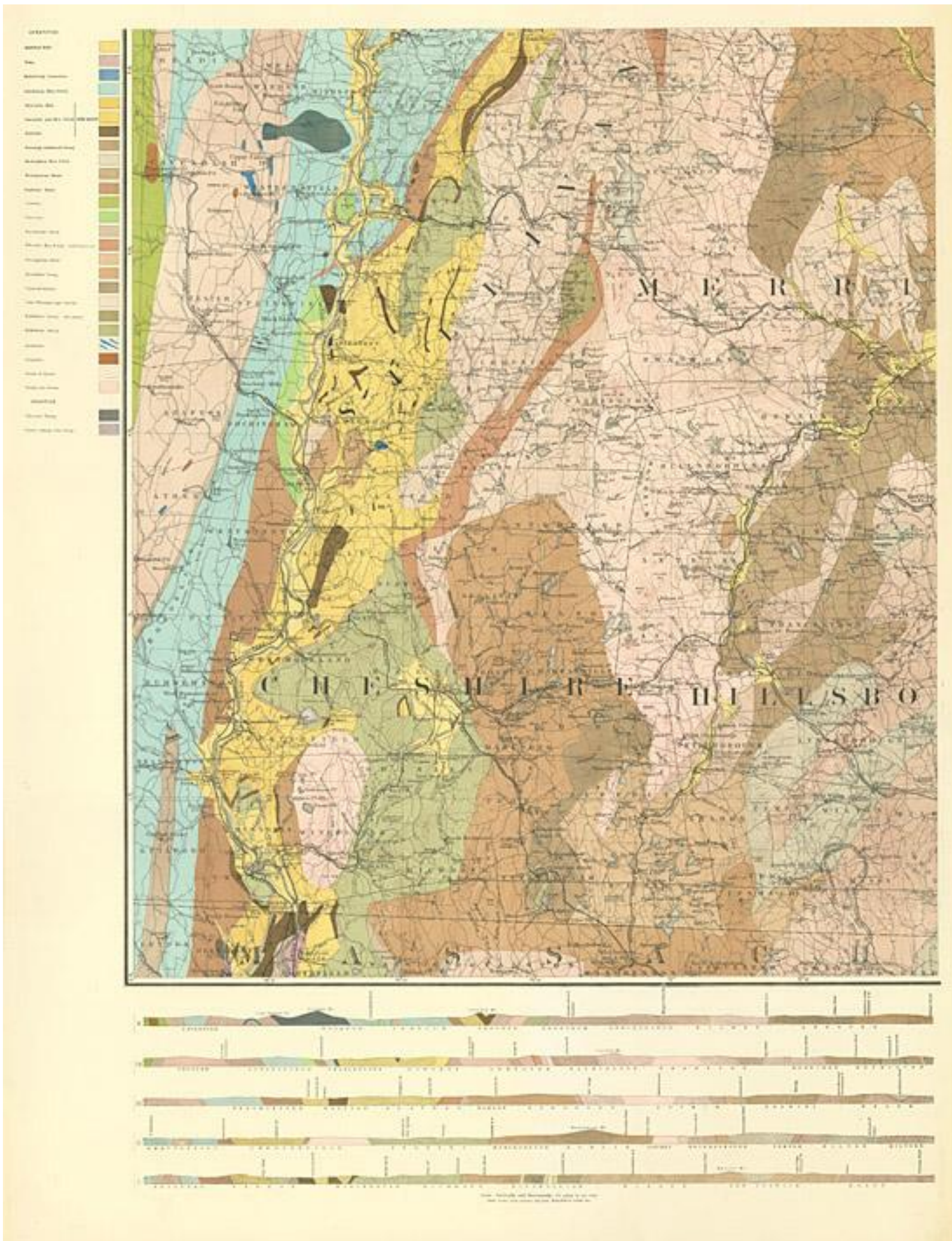
A <u>Brief</u> History of the Hoge Base Reservation and Selected Mineralogy



Geology Map for Cheshire County, Hitchcock, 1878

Compiled by Phil Shute
(Troop 8 Committee, Geology merit Badge Counselor)

A Brief History of the Hoge Base Reservation

Philp A. Shute – Troop 8 Committee, Peterborough NH

The following is a compilation of information gleaned for many sources including an extraordinary meeting of Walpole NH residents who provided insights, history, anecdotes and research to bring to life Pierre Hoge's time in Walpole and how the gift of Hoge Base came to be.

