THE GREEN MOUNTAIN GEOLOGIST

QUARTERLY NEWSLETTER OF THE VERMONT GEOLOGICAL SOCIETY

WINTER 1996 VOLUME 23 NUMBER 1

The Vermont Geological Society's Winter Meeting

Rock and Mineral Industries of Vermont

Norwich University, Northfield, Vermont

Saturday March 2nd

Coffee 9:30, Meeting Starts at 10

See inside for details.

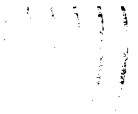
Directions: The Winter meeting will take place in the Cabot Science Annex, which is the southernmost brick building at Norwich University. The building is on the west side of Rt. 12, 0.7 miles south of the Northfield post office. Park adjacent to the building or in the student parking lot to the south. Look for VGS signs at the south entrance.

TABLE OF CONTENTS

THE GREEN MOUNTAIN GEOLOGIST
VERMONT GEOLOGICAL SOCIETY
DEPARTMENT OF GEOLOGY
UNIVERSITY OF VERMONT
BURLINGTON, VERMONT 05405-0122

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

ADDRESS CHANGE?
Please send it to the Treasurer at the above address.
–Printed on Recycled Paper–



PRESIDENT'S LETTER

"Sure I'll be an officer, put me where you need me" is a dangerous sentence. Suddenly thrust into office as your president without the year of training as vice, I find it a scramble to learn the tenor and tone of this organization since last seen as Secretary in 1985. One might think there are ill winds blowing, but I quickly find this not to be the case. You have been ably served by Kent Koptiuch, and we thank him for his commitment and energetic direction as president in 94/95. Were it not for the call of higher learning in Texas, you would be hearing from Ron Parker in this column, so we wish him the best and appreciate his lasting work and farewell words.

Given the different ways that we approach the science of geology, we may agree that an understanding of the earth is fundamental to a host of applied problems. In an era, when dollars go to the "real world" we may forget that conceptual understanding is often paramount before beginning to solve the nuts and bolts of any technical or social dilemma. Recently drafting a letter to Congress concerning the reauthorization of the National Geologic Mapping Act, (which I urge you to support) I list many practical ways geologic data, as they appear on maps, are applied.

Geologic maps are basic and underpin a host of applications such as the discovery, extraction and environmental management of mineral resources which is the subject of the winter meeting. They are used for the development of water and energy resources as well as evaluation and planning for environmental protection. Data garnered from geologic maps are necessary for design and construction of infrastructure improvements such as utility lifelines, transportation corridors, surface water improvements and the siting of critical facilities. Screening and characterizing sites for toxic and nuclear waste disposal are dependent on accurate up-to-date knowledge that can settle the question of what parts of a state or region are suitable or not for siting such facilities. In order to mitigate for hazards such as coastal (lake shore) and stream erosion, landslides and earthquakes, basic earth science data is in part required.

But I would also argue that for many a student searching for an understanding of the earth's physical systems and ecosystems; a geologic perspective, as represented on maps, helps create a sense of wonder for a complex and beautiful world. This is practical and real world because Congress is now bombarded with rhetoric about how to bring direction to America's youth. But direction comes from within, and without a sense of intellectual excitement, the spark to apply knowledge to life's conundrums often just isn't there. I would go so far as to say that when that spark is found, lives are saved, and that is certainly practical and real world.

Larry Becker
Vermont State Geologist

WINTER MEETING PROGRAM

Norwich University
Northfield, Vermont
March 2, 1996

9:30 **Coffee**

10:00 **Larry Becker:** *Vermont's Extractive Industries and the State's Geological Survey*

10:20 **Brian Fowler:** *Practical Procedures for Siting Crushed Stone Quarries*

10:40 **Dorothy Richter and Gene Simmons:** *Lessons Learned—Recent Geologic Experiences with Building Stone*

11:00 **Robert Dawson:** *Degradation of Mineral Aggregates*

11:20 **Victor Rolando:** *Some 19th-Century Vermont Mineral Processes*

11:40 **Lance Meade:** *Talc Mining in Vermont—A 1996 Perspective*

12:00 **Barney Hodges:** *The Development of Calcium Carbonate as an Industrial Mineral in Vermont*

12:20 **Eric Lapp:** *On the Earth, Products and Quality... One Geologist's Weathering, Metamorphism & Current Thoughts*

