Original ex libris bookplate created by the artist Georg Wimmer of Austria
Copper engraving from 1937
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New York Mineralogical Club, Inc.
Founded 1886 ♦ Incorporated 1937

2011 Gem & Mineral Almanac
125th Anniversary Edition
A Compendium of Articles and Advice for the Gem & Mineral Collector

Compiled and Edited by the 2011 Almanac Committee of the New York Mineralogical Club, Inc.
Ted Berkowitz, Vivien Gornitz, Diana Jarrett, Saul Krotki, Mitchell Portnoy, Karen Rice, Bill Shelton, Anna Schumate
Design and Production by Mitchell Portnoy, Editor
Dedication

David Brand, a “Renaissance Man” (1937-2009)

David Brand, a resident of East Rockaway for the past 15 years, died at his home on May 6 from complications due to lung cancer. Dave would have been 72 on May 26, 2009.

Brand was a retired systems analyst from American International Group for the past seven years. His job took him to many places such as Africa, Thailand and Korea. After he retired, he was asked to return as a consultant in Japan. His wife, Pat, joined him on his first of several trips there, and they enjoyed the beautiful gardens and palaces together.

Brand was a graduate of the City College of New York, where he majored in management, and received a Bachelors of Business Administration. He served in the United States Army, and, after the 9/11 attacks, he and Pat served as volunteers for the Salvation Army at Ground Zero. He proudly marched in the Veterans Day parade on Fifth Avenue as a member of the Ground Zero Flag Foundation, carrying a flag that flew over the World Trade Center.

Brand was a Renaissance man who enjoyed painting, reading, photography, baseball (the Yankees) and mineralogy. He was a member of the Nassau Camera club and received several photo awards for his work. He also was the past president of the Queens Mineral Society, and was still an active member of the New York Mineralogical Club based at the American Museum of Natural History in New York City. As an amateur geologist, he enjoyed trips in the field to collect Herkimer diamonds and fossils in the Catskills. He also wrote articles about minerals for the Bulletin of the New York Mineralogical Club - one is on file at the Smithsonian.

David specialized in collecting mineral species and was an avid and nationally recognized micromounter. He also had a great interest in the history of mineralogy.

Brand also enjoyed history and reading about Gettysburg. When he moved to East Rockaway, he was taken with its nautical history. He was seen several times a week walking on the Long Beach boardwalk listening to his beloved classical music or some James Taylor song on his headset. He was a practitioner of meditation and read books about religions of the world. He also enjoyed writing Haiku poetry. He was fond of animals especially his own two cats - Fuzzbucket and Toni Soprano!

Brand was the beloved husband of Patricia April Brand, dear father of Jennifer Kobetitsch and James, and the loving grandfather of Jonathan, Johann, Patrick, and a soon-to-arrive granddaughter.

He will be sorely missed by his family and friends.

New York Mineralogical Club Historical Photograph


Dr. Fred Pough, seated at center with Neal Yedlin, above.
To his left, Joe Stromwasser, Edge Goldstein, Carl Krotki, and Louis Moyd standing behind
About This Almanac

This book is a collection of articles, writings, illustrations, etc., mostly taken from the monthly Bulletin of the New York Mineralogical Club (2003-2008). Much of this past material was enhanced, edited, updated, reformatted, or re-illustrated, etc. However, several of the entries, as noted, were written exclusively for this quasquicentennial (i.e., 125th anniversary) commemorative publication.

All pictures, graphics, drawings, illustrations, etc. are either in the public domain, supplied by the author or obtained by the editors. In every instance permission to use the picture(s), when needed, was received.

The New York Mineralogical Club, Inc. publishes this information on a non-profit basis for its club members and other interested parties to further the hobby of mineral and gem studies and collecting.

Acknowledgments

The New York Mineralogical Club wishes sincerely to thank all of the contributors to this Almanac:

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Section I:
The New York Mineralogical Club, Inc.

Mission Statement
Founded in 1886 for the purpose of increasing interest in the science of mineralogy through the collecting, describing and displaying of minerals and associated gemstones.

2011-12 Officers and Executive Board

President          Mitchell Portnoy   46 W. 83rd Street #2E, NYC, NY 10024-5203   mitchpnc@aol.com
Vice President     Anna Schumate       27 E. 13th Street, Apt. #5F, NYC, NY 10003   annaschumate@mindspring.com
Secretary          Vivien Gornitz      101 W. 81st Street #621, New York City, NY 10024   vgornitz@gmail.com
Treasurer          Richard Rossi       6732 Ridge Boulevard, Brooklyn, New York 11220   judysjems@aol.com
Bulletin Editor    Mitchell Portnoy    46 W. 83rd Street #2E, NYC, NY 10024-5203   mitchpnc@aol.com
Membership         Anna Schumate       27 E. 13th Street, Apt. #5F, NYC, NY 10003   annaschumate@mindspring.com
Director           Alla Priceman       84 Lookout Circle, Larchmont, NY 10538   apriceman@msn.com
Director           Sam Waldman         2358 East 24th Street, Brooklyn, New York 11229   samgemw@optonline.net

Meetings
Second Wednesday of every month (except July and August) at the Holiday Inn Midtown Manhattan on West 57th Street near Tenth Avenue. Generally the meetings are held on the mezzanine level but check the hotel's event board for the specific location when you arrive. The doors open at 5:30 P.M. and the meetings start at 7:00 P.M. Meetings are free and open to the public.

Membership Benefits
Meeting People with Similar Interests
Monthly Newsletters & Special Publications
Monthly Meetings with Educational Programs
Guest Lecturers
Special Study Groups
Museum & Mineral Show Field Trips
Annual Holiday Banquet with Silent Auction
Annual Gem & Mineral Auction
Annual Round Robin (Open Houses)
New York Gem & Mineral Show Participation
Tourmaline Troop (Youth) Activities

Yearly Membership Dues
$25.00 individual, $35.00 family per calendar year

Address
The New York Mineralogical Club, Inc.
P.O. Box 77
Planetarium Station
New York City, New York, 10024-0077
U.S.A.
Website: www.nymineralclub.org
Historical Overview

On September 21, 1886, in the home of Professor Daniel S. Martin at 236 West 4th Street, the New York Mineralogical Club was formed through the efforts of George F. Kunz, B.B. Chamberlin and Professor Martin. Monthly meetings followed at the homes of members, with hosts presiding. George F. Kunz was elected Secretary. At the sixth meeting in March 1887, the name “New York Mineralogical Club” was officially adopted. A constitution and bylaws were approved at the eighth meeting. Since no president was required by this constitution, none was elected until April 1895 when George F. Kunz became the club’s first president, an office he held for many years. At the end of the club’s first year, it had a membership of forty-six, including several notable mineralogists.

The Club, whose original mission was to keep alive an interest in only NYC minerals, is now dedicated to increasing interest in the science of mineralogy through the collecting, describing and displaying of minerals and associated gemstones

The club’s fine collection of more than 700 mineral specimens from New York City is housed at the American Museum of Natural History. The collection includes specimens of beryl, chrysoberyl, garnet, tourmaline, stilbite and xenotime, together with many other species. Many of these specimens were found during the construction of New York City’s subway system or in the bedrock underlying the foundations of New York’s famous skyscrapers.