I want to thank Tami Vittum and Ron Makinen for arranging the Walpole meeting. They opened their home on a beautiful, sunny, Spring-like Sunday afternoon that serves as a metaphor for a wonderful illumination of a piece of Walpole history.

I want to thank, with a deep bow of respect and gratitude…

Walter "Hap" Campbell
Tim Foley (not the baseball player)
Elaine Giacomo
Paul Giacomo
Bill Houghton
Ron Makinen
Adam Plum
Harold Putnam
Kathaleen Rogers
Tami Vittum
Charles Wright

…for sharing their research, their recollections and their love for Walpole and Hoge Base. Their contributions and notes cannot be included in their entirety in this report. I hope the information presented is a faithful representation and compilation of their narrative. Any errors or omissions are regretted and will be corrected when found. I will also attempt to cite all collected facts properly and to their proper source.

Pierre William Hoge was born in Cleveland, Ohio on June 20, 1905[1]. He was the youngest child of James B. Hoge and Ann S. Wallace (also listed as Anna L. in some accounts). Ann was the daughter of David Wallace of Lorain, Ohio. David Wallace was a shipbuilder and president of the First National Bank of Lorain.[2]

Pierre attended Yale University graduating in 1926[3]. His degree may have been in chemical engineering and he his reported to have been employed by the Grasselli Chemical Company which was later part of E. I. DuPont of Wilmington, Delaware (1933). It has been reported that he worked on the Manhattan Project and was an engineer for Remington Arms Company (1944).[4]

Pierre arrived in Walpole in 1946 settling on land adjacent to a farm owned by his brother Wallace Hoge. He purchased part of what is now the approximately 300 acre Hoge Reservation from John Prentiss and the remainder of what was once the Isaac Fisher Farm from Arthur Chickering.[5] This parcel contained an abandoned feldspar mine that ceased operation in the mid 1920's.

Hoge built several buildings on the land and appears to have used his property as part laboratory for his varied interests. One example is the exterior paint on his main building that appears to have been very good at withstanding many years of Walpole weather.[6]

Hoge never married and in later years befriended Cecil ("Buck") Buckman Taylor who was the Scoutmaster for Troop 299 in Walpole from 1966 to 1977[7]. It is this friendship with Taylor and the Boy Scouts that moved Hoge to include the Daniel Webster Council in his will dated October 30, 1967. His bequest of the property and buildings was intended to be made available for the use and /or benefit of the local branch of the Boy Scouts that may be active in Walpole.

Hoge is reported to have died in either New Castle, Delaware[8] or Windham Vermont[9] in 1971. Given his location in Walpole (which is only 15 miles from Windham) the Vermont location seems probable. [10]

As the property came under the ownership of the Boy Scouts, Troop 299 Committee member Walter "Hap" Campbell became the site caretaker. He created the parking areas now used on both sides of Eaton Road. Marshall Putnam and Prentiss "Bing" Haines were also committee members at the time who were also involved in the site preparation for use by the scouts.

Scoutmaster Charles Wright held the first of several Mt Monadnock District Camporees in the spring of 1979. For the 1989 Camporee hosted by Scoutmaster Larry Switzer, Wright spent many weekends clearing brush and saplings as well as making campsites and opening trails. His desire was to bring the site back to the condition it was when he was a scout in the early 1970's. His hope was to help bring Hoge Base to prominence as a rustic camp that many troops in the district would desire to use and value.

Wright and the maintenance committee made further improvements at the Hoge Base and along Eaton Rd in 1991, including sledge hammering of boulders in the parking areas. He also reports that there are Yellow Jackets in residence at the reservation

In 1995, three outhouses were constructed on the site' A water well was installed and the mine quarry (then filled with water and estimated to be forty feet deep) was filled in by blasting some of the rock ledge around the quarry and using existing tailings as fill. A partial list of volunteers who have helped improve Hoge Base over these years is listed below. Any omissions should be noted so that they can be recognized for there work to keep the reservation active. [11]

Larry Switzer
David Davignon
Scott Northcott
Aquilla Gorton
Dean Huber
Adam Plumb
Paul Giacomo
And many, many scouts

Hoge Base continues to host camporees and other district events like the Chuckwagon Derby and is used by scouts and Webelos cubs for day trips and campouts. The Hoge quarry is also a great resource for Boy Scouts and Cub scouts to learn aspects of the geology of New Hampshire and to help fulfill requirements for Geologist Pins and Geology Merit Badges.