12:40 **Lunch**

VGS Executive Committee Meeting: *All members are invited to attend!*

WINTER MEETING ABSTRACTS

VERMONT'S EXTRACTIVE INDUSTRIES AND THE STATE'S GEOLOGICAL SURVEY

Becker, Laurence, R., Vermont Geological Survey, 103 S. Main St., Waterbury, VT 05671

Part of the Vermont Geological Survey's statutory direction is to do surveys of mineral resources and give aid and advice relating to the development and workings of rock or mineral deposits suitable for building, road making and economic and other purposes. The mineral resources data system (MRDS) are data developed in the mid-1980's covering the locations of quarries including rock and commodity type and ownership. Under criteria 9D& E of Act 250, comments are made on the operation and reclamation plans for rock quarries and sand and gravel pits. As a component of a study conducted by the New England Governor's Association in cooperation with the Vermont Survey, information on supply and demand of aggregate in Vermont is available with maps both in paper and GIS format. The Vermont Survey is working in cooperation with the US Geological Survey towards the completion of a new State bedrock geologic map. Digital and paper products of key 1:24,000 and 1:100,000 maps are now available that will be applied to compilations of the statewide map developed at a scale of 1:100,000. The new geologic information can be used for a range of needs including those of the mineral industry.

DEGRADATION OF MINERAL AGGREGATES

Dawson, R.F., Dept. of Civil and Environmental Engineering, University of Vermont, Burlington, VT 05405

Mineral aggregates undergo significant size reduction during extraction, processing, handling, and use. It is important to understand the breakdown mechanisms during all phases of manipulation to assure that the end-product in an aggregate system will have a proper particle-size distribution.

The general mechanisms of abrasion, compression, and impact are reviewed. A material balance model, based upon mineral comminution theory, was formulated as a family of exponential particle-size decay equations. Particle-size gradation analyses were conducted to assess numerical values for aggregate breakage coefficients to enable practical application of the theory.

Several important phases of aggregate handling are examined. The proposed degradation model is a good descriptor of size reduction due to energy induced during transportation, stockpiling, and placement (compaction) of aggregates. The research results show that degradation or breakage coefficients vary with petrographic characteristics as well as with the specific energy applied during the reduction process.

A simple test procedure to measure the susceptibility of an aggregate to degradation during compaction is proposed. Several test procedures exist to measure aggregate degradation due to attrition (abrasion), impact, and compression, but the results from the separate test procedures cannot be extrapolated to other modes of degradation.

PRACTICAL PROCEDURES FOR SITING CRUSHED STONE QUARRIES

Fowler, Brian K., North American Reserve, 67 Water St., Suite 207, Laconia, NH 03246-3300.

This presentation describes the rock mechanics and structural geologic techniques used to locate and develop high-production crushed stone quarries producing sized aggregates at minimum volume-unit cost. These techniques have been widely used in Vermont during the past 25 years, in particular for quarries in Barnet, Shaftsbury, Middlebury, St. Johnsbury, and Clarendon. The Shaftsbury quarry is used to demonstrate the techniques.

The relationship between modulus of elasticity and uniaxial compressive strength of various rocks, expressed as their Modulus Ratio, forms the first basis of the techniques. This ratio has been consistently found to best describe the intact strength properties of rocks suitable as sources for crushed stone production. Plots of Modulus Ratio based on laboratory testing are presented, and their use in quarry-site reconnaissance is described.

The "Talobre" method of stereographic analysis forms the second basis of the techniques where it's friction circles are used to orient proposed workings for optimum rock mass coupling of blasting force and to create maximum fragmentation efficiency and lowest production cost.

The application of these techniques provide mining geologists with ways to initially locate and develop crushed stone quarries, and then to go further during operation to anticipate and compensate for natural variations in the rock mass to maintain minimum in-pit costs.

THE DEVELOPMENT OF CALCIUM CARBONATE AS AN INDUSTRIAL MINERAL IN VERMONT

Hodges, Barney, OMYA Inc., 61 Main Street, Proctor, VT 05765

Over the past 200 years the utilization of marble (calcium carbonate), primarily associated with the Shelburne Formation, as a natural resource has played a significant role in the economic development of Vermont. Originally developed for dimension stone and as a source for lime, marble has, since the mid-twentieth century, also been quarried and milled for use as an industrial filler. Since their purchase of the Vermont Marble Company twenty years ago, OMYA Inc., with their expertise in fine-grinding of calcium carbonate for industrial fillers used in paper, paint, and plastics industries, has successfully developed white high-calcium marble in Vermont as an economically significant mineral resource.

