Granite State Geologist

The Newsletter of the Geological Society of New Hampshire
Spring 2004 Issue No. 44 **www.gsnhonline.org**

Ground Water Awareness Week 2004

Ground Water Awareness Week is March 14-24 this year. You can get more information about this celebration and educational period by going to the National Ground Water Association website (www.ngwa.org).

A GSNH Thank You

A hearty GSNH thank you goes to Greg Kirby, a long time GSNH member, Board Member and Past President. Greg continues to support the Society with his generous donations to our Mineral Raffles. Greg (as well as Bob Whitmore) has supplied us with numerous mineral specimens for the raffles over the years. It is through Greg's efforts that GSNH has been able to offer a variety of mineral specimens from all over the world for the Mineral Raffle.

You might like to know that Greg is currently relocating from Merrimack to Groveton, NH. He will continue to work for the NH Department of Environmental Services, but will now be staffing the Gorham Office as the NHDES North Country representative for the Waste Management Division. We all wish Greg much success on his new venture.

Update from the New Hampshire Geological Survey

David R. Wunsch, State Geologist

Springtime is upon us, and just like the New Hampshire snow pack, funding for earth-science related programs and agencies at both the state and federal levels is slowly melting away. Unfortunately, yearly program authorizations and budget battles are becoming an all too predictable occurrence. From the state side, NHGS has approximately $155,000 in federal funds for geological mapping and a ground water-related project which are currently in political limbo as part of an overall effort to reduce the state's budget. On the federal side, for one of the first times in history, STATEMAP and EDMAP funding requests from all states exceeded the dollars appropriated to these programs. The positive side to this is that this disparity demonstrates the health and success of these programs and it is very timely because the Congressional hearings related to the reauthorization of the National Geological Mapping Act will take

place this spring. The funding shortfall will provide good ammunition to request that the Act be re-authorized at a higher funding level.

Update from the New Hampshire Geological Survey, continued

But this could be a tough task, as the total USGS budget is scheduled to be reduced 1.9 % in the President's proposed FY 05 budget. As a sign of what's ahead, a recently released study by the American Association for the Advancement of Science (AAAS) predicts that with the Congress and the President's commitment to cut the federal budget deficit by half in the next 5 years, the USGS budget would have to be reduced by 13 percent below the *current* budget appropriation to meet this goal. However, time and time again society has raised its collective voice in support of geoscience directives, because it is well recognized that society's overall well-being is critically reliant on data and information that geoscience agencies provide. Thus, we will persevere and continue to make progress. Some programmatic updates from NHGS are listed below:

- Geological Mapping: recently completed maps from the 2002 STATEMAP program include the Enfield, New Boston, and Northfield 7.5 minute surfical geological maps. These maps are currently being edited, but will be available as open-file reports later this year. Seven quads along the Seacoast region of NH are currently being digitized by UNH Complex Systems and concurrently edited and edge-matched by Karl Koteff. We are addressing quality control issues, and we expect to make this map data available from the NHGS and UNH GRANIT portal this summer.

- For the 2004 STATEMAP proposal, NHGS requested a record $85,400, but was only partially funded at $68,717. Due to the success of the national program, $8.5 million was requested by a record 47 states that competed for grants, but only $6.5 million was available, so no state's proposal was fully funded. The good news is that we were sufficiently funded to complete one of the key parts of the NHGS 2004 proposal; to digitize the surfical geological maps along the proposed I-93 Expansion Corridor. This is a 2-year effort that, upon completion, will add another 15 surfical maps to our digital database of geological information, and make a huge contribution toward our goal of getting all NH surficial data at 1:24,000 in digital, GIS format. The NH Department of Transportation (NHDOT) is to be acknowledged for their support of this project. Hopefully, the Governor and Executive Council will authorize NHGS to accept and expend the 2003 STATEMAP funds so we can receive the 2004 funds to carry on this project.

- NHGS has made substantial progress toward the development of a database that contains monitoring well information from NHDES waste site permits on file, and subsurface boring data from NHDOT. As of January 04, we have compiled data from 1162 boreholes from 31 sites in the Seacoast region of NH. Over the course of this project, we have procured digital tax map and parcel information that has allowed us to add 731 additional wells to the water well inventory database. We also continue to compile updated information on large water withdrawals in the region.

- NHGS is coordinating with the Jackson Estuarine Laboratory at UNH in the preparation of a proposal to the U.S. Mineral Management Service (MMS) to compile information and collect new data to map the sub-marine surficial geology off of the coast of New Hampshire. The surficial information will assist with terrestrial interpretations of the glacial history of the region. Project data and maps will be archived at NHGS. The project will assist MMS with evaluation of the offshore sand and gravel resources. Offshore sand can be used royalty free for sand replenishment of publicly owned beaches.