During the 125 years the club has been in existence a number of honorary members have been appointed in recognition of the contributions in the field of minerals and mineralogy. They include: Joseph Arons*, Sir William Henry Bragg*, Russ Buckingham*, Lawrence H. Conklin, Marie Skłodowska Curie*, Edward S. Dana*, Clifford Frondel*, Vivien Gornitz, Victor Goldschmidt*, Richard Hauck, Carl Krotki*, Alfred Lacroix*, Charles Meriguerian, Tony Nikischer, Robert Oppenheimer*, Charles Palache*, Frederick Pough*, Richard Rossi, Waldemar T. Schaller*, Leonard J. Spencer* and Herbert P. Whitlock*. (*Deceased)

Dozens of minerals and varieties have been named in honor of club members over the years. See pages 9 and 10 in this almanac for more information.

Over the years the Club has published significant booklets on a variety of topics. The most famous is probably James Manchester's Minerals of New York City and Its Environs. (See related reprint later in this almanac.) In recent years the Club has published three gem and mineral almanacs, two guidebooks to mineralogy and several others. Most have received regional or national awards.

Currently the Club has a membership of over 250 including a unit dedicated to younger collectors called the Tourmaline Troop. Monthly meetings, most with a guest lecturer, are held on the second Wednesday of each month (excepting July and August) at the Holiday Inn Midtown Manhattan, New York City. Meetings are open to the public. Each month a bulletin is published for members and guests with news, announcements and original articles about minerals and gemstones contributed by club members.

The New York Mineralogical Club is affiliated with the Eastern Federation of Lapidary and Mineralogical Societies (EFMLS) and the American Federation of Mineral Societies (AFMS).

The decades of the 1960’s, 70’s, and 80’s within the Club reflected the changes, bipolarity and tumult that the United States experienced at the same time. It was a time of elitism and feminism, great formality and casualness, comradery and strife, discovery and pettiness. Even as the Club celebrated its 100th Anniversary in 1986 to great acclaim (recorded in the New York Times, for example) with its annual banquet invitations printed by Tiffany’s and with its second female president at the helm, the Club was, in fact, near moribund, with low-participation, wholesale defections of segments (lapidary) and even member withdrawals.

Due to the heroic efforts of Will Heierman during the late ’80s and early 90’s, the Club found a new life and is once again thriving and stable. He was ahead of his time. His emphasis on inclusiveness and diversity (in terms of both membership and activities) remain in effect to this day. The Club remains one of the most active and esteemed clubs of its type in the United States.

The Club has since recombined or merged with the Lapidary Society of New York, the Westchester Mineral Club, the Brooklyn Mineralogical Club and the Queens Mineral Society (one of the charter clubs of the EFMLS).

The Club is celebrating its 125th anniversary in 2011. Special events, lectures, exhibits and actions are planned.

The club is dedicated to increasing interest in the science of mineralogy through the collecting, describing and displaying of minerals and associated gemstones. Anyone who is interested in mineralogy or gemology is welcome as a member.
Over the Club’s 125-year history, there have been forty-eight members, including honorary members, who have had a mineral or mineral variety named after them. (Some have since been discredited but they are included anyway.)

Most of these minerals are what we could call “esthetically challenged”. Tony Nikischer of Excalibur Minerals calls them “lovable uglies”. They are, as a group, very uncommon in most non-species collections. Some are, in fact, so rare that only a small handful of specimens of them exists in the world!

2. Bementite. Silicate named in 1887 for Clarence S. Bement (1843-1923), mineral collector. His collection was purchased by J.P. Morgan and subsequently donated to the American Museum of Natural History, New York City.
5. Braggite. Sulfide named in 1932 for William H. Bragg (1862-1942) and his son, William L. Bragg (1890-1971), English physicists, Nobelists, authors, and pioneers in x-ray crystallography.
6. Brianite. Phosphate named in 1967 for Brian Mason (b. 1917), author and mineralogist at the Smithsonian Institute. Also see stenhuggarite.
15. Goldschmidtite. Named in 1899 for Victor Goldschmidt (1853-1933), crystallographer, author, inventor of the two-circle goniometer. This discredited mineral has been shown to be an intermediate between sylvanite and calaverite.
17. Hiddenite. This is a varietal name for green spodumene. It was named in 1881 after William E. Hidden (1853-1918), author and American mineralogist.
19. Jefferisite. Named in 1861 for William W. Jefferis (1830-1906), professor and collector. Jefferisite has been discredited and shown to be vermiculite.
22. Kunzite. This is a varietal name for lilac or pink spodumene. It was named in 1903 for George F. Kunz (1856-1932), prolific author and gem expert at Tiffany’s in New York City. He was one of the founding fathers, first secretary and first president of the New York Mineralogical Club.
29. Nivenite. Named in 1889 after William Niven (1850-1937), mineral collector who discovered three minerals. Nivenite has been discredited and shown to be uraninite.
31. Palacheite. Named in 1903 for Charles Palache. Palacheite has been discredited and shown to be botryogen. See also charlesite.


33. Perloffite. Phosphate named in 1927 for Louis Perloff (b. 1907), amateur mineralogist and micromount collector.


37. Schallerite, Ferro-Schallerite. Silicate named in 1925 for Waldemar T. Schaller (1882-1967), mineralogist at the USGS. Ferro-schallerite was renamed in 1984 to nelenite.

38. Schernikowite. Silicate named after Ernest Schernikow. Club president in 1927. This mineral has been discredited and shown to be muscovite.


41. Sklodowskite, Cupro-Sklowdowskite. Silicates named in 1924 and 1933 for Marie Skłodowska Curie (Madame Curie, 1867-1934), Nobelist in physics and chemistry, discoverer of radium.

42. Spencerite. Phosphate named in 1916 for Leonard Spencer (1870-1959), author and curator of minerals at the British Museum of Natural History.

43. Stenhuggarite. Arsenite named in 1970 for Brian Mason. Stenhuggarite is from the Swedish word for stonemason. Also see brianite.


47. Whitlockite. Phosphate named in 1941 for Herbert P. Whitlock (1868-1948), mineralogist and curator of minerals at the American Museum of Natural History, prolific author.

48. Yedlinite. Halide named in 1974 for Leo Neal Yedlin. Also see nealite.

Your Valuable Club Membership

By NYMC Executive Team

Did you ever think about what your membership in the New York Mineralogical Club was worth? Well here’s some figures that might give you an idea. This assumes you took advantage of everything that was offered over the past year or so.

<table>
<thead>
<tr>
<th>Item</th>
<th>$ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free Weekend Pass to the NYC Gem &amp; Mineral Show</td>
<td>7.00</td>
</tr>
<tr>
<td>November Banquet Subsidy (including wine)</td>
<td>20.00</td>
</tr>
<tr>
<td>Springfield Show Bus Subsidy</td>
<td>5.00</td>
</tr>
<tr>
<td>Free Ticket to Springfield Show</td>
<td>6.00</td>
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Subtotal $38.00

<table>
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<tr>
<th>Item</th>
<th>$ Value</th>
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</thead>
<tbody>
<tr>
<td>Monthly Bulletins</td>
<td>12.00</td>
</tr>
<tr>
<td>Meetings, Lectures, including Tourmaline Troop</td>
<td>40.00</td>
</tr>
<tr>
<td>Field Trips &amp; Misc. Social Activities</td>
<td>10.00</td>
</tr>
</tbody>
</table>

Subtotal $62.00

Total $100.00

Not a bad deal for your $25/$35 yearly membership dues!

