffee and donuts 8:30

MORNING SESSION Room B112 Rolfe Stanley presiding . . . 9:00

THE TACONIC OROGENY - NEW THOUGHTS ON AN OLD PROBLEM

1. B. Doolan, P. Winner and G. Smith: The quest for Vermont ophiolites: A progress report with emphasis on recent structural/petrological studies of the ultramafic belt of Vt.-Quebec . . . 9:10
2. R. Stanley, D. Roy, M. Gale and P. Tauvers: Real or inferred thrust slices in the Cambrian-Ordovician section in central and eastern Vt. . . 9:30
3. V. Rahmanian: Transition from carbonate to siliciclastic tidal flat sedimentation in the Lower Cambrian Monkton Formation, west central Vermont 9:50
4. B. Baldwin: The Taconic orogeny of John Rodgers, a decade later 10:10
5. D. Potter: Stratigraphic and sedimentological considerations in the Taconic allochthons: Their importance for palinspastic reconstructions 10:30
6. W. Bosworth: Evolution and structural significance of master shear zones within the parautochthonous flysch of eastern New York 10:50
7. D. Rowley: Medial Ordovician flysch sequences of western New England: Implications for stacking sequence and emplacement history of the Taconic allochthon 11:10

Panel discussion 11:30

LUNCH BREAK: Brown bag lunch in B112 . . . . 12:00
(Executive Committee meets in Perkins Hall)

AFTERNOON SESSION Room B112 Lance Meade presiding . . . 1:00

APPLIED GEOLOGY IN VERMONT

8. B. Watson: Soil surveys - A resource tool for geologists 1:10
9. P. Beblowski: The geology of the Winooski site: A stratified middle woodland site in northwestern Vermont 1:30
10. E. Slavin and R. Turnbull: Palmer Springs aquifer study - Middlebury, Vermont 1:50
11. C. Heindel: Road salt effects on ground water in the Williston and St. George area 2:10
12. J. Noyes: Low flow characteristics of high elevation drainage basins in Vermont 2:30
13. J. Limoge: Current theory of how explosives fragment rock 2:50
14. B. Fowler: Structural geologic and rock mechanics considerations in siting crushed stone quarries in Vermont 3:10

Question period 3:30

Brief VGS Business Meeting 4:00

ABSTRACTS

THE TACONIC OROGENY OF RODGERS, A DECADE LATER *

Baldwin, Brewster, Department of Geology, Middlebury College, Middlebury, Vermont 05753

Rodgers (1970) drew together what was then known of the Taconic orogeny and identified three facets:

a. Chazy-age block faulting and unconformity;
b. Black River or early Trenton emplacement of Taconic allochthon;
c. terrigenous sediments spreading west from a mountainous source, late in the Ordovician.

Since then, several developments have clarified his observations. Plate tectonics theory and the New Guinea model suggest that the Taconic orogeny is the array of events caused by a continent nearing and colliding with a volcanic arc. Rates of sediment accumulation have been calculated, using the newly developed absolute geologic time scale. The Taconic sequence accumulated at a rate of 4 m/m.y. (4 microns per year). This very low rate rules out a direct terrigenous supply. Rates for the continental shelf sediments show passive margin behavior until Chazy time, when subsidence essentially stopped. The Black River and early Trenton limestones (30 m/m.y.) are overlain by later Ordovician shales (200 m/m.y.). These numbers quantify the well-known collapse of the margin associated with the Taconic orogeny. Sedimentary features suggest environments of deposition which are, in turn, compatible with the plate model. Moreover, the plate model provides a submarine geography for the deposition of the later Ordovician muds, from turbidity currents running parallel with the continental margin.

* [Editor's note: Rodgers, John, 1971, The Taconic Orogeny (address as retiring GSA President, November, 1970): Geological Society of America Bulletin, v. 82, p. 1141-1178.]

THE GEOLOGY OF THE WINOOSKI SITE: A STRATIFIED MIDDLE WOODLAND SITE IN NORTHWESTERN VERMONT

Beblowski, Peter L.
Albany, New York

Detailed stratigraphic analysis of the Winooski Archaeological Site's stratigraphy revealed that the vertical accretion of the lower Winooski flood plain has been in effect for at least the past 4,500 years.

The Winooski Archeological Site is a flood plain site. It occupies an area of approximately 43,000 square meters on the east bank of the lower Winooski River, approximately 1.7 km downstream from the Winooski "Salmon Hole" Falls.

The 1978 excavation produced a vivid record of fluvial and aboriginal activity. The stratigraphy of the site is representative of a vertically accreted flood plain deposit. →

Fine sands and coarse silts dominate the textural character of the sediments found at the site. Rates of deposition have been documented with ten C-14 dates to be between 50 and 80 cm/ 1,000 years. This, coupled with the fine texture of the sediments, indicates a fairly uniform vertical accretion of the site's stratigraphy over the past 4,500 years. The rising base level of Lake Champlain is suggested to be responsible for the steady-state aggradation of the lower Winooski flood plain.

EVOLUTION AND STRUCTURAL SIGNIFICANCE OF MASTER SHEAR ZONES WITHIN THE PARAUTOCHTHONOUS FLYSCH OF EASTERN NEW YORK

Bosworth, William, Department of Geology, Colgate University, Hamilton, New York 13346

Progressive deformation of the synorogenic Medial Ordovician flysch of eastern New York during emplacement of the Taconic Allochthon led to the eventual development of through-going master thrust faults or shear zones. The location of these structures is marked in the field by the presence of laterally persistent belts of melange and juxtaposed faunally-dissimilar flysch terranes. Microstructures observed in shear zone lithologies include narrow horizons of fault breccia, small, disrupted asymmetric folds and striated phacoidal cleavage. The best exposed shear zone runs approximately north-south at least 15 km along the present Hudson River Valley in the vicinity of Schuylerville, New York. Here the associated melange includes blocks of pillow basalt (Stark's Knob), thick-bedded chert and "anomalous" Early Ordovician shale and argillite. The master shears produce a large-scale imbricate structure in the flysch similar to that found in the more easterly portions of the Taconic orogenic belt. They may merge at depth along a surface of decollement on the underlying Cambro-Ordovician carbonate shelf sequence. Previous tectonic models which invoked down-slope gravity emplacement of massive sections of "Austin Glen" graywacke to produce outliers or klippen structures in an otherwise autochthonous flysch are not supported by structural and lithostratigraphic field evidence. This evidence is believed consistent with deposition and deformation in a trench-accretionary prism setting during the attempted subduction of continental lithosphere.