Update from the New Hampshire Geological Survey, continued

- On the education and outreach front, NHGS staff continues to work with several teachers in NH who are involved in earth-science education projects. Ruth Krumhansl, a teacher at Soughegan High School, was successful in obtaining a grant from the Toyota Tapestry Foundation to utilize geological surficial mapping as a unit for her science program. The unit provides hands-on, inquiry-based learning while students conduct field mapping, sample collection, and sedimentological analysis that assists our professional mappers. Students also use digital cameras, as well as GIS and GPS technologies to geo-reference their data collection sites. Ruth and I presented a well-received poster at the 2003 GSA meeting titled: "Surficial Geologic Mapping as a Discovery-Based Teaching Tool for High School Students." NHGS staff also continue to work with Dan Reidy, a teacher from Moultonborough Middle School and the current recipient of the Christa McAuliffe Teacher Fellowship. Dan is building an interactive web site and a video for teachers and students to use to learn about New Hampshire's Geology. Staff also make presentations at schools and civic groups, and meet numerous requests for geological information from all parts of the state.

- Something to consider: I was invited to speak at the NH Association of Natural Resources Scientists (NHANRS) annual meeting that was held on February 14. It was a well organized and professional meeting, and proved to be an educational experience for me as well. My goal was to inform NHANRS members of the scientific information and products, such as well data and geological maps, that are available from the NH Geological Survey. While chatting with several members, I was pleasantly surprised to discover that quite a significant number of natural resource scientists had at least one degree in geology as part of their educational portfolio. With this in mind, I couldn't help but think that a link of cooperation between NHANRS and Geological Society of NH could be beneficial to both groups. Since then, my NHANRS contact and I have informally discussed the mutual benefits of an occasional joint meeting, which could assist both memberships with obtaining CEU's, and attendees could also learn and appreciate more about the other society's professional issues, nomenclature, and interests. Moreover, it is my guess that NHANRS members have seen their professional jurisdiction threatened by agency rule-making, legislation, or other well organized professional societies that may redefine professional activities such that they encroach, or at times, encompass other scientific professions, such as geology or biology. Another possible idea for collaboration is perhaps both the NHANRS and GSNH could offer a discounted associate membership to members of the other society and encourage reciprocity. As there is strength in numbers, some inter-society cooperation could be mutually beneficial to both. Perhaps this is something the GSNH should consider?

Mineral Box

Need mineral "props" to give a talk to a local school class, scout group or organization? As a current GSNH Member, you may sign up and borrow the "GSNH MINERAL TALK BOX". It contains everything you need to give a "hands-on-talk" on minerals, their identification and uses. Designed with NH specimens, this will make your presentation an interesting and educational event. To make arrangements to borrow the Mineral Talk Box, contact Lee Wilder at: geology@des.state.nh.us .

GSNH Outreach

GSNH has three successful outreach programs, the School Speaker's Program, the Lincoln R. Page Professional Development Fund, and the Classroom Enhancement Grant. Please help spread the word about GSNH's outreach programs by talking with the teachers in your local school district! These programs are funded with the proceeds from mineral raffles at GSNH meetings and other contributions, as well as GSNH Membership Dues. Thank you for your continued support! Our outreach programs are described below:

School Speaker's Program
Interested members of the Society can volunteer to make Earth Science presentations in schools. A list of these volunteers with a brief description of the presentation they could make, is provided to teachers across the state, who must then make the contact and arrangements with the volunteer.

Lincoln R. Page Professional Development Fund
This fund, named in honor of Lincoln R. Page, will reimburse award winners up to $300 for expenses related to their continuing education in the earth sciences. Go to www.gsnhonline.org for more information on the fund and the application requirements and the life of Lincoln R. Page.

Classroom Enhancement Grant
Teachers across the state of New Hampshire are invited to submit proposals for a grant of funds (up to $300) to support the purchase of earth-science related teaching materials (equipment or supplies) for use in the classroom. Go to www.gsnhonline.org for more information on the grant and the application requirements.

The Status of Groundwater Levels in New Hampshire - February 2004

Derek Bennett, NHGS

The February round of groundwater level measurements were collected February 23rd – February 25th. On average, groundwater levels were down 0.67 feet from January 2004. All wells showed a slight to moderate decrease from last month with the exception of GSW-75 in Greenfield and CVW-02 in Concord which showed small increases (0.19 and 0.05 respectively). Levels were up close to a foot (0.91 feet) on average when compared to February of 2003. However, this average increase is misleading as FKW-01 in Franklin was up 5.41 feet from last year and ENW-30 in Enfield was up 3.86 feet from last year, inflating the average.