Lecture Series

Live lectures on interesting relevant topics form the core of the club’s monthly meeting programs.

Dr. Oliver Sacks to Speak at December 10th, 2003 Club Meeting

By Mitchell Porntoy

Over the 100+ years the NYMC has been in existence, we have had many famous speakers who were interested in mineralogy. Two examples that come to mind quickly are Marie Skłodowska Curie and Robert Oppenheimer. But neither of them could claim to have had a Hollywood movie made after their writings as our speaker this month can – Dr. Oliver Sacks.

Oliver Sacks was born in 1933 in London, England (both of his parents were physicians) and earned his medical degree at Queen’s College, Oxford. In the early 1960s, he moved to the United States and completed an internship in San Francisco and a residency in neurology at UCLA. Since 1965, he has lived in New York, where he is clinical professor of neurology at the Albert Einstein College of Medicine, adjunct professor of neurology at the NYU School of Medicine and consultant neurologist to the Little Sisters of the Poor.

In 1966 Dr. Sacks began working as a consulting neurologist for Beth Abraham Hospital, a chronic care facility in the Bronx where he encountered an extraordinary group of patients, many of whom had spent decades in strange, frozen...
states, like human statues, unable to initiate movement. He recognized these patients as survivors of the great pandemic of sleepy sickness that had swept the world from 1916 to 1927, and treated them with a then-experimental drug, L-dopa, which enabled them to come back to life. They became the subjects of his second book, *Awakenings* (1973), which later inspired a play by Harold Pinter (“A Kind of Alaska”) and the Oscar-nominated Hollywood movie, “Awakenings,” with Robert De Niro and Robin Williams.

Dr. Sacks is perhaps best known for his 1985 collection of case histories from the far borderlands of neurological experience, *The Man Who Mistook His Wife for a Hat*, in which he describes patients struggling to live with conditions ranging from Tourette’s Syndrome to autism, Parkinsonism, musical hallucination, phantom limb syndrome, schizophrenia, retardation and Alzheimer’s disease. (This book later inspired a dramatic work by Peter Brook, “L’Homme Qui…”)

As a physician and a writer, Oliver Sacks is concerned above all with the ways in which individuals survive and adapt to different neurological diseases and conditions, and what this experience can tell us about the human brain and mind. His books exploring these themes have been bestsellers around the world and are used widely in universities in courses on neuroscience, writing, ethics, philosophy and sociology. They have served as the inspiration for artists working in forms as varied as poetry, essay, documentary, drama, painting, dance, cinema and fiction.

Indeed, Dr. Sacks writes more than just books. His online press kit provides an eight-page (gulp!) listing of articles written over many decades evincing the interests and mind of a true Renaissance man. What interested me the most as I looked over this amazing roster of titles was one dealing with over this amazing roster of titles was one dealing with Awakenings.”

For a the complete list and more information about Dr. Sacks you can consult his comprehensive website which is http://oliversacks.com

In 1989, Dr. Sacks received a Guggenheim Fellowship for his work on what he calls the “neuroanthro-pology” of Tourette’s Syndrome, a condition marked by involuntary tics and utterances, and how its symptoms can be perceived differently in different cultures.

His nine books, which also include *Migraine* (1970), *A Leg to Stand On* (1984), *Seeing Voices: A Journey into the World of the Deaf* (1990), *An Anthropologist on Mars* (1995), and *The Island of the Colorblind* (1996), have received numerous awards and have sold several million copies worldwide in 22 languages. His most recent books are *Oaxaca Journal* (2002) and *Uncle Tungsten: Memories of a Chemical Boyhood* (2001).

He is a regular contributor to The New Yorker and The New York Review of Books, as well as various medical journals, and he is an honorary fellow of the American Academy of Arts and Letters, the American Academy of Arts and Sciences, the New York Academy of Sciences, and Queen’s College. The New York Times has referred to Dr. Sacks as “the poet laureate of medicine,” and in 2002 he was awarded the Lewis Thomas Prize by Rockefeller University, which recognizes the scientist as poet.

Dr. Sacks has been awarded honorary doctorates from Georgetown University, Tufts University, the College of Staten Island, New York Medical College, the Medical College of Pennsylvania, Bard College, Queen’s University (Ontario), and the University of Turin.

**Special Lecture Review – Dr. Oliver Sacks: “Falling in Love with Minerals”**

By Vivien Gornitz

Club members were in for a special treat this month, as noted author and neurologist, Dr. Oliver Sacks, reminisced about his life-long love affair with chemistry and mineralogy. Although his collecting style may be “eccentric”, he enjoys reading, visiting museums, mines, and talking to fellow mineral enthusiasts. He attributes his introduction to the world of minerals to his Uncle “Tungsten”, also the subject of one of his recent books. His uncle was a chemist and manufacturer of tungsten filaments used in light bulbs. Thanks to his uncle, he became familiar with minerals and especially the native elements, whose physical properties fascinated him. He has a sensuous reaction to the cool, smooth feel of metals, their shiny luster, and especially their weightiness. A favorite item is a small cylinder of pure native tungsten, weighing around 1 kilogram (~2.2 lbs), which he passed around. Tungsten, one of the densest elements (S.G. 19.3), is surpassed only by metals of the platinum group (platinum, osmium, iridium, rhenium). Scheelite is one of his favorite minerals, but the heftiness of wolframite also holds a special appeal.

His education came more from leisurely reading and wandering about museum exhibits than from the Dickensian boarding school he attended. His growing awareness of global geography was based mainly on mineral localities, e.g. Strontian, Scotland, or Mt. Etna, Italy. He “worshiped” the giant stibnite prisms of Shikoku and viewed Japan as the “land of stibnite”, or Australia as the “land of opal”. He yearned to go to Greenland for its cryolite and recently achieved a life-long ambition to visit the mines at Ytterby, Sweden, source of rare earth ores from which at least for chemical elements were first derived.

Although of a bookish nature as a boy, his curiosity led him to experiment with chemicals, including aqua regia, which he tested on a gold coin that promptly dissolved. He was also attracted by the sparkle of his mother’s diamond ring, which fortunately he did not subject to any experiments. His mother told him to touch the stone to his lips and feel its iciness and fortunately he did not subject to any experiments. His mother told him to touch the stone to his lips and feel its iciness and especially its weightiness. A favorite item is a small cylinder of pure native tungsten, weighing around 1 kilogram (~2.2 lbs), which he passed around. Tungsten, one of the densest elements (S.G. 19.3), is surpassed only by metals of the platinum group (platinum, osmium, iridium, rhenium). Scheelite is one of his favorite minerals, but the heftiness of wolframite also holds a special appeal.

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These boyhood interests have remained with Dr. Sacks all his life. Even as he spoke, one could feel his childlike enthusiasm, enjoyment, and even passion for the raw materials of the earth.