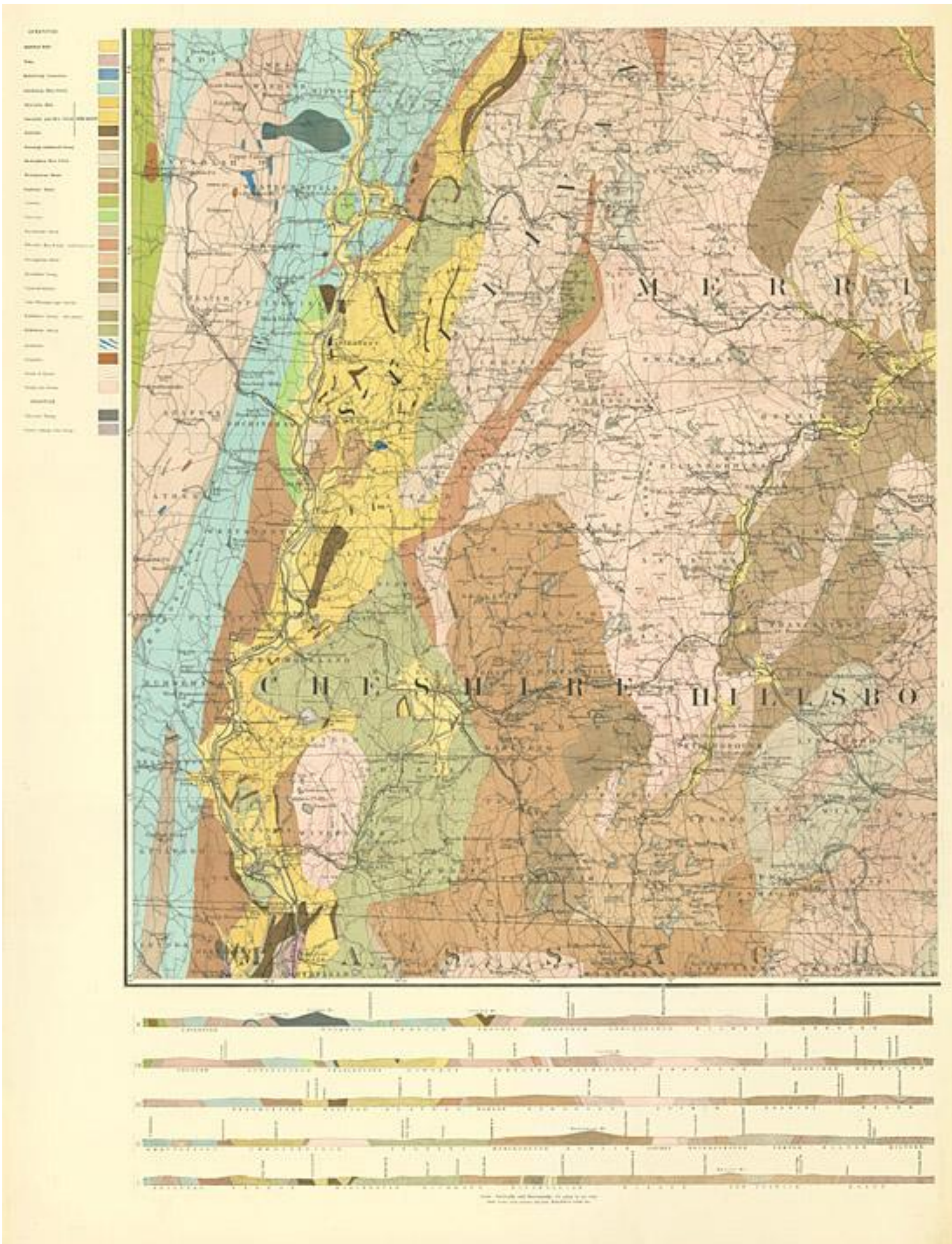
The following pages are a brief description of the feldspar quarry on the site and some ideas on how the site can fit into activities for scouts and Cubs.