Winter Dinner Meeting

Seventy two members and friends filled the Cat 'N Fiddle Restaurant in Concord for the 2004 Winter Dinner Meeting of the Geological Society of New Hampshire (GSNH). Thanks go to Dave Wyman for organizing dinner and another impressive speaker. Thanks to Professor James Gardner for his presentation on "Deep Water Reefs of the Northern Gulf of Mexico" – what fabulous imagery from the multibeam echo sounder! Thanks also to Greg Kirby for organizing the mineral raffles. Proceeds from the raffle go to the GSNH outreach projects. The winners of the raffles were as follows:

- Siderite – Gene Simmons
- Hanksite – Rick Barry

Mineral Raffle for Spring 2004 Dinner Meeting

Greg Kirby

First Prize

First prize for the Spring 2004 Mineral Raffle is an exquisite, miniature specimen of cerussite ($PbCO_3$) from the Tsumeb Mine in Namibia. Cerussite is used as a minor ore of lead – as you can tell from the weight – and is also an interest to mineral collectors. Cerussite is also known for its famous "sixling" twins that can be seen in this specimen. The retail value of this specimen is $60.00.

Second Prize

Second prize is a 4x6 mm cut sapphire from Australia. This stone has not been heat-treated and is a translucent, indigo blue. It would make a nice ring for that special geologist. It's best not to tell you the retail value.

Proceeds from the mineral raffle go toward the GSNH student/teachers scholarship funds. Costs for the raffle are $1.00/chance and 3 chances for $2.00. For those wishing to contribute a specimen of their own, please feel free to contact Greg Kirby at gkirby@des.state.nh.us. Donations are tax deductible as a business expense.

Membership Update

Steve Shope, Membership Committee

Our membership is consistent; we have a total of 290 members. Of this total, 83 members were current through December 2004, with 139 members current as of December 2003. The rest are folks who signed up in 2002 but have not renewed since. Its time to renew your membership if you have not renewed already!

Year 2004 renewal forms were sent out this past fall with the newsletter, and are also available on our website (www.gsnhonline.org). The database is updated as renewals come in. If there are questions about your membership status at any point, please feel free to e-mail me at sshope@rcn.com.

NHDES/BIA 2004 Waste Management Seminar

Tim Stone, VP PG Section, GSNH

Many of you most likely have just received the registration notice for the NHDES/BIA 2004 Waste Management Seminar (a.k.a. Consultants Day) to be held on March 17 at the Center of NH. The Geological Society of NH is a member of the Business & Industry Association (BIA); therefore, GSNH members can register at the discounted BIA Member rate of $95, a $30 savings. When you register, just add GSNH in parenthesis next to your company name on the "Company" line.

Additionally, you will be able to receive continuing education contact hour credits for attending the seminar. Continuing education forms will be provided at the seminar.

NHDES Waste Management Division To Hold Technical Topic Seminars

Mike Sills, NHDES

The New Hampshire Department of Environmental Services Waste Management Division will be hosting a series of special interest technical seminars for staff and all interested public, consultants, municipal officials, regulated community and other stakeholders at our offices on 29 Hazen Drive in Concord, NH. The presentations will be structured like a Town Meeting so that everyone can ask questions and participate in the discussion in any way they feel comfortable. A number of experts from UNH will be part of the presentations and bring us up to date on the latest in technical innovation regarding waste reuse. The topics were chosen in technical areas that a number of people have expressed interest in recently and could certainly benefit from such free and open discussion. The seminars are free and to be held at noon in the DES auditorium or the adjacent meeting rooms 110-114. Please contact Amy Azeredo at aazeredo@des.state.nh.us or phone 271-2905 if you plan to attend. Please feel free to bring your lunch. We also have a cafeteria with take-out in the building.

Date	Topic
March 19	"Tanks for the Memories" – The Remedial Legacy of MtBE in NH"

Where did it come from? How did it get here and how do we deal with this unwanted legacy from modern gasoline?

April 16	"Urban DNAPL Site Remediation - When is Enough Really Enough?"

These chemical "sinkers" can cause more problems than most other contaminants in the groundwater. What is really the best way to deal with them in an urban setting where contact may be limited?

May 14	"Waste Reuse in Highway Construction – From the Big Dig to Rt. 93"

What have they been doing at the UNH Recycled Materials Research Center to help you drive on something you just threw away? Flowable fill, Glassphalt and glass/coal ash aggregate. The new commodities market?