The practical use of geology has been critical in locating, evaluating, and developing these mineral resources. An understanding of the unique mineralogy, geologic structure, and stratigraphy of each specific marble deposit has been essential for successful exploration and economic quarry development. OMYA's Middlebury Quarry development plan, with progressive reclamation, is a model industrial mineral development concept demonstrating the effective use of economic geology.

TALC MINING IN VERMONT—A 1996 PERSPECTIVE

Meade, Lance, Luzenac America, Stone House, P.O. Box 212, Ludlow, VT 05149

Talc, the Vermont State Mineral, has, since prehistory, been important to the people and economy of Vermont. Today, with international companies consolidating the mining industry and the need to compete with other minerals in the world market, the talc industry in Vermont has undergone some dramatic changes. These changes will for the most part help maintain the viability of Vermont talc as ore and keep talc an important part of the Vermont economic picture.

The geological sciences have contributed to this scene with the evolution of understanding of the ore bodies and the new mines that have been developed in Vermont during the past 20 years. Needless to say, geologists have played a major role in this story and will continue to participate in the industry in the years to come.

ON THE EARTH, PRODUCTS AND QUALITY... ONE GEOLOGIST'S WEATHERING, METAMORPHISM & CURRENT THOUGHTS

Lapp, Eric T., OMYA, Inc., Proctor, VT 05765

Several past VT Geological Society trips have toured various OMYA quarries. This discussion will examine and ponder what's beyond the quarries:

- •OMYA: Vermont & world-wide; processes, products and more
- •Quality, Management, Systems and this thing, ISO 9000
- •Geologists' career paths, change and other topics

My goal is to take those "outside of industry" on a field trip of sorts, where we will hope to see:

- •The evolution of a stone product business
- •The topography and morphology of change
- •Stratigraphy of the paperwork environment
- •The structure and nomenclature of quality aspects
- •The state of the union between customers and suppliers

We may even have an outcrop photo!

LESSONS LEARNED —RECENT GEOLOGIC EXPERIENCES WITH BUILDING STONE

Richter, Dorothy and Gene Simmons, Hager-Richter Geoscience, Inc., 8 Industrial Way - D10, Salem, New Hampshire 03079

For the most part, the modern building stone industry manages to thrive with minimal geologic input (much to the disappointment of our profession). Except for a few large, carefully engineered and/or well-funded projects, geologic evaluations of building stone generally are not made at the "front end" of a project, and often only occur after a lawsuit or construction claim has been filed or a serious problem has been encountered. The types of problems that are commonly investigated from a geologic perspective include the cracks in the stone on buildings (i.e., natural or man-made?), variations in appearance (color, textures) and/or physical properties of stone supplied (low or variable strength test results), and apparent degradation of the stone due to bowing, cracking, fading, discoloration, or development of efflorescence. The perceived "geologic problems" generally turn out to be due to non-geologic factors such as anchorage design, workmanship, and handling. In this talk, we review a few case studies of building stone investigations and offer some observations of the geologic factors that can affect modern building stone performance.

SOME 19TH-CENTURY VERMONT MINERAL PROCESSES

Rolando, Victor R., Research Associate, Division of Historic Preservation, RR 1 Box 1521-3, Manchester Center, VT 05255

Geology and archeology often cross-links when it comes to the discipline of industrial archeology, which is the study of early industrial remains. Vermont has a rich industrial heritage of processing her better-known limestone, marble, slate, and granite resources, but also of such lesser-known metallic resources as iron and copper. Two of these processes will be examined from the perspective of an industrial archeologist—that of iron smelting and burning lime. Specifically I will describe what the visible surface remains of blast furnaces and lime kilns tell us about the technology of these 19th-century Vermont extractive industries and extent of their geographic impact.

Vermont can boast of visible surface remains of nine 19th-century blast furnaces (of over 30 known sites), although most of these are today nothing more than piles of stones. Better remains stand at Bennington (2), East Dorset, Pittsford, Forestdale, and Troy. That at Forestdale (ca. 1823–1865), in Brandon, will be examined to discover what the ruin tells us of the processing of iron.

Lime burning was also a major industry in the state, the earliest at Isle La Motte during the period of the French occupation (ca. 1666), and lasted to the closing of the lime kilns at Winooski in the 1950's. Over 100 lime kiln ruins have been found in the state that run the range from small farmer-operated kilns to major industrial enterprises. Samples of these remains will be examined to show the evolution of the industry as experienced in Vermont.