Bibliography of Section 1

1. Charles Wright
2. History of Ohio, Rise and Progress of an American State, Vol 6
3. (Wright)
4. Heagley Museum & Library, Wilmington, DE
5. History of Walpole, New Hampshire, M. Frizzell
6. Walter Campbell
7 Will of Pierre Hoge
8 Social Security (through Ancestor.com)
9 Conversations with Walpole Group
10 Conversations with Walpole Group
11 Wright

A Brief Geology of the Hoge Base Quarry

1. General Geologic History of New Hampshire



New Hampshire bedrock geology contains rocks of Precambrian to Cretaceous origins spanning time in excess of 300 million years. The succession of rocks, mostly igneous and metamorphic, formed during successive collisions of continental plates and island arcs during the Paleozoic. The end of the Appalachian mountain building came prior to the opening of the present Atlantic Ocean with remnant parts now forming the Atlas Mountains in Morocco. It is speculated that the mountains may have once resembled the Alps or Andes.

During the opening of the Atlantic, successive failed rift valleys were formed along what is today the eastern shore of the northeast United States. The Connecticut River valley follows one of these rifts where crustal thinning in Massachusetts and Connecticut caused valleys to drop in elevation and fill with sediments along the fault zone. These sediments contain the remains of dinosaur tracks and evidence of oil bearing rocks. The west side of the Connecticut River shows generally younger aged beds (Mesozoic) while the eastern shore shows Paleozoic schists and metamorphic rocks. Late Paleozoic granite plutons formed what we now see as the many granite and pegmatite (large grained granitic rocks >3cm) outcrops in New Hampshire.

The Hoge Base Feldspar quarry is on of these pegmatite outcrops. It was first mined for the abundant feldspar in the 1800's. It is probably known as the Chickering Mine to most rock hunters today and has been the reported source of a relatively rare form of blue tourmaline known as Indicolite. Web references on "NH Indicolite" will immediately mention specimens from the Chickering Quarry. This presents a quandary for those who want to preserve Hoge Base. Rock hunters have and are currently coming to the reservation and the damage to the outcrop is obvious.

Other minerals are just as inviting as is the activity of mineral prospecting. Pegmatite quarries often yield beautiful crystals that command good selling prices or bragging rights on a collector's shelf. Below is a short list of the minerals that can be readily found at the site.

Quartz
Albite (Feldspar)
Muscovite (Mica)
Tourmaline
Beryl

The short list will suffice to describe the quarry and its relation to scouting and its use as a learning resource

Hoge Quarry Entrance looking SW

2. Selected Mineralogy

Mineralogy is (as you might suspect) the science of the structure and chemistry of minerals in the natural environment. The science includes the crystal structure of these minerals, their occurrence in nature (including conditions under which they form) and their description from which the field geologist (or in our hoped for case, the scout) can identify a particular mineral from its often unique properties.

Pegmatites form all over the world. *Dana's Manual of Mineralogy* describes them as follows.

> "Pegmatites are extremely course-grained igneous bodies closely related genetically and in space to large masses of plutonic rocks."

Pegmatites are associated with granites and thus are commonly known as "*granite pegmatite*". They form in veins and dikes and frequently extend outward into the surrounding granite. The reason for the formation of these large crystalline bodies is the cooling of magma bodies. As the rock cools and crystallizes, the remaining liquid becomes a concentration of volatile constituents such as water, boron, fluorine, chlorine and phosphorus. The viscosity of this mix decreases and crystallization is facilitated. These elements along with some rare elements were originally mixed in the magma but now can harden into the large crystals (often according to temperature) that we see in quarries like that at Hoge Base.

The rate of cooling and the concentration of volatile elements often lead to phenomenal results. Spodumene crystals over 40 feet long have been found in the Black Hills of South Dakota. Beryl crystals 27 feet long and 6 feet in diameter have been found in Maine. The largest known crystal was a feldspar that yielded thousands of tons from a mine in Russia. A similar result is unlikely at Hoge Base, but the wonder of the geology and the joy of discovery can be just as rewarding.

The three main constituents of most granites are quartz, feldspar and mica. The minerals found in these granites and pegmatites are from a large group known as silicates (meaning that the chemical compositions are based on SiO_2 the chemical compound that is quartz). These three main minerals have the following chemical compositions:

Quartz	**SiO_2**
Feldspar (Albite)	$Na(Al\mathbf{Si_3O_8})$—$Ab_{90}An_{10}$ (This is the chemical composition of Albite, a feldspar found at Hoge Base. Feldspar is actually a family of similar silicates)
Mica (Muscovite)	$KAl_2(Al\mathbf{Si_3O_{10}})(OH)_2$ (Like Feldspars, Mica is a family of minerals. Muscovite is a light tan variety common in the quarry)

Because of the conditions and chemistry of the pegmatite formation processes described previously, many other minerals can be found at the quarry if one has time, patience and a very good and discerning eye. The last item can, fortunately, be trained by careful observation and some help from a few useful items.