June 18	"Contaminated Dredge Spoils Management – It's Not Just for the Seacoast Anymore"

Sure we need to dredge the Piscataqua to get the oil tankers in, but what happens if you run into contaminated sediments in the old town swimming hole? What are the options for the disposal of contaminated dredge spoils and why? What has UNH been investigating to help solve the problems involved with contaminated dredge spoils disposal?

From the Legislative/Regulations Committee

Tim Stone, VP PG Section, GSNH

In addition to attending regular NH BIA meetings, committee members have been quite active the past several months attending hearings for House Bill 1160, nominating a GSNH member for a position on an instream flow committee, representing GSNH on an ad hoc committee reviewing the revised Env-Wm 1600 rules which will apply to the reporting and remediation of oil discharges, considering the impacts of revised Remediation Consultants list on non-engineering firms, and fielding geologist licensing questions.

House Bill 1160

House Bill HB 1160 which proposes to add the State Geologist to the Geologist Board has been making its way through committees and public hearings. This bill also contained a provision to reduce the continuing education requirement from 24 hours biennially to 12 hours. However, at the ED&A Committee hearing and

From the Legislative/Regulations Committee, continued

subsequent Licensing Subcommittee meeting, all of those in attendance representing the interests of geologists, recommended leaving the continuing education requirement as is. In attendance at the first hearing were Tim Stone and Garret Graaskamp representing GSNH, Dave Wunsch representing NHDES, and John Cotton, Tim Allen, and Dorothy Richter from the Geologist Board. Adding the State Geologist to the Geologist Board was supported by all who provided testimony and the Committee members appeared to support the provision. In general, the Committee members indicated that not only would they not support reducing the continuing education requirement, they would prefer to see the requirements increased. Representative Pierre Bruno, the sponsor of the bill, also requested that the committee delete the section which reduced the continuing education hour requirement. At this time it looks like the continuing education requirement will remain at 24 hours biennially.

Geologists in the Public Eye

The more that geologists are visible in public forums, the greater the recognition of our profession and it's importance to the citizens of New Hampshire. There are many opportunities for geologists to contribute their expertise and experience to local or state commissions, committees, boards, and more. If you hear of such opportunities which would be a good fit for a geologist or member of GSNH, please contact the Regulations/Legislation Committee and we will get the word out. A good example of how this can work is GSNH's recent nomination of John Nelson to serve on the Souhegan River Instream Flow Technical Review Committee. John's nomination was supported by the Executive Council and approved by the Governor. Elsewhere in this newsletter is a piece by John about the instream flow study.

Documenting Continuing Education Activity Hours

The licensed geologist is responsible for documenting and maintaining records to support continuing education activity hours (CEAHs) earned. A Generic Activity Form used to document individual event CEAHs and a Continuing Education Activity Log Form used to summarize continuing education activities and CEAHs earned between each license renewal, are available at http://www.state.nh.us/jtboard/pgce.htm. The complete rules can be reviewed at http://www.state.nh.us/jtboard/geoce.htm.

The following is a summary of the record keeping requirements in Geo 403.07.
(a) Maintaining records to be used to support continuing education hours claimed shall be the responsibility of the licensee.
(b) Records shall contain at least the following documentation:

(1) A log showing: the type of activity claimed; sponsoring organization; address; contact information; location; instructor's or speaker's name and title; and number of continuing education hours earned.
(2) Attendance verification records in the form of completion certificates or other documents supporting evidence of attendance such as: signed attendance receipts; paid receipts; or a copy of a listing of attendees signed by a person responsible for course or program or the course or program provider.

The licensee shall retain attendance verification records for a period of at least 3 years. Such documentation shall be made available to the board for random audit and/or verification purposes. Documentation shall support continuing education hours claimed. Failure to provide documentation for audit verification shall result in disciplinary action. The rules also require that the Geologist Board audit a minimum of 5 percent of the licensee renewals each year for compliance with the continuing education requirements.

From the Legislative/Regulations Committee, continued

Revised Remediation Consultants List Published

The NHDES recently published the revised Remediation Consultants List which is intended to give consumers information on consultants potentially qualified to provide environmental investigation and remediation services. To be included on the list, consultants are required to submit documentation to NHDES indicating that they employ a licensed geologist and/or licensed professional engineer. The major format changes to the List include a column which indicates whether each firm employs a professional geologist and/or engineer, and a table which presents the professional stamping requirements for documents to be submitted to the NHDES. Consultants are encouraged to review the list at http://www.des.state.nh.us/orcb/doclist/consult.pdf to make sure their listing is accurate.