STATE GEOLOGIST'S REPORT

Laurence R. Becker
Vermont State Geologist and Director, Vermont Geological Survey

The Vermont Survey continues developing a new State bedrock geologic map in cooperation with the U. S. Geological Survey. In this STATEMAP grant year ending July 1996, Marjorie Gale under contract to the Vermont Survey is assisting the Northern Vermont compilers (in alphabetical order) Professors Barry Doolan, Charlotte Mehrtens, and Rolfe Stanley as they bring together information for the following one degree sheets, Mount Mansfield, Lake Champlain North and South, and Montpelier.

At the Northeast Geological Society of America meeting in Buffalo in late March, the compilations are to be shown at a poster session entitled "New 1:100,000 Bedrock Geology Map of Vermont: Progress and Preliminary Maps". This will be the jumping off point for feedback from the geological community while facilitating planning to fill the gaps in the 1996 field season.

Key 1:24,000 quadrangles are digitized along with several one degree sheets. As of March 1996, there will be 18 quads available and the one degree sheet, Lake Champlain North. These sheets cover some of the growth areas in Vermont such as ski areas and the Champlain Valley. David Dreher digitizes the Northern Vermont maps under contract to the Vermont Survey.

Diane Vanecek is on leave of absence until April in Oman where her husband is teaching computer science. Filling in is Laura Cadmus, UVM graduate, who is rapidly learning the system for delivering geologic information to you. Laura is experienced with ARCVIEW II and we hope to apply her skills to Survey work.

The new publications catalogue came out in October, 1995 commemorating the 150th year of the Survey. As an illustration, the cover shows an idealized cross-section from the first State Geologist's report of 1845. In the center you will find an open file report section through which you can order the digital products both on diskette and/or paper. Please call Laura at 241-3608 to receive a copy of the catalogue or via e-mail at laurac@anrimsgis.anr.state.vt.us.

In mid February, preliminary results from the hydrodynamic study of Missisquoi Bay are expected. The Vermont Survey manages a study that models any

predicted changes in sediment transport throughout the Bay, with and without the route 78 causeway in place. Funds for the contractor, Applied Sciences Associates of Narragansett, Rhode Island, and the Survey's oversight role are supplied by the Vermont Agency of Transportation.

As delays in budget negotiations go, so goes the timing of the Texas/Vermont/Maine low-level radioactive waste compact in Congress. With votes in relevant committees in the House and Senate and a "rule" to bring the bill to the floor of the House complete, March 1996 is the next opportunity for a floor vote.

A special Vermont legislative study committee met on the granite industry during the fall 1995. A range of testimony was offered covering issues from Act 250 review to topics such as developing new markets for extracted material. As of this date, the report by the committee is not yet available.

Gold is the subject of two bills before the legislature. H538 prohibits gold dredging in streams and proposes to require a permit for panning. H528 is an act relating to small motor mineral dredges and prohibits those with suction nozzles greater than four inches in diameter. Well head protection is mentioned in two bills. H496 allows municipalities to adopt regulations whether or not they have adopted a town plan or other bylaw. H704 shall not limit the use of property on which the well is not located. An act relating to the licensure of well contractors and pump installers, H686 supports licensing. There has been talk of eliminating the licensing program.

This office is beginning to think about how a surficial mapping program might look now that the compilations of the bedrock work are advancing. I will be reaching out to the geological community to help mold a vision for the future. If you have thought about the needs and the means all ready, please contact me to begin a discussion as well as providing advice on how to bring the interested parties together to ruminate and plan.

FALL FIELD TRIP/ANNUAL MEETING REPORT

The Fall Field Trip was a great success (if a little damp). At 10 in the morning the intrepid few gathered in the rain at the Rock of Ages quarry in Barre for a terrific tour of the quarrying operation and the finishing plant. Bob Campo of Rock of Ages took us all over the place; it was especially interesting to hear about the various cutting techniques being tried, from compressed gas to high-pressure water jets to diamond-wire saws. We were especially fortunate to have Dorothy Richter join us; she was the geologist for Rock of Ages for a number of years and came prepared with copies of a paper she wrote about the Barre granite bodies and a wealth of information about the quarry. And the tour of the finishing plant alone was worth the trip: the monuments being prepared ranged from delicate hand-carved artwork to massive, ornate blocks (one single, solid monument measured about eight feet long, six feet wide and six feet high!). Particularly impressive were the "rolling pins" designed to roll water out of pulp for the paper industry. These massive cylinders of solid granite are about six feet in diameter and over twenty-five feet long!