Before we get to the how of collecting and discerning minerals it would be useful to know a few of the properties most useful to understanding the mineralogy.

Chemical Composition
Crystal Structure
Specific Gravity
Hardness (Mohs Scale)
Color
Luster

Chemical Composition

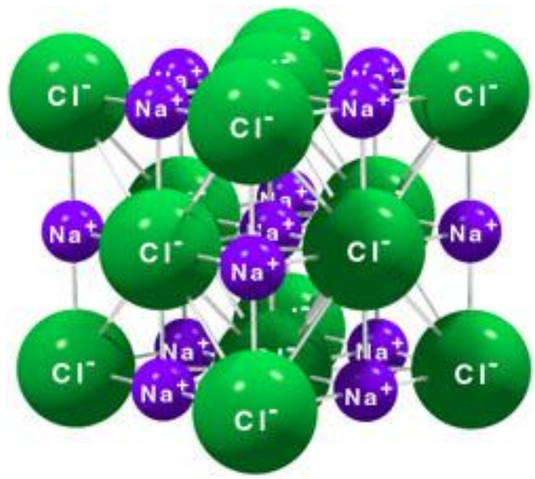
We have already talked about the chemical composition of pegmatites in general. Most of the minerals in the quarry (if not all) will be from the silicate group. It might be possible to find a non-native mineral (perhaps left by a glacier), but here silicates rule. Indeed, 80% of all atoms in the earths crust are either Silicon (Si) or Oxygen (O). Thus the structure and makeup of the various minerals you might find at the quarry vary because of the other elements (beside silicon and oxygen) that were in the original magma soup that cooled and condensed to form the pegmatite. The analogy I like is having a soup that is boiling on a stove. You remove some of the heat and some of the cooking oil will separate on the surface. You remove more heat and maybe some of the butter will congeal as the soup cools. The magma-to-pegmatite transition can be thought of as a cooling soup; in the end, you can see some of the ingredients and from that knowledge you can learn about the original composition. The list of element abundance in the Earth's crust looks like this:

Total Atoms	100
Silicon	60
Oxygen	20
Aluminum	6
Iron	2
Calcium	2
Magnesium	2
Sodium	2
Potassium	2
All others	4

As we will see, the crystal structure of the mineral can depend on what is really a tiny part of the total atomic abundance of the pegmatite. Color and shape can depend on one atom in the formula that is attached (actually an ionic bond) at the right place in the compound. As we will also see, that tiny variation can mean rarity and, in rarity, you have heightened interest from mineral collectors and increased pressure on the environment at Hoge Base. This facilitates a need to monitor the quarry and protect the reservation as a whole.

Crystal Structure

Going back to our original short list of minerals in the quarry: quartz, mica, feldspar, tourmaline and beryl, you will see the evidence of atomic composition having an effect on the crystal structure. This is probably obvious since we have all seen this in our everyday life. For example, a close inspection of table salt will show very tiny cubes. The chemical compound is sodium chloride or NaCl. The atoms bond into a simple cubic structure as you can see in the image.



The crystal structure (represented as green-chloride and blue-sodium atoms) forms a perfect cube. This basic structure holds as the salt is broken. Each smaller piece will form a cube. This breaking property or "cleavage" varies in its ability to form straight lines among various minerals. Perfectly straight lines like this in the three directions of the cube are called "perfect cleavage" in three planes and common table salt just happens to be a very good example. Other minerals like Mica have perfect cleavage along one plane. This can be seen when the "flakes" of mica easily peel off, one after another. This "straight line" cleavage takes place along areas of weaker bonds in the crystal structure and is a visual clue to the nature of the structure itself. Some very rigid looking crystals like quartz, which grows as a six-sided crystal shape, lack the weak bonds that will show a straight cleavage line when broken. Therefore it will always break as an irregular "fracture".

Crystal classification is very complex and beyond the scope of this writing. In a very strict and simplified sense, consider the three dimensions up-down (***c***), side-to-side (***b***) and forward-backward (***a***). Most crystals can be generally defined in three dimensions. The only thing you have to keeping mind is the ratio of the dimensions. Some crystals will be somewhat equal on size in each direction. Others will be elongated like tubes or prisms. While others will be so different in on direction that they will resemble a flat rock, perfect for skipping across a pond! I recommend however that you safe the skipping for a lee "interesting" rock!