Approximately 25 percent of the firms on the list are non-engineering firms. The issue has been raised by several of these firms as to whether the list as published steers consumers away from non-engineering firms by implying that they are less qualified since such firms are not allowed to stamp several types of documents potentially required for submittal to NHDES. However, to be included on the List one only has to indicate whether they have a licensed geologist or engineer on staff, not whether those professionals have the qualifications or experience to complete the required work. Furthermore, when a consumer refers to the List, they are likely to look up firms with an office nearby and then contact a firm which the List indicates can submit the most types of documents to NHDES. The Regulations/Legislation Committee is looking for GSNH member feedback regarding the new List, including whether the List may have or has had an impact on their business. Additional background and discussion on the development of the List can be found in the September 2003 GSNH Newsletter available at www.gsnhonline.org.

Souhegan River Instream Flow Protection Pilot Program

John R. Nelson, P.G. MWRA

In 1988 with the passage of the Rivers Management and Protection Act, the New Hampshire River Management and Protection Program was established under the administration of the New Hampshire Department of Environmental Services. Under this program certain rivers are officially designated for protection for their natural and cultural resources. Rivers were designated as part of the passage of this act; they may also be designated for protection by petition by the public and acceptance by NHDES and the Legislature. After designation, a volunteer, local river advisory committee develops and implements a management plan to protect the outstanding qualities of the river for future generations as well as coordinates activities affecting the river on a regional basis. NHDES assists with the development and implementation of the plan and also enforces regulations concerning the quality and quantity of flow in protected segments of the designated river.

In 2002 the legislature passed an act to establish a pilot program to study and establish protected instream flows and water management plans for the Souhegan and Lamprey Rivers. The establishment and enforcement of protected instream flows is an important component in the protection of any river system so that flows are maintained for the instream public uses and to protect the resources for which the river has been designated. In this process the river's instream public uses, outstanding characteristics, and resources are inventoried and studied to establish the protected instream flows. These three categories have specific regulatory designations but include river features such as navigation; recreation; fishing; storage; conservation; maintenance and enhancement of aquatic, fish, and wildlife life and habitat; protection of water quality and public health; pollution abatement; aesthetic beauty; hydroelectric energy production; and

Souhegan River Instream Flow Protection Pilot Program, continued

agricultural and public water supply use. The effect of the protected instream flows on existing hydroelectric power generators, water supply, flood control and other riverbank uses are also assessed in this study.

This pilot program is currently underway for the Souhegan River. The program consists of the establishment of two committees to assist NHDES in the development of the protected instream flows and a water management plan. These include a Technical Review Committee consisting of members from state and local government, conservation groups, business interests, and representatives from the state legislature and the senate; and a Water Management Planning Area Advisory Committee consisting of government, conservation, business, and citizen membership, as well as representatives from the state legislature and the senate from the applicable water management planning area. John Nelson was nominated by GSNH for a position on the Technical Review Committee supported by NHDES Commissioner Michael Nolin to represent the GSNH and business interests on the technical committee.

The technical committee was convened in February and will initially assist NHDES with the selection of a contractor to complete the instream flow study. The selected contractor will conduct the protected instream flow study and draft recommendations for the protected instream flows for the public instream uses, resources, and outstanding characteristics and draft a Water Management Plan. The technical committee will meet regularly to advise NHDES during the completion of the study. The legislature has allocated $355,000 for the completion of this project. The draft study and plan are scheduled to be completed in 2005 with adoption of the protected flows in August 2005 and adoption of the Water Management Plan in February 2006. The DES is required to adopt and implement the protected instream flows and Water Management Plan by October 2007 with a final report on the pilot program with recommendations for legislation to the legislature by December 2008.

Mr. Nelson is a 14-year resident of New Hampshire from Nashua. He has been employed in the environmental consulting and management fields for 20 years and for the past 8 years has been employed by the Massachusetts Water Resources Authority (MWRA). Mr. Nelson works in the environmental management group and is responsible for environmental regulatory compliance at the MWRA's water supply transmission, treatment, and distribution facilities.

AWG Geologist-in-the-Parks program

www.awg.org

Agate Fossil Beds. (photo from NPS website)

Looking for a unique field opportunity? Career enhancement? High-profile research project to broaden your graduate school experience? Planning a sabbatical? AWG, in cooperation with the National Park Service, is pleased to announce its support of new Geologist-in-the-Parks positions for 2004. Agate Fossil Beds National Monument, Mojave National Preserve, Florissant Fossil beds National Monument, and The George Washington Nation Parkway were chosen for their outstanding scientific and educational potential, spectacular locations, time-frame flexibility, and housing availability. All appropriately qualified women are welcome to apply, including students. As long as credentials match a position, any application is welcome; you do not have to be a member of AWG to apply. Stipend for each position is a flat rate of $2,500, payable in three installments, with the final installment contingent upon submission of a final report and photographs to AWG. Please see the AWG website (www.awg.org) for full descriptions of the positions, park geology, and park contacts, and application instructions. The application deadline is April 1, 2004. Please pass this announcement on to colleagues.