The evening ended with many members sharing their own “explosive” childhood experiences with minerals.

By Vivien Gornitz

The fabled wealth of India has lured Westerners ever since the conquests of Alexander the Great. Starting with Marco Polo, Western travelers were drawn East, seeking gold, gems, spices, and silks. Christopher Columbus was actually looking for a short-cut to India, completely unaware of an entire continent lying in his path. Pliny, Ptolemy, and many centuries later, Jean-Baptiste Tavernier were just a few of the writers who described Indian gems in great detail.

Mitch Portnoy, former club president and current Bulletin editor, presented a beautifully-illustrated and informative description of the Mogul Empire of India, which lasted from the early 1500s to 1857, during which period Indian arts, architecture, and culture flourished. At its peak, the Mogul Empire covered most of modern India, Pakistan, excluding Sri Lanka (Ceylon) and the southern tip of India. Of the Mogul emperors, Shah Jahan (1592-1666) is best known in the West for building the Taj Mahal, one of the most beautiful buildings in the world.

Although Moslem, the Mogul emperors were tolerant, on the whole, and permitted representation of the human figure, which resulted in the flowering of exquisite Indian miniature paintings similar in style to Persian miniatures. Portraits of emperors illustrated their love of jewelry. In fact most of the Mogul gems were worn by male royalty, not the women! The main spoken language was Farsi (or Persian)—an Indo-European language. Thus, a number of words for gemstones are somewhat similar to English, e.g.:

- Agate=Alik
- Corundum=Korund
- Jasper=Jaschep
- Opal=Upal
- Tourmaline=Turmalin

The Treasury of jewels, assembled by several generations of Mogul emperors, was looted in 1739 by Nadir Shah of Persia, who took the original Peacock throne, the Koh-I-Noor diamond and many other treasures. To reconstruct the contents of the Treasury, one must now turn to the British Museum, London, the Hermitage, St. Petersburg, Russia, the Topkapi Museum, Istanbul, and the Crown Jewels of Iran, as well as early travelers’ accounts, of which the writings of Jean-Baptiste Tavernier (1605-1689) are perhaps the most detailed. Tavernier visited the major diamond mines, saw Aurangzeb’s Treasury, and made drawings of some large diamonds, including the “Great Mogul”, the “Ahmadabad” diamond, originally 160 ct, and the “Darya-i-Nur” (pink, 186 ct). Other historic Mogul diamonds include the “Shah”, an 89 ct inscribed diamond (now in the Kremlin, Moscow), not to be confused with the “Shah Jahan, 60 ct pinkish table cut stone, worn as a turban ornament, the legendary Koh-I-Noor (“mountain of light”), originally over 600 ct, subsequently recut and now part of the British crown jewels, and the Hope diamond, 45.5 ct (probably the large blue diamond described by Tavernier), now at the Smithsonian Museum, Washington, D.C.

The gem aesthetics of the Moguls was quite distinctive. The Moguls valued diamonds above all gems, and the bigger the better. Stones were cut to retain weight, not achieve brilliance, as today. To the Indians, diamonds were “vajra”—the thunderbolt, and “Indra’s weapon”. The most important qualities were its whiteness of color denoting purity (reserved for upper-caste Brahmins—with other colors for lesser castes), its “fire” or dispersion, and hardness. Until the discovery of diamonds in Brazil in the 1700s, India was the only source of this gem. Exported diamonds were generally of lower quality. Second to diamond was emerald, valued for its deep green color, reminiscent of the lush gardens of Islamic paradise. Emeralds were frequently engraved and cut to retain the hexagonal shape of the original crystal. They were often incorporated into “aigrettes” or turban jewels. The magnificent emeralds covering the Topkapi dagger (now in Istanbul) were originally part of the Mogul Treasury. The Moguls were the major consumers of Colombian emeralds (although at least one emerald in the Nizam of Hyderabad’s treasury came from Panshir, Afghanistan, V.G.). Rubies and red spinels were also abundant in Mogul jewelry. These two gemstones were not differentiated. For example, the Timur “ruby” (352 ct), now in the British crown jewels, is actually a red spinel (“Balas ruby”). The Moguls also favored pearls. Jade (a pale green nephrite) was finely carved and often inlaid with gold and precious gems. Curiously, blue sapphire was rare-to-absent from their Treasury.

Mitch continued his talk with an overview of the fine intarsia woodwork of the Taj Mahal, which he described as the world’s largest jewel box. He then concluded the lecture quick section displaying jeweled objects such as bowls, plates, decanters, etc, once in the Imperial Mogul Treasury but now on display in the Hermitage in St. Petersburg, Russia.

(Lecture originally presented September 9, 2005)
March 12th, 2008 Meeting: Darryl Pitt: “Meteorite Tales”

Darryl Pitt is the curator of the celebrated Macovich Collection—the largest collection of aesthetic iron meteorites in the world.

Pitt’s biggest contribution to meteorite lore is perhaps best expressed by legendary meteorite hunter Robert Haag: “Darryl opened a whole other market to sell the ‘beauties,’ and this just never existed before.” Added Haag, “No one has done more to popularize meteorites than Darryl...except ME!”

Indeed, when Pitt made several choice specimens available in the first natural history auction at Phillips in New York City in 1995, he indirectly became the single biggest catalyst to the most recent surge in the popularity of meteorites.

The initial natural history auctions were a novelty and, as a result, were typically attended by a dozen print journalists (many of whom were syndicated), and a half dozen television crews. The extensive international media coverage—along with reports of the high prices realized—spiked the public’s interest in meteorites to previously unheard of proportions.

Said Henry Galiano, of New York City’s Maxilla & Mandible, the premiere natural history store in the U.S., “News of the high prices meteorites attained at auction in the mid-nineties made its way across the ocean and motivated legions of new meteorite hunters, primarily from Germany and France, to explore the Sahara Desert in search of more material.”

Pitt marketed the sculptural specimens as “Natural Works of Art from Outer Space,” and his background as a professional photographer proved useful (he had been published in Time, Newsweek, Rolling Stone and The New York Times). For the first time, meteorites were distinguished as objects of art, and each image was accompanied in auction catalogs by a highly detailed description concerning the aesthetic qualities and unique histories of every specimen offered.

For the first time iron meteorites were also distinguished — and valued — by the quality of their patinas and crenelations. Select specimens possessed a syncopated asymmetry or were deemed zoomorphic while others were said to evoke Chinese scholars’ rocks or the work of sculptors Boccioni, Hepworth, Giacometti or Moore. Choice iron meteorites were now desired not only for the allure of their otherworldly origins, but also for their aesthetic appeal.

Luminaries such as Steven Spielberg, Yo-Yo Ma, Nicholas Cage and James Taylor acquired choice specimens from the Macovich Collection. “Art & Auction” selected a meteorite from the Macovich Collection as one of its “100 Top Treasures of the Year.” Matchless specimens now carried estimated values in excess of $100,000 and, at times, realized such lofty sums.

“I had to give up some of the most visually compelling meteorites if I was going to inspire others to jump on this train,” Pitt said. “I thought of it as a necessary sacrifice. Sure, I made money, but I really miss a few of these meteorites. And the value of the best of the specimens will continue to escalate far more quickly than the rest of the meteorite market as the appeal of such specimens is to a broader audience.”