THE QUEST FOR VERMONT OPHIOLITES: A PROGRESS REPORT WITH EMPHASIS ON RECENT STRUCTURAL/PETROLOGICAL STUDIES OF THE ULTRAMAFIC BELT OF VERMONT-QUEBEC

Doolan, Barry L., Philip S. Winner and Gerald Smith, Department of Geology, University of Vermont, Burlington, Vermont 05405

Ongoing studies along a sixty km segment of the Vermont-Quebec ultramafic belt have recognized 5 major tectonostratigraphic rock units: (I-V; Cambrian(?) to Middle Ordovician). The oldest rock units (I and II) are polydeformed metasediments (continental derived or reworked turbidites, shales and quartzites). These units are separated from less deformed shales, quartzites, breccias and volcanic rock types (unit III) by ophiolites and ophiolite melange rocks in the Chagnon area, Quebec, by thrust faulting and tectonic imbri- →

cation with ultramafic/mafic igneous rocks from Chagnon Mtn. to the international border and locally by unconformity south of the international border. Late-syn(?) to post emplacement flysch sedimentation of Middle Ordovician age (unit IV) unconformably overlies unit III in Quebec. Volcanic and volcanogenic rocks with a variety of mafic to felsic intrusive rocks (unit V) are exposed east of unit III.

Ultramafic/mafic complexes from Chagnon Mtn. and North Troy, Vermont, preserve primary fabrics of pyroxenite, pyroxene and hornblende gabbro and diabase. These rocks consistently are found in fault bounded contacts with serpentine melange. Volcanic rocks interbedded with unit III east of North Troy are similar in petrography and chemistry to "upper" volcanic rocks at Chagnon Mtn. as well as other northerly examples of Quebec ophiolites. The similarity in petrography, chemistry and structure of the ultramafic/mafic complexes from North Troy, Chagnon and ophiolites of Asbestos and Thetford, Quebec, suggest a common origin for the entire Vermont-Quebec ultramafic belt. The ophiolite melange zone west of Chagnon Mtn. contains well-preserved slivers of foliated gabbro, felsic intrusives, chert, pillowed volcanics and ultramafic rocks imbricated with flyschoid slates, breccias, greywackes and semischists. These rock types should predictably be found in "western Stowe" rocks of Vermont. However, recognition of these features are complicated by increased deformation to the south perhaps as a result of oblique collision of a volcanic arc complex (unit V) against the southern arm of the Quebec reentrant following ophiolite emplacement.

STRUCTURAL GEOLOGIC AND ROCK MECHANICS CONSIDERATIONS IN SITING CRUSHED STONE QUARRIES IN VERMONT

Fowler, Brian K., Geological Engineer, Pike Industries, Inc., Tilton, New Hampshire 03276

The purpose of this paper is to describe the structural geologic and rock mechanics methods that have been recently applied to the location and development of four crushed stone quarries in several widely separated and geologically diverse areas of the State of Vermont. The methods represent a typical example of the combination of geotechnical information with the cost-effective requirements of the construction aggregate industry so as to produce a useful product at a minimum unit cost. The quarries are located in Barnet, Shaftsbury, New Haven and Waterford, Vermont; and respectively, utilize rock from the Gile Mountain, Monkton/Winooski, and Chipman Formations, along with the Monroe contact zone facies of the Albee Formation.

The relationship between modulus of elasticity and the uniaxial compressive strength of the various rock types is expressed in terms of their Modulus Ratio, since it is believed that this relationship best describes the intact strength properties desirable for crushed rock sources. Plots of Modulus Ratio are included for the field worker who will be able to use them as a reference in locating suitable rock types from amongst already mapped geologic units. The Talobre method of pole diagram analysis is used in the design of the quarry layouts, since it provides for the calculation of the optimum working design and lowest fragmentation cost.

ROAD SALT EFFECTS ON GROUNDWATER IN THE WILLISTON AND ST. GEORGE AREA, VERMONT

Heindel, Craig D., Wagner, Heindel, and Noyes, Inc., 301 College Street, Burlington, Vermont 05401

Local zones of shallow groundwater in the study area, primarily down-gradient from and within 200 feet of salted roads, are clearly contaminated by road salt. Levels of sodium and chloride ions in shallow groundwater in these zones are roughly one order of magnitude higher than background levels of 5 to 10 ppm. Bedrock groundwater appears to be unaffected by road salt, perhaps due to soil adsorption of salt ions, dilution in the large bedrock groundwater body, and the location of salted roads away from sensitive recharge areas.

Recommendations are made to owners of new shallow wells to avoid the contamination zone downslope from salted roads, to bedrock well owners to insure a tight seal at the well casing against contaminated surface waters, and to communities to institute groundwater monitoring programs in potentially sensitive areas.

CURRENT THEORY OF HOW EXPLOSIVES FRAGMENT ROCK

Limoge, Jeffrey L., Quarry Engineer-Geologist, Vermont Asbestos Group, Inc., Lowell, Vermont 05847

The original theories on how explosives broke rock held that the rapidly expanding gases from the detonation were the main fragmentation mechanism. While watching a slow motion film of a blast during the late fifties, researchers of the U.S Bureau of Mines noticed that before any movement of the major rock face occurred, a large boulder in the front of the face shattered first. Further research into this phenomenon led them to the conclusion that explosives could effectively break rock without any transfer of gasses through the rock, and that another process was the primary fragmentation mechanism. What they saw was the rock's response to the compression-tension waves passing through it. The tensile strength of rock is much less than its compressive strength, usually around the order of 1 to 10 for most rocks. They found that the compressive strain pulse from the detonation passed through the rock, but upon encountering a free surface, it was reflected back into the rock as a tensile wave. The interaction of the rock with this moving tensile wave resulted in slabs of rock being torn from the main mass. This led to the attempts of blasters to try to match the impedance of explosives to that of the rock in order to attain maximum shock wave transfer.