The Geology of THE OLD MAN OF THE MOUNTAIN

Reprinted with permission of Lee Wilder

Some 1200 feet above Profile Lake, in Franconia Notch State Park, the Old Man of the Mountain hung out over the valley below. This famous rock profile was formed from five horizontal ledges of rock, stacked one upon the other. From the top of the forehead to the bottom of his chin, he measured about forty-five feet high and weighed approximately 7,200 tons. The Old Man of the Mountain is New Hampshire's state symbol. During the night of May 2-3, 2003, The Old Man of the Mountain tumbled from the cliffs of Cannon Mountain (also called Profile Mountain*), and was gone forever. To understand his demise, we first must look at how the rock profile was formed.

Formation of the Conway Granite

Geologically, the Old Man was a new (young) geologic feature. It may have been as old as 12,000 years and as young as several thousand years. But the rock itself, Conway Granite, is very old and goes back to the Jurassic Period.

By this point in geologic time, all the continents had collided to form a "super continent" that geologists call Pangaea. The Jurassic was the time that the dinosaurs were a common life form on planet Earth…about 175 million years ago (MYA). The collision that formed Pangaea forced the crust into large mountains of folded and faulted rock–the Appalachian Chain, which includes our White Mountains. These mountains may have been as high as the current Himalayan Range. But Pangaea was not to last. Convection currents ("rising swirls" of hot rock) within the lower crust, were pulling Pangaea apart (rifting). With this rifting process, large masses of molten magma (igneous intrusions), deep within the crust, cooled, crystallized and hardened into intrusive igneous rock. Some of these igneous intrusions, formed a coarse grained pinkish colored granite, known as the Conway Granite, that is found in several locations in New Hampshire and Maine. Obviously lots of weathering and erosion occurred over the last 175 million years. 175 million years is a lot of time…enough time to remove thousands of feet of overlying rock. Today, what we see as the Conway Granite of Cannon Mountain, are rocks that were once formed deep in the Earth's crust.

Glacial Action

About 1.8 MYA, as the Earth's climate cooled (…maybe as little as nine deg. F. below the averages of today), snow began accumulating in three "ice centers" in North America…the Cordilleran (in the Rockies), the Keewatin (near Hudson Bay) and the Labrador (near the east coast of Canada).

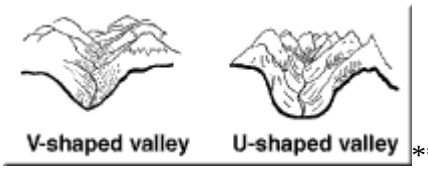
Each year, the winter's snows would melt at the ice centers, but some snow would make it through the cooler summers. As this snow piled up, the lower portions of the accumulated snow-pack would melt and refreeze under the pressure exerted by the upper snow. This melting and refreezing changed the lower snow accumulations to glacial ice. Snow accumulating at the Labrador Ice Center became the continental glacial ice that would advance over New England.

A great thickness of ice, under pressure of its own weight, flows like "silly putty". When the accumulated ice is thick enough to flow, it "oozes" out from these ice centers. Soil and rocks become embedded (frozen) in the moving ice as the edge of the spreading ice advances. The continental ice sheet now has the tools it needs to act like a huge sheet of sandpaper moving over the land surface. The rocks and soil frozen into the ice scrape the now exposed bedrock. (Bedrock is the solid rock of the Earth's crust, under the soil.)

As the ice advanced over New Hampshire's White Mountains, this "sandpaper action" smoothed and rounded the bedrock summits. In some cases the rocks that the ice carried left scratches (glacial striae) in the bedrock. These striae were generally parallel with the direction of the glaciers flow. Most striae in NH bedrock are orientated NW-SE…the general direction of the ice flow. This left smoothed and polished bedrock surfaces that are still visible in some places today.

The Geology of THE OLD MAN OF THE MOUNTAIN, continued

As the ice flowed through the Franconia area, it moved though existing stream valleys. Under normal conditions, streams flow in the bottom of their valley, removing material and causing the slopes above the stream bed to slide down into the stream, creating V-shaped valleys. However, glacial ice, moving through these existing stream valleys, scrapes the bottom AND sides of the valley. This abrasion process makes glacial valleys U-shaped. In New Hampshire, we call the U-shaped valleys, left by the glacier's erosional processes, notches. Besides Franconia Notch, there are Crawford, Pinkham, Jefferson and Dixville Notches, plus several smaller U-shaped valleys.