For the afternoon, we drove to Rochester, where, after a quick lunch (in the *sun*) we poked around the verde antique quarry, admiring that beautiful rock and the narrow, deep hole being quarried. Then it was off to the Inn at Long Trail, in Sherburne, where the still-intrepid (including our newly-minted VGS president and some hardy Castleton State College students) went for a lightning hike up Deer's Leap for a terrific (if windy) view of western Vermont and adjacent New York. Irish music at the Inn followed, provided by the semi-unprofessional group Extra Stout (including yours truly). A super dinner and VGS elections followed. A good time was had by all!

Helen Mango
no-longer-Member-at-Large

Additional Note from Eric Lapp:

A highly abbreviated annual meeting was held after dinner as only five members were present. The proposed bylaw change and given slate of officers was read and a general query for any other nomination/write-ins was asked. I noted that since we did not have the write-in ballots at the meeting, final results would await verification at a later date. Jeff Pelton was nominated secretary for the open ballot slot and he accepted. The vote was called and the slate carried unanimously. Larry Becker was congratulated as our new President. **NOTE**: The Society still needs a Vice President to round out the Executive Committee. He also gave out copies of the new Vermont Geological Survey publications list and gave us a look at a plotter version of the new state map.

VERMONT GEOLOGICAL SOCIETY BUSINESS AND NEWS

New Members:

We welcome the following new or returning members who have joined the Vermont Geological Society since the last issue of the *GMG* was published:

John Akielaszek	Montpelier, Vermont
Martha Doelle	White River Jct., Vermont
David Dreher	Waterbury, Vermont
John Jemsek	White River Jct., Vermont
Kimberly Hannula	Middlebury, Vermont
Roger Haydock	Brattleboro, Vermont
Barney Hodges	Middlebury, Vermont
Leslie Kanat	Johnson, Vermont
Jade Lackey	Middlebury, Vermont
Ronald Marcotte	Bakersfield, Vermont
Todd Martin	Colchester, Vermont
Derek Murrow	Putney, Vermont
Marlene Patterson	Fair Haven, Vermont

Treasurer's Report

The financial condition of the Society remains strong. I have submitted a complete financial report (as of December 31, 1995) to the Executive Committee. Copies will be distributed to any member wishing one. A summary of this report follows:

Checking Balance	$3,995.23
Excess of Income over Expense:	$896.74

Fourteen new applications for membership have been received since May 15, 1995 (see above).

I recommend that the Executive Committee discuss the development of a general fiscal plan for the 1996 calendar year.

It is a pleasure to serve as Treasurer. As always, suggestions and comments are welcome.

Respectfully submitted,

Al Carpenter

Executive Committee Meeting—18 January 1996
Squirrel's Nest Restaurant, Bristol Vermont

Minutes

The following members of the Executive Committee were present: Larry Becker, Eric Lapp, Al Carpenter, and Stephen Wright. Stephen Wright agreed to take notes.

The Minutes of the 29 April 1995 Executive Committee Meeting were read and approved.

Treasurer's Report:: Allan presented a brief summary of a very complete series of reports that he had completed for 1995. New member applications were briefly reviewed and all were approved for membership.

Executive Committee Expenses: Stephen reviewed the types of expenses that Executive Committee members could be reimbursed for.

Winter Meeting: The organization and theme of the 1996 Winter Meeting was agreed to and the results appear earlier in this issue of the *GMG*.

Spring Meeting: Tentative dates of April 20 or 27 were suggested. Stephen agreed to finalize the date after discussions with the faculty at both UVM and Middlebury.

Summer/Fall Field Trips: Stephen will take responsibility for organizing the fall field trip which will focus on the glacial geology in the Huntington, Richmond, Jericho, Underhill region. No plans were made for the Summer field trip.

Vacancies: The Committee decided to seek members to serve as Vice President and on the Nominating Committee at the Winter Meeting.

Role of V.G.S: Larry briefly discussed his ideas for clarifying the role that the V.G.S. should play in proffering opinions on issues of public concern. He suggested that the opinions of members on these issues could be polled quickly via e-mail. Member opinions would be solicited during the Winter Meeting.

V.G.S. Research Grant: The Executive Committee recognized the need to seek applicants for V.G.S. Research Grants. Applications should be sent to institutions with students and a tentative deadline set for sometime in April.