However, studies in the mid-sixties demonstrated that the powder factors utilized in commercial blasting would never approximate those in the tests. It was also noted that the amount of breakage observed in commercial blasts could not be accounted for by tensile slabbing. The studies did reveal though, that the radial cracks surrounding the borehole were caused by the detonation pressures of the explosives used. This was further confirmed with tests utilizing aluminized explosives. Since aluminized blasting agents produce a higher heat of reaction than non-aluminized explosives, the gases →

expand more and at a faster rate which also increased the radial cracking. These new results brought about a resurgence of the expanding gas bubble theory as the primary fragmentation mechanism.

The latest theories on fragmentation utilizing explosives are by Richard Ash and Calvin Konya. They deal with the expanding gas bubble producing a phenomenon known as flexural rupture. During the explosion, the whole rock face bulges outward, bending the strata and creating more fracturing due to new tensile stresses within the rock.

LOW FLOW CHARACTERISTICS OF HIGH ELEVATION DRAINAGE BASINS IN VERMONT

Noyes, Jeffrey E., Wagner, Heindel, and Noyes, Inc., 301 College Street, Burlington, Vermont 05401

High yield groundwater sources in mountainous areas can present problems for water intensive users in the ski industry. In the past, water wells have been used to supply typical domestic needs and have fared reasonably well. However, with expanded snow making operations in many areas, bedrock wells have been taxed far beyond their production capability.

An alternative to bedrock wells, involves diversion of flow from groundwater fed streams. In most cases water quality from such diversions is expected to be superior, since land development in the headwater areas is minimal at the present time. Water quality from such streams is well suited for both snow making and domestic water supply.

When off stream diversions are made, it is essential that limits for withdrawals are established so that excessive water use will not effect fish or other biological populations at any time of the year. Unfortunately, little is known about flow duration characteristics in upland streams with small drainage basins. This paper presents the results of two separate methods which were used to describe both daily and 7-day ten year low flows for small upland streams from a limited period of record.

STRATIGRAPHIC AND SEDIMENTOLOGICAL CONSIDERATIONS IN THE TACONIC ALLOCHTHON: THEIR IMPORTANCE FOR PALINSPASTIC RECONSTRUCTION

Potter, Donald B., Department of Geology, Hamilton College, Clinton, New York 13323

Three major thrust sheets in the central Taconics are from lowest and first emplacement, the Giddings Brook (I), Rensselaer Plateau (II) and Berlin Mountain (III). In this order they also present increasing uncertainty as to age of their formations and the tectonic framework in which these were deposited. Thrust sheet I consists of 53 percent pelites, 40 percent graywacke, 30 percent chert, 2 percent carbonates, and 1 percent quartzite, and spans the time from Early Cambrian through Middle Ordovician as indicated by fossils in five different formations. A continental rise environment is inferred for these formations which locally contain a conspicuously thick sequence of carbonates as well as gray- →

wackes and quartzites which are composed of mature quartz grains probably slumped from the continental shelf. The second-cycle lithic graywacke (Austin Glen) was deposited on and in front of this thrust sheet as it was thrust westward. Thrust sheet II is comprised of about 75 percent feldspathic graywacke and 25 percent phyllite, and is inferred to have been deposited in the deep waters of a rift basin by turbidity currents carrying detritus from a crystalline source area. The age is tentatively inferred from interbedding of these graywackes with pelites, which lithologically resemble Early Cambrian pelites of thrust sheet I. Thrust sheet III is comprised of 95 percent pelites and about 5 percent quartzite, graywacke, limestone. While these pelites resemble some Early Cambrian pelites in I, their age has not been determined and is weakly inferred to be Early Cambrian(?). A more easterly continental rise environment is inferred for their site of deposition. When restored palinspastically, I would form the continental rise, II would lie to the west in a graben near the edge of the shelf, and III would lie east of I at the outer part of the rise or at the rise of the African plate.

TRANSITION FROM CARBONATE TO SILICICLASTIC TIDAL FLAT SEDIMENTATION IN THE LOWER CAMBRIAN MONKTON FORMATION, WEST CENTRAL VERMONT

Rahmanian, Victor D., Department of Geology, University of Vermont, Burlington, Vermont 05405

The dominantly siliciclastic Monkton Formation (Lower Cambrian) is underlain and overlaid by dominantly carbonate sequences (the Dunham and Winooski Formations respectively) in west central Vermont. The Monkton Formation in this area consists of as much as 300 m of interbedded terrigenous clastic and carbonate deposits, arranged in repeated alternation of fining-upward mixed siliciclastic-carbonate cycles (in lower and uppermost parts) and siliciclastic cycles (in the middle part of the formation). Each cycle is characterized by a fining-upward lithofacies assemblage which shows many attributes of subtidal-intertidal flat sedimentation. The mixed siliciclastic-carbonate cycles are terrigenous in the lower part and carbonate-rich higher up, and are interpreted to represent the following succession of environments, from base upwards:

(1) subtidal sand shoal and channel system;
(2) sand, silt and carbonate intertidal flat; and
(3) carbonate upper intertidal-supratidal.

Lithofacies arrangement of the siliciclastic cycles is suggestive of sedimentation in the following succession of environments, from base upward:

(1) subtidal bars and tidal channel, and
(2) mixed sand and mud intertidal flat with sand-filled tidal channels.

Vertical lithofacies succession in both types of the fining upward cycles is interpreted to represent progradational cycles reflecting shallowing-up condition of sedimentation. The mixed carbonate-siliciclastic cycles interfinger with and grade both east and northward into oolitic dolomite beds and horizons of carbonate breccia consisting of platform- and platform margin-derived detritus. →

Paleoenvironmental analysis of the lithofacies distribution of the Monkton Formation is suggestive of an overall regressive sedimentation in a tide-dominated platform and platform margin setting during the Early Cambrian time.