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The glacial ice that covered New Hampshire may have had a thickness of up to one mile deep. Ice this deep would have easily covered all of the tops of the White Mountains as it flowed to the southeast. Where the forces of weathering haven't removed them entirely, glacial striae and polish can still be found on the bedrock of many New England mountains.

Some of the rock structure, that made up the Old Man, may have existed at the end of the Pleistocene…left by the plucking action of the glacial ice. (As the ice flowed over the top of the mountain, melt water under the ice would freeze into rock fractures and the moving ice would "rip/pluck" pieces of the bedrock from the cliff face as the ice flowed forward.) Glacial plucking left Cannon Mountain with its characteristic roche moutonne shape – a gentle slope in the direction that the ice came from and a steep slope/cliff on the down-ice side. (See Fig. 1.)

Fig. 1. Classic roche moutonnee shape of Profile/Cannon Mountain.
(Photo courtesy of Mike Pelchat.)

About 15,000 years ago, the glacial ice began melting away, as the Earth's climate warmed up. The total time in which the ice was here (1.8 million to 10,000 years ago) is called the Pleistocene Epoch or Ice Age. It should be noted that during the Pleistocene, the ice may have advanced and melted back (retreated) across New England up to four times. The last advance was as far south as Cape Cod and the Southern edge of Long Island, NY. The ice began retreating from there about 15,000 years ago and was gone from north central New Hampshire by about 12,000 years ago.

The Geology of THE OLD MAN OF THE MOUNTAIN, continued

The Work of Weathering and Erosion

Remember, the Old Man was made by weathering and erosion. The western side of the U-shaped valley that is Franconia Notch is tall and very steep…nearly vertical. Geologically this is a very unstable slope. Thus, weathering and erosion are a very active process here.

Weathering is the breaking down of the rock by mechanical and chemical processes. Mechanical weathering includes: the physical break down of the rock by frost action – water freezing in the cracks of the rock, expands by 10% and breaks the rock apart; exfoliation – "peeling" off of sheets of rock from the rock surface, caused by the expansion of the "outside" of the rock due to heating and cooling, splitting off shallow layers or "peels" of the rock, which then break off and fall away; and root pry – where tree roots grow into the cracks in the rock, pushing the rock apart.

Chemical weathering occurs when water, combined with oxygen and carbon dioxide, forms chemicals that dissolve (break-down) the minerals in the rock. The plentiful rain water and cloud droplets high on the Cannon Cliffs help chemical weathering dissolve the feldspar minerals in the Conway Granite. With the feldspar minerals weakened, other minerals in the granite loosen and the rock crumbles apart.

Removal of these broken rock pieces and loosened minerals is called erosion. Geologists recognize four erosional agents: running water, glacial ice, wind and gravity. On these steep cliffs, gravity is the chief erosional agent. Wind and running water from rains and snow melt, erode weathered pieces. Glacial Ice has NOT been a recent erosional agent, since the ice melted back from Franconia Notch 12,000 years ago.

After the glacial ice melted out of Franconia Notch, water in the many fractures (cracks) of Cannon Mountain caused the rocks of the cliff to break off by frost action. Freezing water in the fractures in the Conway Granite split the rock into smaller pieces. (We have all seen the power of freezing water in producing "frost heaves" in our roads.) When the ice melts, broken bedrock pieces fall to the floor of the Notch due to gravity. As accumulated fallen pieces pile up, a talus slope of broken bedrock forms against the lower face of the cliff. The large accumulation of talus at the base of the Cannon cliffs, where the Old Man was located is evidence that the cliff has been undergoing lots of weathering.***

The Conway Granite in the cliff area of the Old Man had a series of nearly equally spaced horizontal fractures that ran back into the face of the cliff top. (See Fig. 4.) The Old Man Profile was a chance formation from the weathering of these five ledges of Conway Granite. Standing in just the right place (to the north of Profile Lake) on the floor of Franconia Notch and looking up toward the top of the Cannon cliffs, a very life-like profile of an "Old Man" could be seen. The first reported sighting of the Old Man was made in 1805 by two surveyors working in Franconia Notch.

Collapse of May 2-3, 2003

Weathering and erosion are relentless, and the same process that created the Old Man took him away. 1970's surveys during the I-93 construction through Franconia Notch showed that the five ledges making up the Old Man, were "balanced" on a small point under the profile's "chin". Over the years, several metal bolts/steel rods have been placed into some of the loose rocks that made up the forehead, to prevent them from sliding off the mountain. You can clearly see these five ledges and a couple of the steel rods in the photo available on-line at: http://www.moultonborough.k12.nh.us/ma/vienneau/nhgeoindex.html

It now appears that the rocks under the chin, at the center of gravity of the five ledges, gave away. Weathering had finally deteriorated the rock so much that it had lost strength and was unable to hold the massive weight of the five ledges above. Break away of the supporting rock under the chin caused the ledges to tumble forward and pitch headlong onto the talus slope below. The steel rods and bolts were no

match for the great weight of the rocks making up the Old Man. The rods pulled from the falling rock–some remain sticking out from the top of the cliff (See Fig.2.) …others were found in a mass of broken rock pieces strewn down the talus slope below. (See Fig.3).