In 1997, Pitt created the first interplanetary collectible, the limited edition Mars Cube: 1/10 carat of the Zagami Martian meteorite, sealed in a sterile vial, embedded in a 2.5-inch Lucite Cube. The Mars Cube (and accompanying 20-page Mars Owner’s Manual) was launched on QVC to great fanfare and thousands of units have been sold.

When the films “Deep Impact” and “Armageddon” were released in 1998, the public’s interest in meteorites peaked, and the natural history auctions timed with these releases provided the high-profile outlet for this growing appetite. Producer Jerry Bruckheimer and Bruce Willis acquired Macovich meteorites. And one gram of a Martian meteorite with a Macovich provenance meteorite went for $16,000—a transaction which the Guinness Book of World Records heralded as the most expensive chunk of Mars ever sold.

While Pitt still travels the continents in pursuit of singularly shaped rocks from outer space, such examples now show up only once in a blue moon.

Darryl Pitt resides in New York City on the Upper West Side.

An Interview with Darryl Pitt

Source: Meteorite-Times Magazine. Permission granted to reprint.

What or who got you interested in meteorites and how old were you when you got your first meteorite?

It was a trip to Meteor Crater when I was thirteen that first piqued my interest. I remember being flabbergasted and in awe when I was informed that a meteorite was the responsible culprit.

What was your first meteorite?

Canyon Diablo. I bought it from Al Lang at a Springfield show. I was working nearby and some friends asked if I wanted to go to a rock show. I simply couldn’t believe that meteorites were available in the private sector, but there was something about Al that inspired confidence that convinced me it was real.

While speaking of folks who got me started, I would be remiss if I didn’t mention the P.T. Barnum of meteorites, Bob Haag. I experienced Bob’s inspiration so potently, it was as if I became infected with a virus that resulted in an insatiable appetite for any and all meteorites. And with a somewhat different perspective (ha!), the late Dr. Marty Prinz of the American Museum of Natural History was a great friend and patient teacher. I would not have been deeply involved in meteorites if it weren’t for each of these men—two remarkable men.
men with remarkable legacies. Their combined effect on me was greater than the sum of their parts. **Do you still have your first meteorite?**

I do. While I subscribe to the notion of having something for a time and then letting it go into the world for others to enjoy—and I’ve let go of some singular meteorites—I haven’t been able to bring myself to even consider parting with numero uno. **Do you have special areas of interest that you focus on in regards to meteorites (thin sections, photography, chemistry, age dating, etc)?**

Photography, certainly. But what I have is just a passion for these objects and trying to find ways to share my enthusiasm. **Does your Family share in your interest in meteorites?** [Laugh] Nope. **Do you have any special approaches to collecting? (Type collection, only stones, only irons, only by aesthetics, etc. or any and all that you like.)**

Aesthetics were always primary in the mix. When I began collecting, I could pick-up aesthetic irons for the same price as the dogs. Gibeons could be had for as little as $8.50/kg in 1990-91. When African dealers noticed the peculiar-looking specimens I was cherry-picking, they wanted to charge me more for such meteorites and agreed to keep the same low price only if I bought some of the other stuff. I agreed and that’s how I first became a dealer: flipping the meteorites I never wanted in the first place.

I did give up on large irons after two back surgeries—one of which was meteorite induced—but I’ve somehow drifted back towards these behemoths. **Do you mind saying how many locations your collection represents?**

Several hundred locations are represented. I’ve largely stayed away from the unnamed Saharan material. **Is your collection displayed or kept in a dry box or both?**

Most of the collection is in storage, but I’ll display a few select specimens and rotate them over time. I do use a dessicator, but I’ve finally learned the best way for me to deal with meteorites that are fragile in our environment is to let others collect them. **In what ways do you use your computer for meteorites?**

MetBase. Cataloging. Imaging. **Do you ever hunt for meteorites?**

Not as nearly as often as I would like. My day job keeps me tethered to city-life. But it was my day job which took me around the around the world and allowed me the opportunity to acquire more meteorites in exchanges. When I was involved in governmentally funded events, invariably I would be asked “Is there anything we can do for you?” to which I always responded, “Yes, I would like to meet the curator of your meteorite collection.” Talk about eliciting strange looks!

**What is the favorite meteorite in your collection?**

I truly don’t have a favorite as what I find appealing about different meteorites are characteristics which are for me incomparable. **What meteorites are currently on your wish list?**

If I were to tell you, I’d have to kill you! **What methods have been most successful in building your collection?**

Exchanges with institutions, by far, but the halcyon days are over.

**December 10th, 2008 Meeting: Irving Horowitz: “Inclusions in Mineral Crystals”**

By Irving Horowitz

Many interesting questions arise from seeing mineral inclusions of solids, liquids and gases within a mineral crystal. How do inclusions form? How common are they? What do inclusions tell us about the environment in which the crystals formed? Why are inclusions of interest to the collector?

Inclusions are widespread because they are found in rocks of every kind: igneous, sedimentary and metamorphic. This means that they occur in many different temperature, pressure and chemical environments.

Rapid crystallization favors the inclusion of impurities. However, the conditions under which crystals form in nature are not static. Primary inclusions are those which formed simultaneously with the host material. On the other hand, external events, such as seismic waves may open cracks through which other material(s) are introduced. Then the cracks are healed. Such inclusions are secondary. When we confront a mineral specimen we are challenged to guess about the history of its formation and inclusions offer important clues.

Gem crystals attract attention to inclusions for practical reasons. Inclusions affect the clarity and possible commercial value of the gem; inclusions make some stones more attractive (e.g., rutiled quartz) or distinctive (e.g., star sapphires); inclusions can help distinguish between natural, treated or synthetic stones.

Let us consider one example, gem crystals from pegmatite formations. Many of the principal rock-forming minerals, such as pyroxene and feldspar among others, are the earliest minerals to crystallize from the hot complex solution called magma. The end stage of crystallization is a magma rich in water and a number of elements called “mineralizers” because they contribute to the formation of many minerals, some of which are gems. Examples are beryllium (emerald, aquamarine, morganite), fluorine (topaz), lithium (spodumene, kunzite), free and silica (quartz, chalcedony). When one considers the nature of the “soup” in which the gem crystals grew, it is not surprising they have incorporated numerous solid, liquid and gas inclusions.
Surface deposits at much lower temperature yield interesting inclusions. Playa lakes and other saline lakes yield inclusions that are predictable because we can almost see the crystals grow as the water evaporates. Two common minerals, gypsum and halite, may be collected from such lakes during dry seasons.

Space does not permit extensive coverage here in this introduction to my lecture. The slide presentation will address many other situations. Meanwhile, see the erudite treatment of this subject by Dr. Vivien Gornitz in the May 2003 (pages 3-4) issue of the Bulletin of the New York Mineralogical Club.