MEDIAL ORDOVICIAN FLYSCH SEQUENCES OF WESTERN NEW ENGLAND: IMPLICATIONS FOR STACKING SEQUENCE AND EMPLACEMENT HISTORY OF THE TACONIC ALLOCHTHON

Rowley, David B., Department of Geological Sciences, State University of New York at Albany, Albany, New York 12222

Stratigraphic relationships between syn-orogenic flysch deposits and underlying sequences allow definition of the time of initiation of orogenic activity, demonstrate along-strike and across-strike diachroneity of orogenic activity, and allow reconstruction of large-scale stacking sequences of allochthonous terrains. The detritus constituting the flysch provides information on the compositional make-up, deformation and metamorphism within the source terrain. Easterly-derived flysch deposits of the Taconic Allochthon and surrounding carbonate platform have recently been examined with these properties in mind. Flysch sediments within the Taconic Allochthon constitute the highest stratigraphic unit and conformably overlie continental rise facies sediments in western parts of the Allochthon. To the east, within the Allochthon, flysch conformably to disconformably overlies rise sediments. This relationship suggests that at the time of initiation of flysch sedimentation this paleogeographic realm remained undeformed and untransported, contrary to previous interpretations of Taconic workers. At least three sources contributed detritus to this flysch. 1) Taconic sequence sediments; 2) variably deformed and metamorphosed pelitic, psammitic, and volcanic lithologies; 3) igneous rocks of dominantly mafic volcanic and lesser mafic-ultramafic affinities. These three sources are interpretable as continental rise, accretionary prism, and volcanic arc-opholite assemblages. All three sources are recognizable in the regional geology of western New England.

Flysch sediments conformably overlie shales and carbonates of the carbonate platform sequence. The detrital constitution of these parautochthonous to autochthonous flysch sediments is identical to that of the allochthonous flysch, except with the addition of a minor shelf carbonate source in more westerly exposures. The age of the base of the flysch sequences becomes progressively younger in a westerly paleogeographic direction from allochthonous to parautochthonous to autochthonous sections, indicating westerly progradation synchronous with westerly transport of allochthonous realms. Regional folds within the Allochthon are truncated by the basal thrust of the Allochthon, demonstrating that the rocks of the Allochthon were consolidated and strongly deformed well prior to the end of their westerly transport. →

These stratigraphic and petrographic data indicate progressive and diachronous east to west thrust stacking, deformation, and metamorphism of paleogeographic realms of the early Paleozoic Atlantic-type continental margin during the medial Ordovician Taconic Orogeny - a continental margin-volcanic arc collision. They are evidence contrary to the emplacement of the Taconic Allochthon as one or several gravity slides detached from their source.

PALMER SPRINGS AQUIFER STUDY - MIDDLEBURY, VERMONT

Slavin, Eric J., Dufresne-Henry, Inc.,
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Turnbull, Richard, Geotechnical Engineers Inc.,
Winchester, Massachusetts 01890

In response to a growing concern over the potential contamination of its existing water supply well, the Aquifer Study Committee of the Town of Middlebury requested an investigation to define the geological setting and extent of the Palmer Springs aquifer and its recharge area and to determine the potential for contamination due to present and future land uses. Of particular concern was the potential for contamination due to activities associated with a pesticide spraying operation located at the Middlebury airport.

The investigation was completed in two phases. Phase I included a review and evaluation of existing information, surface mapping, refraction seismic investigation, subsurface borings (3 locations) and water level measurements. Conclusions reached during Phase I allowed establishment of the Phase II program which included five additional borings, groundwater level measurements and chemical analysis of groundwater samples.

From the data collected, the geology of the aquifer system was determined, and approximate groundwater flow patterns established. Potential sources of contamination to the aquifer were located and recommendations regarding land use and water resources protection were made to the Town of Middlebury.

The general area to which most of the investigation was directed extends from the vicinity of Route 116 on the west to the 500 foot topographic contour on the east and from about 1000 feet north of the Middlebury well to the southern extent of the Middlebury airport.

REAL OR INFERRED THRUST SLICES IN THE CAMBRIAN-ORDOVICIAN SECTION IN CENTRAL AND EASTERN VERMONT

Stanley, Rolfe S., Dana Roy, Marjorie Gale, Peter Tauvers: Department of Geology, University of Vermont, Burlington, Vermont 05405

Recent field studies and regional synthesis indicate that much of the Cambrian-Ordovician metamorphic stratigraphy east of the Hinesburg thrust consists of imbricate thrust slices of slope, rise and ocean floor material. Abundant fault zone evidence is found along the Hinesburg thrust and between and within the traditional metamorphic stratigraphy from the Hazens Notch Formation eastward into the Moretown Formation of the Missisquoi valley in northern Vermont. A major thrust is thought to exist between the serpentine-bearing Hazens Notch and the Underhill Formation to the west. This slice, here designated the Hazens Notch slice, passes beneath the Belvidere Mountain thrust zone which essentially forms the western boundary of the Ottauquechee Formation as it appears on the Geological Map of Vermont. Recent work in the Lincoln Mountain area suggests that the Hinesburg thrust zone crosses the Green Mountain anticlinorium north of this area, following the Underhill contact to the south where it too is buried by the southern continuation of the Belvidere Mountain thrust, which in turn becomes the Whitcomb Summit thrust on the east limb of the Berkshire massif in western Massachusetts. The Taconic allochthons root along the Hinesburg-Whitcomb Summit thrust zone and are interpreted as erosional outliers resulting from horizontal compression and imbrication of the western margin of Iapetus.