Fig. 2. All that remains of the Old Man after May 2-3, 2003. Note the three remaining steel rods that had been installed to hold the rocks of his forehead from sliding. (Photograph courtesy of George Bliss.)

Fig. 3. New Hampshire Geological Survey (NHGS) staff using a Global Positioning System (GPS) Unit to plot the location of one of the steel rods from the Old Man found on the talus slope. (Photo from NHGS.)

Notes for asterisks (*) in text:

*If you look carefully to the right (North) of the former site of the Old Man of the Mountain, you will see another “rock profile” high along the ridge, that looks very much like a cannon. Thus the name, Cannon Mountain, also called Profile Mountain, in reference to the Old Man’s profile being on the same mountain.

The Geology of THE OLD MAN OF THE MOUNTAIN, continued

** Sketch from: http://wrgis.wr.usgs.gov/docs/parks/glacier/uvalley.html

*** Cannon Mountain is composed of an igneous rock, which geologist classify as Conway Granite–having a light pinkish color, due to the pink feldspar mineral in the rock. Granites are igneous rocks (magma that cooled, crystallized and hardened in the Earth's crust, long ago), composed generally of the minerals quartz, mica and feldspar. As you walk along the bicycle path in Franconia Notch, south of Profile Lake, you can see that pieces of granite are still falling from the cliff as weathering breaks off the rock and gravity causes it to fall and roll down the talus slope.

Lee Wilder, Outreach Coordinator, NH Geological Survey
David R. Wunsch, State Geologist, NH Geological Survey

Fig. 4. The Old Man of the Mountain before May 2-3, 2003. (Photo by Mr. Vienneau's eighth grade Earth Science Students, Moultonborough Academy, NH.)

Earth Science Week 2004

Don't forget that Earth Science Week 2004 will be October 10-16, 2004. It is never too early to start planning. Put the GSNH Annual Meeting on your calendar (10/14/04), get a package from the American Geological Institute (AGI) and give a talk at a local library, or just take some of your rocks, mineral specimens or fossils to a local elementary school. Young kids love rocks and fossils! But, their opportunities to learn about them are limited. You can make a difference, and, keep our discipline alive!

Geological Society of New Hampshire

2004 Spring Dinner Meeting

Speaker: Dr. Larry Mayer

Center for Coastal & Ocean Mapping
NOAA/UNH Joint Hydrographic Center, UNH, Durham, NH

Topic "New Advances in Seafloor Mapping and Data Visualization"

When: Thursday, April 8, 2004
Where: Cat 'n Fiddle Restaurant
Manchester Street, Concord, NH

6:00 pm Social Hour
7:00 pm Dinner

GSNH Winter Dinner Meeting, Thursday April 8, 2004
Dinner will be a buffet.

Reservations: _____members @ $18.00 _____ non-members @ $20.00 (in advance)
Half-price for students (must show student ID card)
Reservations will be taken until Monday afternoon, April 5, 2004
There will be a $2.00 surcharge for those paying at the door without reservations

Make checks payable to: Geological Society of New Hampshire
Mail to: Dave Wyman, Buoy Technologies, Inc., 31 Columbus Ave., Concord, NH 03301
phone: 603-224-9031 or davew@buoytec.com for information

Name:_____

Address:_____

Phone and/or Email:_____

Half the cost of the dinner may be tax-deductible as a business expense.
The lecture part of the program counts as 1.5 hours of CEU contact hour credit.

Dates to Remember!

- Spring Dinner Meeting Thursday, April 8, 20046PM
Cat n'Fiddle Restaurant, Manchester St., Concord, NH.
Speaker: Dr. Larry Mayer, Center for Coastal & Ocean Mapping
Joint Hydrographic Center, UNH, Durham
Topic "New Advances in Sea Floor Mapping and Data Visualization"

- NH Science Teachers Assn. Conference March 23, 2004,
Phillips Exeter Academy, www.nhsta.net.

- Next Newsletter Deadline, Friday May 28, 2004

- GSNH BOD Meeting June 10, 2004, 6 PM

- Summer 2004 Geology Field Trip, TBA

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2004 Memberships are due now!
Your membership status is listed on the mailing label.