**Bulletin of the New York Mineralogical Club**

*The monthly newsletter is an important club membership benefit.*

**It's Been Ten Years!**

By Mitch Portnoy, *Bulletin Editor*

The EFMLS has a special group of bulletin editors called the “Decade Club.” This so-called club, founded in 1991, is actually a listing of the Federation’s mineral clubs’ bulletin editors who have served their clubs in that capacity for ten years or more. It is with both surprise and alarm that I report that I have been the Bulletin Editor for the NYMC for ten years now (1996-2005) and, therefore, I automatically qualify for that club!

I was unaware what was ahead of me in the fall of 1995 when John Betts, then both president and editor, asked me to take over the job for the following year. I had recently joined the club after moving to the Upper West Side and this activity was my first field collecting trip, to Limecrest Quarry in New Jersey.

John was the van driver on that day. Other members in the vehicle were Rich Blackman and Karen Rice. There were a few others, but I do not remember who they were. The drive to Limecrest was a few hours from Manhattan, so we all had plenty of time to talk and get to know each another.

The conversation was about what you would expect from such a group. Topics included our other field collecting experiences, what we specifically collected or wanted to collect, and anecdotes regarding the club and its members. The talk gradually grew more personal as the barriers came down and like all New Yorkers, we talked about our work and professions. That’s when I told the group that I worked for The Prudential in New Jersey (now called Prudential Financial) and my specific responsibilities involved PC software support and services with an emphasis on word processing, presentations, graphics and desktop publishing.

John contained his joy at hearing this, avoided driving off the highway and asked me if I would consider taking over the job as bulletin editor for a “year or two.” John, a crafty salesman even then, assured me it was a rewarding job, that I would be an immediate club officer and in the epicenter of all that the New York Mineralogical Club has to offer.

“Me and my big mouth,” I thought. I could see my much wiser and taciturn friend Rich Blackman grinning broadly while looking out the window. I managed to not say yes immediately, containing my normal enthusiasm to get involved in things. I expressed my concerns to John as follows:

I was not worried about my ability to layout and compose a monthly 12-page bulletin since my job involved my producing hundreds of attractive pages every week using various pieces of software. Nor did the reproduction or distribution of it concern me, as I would have (with eventual permission) Prudential’s vast printing and mailing resources at my disposal.

What did concern me in accepting this office was I was new to the hobby and really could not write intelligently about it. In all the earlier bulletins I had seen it seemed to be the editor himself who did most of the writing! So where, I asked, would the content come from? John convinced me that “the bulletin will fill itself.”

With that, I agreed to become the Club’s next Bulletin Editor. He announced this at the Club’s 1995 banquet (my first) and I was rewarded with the Club’s electric stapler – an ordinary device on which someone had pasted a picture of George Kunz. I think it jammed permanently sometime in my sixth year as editor.

A lot has happened over these ten years. The USA has been in two wars, the first “completed” and the second ongoing, both in the same place. The midpoint over this time was the 9/11 attack on New York City, creating a palpable “before and after” feeling in us all.

During 1996, the club officers suggested that we abandon the dated “academic” year that the Club operated on - by this I mean we had “closed down” during the summer. (There have been summer activities ever since!) Members received bulletins during both July and August for the first time and received twelve rather than just ten issues. Although now down to “only” eleven issues a year to save a little money, if you were a member in good standing over the past ten years, you received a total of 115 *Bulletins of the New York Mineralogical Club.*

So here are some numbers: Since becoming the club’s editor, I have assembled, designed, produced and distributed 115 different issues. If we assume an average mailing of 180 per month over this decade, I have mailed out nearly 21,000 bulletins! The majority of these issues had 12 pages, although many had 16. There was even one with 20 pages and recently one with only 10! Nevertheless, I guestimate that this means 1,500 different pages were produced since 1996. How was I able to fill all those pages with content? Did the bulletin really “fill itself”?

Well, no and yes. The bulletin, neither alive nor magic, cannot fill itself like some blank book from the world of Harry Potter. The phrase was, of course, meant to be rhetorical. The bulletin does fill itself because of the endless stream of regular contributors and columnists from the deep membership roster of the club. Indeed, according to virtually every other bulletin editor I talk to, my never having to worry about filing the bulletin with quality content, year after year, is the trait that most strongly differentiates my job from any and all of my
peers around the mineral club nation. (There is more on this topic later.)

The first thing I did when accepting this responsibility of producing the NYMC bulletin was to set up a “skeleton document” – a standard template – into which I could eventually place the content as it was created. (I use WordPerfect to do it by the way.) Having a template would help ensure the timely production and mailing of the issues, and that I would not have to reinvent the wheel every month. I made three copies of it, each with a new name, since I always work three months ahead.

This template, which established the look and feel of our bulletin, has little changed over ten years. Modeled on the previous issues that were shown to me, the early bulletins employed a 2-column format with serifed Times Roman as the body/text font and sans-serifed Helvetica/Ariel for headlines and titles. The original basic font size was 12 points; I had to lower it eventually to the current 10.3 because there was too much good content to have to fit in. I added an alternating header and gave the bulletin its current name. I tried to add some kind of graphic element (e.g., drawing, photograph, table, etc.) With the exception of varying the number of columns on a given page to diversify the overall layout and having a large headline on the first page, I am sure you would agree that if you look at the first issue I produced in January of 1996, it looks pretty much the same as the one you are reading now.

I must have done something right that first year. In 1997, the EFMLS awarded me the trophy in the “New Editors” category in their yearly Bulletin Editors’ Contest. The green stone pyramid they gave me with a small, engraved plaque has rarely left my desk.

I hope everyone has noticed, but the content placement in the bulletin has also followed something of a formula. An average bulletin would be something like this: Page 1: headline/lead story, next meeting program preview; Page 2: club business including the President’s Message, previous meeting minutes, new members, other issues, etc.; Pages 3-4: World of Minerals (a.k.a. Minerals in the News) regular column; Page 5: Club or mineral history regular column; Page 6: review of shows, exhibits, books, trips, etc.; Page 7: “surprise” articles, shorter articles, poems; Page 8: mineral basics regular column; Page 9: mail-in forms for dues, banquet, almanac, field trips, etc.; Page 10: regular column for micromounting/field collecting (or gems/jewelry); Page 11: show and event calendars; Page 12: the mailing page, next meeting, officers.

What has allowed me to produce a bulletin filled with a consistent quality/quantity of content has been a bedrock of regular columnists? The richest vein has of course been that of Vivien Gornitz, who has written from 1-3 pages in virtually every one of those 115 issues - do the math! Other important contributors have been Saul Krotki (A Closer Look), Bill Shelton (Topics in Mineralogy), Richard Rossi (Mineral of the Month), Karen Rice (Gemstone of the Month), David Brand (historical and species articles), Mitchell Cohen (poetry), Anna Schumate (exhibit and show reviews), and, most recently coming into the fold, Diana Jarrett (gems, jewelry, etc.).

All of the above writers have been acknowledged (or shortly will be) in some way by the EFMLS in its annual article judging. A far greater tribute to these author-angels is that their writings appear far and wide as borrowed articles in almost every other bulletin I receive. The Bulletin of the New York Mineralogical Club is a prime source for mineral and gem content. Club bulletins tend to be ephemeral material, received, read and tossed shortly thereafter. But the good news for us and mineral collectors of the future is that the best writings of all the above as well as the dozens of other writers have been preserved in the several Almanacs that the Club has published. (We have produced three almanacs; the first two are out of print.)