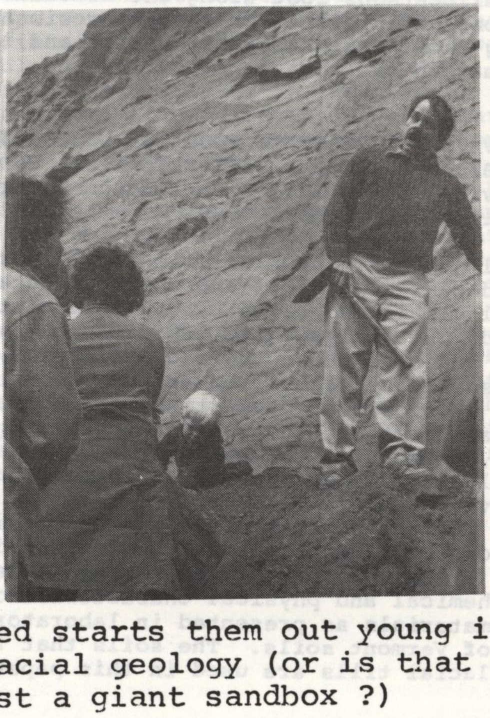
SOIL SURVEYS - A RESOURCE TOOL FOR GEOLOGISTS

Watson, Bruce G., State Soil Scientist, USDA Soil Conservation Service, Suite 205, 1 Burlington Square, Burlington, Vermont 05401

Soil surveys, now available for 52 percent of Vermont, provide detailed physical and chemical data on different surficial glacial deposits. Soil scientists have studied, described, and analyzed the 160 different soil series in Vermont, and have shown their distribution on aerial photos. Whereas soils are classified and described in terms of their physical and chemical properties, and whereas the kind of parent materials are the surficial glacial deposits - it is possible, therefore, to characterize, classify, and locate surficial glacial deposits by an interpretation of the detailed soil survey.

The purpose of this paper is to demonstrate that soil surveys can supplement glacial geology studies, past and present. This can be achieved through a better understanding of the chemical and physical characteristics of the surficial glacial materials as presented in laboratory studies and reports of Vermont soils. The soils that formed in the different glacial tills are used in this paper as an example or model.

Fred describes the one that got away at the Northfield esker!



Fred starts them out young in glacial geology (or is that just a giant sandbox ?)

COCORP IN VERMONT

Consortium for Continental Reflection Profiling

In the past 5 years, COCORP has made deep (to 60 km) seismic profiles in New Mexico, Texas, Wyoming, and the Southern Appalachians. This past summer COCORP completed field work on a profile across Vermont, south of Rutland; this work was then extended to the west with a line in the eastern Adirondacks (GMG, Summer 1980, p. 4).

COCORP was initiated in 1975, as part of the U.S. Geodynamics Project; principle funding is by the NSF. It uses the VIBROSEIS system (registered trademark of Continental Oil Company); seismic energy is generated by perhaps 5 large trucks (see cover photo of Geology, November, 1978) equipped to cause a belly-mounted pad to vibrate at 10 to 40 hertz (low-frequency vibrations penetrate deeper than high-frequency ones). The trucks, which are operated by Geosources, Inc. under contract to COCORP, are "tuned" every day before beginning a traverse. The line of traverse, picked by a planning committee, usually follows back roads in a fairly straight line. The line is surveyed for elevation and location of each station, the stations being 330 feet apart. For each station, an array of 24 geophones feeds a single line; 96 such lines feed into the seismograph van, representing about 6 miles of traverse.

The trucks move bumper to bumper, set down their pads, shake for 18 seconds, lift their pads, and have 20 seconds to move ahead 20 feet and start the next shaking. The trucks commonly by-pass areas where there are houses near the road.

Field data are recorded on magnetic tape, which is sent to COCORP headquarters at Cornell University. There, the COCORP computer is used to process the field records, to eliminate noise from traffic and other sources. Once the data are smoothed, the records are re-studied for possible planes of reflection, and these parts of the record are played through the computer, using different assumed velocities until the record is enhanced.

Two Middlebury seniors, Bernadette Czuchra and Teresa Walsh, have spent the fall semester at Cornell, helping to process the field data for the Vermont line.

Results of the work in the southern Appalachians were reported in Geology, 1979, p. 563-567. [Editor's note: The October 1980 issue of Scientific American also contains an excellent article.] One interpretation is that there is a plane (6 to 15 km deep) along which Piedmont and Blue Ridge rocks have moved westward a considerable distance. Perhaps we will learn that the Precambrian coring the Green Mountains actually rests on a similar decollement (profile B-B' of the Centennial Map of Vermont anticipated this interpretation).

Submitted by Brewster Baldwin

COSUNA

Correlation of Stratigraphic Units of North America

The national effort to compile correlation charts for some 15 or 20 regions of the United States is known as the COSUNA Project. Orlo Childs is a member of the AAPG Stratigraphic Correlation Committee and is Director of the COSUNA Project. J.W. Skehan, S.J., is Coordinator of the New England Region. Jim asked Dr. Charles Rattè, as State Geologist, to serve as, or provide, a representative for Vermont; Chuck in turn asked me in September 1978 and I accepted.

The regional committee was organized in 1978; since then, it has met each fall and February. The committee agreed on a number of items:

1. The location of about 30 composite sections.
2. Assignment of particular sections to individuals. My sections for the St. Albans area and for central Vermont are noted below. Rocks of the Taconic allochthon and of west-central Vermont are being included in sections compiled by Don Fisher of the New York State Geological Survey. Rocks of eastern Vermont, and of southern Vermont are being included in sections for western New Hampshire and northern Massachusetts, respectively.
3. Cartographic solutions to the ways of showing metamorphism, igneous intrusions, radiometric ages and such. One problem has been to design a way of showing thrust slices.
4. The particular representations for the individual columns. (Some minor changes will, of course, be made in the next year.)

My Section 11, using the St. Albans work of Alan Shaw, shows the transition from carbonate shelf sediments to shales of the upper continental slope. For Section 10, Rolfe Stanley suggested we show the metamorphic rock units of central Vermont as thrust slices instead of following the Centennial Map's interpretation of depositional contacts between metamorphic units. This tectonic approach is probably wrong in detail but gives a truer sense of the geology. The two sections were part of the COSUNA display wall at the November meeting of the Geological Society of America in Atlanta. Hand-colored copies of Sections 10 and 11, dated December 1980, are being sent to UVM, to Dr. Rattè, to Norwich University, and to Lyndon State and Castleton State.