Respectfully Submitted, Stephen Wright

WATER UPDATE

Kent Koptiuch, CGWP

Methods of enhanced bioremediation for contaminated soils and groundwaters have been developing rapidly in the last year or two. Many emerging methodologies hold great promise in creatively mitigating some of the problems we have created in our environment.

Dupont Environmental Remediation Services, working in conjunction with the Texas Water Commission, has announced a breakthrough for in-situ treatment of chlorinated hydrocarbons, anaerobically, through the injection of sodium benzoate. The method was highly successful in reducing levels of dissolved perchloroethylene (PCE), vinyl chloride, and dichloroethylene in groundwater to below detection levels of 0.005 mg/L in less than 700 days. Sodium benzoate, a common food additive (check the contents of your soda can) was introduced as a nutrient to the impacted aquifer through monitoring wells. Pre-existing soil microbes began consuming the product and, in the process of population expansion, depleted all available oxygen in the saturated zone. The microbes then began consuming the dissolved chlorinated compounds as an oxygen substitute. Dupont intends to market the technology on a widespread basis in the near future. (Source; "The National Environmental Journal," January/February, 1996).

Philip Environmental Services Corporation is promoting chlorinated bioremediation through methane injection. Through the introduction of methane as a nutrient to the groundwater, in a 4% by volume solution, methanotrophs co-metabolize TCE and DEC with methane while successfully reducing dissolved concentrations from 28 ppm to 5 ppm, and from 12 ppm to below detection levels of 0.005 ppm, respectively. (Source; "Water World," Nov/Dec 1995).

The Center for Bioremediation and Detoxification at the Pennsylvania State University has been experimenting with horseradish. Co-Director, Jean-Marc Bollag announce the successful use of minced horseradish root in removing phenols from industrial waste streams. An enzyme in the root apparently causes pollutants to form insoluble polymers; these polymers can then be filtered out of the water. Studies are ongoing to determine whether or not any un-wanted byproducts are created. (Source: "Environmental Solutions," August, 1995).

"Phytoremediation" is one of the newest buzzwords in contaminated groundwater and soils cleanup these days. This process entails the use of tolerant vegetative species to attenuate contaminant compounds. The approach is multi-dimensional in that the plants act as a hydraulic control mechanism by withdrawing water from the aquifer (up to 30,000 gallons per day per acre in a stand of mature poplars), hyperaccumulating metals in wood and leaf tissue, (lignification) through phytoextraction, and bacterial biodegradation of BTEX hydrocarbons and chlorinated solvents in the rhizosphere (root zone). Phreatophytes, deep-rooted plants that draw water from below the water table, can work on impacted water at depths of up to 60 feet. Successes have been documented utilizing a wide range of vegetative species, with species chosen dependent upon the target contaminant. In addition to poplar, scientists can choose from willows, radishes, rye grasses, indian mustard, pennycress, cattails, rushes, latex producing tree species, and a variety of legumes.

In the surface water world, the zebra mussel continues to pose a major threat to water and waste-water treatment plants throughout the Great Lakes, Saint Lawrence Seaway, and Lake Champlain basins. Research has been proceeding in a many-pronged approach with successes being heralded through the use of teflon coatings, chlorine, and hypochlorite. The most recent success was announced by the Bay Metropolitan Water Treatment Plant in Bay City, Michigan. Plant operators gradually increased dosage of potassium permanganate ($KMnO_4$) over a three month period using a chemical feed pump at the water intake crib. At a rate of 1.25 mg/L, operators achieved 100% control with the added benefit of eliminating all algae and freshwater sponge growths inside the intake pipes. (Source; "Water World," Nov/Dec 1995).

Many other ground-breaking remedial approaches are constantly being employed by innovative scientists on a daily basis; it's nice to know that the news doesn't have to be all bad!

SEMINARS, MEETINGS, AND FIELD TRIPS

March 5–8, 1996: "Geochemical Modeling of Ground Water," NGWA Short Course, Columbus, OH. Contact: National Ground Water Association; (800)-551-7379.

March 11: University of Vermont Fall Seminar Series (4 P.M.): *"Geoarcheology—past peoples, past landscapes"* Peter Thomas, University of Vermont, Anthropology.

March 11–14, 1996: "Analysis and Design of Aquifer Tests including Fracture Flow," NGWA Short Course, Columbus, OH. Contact: National Ground Water Association; (800) 551-7379.