There is a regular calendar of club activities every year and this has made the placing of bulletin content over an entire year to be formulaic and predictable. For example, the March issue always deals with the (March) NYC Mineral Show; the June issue contains the (June) benefit auction listing, the November issue has a biography of the guest speaker at the (November) Holiday banquet. I can look at any month’s issue from last year and have a model about what I need to do for the current year. I’d like to think that any future bulletin editor would pretty much do the same.

The production and distribution schedule also follows a plan. At any given time I am working three months ahead. (Thus, the February ‘06 and March ‘06 bulletins already exist to some degree!) After receiving the minutes of the most recent meeting from the club’s secretary, I aim to finish the bulletin by the 19th of the month, giving it a final reading on the 20th. I bring the final camera-ready copy to the copying place on the 21st and they are given to me usually on the same day. Over the next few days, the copied bulletins are folded, stapled, stamped and the address labels are attached, those having been produced by the membership coordinator and sent to me a few days before. The completed bulletins are mailed on the 25th of each month. I have followed this schedule, plus or minus a few days for ten straight years. [Note: So, when I am called or emailed after the 25th with a request to put in a personal, commercial or show announcement for the following month, please do not be “shocked” when I inform you that you are too late, despite what others may tell you!]

As a tangent, I recently came upon a 1965 EFMLS 30-page publication advising a club editor how to produce a bulletin; fully 50% of the book dealt with mimeograph machines, stencils, dittos and carbon paper. This was not only the world before PCs - it was the world before Xerox machines!

The way the bulletin has been reproduced has undergone some changes over the years. For the first five years, I was able to use (for free) the business machines at my company’s offices. Older members might remember that we had for about four full years a full color bulletin each and every month, likely unique in the country! After leaving Prudential, I decided to print and collate each month’s issue (2000) from home, employing my personal printer. This was a mistake and a
failure. Not only was this very time consuming (and I hated doing it) it turned out to be a poor financial decision. I burned through an entire toner cartridge every month besides wasting a lot of paper due to the constant paper jams in the always overheated printer. I now happily use a local copying service that actually costs less than my doing it myself. And they always throw in a few extra copies “just in case!”

The cost of your bulletin, by the way, is now roughly $1.00 per issue, accounting for half of the club dues for an individual.

I am most proud of the following three things with regards to being the Bulletin Editor:

1. I managed to layout, populate, produce and deliver a high quality and interesting product to all club members on a timely basis for ten full years that helps the club retain members and attract new ones;
2. Many members and organizations (USGS Library) preserve their copies of the Bulletin for future reference and reading, its content regularly a prime source for articles for many other publications; and,
3. The collected issues may provide a thorough and accurate picture of the Club for members, researchers and mineralogical historians of the future.

What of the future, with me continuing as your editor? For now, it is so ingrained into my daily activities that I can barely remember NOT being the editor. I enjoy it and feel good about supporting the Club. The procedures I use to put it together have functioned well, so much so that it has gotten easier and easier to produce, providing a respite from other “real” work I have to do in order to support myself. I will keep this responsibility as far as I can see into the future.

However, if there is someone who would like to work with me, get the hang of it with the possibility of eventually absorbing this role, let’s talk about it sometime.

President’s Message (March 2008)
By Anna Schumate

I hope to see everyone at the New York City Spring Gem and Mineral Show. Don’t forget we are having a dinner complete with wine, at the Holiday Inn’s restaurant on Saturday evening when the show closes. Let Mitch or me know if you would like to join us.

Meanwhile, I would like to recommend the American Museum of Natural History’s most recent special exhibit.

**Water: \( H_2O = \text{Life} \)** is at the American Museum of Natural History until May 26, 2008. This exhibit is a visually stunning collaboration of AMNH, the Science Museum of Minnesota, Great Lakes Science Center of Cleveland, OH, The Field Museum of Chicago, Instituto Sangari of São Paulo, Brazil, National Museum of Australia, Canberra, Royal Ontario Museum of Toronto, Canada, San Diego Natural History and Singapore Science Centre and the National Oceanic and Atmospheric Administration and NASA’s Goddard Center. You enter the exhibit through a brilliant blue fog curtain with the word water in various languages projected on it. The curtain, by Fog Screen™, is made of microscopic water vapor droplets that act as a translucent projection screen. It feels absolutely dry to the touch as you walk through it.

The exhibit consists of eight sections starting with life in water and how various plants and animals gather and conserve water, sometimes in bizarre ways. For example, Namibian desert beetles collect fog droplets on their bumpy exoskeletons. The beetles tilt themselves head down and catch the water in their mouths. Scientists have copied these beetles with a polypropylene cloth design that collects water vapor. Contrary to popular belief, camels do not store water in their humps. The humps store fat only. Camels cope with desert environment by absorbing all water vapor from the air in their spongy nasal passages. Moreover, they tolerate higher temperatures than most other mammals and do not lose water through sweating. We humans, in contrast, are not very efficient water conservers. We sweat, urinate often and lose water constantly through exhalation. Freshwater fish must balance the water they take in with special cells that conserve salts and electrolytes. In contrast, saltwater fish have cells that desalinate their systems from all the salt water that flows through their gills. Marine iguanas collect the salt from seawater in glands near their nasal passages. Then they simply sneeze it out. Often they can be seen sporting white deposits of salt crystals on their snouts.

An exquisitely gorgeous globe that projects NOAA images of Earth dominates the Blue Planet section. This area shows water’s dynamic role in Earth’s processes and why fresh water is scarce or abundant in different parts of the world. There is an impressive Grand Canyon walk-through to the next section, Water Works. It explores how we use water systems, some ecologically sound and some quite damaging to our planet. Dam construction is one example of a practice that has proved ultimately harmful to earth’s ecosystems. Over 60% of the world’s rivers have been dammed or diverted to produce only 20% of its electric power. Although dam turbines do not burn polluting fuels like coal, there are other serious impacts. Dams block fish migration routes. Recently, the French government has decided to remove the three dams from its Loire River. The dams are very expensive to repair and maintain. Sediment collects, eventually choking dams and is very expensive to remove. In 1998 the first of these dams, the Saint Etienne du Vigan, was removed. The happy result was the reopening of one of the world’s best Atlantic salmon spawning grounds. Since then, populations of these important fish have flourished. Constructing the Three Gorge Reservoir on the Yangtze River in south central China required dynamiting the entire city of Zigui, displacing thirty thousand people. The Chinese government moved all these folks to a new city on higher ground. Dam reservoirs are also harmful. Submerged trees and other plants in the reservoirs decompose and emit copious amounts of methane and carbon dioxide, greenhouse gasses
accounts of Petra existed for those early travelers. Two texts, sketches, watercolors and oil depictions of Petra's edifices. Few and a succession of explorers and archeologists visited to make News of Burckhardt's find soon spread throughout Europe "Stream of Moses." What he found was even more amazing. hidden in a strange natural fortress near the Wadi Musa or the disguise. He had heard that extraordinary relics were to travel in that troubled region of the Ottoman Empire, hence Jordan. In Burckhardt's day it was dangerous for non-Muslims Damascus through Egypt into what is now the nation of Jordan Rift Valley. The sandstone itself exhibits an from the sandstone cliffs hidden in a fortified gorge in the world. Her temples, monuments and dwellings were carved of the architectural and engineering marvels of the ancient Roman style. There is a huge Roman-style cantharis, or water urn, carved from pavonazetto marble. This black and white marble was quarried in Phrygia, now in Turkey, and was the same marble used in the Roman baths of Caracalla. The immense temple, Qasr al-Bint, was dedicated to the goddess al-Uzza and the sun god, Dushara. At the far end of the temple was a platform that held the baetyl or idol of Dushara, a black quadrangular stone, 4 feet high. Dushara's worshippers offered it sacrifices by pouring their victims' blood on this baetyl. There are examples of jewelry made from copper, silver and gold with granulation and carved carnelian.