Submitted by Brewster Baldwin

VERMONT GROUND WATER STRATEGY

GROUND WATER PROTECTION STRATEGY
BEING DEVELOPED

Members of the Vermont Geological Society have a keen interest in Vermont's ground water resources. Charles Ratté, the Society's President announced when he took office that this year he would urge the organization to make ground water protection and management a priority concern of the society in the month's ahead.

A specific opportunity to influence the direction of a statewide ground water protection strategy is before us. The Vermont Department of Water Resources and Environmental Engineering is developing a Vermont Ground Water Protection Strategy, a process which began in December. Based on a 1973 Vermont Legislative mandate, the Secretary of the Agency of Environmental Conservation was directed to "protect, regulate and where necessary control Vermont ground water resources in order to protect and promote the general welfare of the public".

To that end, the Secretary asked the Department of Water Resources and Environmental Engineering to develop a Vermont Ground Water Strategy - a process for which we are inviting your participation.

To begin the process to protect and manage our ground water resources, the Department outlined ten principles upon which the Strategy would be built, and presented them for public discussion at the December 4, 1980 Ground Water Forum. They were the following:

PRINCIPLE 1

Ground water is a critical resource and must be protected.

PRINCIPLE 2

Threats to ground water quality are increasing. A strategy based on the best "State-Of-The-Art" knowledge and management techniques must be developed immediately.

PRINCIPLE 3

The Strategy will emphasize protection of high quality present or future drinking water sources. Less priority will be given ground water already contaminated or that so located to reduce its use potential.

PRINCIPLE 4

Ground water shall be classified in categories according to the degree of protection warranted.

PRINCIPLE 5

The protection of ground water will be administered through existing state and local regulatory programs. No new permit programs will be established unless program operating experience indicated jurisictional gaps.

PRINCIPLE 6

The initial definition of the classified protection zone boundaries will be based on surficial geology rather than detailed hydrological studies. Adoption of a zone designation will occur only after the public has been afforded an opportunity to comment.

PRINCIPLE 7

The strategy will encourage local management. It will recommend amendments to the statutes to authorize and require municipalities to adopt ordinances to prohibit uses within the classified zones.

PRINCIPLE 8

A process must be defined whereby local government and the public can set priorities among competing activities which may use or contaminate ground water.

PRINCIPLE 9

A committee will be established within the Agency to integrate and coordinate the strategy as it relates to state programs, federal programs and local programs.

PRINCIPLE 10

It is important that before major decisions in the development adoption, and implementation of the strategy are resolved, full public input is gained. A public participation plan will be developed to assure that input occurs.

Over ninety people, representing a wide range of interests attended the Ground Water Forum and offered many comments, asked many questions and raised points which the Department is considering as it prepares to draft the strategy.

Forum attendants generally agreed and supported the need for strategy development. The degree of protection (or the amount of possible contamination) which will be given ground water, classification of surface activities in aquifer protection zones, the application of the strategy to state and local decision making processess; the degree of regulation versus the amount of technical assistance; the avenue(s) to implement the strategy including regional planning commissions and local government and a strong voice for no further regulatory reform at this time were points most frequently raised.

Names of VGS members are on the Agency's mailing list and will receive a draft of the strategy. Your careful consideration, review and comments are encouraged.

One possible ground water protection mechanism is the development of an aquifer protection zone classification system. How they will be identified, where they will be located and what human activities will be permitted within their boundaries are questions with which the Environmental Conservation Agency is now grappling. VGS members have a great deal of background and experience to lend to this discussion. Agency staff would appreciate your participation in the strategy development process.

There will be numerous opportunities to participate in the development of this strategy if you are interested. The Public Participation schedule is as follows:

March, 1981 - Draft Vermont Ground Water Strategy to be discussed at Public Information Meetings around the State.

Draft Strategy Public Comment Period - will be held open for thirty days following last meeting.

Draft Strategy Public Hearings - Tentatively scheduled for late May.

Target Date for Strategy Adoption - July, 1981

If you have any questions, comments or suggestions about the Vermont Ground Water Strategy please contact Cheryl King at the Ground Water Management Section in the Department of Water Resources and Environmental Engineering (802) 828-2761.

We are looking forward to your participation.

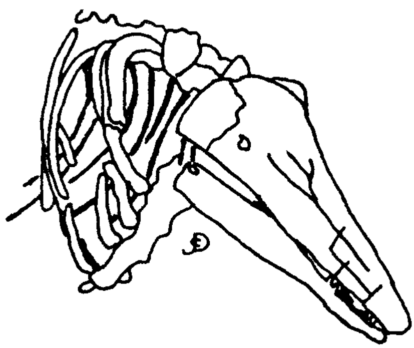
Submitted by Cheryl King

FOSSILS OF THE QUARTER

Since we are still in the throes of a "typical" Vermont winter, our field trip this quarter will be a visit to the Geology Museum at the University of Vermont. Any of our readers not familiar with it will find it on the ground floor of Perkins Geology Hall which is between the Ira Allen Chapel and the Fleming Museum off Pearl Street in Burlington. The museum has many interesting fossils found in Vermont and in other parts of the world but the two we will discuss, in keeping with our recent record-setting sub-zero weather, are relics of early post-glacial times in Vermont. One is a small whale skeleton; the other, remains of a long tusked mastodon- an extinct elephant-like animal. Both were found during the construction of the roadbed of the Rutland and Burlington Railroad between Burlington and Bellows Falls, Vermont.