March 25: University of Vermont Fall Seminar Series (4 P.M.): *"Periphyton-phosphorus interactions in a cold-region eutrophic river"* Jim Hoffmann, University of Vermont, Botany.

March 21–23: **Northeastern Section Geological Society of America Annual Meeting**, Buffalo, New York. Info: 716-645-3869.

April 1: University of Vermont Fall Seminar Series (4 P.M.): "Water, Chloride, and Phosphorus budgets for Lake Champlain" Eric Smetzler, State of Vermont.

April 8: University of Vermont Fall Seminar Series (4 P.M.): "Environment and internal seiche of Lake Champlain" Thomas Manley, Middlebury College.

April 13–15, 1996: "10th National Outdoor Action Conference & Exposition." Las Vegas, NV. Contact: National Ground Water Association; (800) 551-7379

April 15: University of Vermont Fall Seminar Series (4 P.M.): "Sediment resuspension in Lake Champlain" Patricia Manley, Middlebury College.

April 22: University of Vermont Fall Seminar Series (4 P.M.): "Late Wisconsinan glacial lake history of the Boquet and AuSable Valleys" Dave Franzi, SUNY Plattsburgh.

April 26: University of Vermont Fall Seminar Series (4 P.M.): "Negative pH, ultra acidic mine waters and the challenge of environmental restoration at the Iron Mountain mine superfund anomaly" Kirk Nordstrom, U.S. Geological Survey.

April 27: **Vermont Geological Society Spring Meeting** for the presentation of Student Papers, Middlebury College.

April 29: University of Vermont Fall Seminar Series (4 P.M.): *"Lake Champlain: A thirty year perspective"* Bruce Corliss, Duke University.

May 7–10, 1996: "Annual Spring Meeting," New York Section, American Water Works Association, Albany, NY. Contact: NYS AWWA, P.O. Box 9, Syracuse, NY 13211; (315) 455-2614.

June 9–14, 1996: "From Small Streams to Big Rivers," Society of Wetland Scientists National Meeting, Kansas City, MO. Contact: Thomas J. Taylor, (913) 551-7226, e-mail; taylor.thomas@epamail.epa.gov.

June 16–22, 1996: "Karst Hydrology" Short Course offered by Center for Cave and Karst Studies, Western Kentucky University & Mammoth Cave National Park. Contact: Nicholas Crawford, Director, Center for Cave and Karst Studies, Dept. of Geography and Geology, Western Kentucky University, Bowling Green, Kentucky 42101-3576

July 7–10, 1996: "Annual Conference/Rocky MTN Rendezvous/Soil Quality & Soil Erosion Interaction," Soil & Water Conservation Society, Keystone, CO. Contact; (800) THE-SOIL, e-mail; swcs@netins.net.

September 27–29: 1996 New England Intercollegiate Geologic Conference headquartered in the Gorham-Littleton area of northern New Hampshire and jointly sponsored by Harvard University, the Mount Washington Observatory, and the New Hampshire Geological Society. Contact: Mark Van Baalen, Dept of Earth and Planetary Sciences, Harvard University 617-495-3237; mvb@harvard.edu.

¿Por favor, donde están las rocas interesantes? (Excuse me, where are the interesting rocks?) Taking Vermont geology students south of the border.

by Helen Mango

This past summer, I helped to lead two very interesting and enjoyable geology trips, one to Costa Rica and one to Mexico. While the general goals of the two programs were very different, both intended to introduce geology students to new rocks, landscapes and cultures unavailable to them at home.

Costa Rica

This six-week program was developed two years ago as a joint geology and Spanish-language course for Castleton State College. The idea arose because I wanted to take Castleton geology students on a real field trip (a little farther afield than, say, the Adirondacks), and Spanish professor Dr. Ana María Alfaro-Alexander wanted to offer her Spanish majors an alternative to a solo semester abroad (study in a Spanish-speaking country is required for Castleton Spanish majors). We chose Costa Rica because of its active volcanoes, its small size (allowing easy travel to almost all parts of the country), its great variety of geologic and ecological zones (from recent lava flows to tropical rain forests to ophiolitic coastlines to dry grasslands), its clean drinking water, and its political stability.

This summer's trip was our second visit. Our itinerary took us from our base in the capital, San José, to four volcanoes, each in various stages of activity. Irazú had its last big eruption in 1962. Recently, there has been seismic activity resulting in small landslides down its northern slopes. At 3432 m elevation, the cool climate (just like home!) encouraged our Vermonters to run around, only to get giddy from the altitude!