There are six general crystal systems in mineralogy. These break down to 32 crystal classes which I will not go into. The systems are enough to get a taste for how these crystals look in nature and how the structure points to some general shape of the atomic structures.

Isometric – The three axes (***a, b, c***) are perpendicular to each other and of equal lengths. Cube

Example = Halite (table salt)

Hexagonal – There are axes forming a six–pointed star with a perpendicular axis through the center. **Example** = Beryl

Rhombohedral – A subclass of Hexagonal mentioned here because of one of the major Hoge quarry minerals. This has a more triangular prism shape or a distorted hexagonal cross-section but is generally in the hexagonal form. **Example** = Tourmaline, Quartz

Tetragonal – Like the Isometric crystal, there are three mutually perpendicular axes. The two in the horizontal plane (***a, b***) are the same length while the vertical is either longer or shorter. **Example** = Zircon

Orthorhombic – These have mutually perpendicular axes each a different length than the other two. **Example** = Topaz

Monoclinic – Two axes inclined to each other but not perpendicular with the third axis perpendicular to the other two. **Example** = Mica

Triclinic – Three axes of unequal length intersecting at oblique angles. No perpendicular axes. **Example** = Feldspar

Specific Gravity

This property is hardest to see (you can't) and is certainly unglamorous if you are out rock hunting but it can be helpful in identifying similar minerals. As we have already mentioned and will later, there are many trace and replacement elements that change the look and feel of minerals in subtle ways. Specific Gravity is the ratio of weight between the mineral and an equal volume of water (at 4°C). For example, calcium, barium and lead are increasingly heaver elements on the periodic table. They also, at times, can be interchangeable in the same part of a chemical compound if they bond with the same positive charge (that is, stripped of the same number of electrons). As can be seen in the following table, this replacement can change the specific gravity (weight) of a mineral and help in its identification.

Mineral	Composition	Atomic Weight	Specific Gravity
Aragonite	$CaCO_3$	40.08	2.95
Witherite	$BaCO_3$	137.34	4.29
Cerussite	$PbCO_3$	207.19	6.55

I mention Specific gravity only in an abstract way as a demonstration of the beauty of the chemistry of minerals and an illustration of how atomic weights can yield information to the nature of a mineral's composition. To REALLY determine the Specific Gravity of a mineral would require laboratory apparatus and considerably pure minerals. Neither is a likely outcome from your quarry experience (but not out of the question if you really are lucky and like laboratories!) nor necessary in your quest at identification.

Hardness – The Mohs Scale

The Mohs Hardness scale IS something that is practical in the field and one of the handy ways to make quick determinations of a mineral if the first look leaves you with questions. The Scale is a numerical ranking (from 1 to 10) of ten familiar minerals running from soft (1) to hardest (10). All other minerals lie somewhere in between on the scale. Common substances can be carried on a field trip that will give the geologist scout a relative scale to work with as he makes his determinations of a mineral's identity at the quarry. The official Mohs Scale is listed below along with the handy references to everyday items to help in the Hardness ranking.

The Mohs Scale

1 - Talc	
2 - Gypsum	**2.5 - Finger Nail**
3 - Calcite	**3.5 - Penny**
4 - Fluorite	
5 - Apatite	**5.5 - Knife**
6 - Orthoclase	**6.5 – Porcelain Streak Plate**
7 - Quartz	
8 - Topaz	
9 - Corundum	
10 - Diamond	

The Mohs scale is not linear however (that is, it is not an equal scale between the numbers). For example, #3 Calcite is only slightly softer than #4 Fluorite while #10 Diamond (crystal carbon) is ten times harder than #9 Corundum (which in the crystal form would be Ruby or Sapphire (depending on the replacement element we read about earlier)).

As you can see, you have a powerful tool in the Mohs Scale to use at the quarry to determine the mineral you are holding. While you may not want to scratch that beautiful perfect crystal you just discovered (if it is perfect you likely already know what it is!) you can now have a quick reference to some of the soft to medium minerals in the quarry. The harder ones (harder than your tools will require other property determinations)

Color

Mineral color can vary wildly even in the same outcrop. Some are always the same and the color is diagnostic. Azurite is always blue (There is no Azurite at Hoge however!). Pyrite is always gold in color (Sorry, no Pyrite either). But other minerals run in many colors determined by the elements within.