The mastodon remains were encountered in 1848 near Mt. Holly, a few feet below the summit of a 1415 ft. elevation hill of gneiss where the railroad crossed the ridge of the Green Mountains. While making a deep cut in the rock, workers found a basin filled with well-rotted vegetation and muck in their path. In this basin, lying on gravel 11 feet below the surface, they first found a huge grinding tooth (a cast of which is displayed at the museum) then several feet further on a huge tusk 80 inches long and almost 4 inches in diameter. Another tusk and several bones were also uncovered. These items were given to the University of Vermont by the directors of the railroad so they could become part of an exhibit of Vermont fossils. Zadock Thompson was involved in identifying these remains as those of an extinct species of elephant with the ais of Professor Agassiz at Harvard University. While they were in his possession, the tusks began to dry out. This caused them to develop cracks and shrink. He became concerned that they would shatter and he wrapped them with wire. You will see them in the Vermont fossil display just as he wired them.

In a separate case directly in front of the model of the Grand Canyon, you will find the skeleton of the small whale which was found in a hill in Charlotte in August of 1849 when the railroad cut was being widened. In a large lens of blue clay, workmen uncovered the skull of an animal they took to belong to a horse that had been buried there. Amid lots of joking, they broke up the skull. Not realizing what they had found, some parts of the skull were carried away with the earth that was removed. The foremen of the railroad gang became interested when they saw the unusual shape of some of the bones that were unearthed. They began to dig more corefully and found, going into the hill, lined up as they had been in the living animal, many vertebrae. About 4/5 of the skeleton was retrieved and sent to Professor Thompson. After studying them and consulting with Louis Agassiz again, they confirmed that the remains belonged to a living species of Northern White Whale.



Partial sketch of White Whale skeleton in Perkins Geology Hall, University of Vermont.

The writer finds the discovery that the White Whales had lived in the Champlain Valley very interesting, having personally seen them playing in the waters of the Saguenay River where it empties into the St. Lawrence in northern Quebec. This animal prefers a habitat where fresh water meets salt water. Together with the whale remains in the Pleistocene clay deposit were found the small clams, Macoma and Saxicava. These animals live today off the shores of Labrador. We can project ourselves back in time to the post-glacial days about 9000 years ago. The continental ice sheet has retreated enough so that the St. Lawrence River Valley is free of ice. All the land so recently uncovered by the heavy burden of ice is still depressed into the mantle and therefore Atlantic Ocean waters stream up the St. Lawrence Valley and into the Champlain Valley, creating a new arm of the sea, which has been called the Champlain Sea. The icy cold waters lap against Mt. Philo, Snake Mountain, Cobble Hill and other highlands, making them islands. In these waters, where fresh meltwater enters the sea, White Whales play.

Here we should also say a few words about Zadock Thompson, who was involved with these finds. He was born January 19, 1796 in Bridgewater, Vermont. His was a searching mind and a personality of great persistence and enthusiasm. He also learned well to study the wealth of natural things around him. Because he was poor, getting formal education was difficult for him. In order to pay for his education at the University of Vermont, he sold an almanac which he wrote himself. Finally, at the age of 27, he received his degree from the university. He continued to write, publishing texts on arithmetic, geography, Canadian history, a Vermont Gazetteer and a History of Vermont. His most ambitious and famous publication (which was reissued in paperback in 1972) was his 3-volume Natural History of Vermont. He insisted that it be published in one volume, so that it would cost less, and poor students could afford to buy it. The book covered the geology, botany and zoology of Vermont. In 1845, when the state legislature authorized a geological survey of Vermont, he worked as a field assistant in the survey. The funding was inadequate to complete the task, and when the legislature refused to continue the funding in 1848, the project was suspended. In 1891, Zadock Thompson was made Professor of Natural History at the University of Vermont. In 1853, when the state legislature was again convinced that the Vermont Geological Survey should be completed, he was appointed State Naturalist and given charge of the program. Due to his cronic poor health, Thompson was only able to outline the plans for the survey before he died of heart trouble in 1856. He was very disappointed that he could not finish the job which he felt would be so important to the economic welfare of Vermont.

Submitted by Ethel Schuele

STATE GEOLOGIST'S REPORT

Legislation was passed by the 1980 Vermont General Assembly which will undoubtly have an inhibiting effect on the exploration, mining or milling of uranium or other radioactive element-bearing substances. The new las was encorporated into the existing Land Use and Development Law know as Vermont's Act 250.

Specifically, the new law requires an exploration firm to seek a permit to explore the subsurface. Reconnaissance level of exploration which requires no excavating, core-drilling, etc. may be conducted without a state permit. Trespass rights, etc. are required on private lands.

Mining and milling rights for uranium or other radioactive substances must first receive legislative approval. If the legislature finds mining and milling of uranium or other radioactive substances to be in the best interest of the state, the developer must then seek a permit through the normal process set forth in the Land Use and Development Law.

Arthur D. Little, Inc., has completed the "study of the Slate Mining Industry of Vermont/New York" and made its recommendations to the U.S. Bureau of mines and the State of Vermont. This study was conducted at the request of the State of Vermont and sponsored by the U.S. Bureau of Mines (Contract No. J0199-75) through the U.S.B.M. - State Geologist's Office cooperative agreement. Copies of this report may be obtained from this office.

Long-range plans for completing the topographic mapping of Vermont in the 7 1/2 minute - 1;25,000 scale format have been established with the U.S.G.S. National Mapping Division. The plan is to complete state coverage by the late 1980's through the Vermont-U.S.G.S. cooperative funds and SIR funds.

The detailed geologic mapping and mineral resource assessment of the Okemo State Forest continued for the second summer. A detailed ground radiometric survey was initiated during the summer of 1980.

The State Geologist's Office is providing partial financial and logistical support for an advanced degree thesis at the University of Vermont involving a detailed stratigraphic and structural analysis of Precambrian rocks in the vicinity of Lincoln, Vermont.

The office continues to provide geologic information providing advice and consultation to government, industry and private citizens.