The activity of Poas is most easily predicted by watching the level of the crater lake: the green lake, which occasionally has rafts of sulfur floating on it, and has a pH of 0.5, rises and falls in a complicated response to rainfall and magmatic activity below the volcano. We visited Poas with geologists from the University of Costa Rica, and thus were able to go down to the first major terrace above the crater lake; we could look up at the poor tourists stuck at the official overlook high above us. Capped vertical tubes for collecting radon gas are scattered about the crater; volcanologists are trying to determine if fluctuations in the release of radon gas indicate impending eruptions. There are also containers for collecting rain; the gases emanating from the crater acidify the local precipitation, causing a pronounced "dead zone" down the side of the volcano in the prevailing wind direction.

Arenal is currently the most active of Costa Rica's volcanoes. Ash, blocks, bombs and lava erupt from the small, perfectly-shaped cone at fairly regular intervals, accompanied by very impressive booms. The show was particularly wonderful at night, with showers of sparks and red hot rocks tumbling down. We hiked over a lava flow (dating from the 1960s) in search of fumaroles to sample. After finding that the fumaroles we had visited two years ago had dried up, we rewarded ourselves for the difficult hiking (lava is sharp!) with a soak in one of the warm rivers that drain the southern side of the volcano.

Rincon de la Vieja's activity comes in the form of large fumaroles, pools of boiling water, and a great assortment of bubbling mudpots. The mud's temperature was well over 100°C; it used to be considered a great beauty aid as a facial, but too many people got scalded and so we had to toss our temperature probe over the new restraining fence. We were successful as well with our sampling of the fumaroles. Using gear consisting of aluminum tubes that threaded together, Tygon tubing, a collection bottle and a hand pump, we collected steam from a fumarole and condensed it. Its near-neutral pH and low salinity suggested that the steam was mostly rainwater that had percolated down, become heated by the near-surface hot rocks, and risen as steam.

In two more years we may return to Costa Rica, or we may choose some new Latin American country to visit. We hear the geology of Chile is very interesting....

Mexico

This three-week trip was part of an eight-week project financed by the National Science Foundation, under their Research Experience for Undergraduates (REU) program, and run jointly by Dr. Lois Ongley of Bates College in Maine, Dr. Alison Lathrop of Millerville University in Pennsylvania, Dr. Aurora Armienta of the Universidad Nacional Autonoma de México (UNAM) in Mexico City, and me. The idea behind the REU was to provide students with an opportunity to study geology in a place and with equipment not available to them in their home institutions, and to help in the ongoing study of the hydrogeology of the mining town of Zimapán, in east-central Mexico. The water in the village of Zimapán is contaminated with arsenic, to the point where some residents, mainly children, are beginning to show the signs of arsenic poisoning. Researchers from UNAM are trying to determine *why* the arsenic is present in the water, most of which comes from a few major wells and is pumped to the town for distribution to individual houses. Possible culprits include the sedimentary rocks of the Zimapán basin,

material filling the many fractures in the rocks, and the tailings piles from the mines. Zimapán has for centuries been an important source of lead and zinc in Mexico; arsenic is a fractious by-product of the ore. The mineralogy of the ore deposits is dominantly galena, sphalerite (a black, high-Fe variety known as marmotite), pyrite, pyrrhotite and arsenopyrite, and a couple of hundred grams of silver per ton.

Our preliminary work this past summer has shown that the tailings piles are not likely to be the source of the arsenic contamination of the groundwater. We hope that detailed structural analysis, and soil, rock and water sampling will help define the arsenic source and suggest ways to prevent further contamination of the town's water supplies. The students involved this past summer came from a variety of schools across the country, including Arizona, Illinois, Georgia, Nebraska, Maine, New Hampshire, and two students from Castleton State College. The geology department at Bates College was our home base; they have equipment such as an ICP and SEM for analysis of our Mexican samples.

The REU will return to Mexico next summer with a new group of twelve students. The only requirements for application are that the student still be a matriculated undergraduate during the summer of 1996, and demonstrate a compelling reason to want to be a part of the project. I encourage any undergraduate reading this article or hearing about this project, and interested in joining us next summer, to contact me for further information. I can be reached at the Department of Natural Sciences, Castleton State College, Castleton, VT 05735, (802) 468-5611 x478, e-mail mangoh@sparrow.csc.vsc.edu.