One prime example is Tourmaline. The Hoge Quarry contains abundant black Tourmaline that is evident just about anywhere you look. A closer look in some areas will show you green and pink varieties and the lucky person will even find a rare blue variety known as Indicolite. The **Tourmaline** composition is listed in a general form as follows:

$$\mathbf{XY_3Z_6(T_6O_{18})(BO_3)_3V_3W}$$

As you can see, this doesn’t look like the regular chemical symbols we have already seen. That is because some of the letters used are symbols for a set of elements anyone of which can occupy that spot in the formula at any given time. X, Y, Z, T, B, V and W are not element symbols from the Periodic Table. They represent lists o possible minerals that when present determine the color of Tourmaline.

X = Ca, Na, K,

Y = Li, Mg, Fe^{2+}, Mn^{2+}, Zn, Al, Cr^{3+}, V^{3+}, Fe^{3+}, Ti^{4+}, vacancy

Z = Mg, Al, Fe^{3+}, Cr^{3+}, V^{3+}

T = Si, Al, B

B = B or vacancy

V = OH, O

W = OH, F, O

.

Here the number shown does not mean the number of atoms but the number of electrons missing from an atom. Fe^{2+} means that the iron atom is positively charged and therefore will form a strong chemical bond with most negatively charged atoms (like O^{2-})

Indicolite = $[Na][(Li,Al)_3][Al_6][(OH)_3|OH|(BO_3)_3|Si_6O_{18}]$ = BLUE/GREEN

$[Na][(Fe,Al)_3][Al_6][(OH)_3|OH|(BO_3)_3|Si_6O_{18}]$ = BLACK

$[Na][(Mg,Al)_3][Al_6][(OH)_3|OH|(BO_3)_3|Si_6O_{18}]$ = YELLOW

This is not to say that other parts of the above formulas remain the same in these examples. This is an illustration that color can be determined by very small changes in the chemical composition. Some Tourmalines vary in color in the same crystal! (Evidence of the abundance of free cations (positively charged atoms) in the mix of cooling plutonic liquid) The color is another key to making broader determinations of the elements at work in the formation of the minerals.

Left Black Tourmaline, Right Indicolite (Hoge Quarry)

There are also color varieties in the Quartz found in the quarry from the common white or "Milky Quartz" to the dark gray "Smoky Quartz" to purple "Amethyst". These color variations have been attributed to trace amounts of impurities such as iron (citrine), manganese (amethyst) and titanium (rose quart). Or they can also be caused by gas and fluid inclusions (smoky and milky quartz). In its purest state, Quartz will be clear and colorless.

The Feldspar at the Hoge quarry is of the **orthoclase** variety which is a silicate with potassium (K) and aluminum (Al) (cations). At the other end of the Feldspar family are the **plagioclase** varieties with sodium (Na) and calcium (Ca) as the cations. One member, of the plagioclase group, Albite, has been reported in the mine.

The general chemical composition is:

Family	**Composition**	**Color**
Orthoclase	$KAlSi_3O_8$	White to Greenish to Pink
Plagioclase	$NaAlSi_3O_8$ $CaAlSi_3O_8$	White to Yellowish to Gray

Luster

Luster is described in *Dana's Manual of Mineralogy* as "the general appearance of a mineral surface in reflected light". You might ask 'What does THAT mean?" On the surface (no pun intended!) it would not appear to be a useful bit of information but a further read into the meaning of "luster" in mineralogy brings about the central point in determinative mineralogy in the field. Making observational judgments and categorizations and practice allows the geologist-scout to become quite proficient in mineral identification.

Luster uses six categories or terms to describe the "look" of non-metallic minerals.

Vitreous – The luster of glass, example: Quartz

Resinous – Having the luster of resins, Example: Sulphur

Pearly – An iridescent pearl-like luster. Often seen along a perfect cleavage plane Example: Talc

Greasy – Appears as if covered with a thin layer of oil. (Result of light scattering on the surface) Example: massive Quartz

Silky – Silk like (duh!). This is caused by fibrous parallel grains. Example: fibrous Gypsum

Adamantine – Hard and brilliant like a diamond. Due to a high index of refraction. Example: The transparent lead minerals, Cerussite (maybe also Diamond?)