The State Geologist serves on the following committees:

- -State Mapping Advisory Committee - Chairman
- -Radiological Emergency Response Committee - Chairman of the AEC Supplemental Plan Committee
- -Nuclear Waste Review Committee
- -Act 250 Review Group
- -Environmental Team
- -Ground Water Advisory Group
- -Erosion/Sedimentation Review Panel

Submitted by Charles A. Ratté, State Geologist
Agency of Environmental Conservation
Montpelier, Vermont 05602

WATER RESOURCES UPDATE

This is the continuing story about the condition of water resources in Vermont, which was started in the Summer 1980 (v. 7, no. 2) issue of the Green Mountain Geologist. Fifteen monitored state water wells show a mixed response to ground water conditions, with above normal levels for some wells in the Champlain Valley (for example, the Middlesex well data in Figure 1) and below normal levels in southern Vermont (reflected in the Hartland well data, Figure 2). The year-end level of Lake Champlain (a normal amount of 95.5 feet) indicates that the Champlain Valley made a good recovery from the below normal summer levels as a result of adequate fall rains. This winter was not a repeat of last, and, happily, there has been enough snow for the ski resorts to operate successfully. However, the amount of snow may not be adequate to recharge ground water to normal levels when the spring thaws occur. The ground has also been frozen deeper than normal during a protracted cold spell and this may also effect recharge of ground water. Although Vermont is not suffering from the water problems that currently plague New York City and New Jersey (a result, some say, of poor planning and lack of cooperation), these facts reinforce the need for the Vermont Ground Water Stratgey (page 27) being developed. →

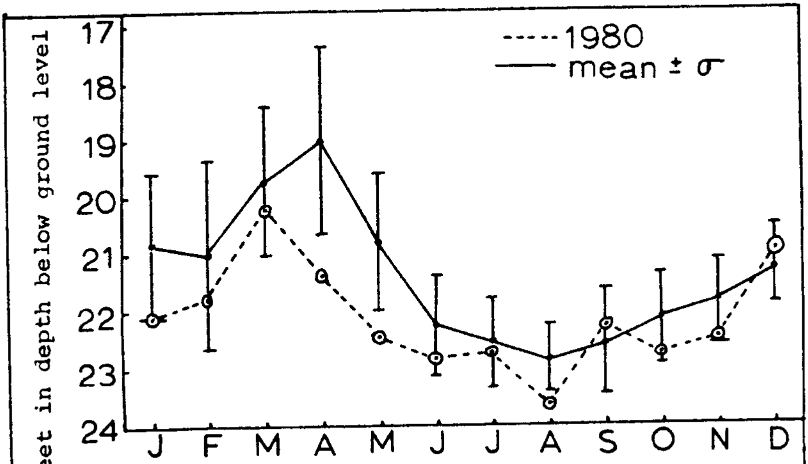


Figure 1. Ground water levels in Middlesex well.
(Records for the period 11/66 - 12/80)

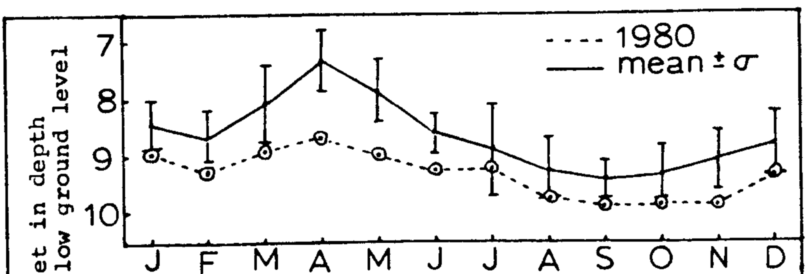


Figure 2. Ground water levels in Hartland well.
(Records for the period 8/69 - 12/80)

Submitted by Jeanne Detenbeck

MEETINGS

FEB 14 — Well Driller's Workshop at Vermont Technical College, Randolph, Vermont. See item below for details.

FEB 21 — VERMONT GEOLOGICAL SOCIETY Winter Meeting- see the program on page 14 this issue for details.

APR 3-5 — New England Section, National Association of Geology Teacher's, annual meeting, Fitchburg, Mass. (Robt. Champlin, Dept. of Earth Science, Fitchburg State College, Fitchburg, Mass. 01420).

APR 9-11 — Northeastern Section, Geological Society of America, meeting at Bangor, Maine (Dr. Frank Howd, Dept. of Geological Sciences, 110 Boardman Hall, University of Maine at Orono, Orono, Maine 04469)

APR 25 — VERMONT GEOLOGICAL SOCIETY Spring Meeting- presentation of student papers at Middlebury College.

WELL DRILLER'S WORKSHOP

State Geologist, Dr. Charles A. Ratté, and the Vermont Department of Water Resources and Environmental Engineering, will sponsor the Third Annual Well Driller's Workshop at Vermont Technical College, Randolph, Vermont, Room 124 Green, on Saturday, February 14, 1981 starting at 9:00 A.M. The workshop will focus in the morning on Scientific Methods of Finding Water, and in the afternoon on Methods of Improving Well Yields. Dr. Philip Wagner of Wagner, Heindel and Noyes, Inc. of Burlington, and James Ashley of the Department of Water Resources will discuss methods of using remote sensing or on-site scientific surveys to determine the most probable locations of water bearing rock fractures or presence of saturated sands or gravels. Dr. Wagner will also review some of the down-the-hole tools and methods which can be used to evaluate dry or low yield wells.

In the afternoon, Dr. Glenn Stewart of the University of New Hampshire will discuss their experimental project of increasing well yields through hydraulic fracturing. This project increased the yield of one well from four gallons per minute to 24 gallons per minute while increasing another from 3.6 gallons per minute to 15 gallons per minute before the packer slipped. Following the presentation on hydraulic fracturing, a panel of Vermont Drillers will discuss their experiences in improving well yields through surging, dynamiting and the use of dry ice. Some exciting new methods may also be discussed

The workshop is free to all and lunch will be available at a reasonable cost. Additional details can be obtained by calling James Ashley, Water Resources at 802-828-2761.

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FIRST CLASS

Get DH report from Middlebury Thur mtg.

Application of salts summer vs winter

Gerald Greiner R.P.I. doing MS on carbonates in VT