Hoge Base Quarry – Selected Mineralogy Table

Mineral	Luster	Hardness	Color	Crystal
Quartz SiO_2	**Vitreous**	**7**	**White-Purple.**	**Rhom.**
Tourmaline $XY_3Z_6(T_6O_{18})(BO_3)_3V_3W$	**Vitreous**	**7-7.5**	**Various**	**Rhom.**
Feldspar $K(AlSi_3O_8)$	**Vitreous**	**6**	**White-Grn-Pink**	**Monocl.**
Beryl $Be_3Al_2(Si_6O_{18})$	**Vitreous**	**7.5-8**	**Blue-Green**	**Hex.**
Garnet A_3 "B_2"$(SiO_4)_3$ **(A=Mg,Fe,Mn,Ca B=Al,Fe)**	**Vit.-Resin**	**6.5-7.5**	**Varied**	**Isometric**

Note: Garnet is mentioned here for the first time because it is abundant at Hoge Base but not from the Quarry. It is found in the Micaceous Schist (bright silvery rocks) that litter the grounds. If you pick up one of these rocks look closely. Many of the Garnets are small bead-like hard bumps that are copper-colored in the silver schist. The schists are ancient Paleozoic rocks found on the east side of the fault that forms the Connecticut River Valley. The up-lifted side of the fault is in New Hampshire. The down-thrown side is in Vermont.

Mica Schist with Garnet, from Hoge Reservation

Field Activities

1. Equipment List

For your hike into the quarry, the following supply list would be helpful in your exercise in Determinative Mineralogy. All this will fit in a day pack and allow you to be self-contained to enjoy the quarry.

Day Pack
Water
Gloves
Sturdy Shoes
First Aid Kit
Bug Repellent
Compass
Safety Mirror and Whistle
Safety Mylar Thermal Blanket
Healthy Food Snacks
Hat

Rock Hammer (or Mason's Hammer)
Safety Goggles
Collection Bags
Tissue (Wrapping specimens)
Pocket Knife (Scout approved, need Totin Chip)
Notebook
Pencils

Small Ruler (for measuring your specimens)
Magnifier (best is a folding type to protect the lens)
Streak Plate (<u>Unglazed</u> Porcelain)

2. Webelos and the Geologist Pin

As a Den activity, Hoge Base would be a great place for a day trip and fulfillment of a good portion of the Geologist Pin. Three of the requirements could be done at Hoge. The real fun, of course, would be being the quarry, but the visit can greatly illuminate with a real example, the idea of mining and the use of minerals.

Hoge Base activities that can satisfy selected requirements from the Geologist Pin

Geologist pin requirement

1. Collect five geologic specimens that have important uses.

2. Rocks and minerals are used in metals, glass, jewelry, road-building products, and fertilizer. Give examples of minerals used in these products.

3. Make a scale of mineral hardness for objects found at home. Show how to use the scale by finding the relative hardness of three samples.

Possible Activity

1. Some of the material at Hoge Base would fall into this category. The garnets found in the Schist's are used in the production of sandpaper. The quartz can be used to make radio frequency crystals. The feldspar (the original reason for the quarry) is/was used in the production of porcelain. The tourmalines and beryls are used for mineral collections and gem-quality for jewelry.

2. See question 1! Places like the Hoge quarry are perfect to instruct Webelos Cubs about mining and the economics of these products in society.

3. A review of the Mohs Hardness scale and the use of the tools in the field will make the home project much more understandable and FUN!

Can you think of any more?

3. Geology Merit Badge

Requirements 1, 2, 3 and 5c could be finished using the Hoge Quarry as a resource.

1. Define Geology.
Discuss how geologists learn about rock formations.
In geology, explain why the study of the present is important to understanding the past.

2. Pick three resources that can be extracted or mined from Earth for commercial use. Discuss with your counselor how each product is discovered and processed.

3. Review a geologic map of your area with your counselor and discuss the different rock types and estimated ages of rocks represented. Determine whether the rocks are horizontal, folded, or faulted, and explain how you arrived at your conclusion.

5 c. Mineral Resources Option

1. Define rock.
Discuss the three classes of rocks including their origin and characteristics.

2. Define mineral. Discuss the origin of minerals and their chemical composition and identification properties, including hardness, specific gravity, color, streak, cleavage, luster, and crystal form.

3. Do ONE of the following:

a. Collect 10 different rocks or minerals. Record in a notebook where you obtained (found, bought, traded) each one. Label each specimen, identify its class and origin, determine its chemical composition, and list its physical properties. Share your collection with your counselor.

b. With your counselor's assistance, identify 15 different rocks and minerals. List the name of each specimen, tell whether it is a rock or mineral, and give the name of its class (if it is a rock) or list its identifying physical properties (if it is a mineral).

Consider a Hoge Base campout with partial completion of the Geology Merit badge as a goal!