During the reign of Aretas IV (9 BC – 40 AD) Petra's prosperity was at its zenith. Under his successors, Roman influence grew until the Roman emperor Trajan peacefully annexed Petra in 106 AD, creating the Province of Arabia. Subsequently, Trajan forged new trade routes, eclipsing Petra's dominance as a trade center.

“Petra: Lost City of Stone” – Exhibit at the American Museum of Natural History
By Anna Schumate

Deep in the Jordanian desert lies the lost city of Petra, one of the architectural and engineering marvels of the ancient world. Her temples, monuments and dwellings were carved from the sandstone cliffs hidden in a fortified gorge in the Jordan Rift Valley. The sandstone itself exhibits an extraordinary range of colors in banded patterns. In 1812, a Swiss explorer was the first European in centuries to gaze in wonder at the lofty rose-colored stone facade of El Khazneh, the Treasury of the Pharaoh, the first sight one sees upon emerging from a half-hour trek through the narrow gorge called the Siq. Disguised as an Arab called Sheikh Ibrahim, the explorer Johann Ludwig Burckhardt had traveled from Damascus through Egypt into what is now the nation of Jordan. In Burckhardt’s day it was dangerous for non-Muslims to travel in that troubled region of the Ottoman Empire, hence the disguise. He had heard that extraordinary relics were hidden in a strange natural fortress near the Wadi Musa or “Stream of Moses.” What he found was even more amazing. News of Burckhardt’s find soon spread throughout Europe and a succession of explorers and archeologists visited to make sketches, watercolors and oil depictions of Petra’s edifices. Few accounts of Petra existed for those early travelers. Two texts, however, the Library of History by Diodorus of Sicily and Geography by geographer and historian, Strabo, did include Petra. Both historians described how Petra, the capital of the Nabataean people, became wealthy from the caravan trade, circa 312 BC, shortly after the death of Alexander the Great.

The Nabataeans developed an ingenious system to capture seasonal rainwater, conduct it through rock-cut and terracotta channels and then store it in underground cisterns. Not only did this collect and save precious water in a desert land but it prevented flooding during the rainy season. The AMNH exhibit has a fragment of one of these terra cotta water pipes and diagrams of the conduit system. This amazing water system amply provided for gardens, pools, fountains and a population of 20,000 citizens, with water to spare!

Petra was something of a cosmopolitan city. Monuments, dwellings and temples combine Greek, Egyptian and Roman styles of art and ornamentation. The exhibit has some stunning examples. Here are just a few you will see. A photograph of a banquet hall ceiling shows a fresco with motifs of birds, cupids and grapevines and conforms Strabo’s accounts of wine drunk from golden goblets and viniculture in Petra. Pinecones, symbolizing rebirth, dolphins, believed to carry the dead to the next world, eagles, serpents, and fruits were other motifs used in decoration. A partial bronze statue of Artemis-Diana, unearthed by Bedouins in Wadi Mataha, Jordan, is a superb example of Greco-Roman style. There is a huge Roman-style cantharis, or water urn, carved from pavonazetto marble. This black and white marble was quarried in Phrygia, now in Turkey, and was the same marble used in the Roman baths of Caracalla. The immense temple, Qasr al-Bint, was dedicated to the goddess al-Uzza and the sun god, Dushara. At the far end of the temple was a platform that held the baetyl or idol of Dushara, a black quadrangular stone, 4 feet high. Dushara’s worshippers offered it sacrifices by pouring their victims’ blood on this baetyl. There are examples of jewelry made from copper, silver and gold with granulation and carved carnelian.

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On May 19, 363 AD, an earthquake destroyed much of Petra. Located near the boundary of the Arabian plate, Petra was further damaged by earthquakes in 551 and 747. Natural erosion also threatens the site. In 1989 Queen Noor Al Hussein of Jordan formed the Petra National Trust in Amman. Along with UNESCO (United Nations Educational, Scientific and Cultural Organization) the Trust is working on a plan to preserve this rare treasure. It is one of life’s ironies, albeit a very sad one, that I visited this wonderful exhibit on the day after a catastrophic earthquake struck Bam, Iran. I have described only a few of the exhibit’s highlights here. I urge you to see it for yourself and explore the mysteries of Petra.

Banquet Fun & Games
Here’s a result of one of the games played at the annual club holiday banquet.

Very Thin Books
By Mitch Portnoy

Years ago, I was an avid reader of Mad Magazine. Mad had a feature from time to time called “Thin Books” which contained fictional (and comic) titles of a topical, political or popular content. Examples might have been something like “The Acting and Vocal Range of Pia Zedori” or “The Televised Charisma of Richard Nixon.”

I always thought a corresponding feature could work for the bulletin, and I had been keeping a list of similarly sardonic titles.

My Examples:

❖ Minerals from the Catskills
❖ Ethical Mineral Dealers
❖ American Gem Rubies
❖ Authentic Amber & Untreated Turquoise
❖ Contributions to Mineralogy by the EFMLS
❖ Engaging Club Presentations by Mitch Bogden
❖ Aesthetic Clay Minerals (via Bill Shelton)

We always have some kind of game or two at the holiday banquet. I thought it would be fun to ask the participants for their ideas for funny, thin book titles. (and to get a good feature article written for the bulletin at the same time!) Here are what the banquet participants came up with:

By Members of the New York Mineralogical Club:
Winner – Al Rauch
1. Collectors Who Know When to Quit

Second Place – Chris O’Neill
2. Diamonds I’ve Never Owned by Liz Taylor

Runner Up – Alfredo Petrov
3. The Pegmatites of Nebraska

OTHER SUBMISSIONS
On the New York Shelf
Gold Panning in the Gowanus Canal........... (Bill O’Neill)
Vol. I Central Park Diamonds.................. (Richard Rossi)
Vol II Great Diamonds from MTA Mines. (Barbara Levine)
Recent Club Springfield Show Trips...... (Corinne Orr)
Lost Mines of Queens......................... (Susan Rudich)
Famous Gems of Brooklyn.................... Ibid.
How to Prospect for Copper & Gold in New York. . . . . . Ibid.
Gems and Minerals of Greenwich Village....... Ibid.
The Sex Life of Herkimer Diamonds....... (The Bolinders)
On the Mineral Shelf
Minerals of Malta.............................. (Anonymous)
Fluorescent Minerals in Daylight........... (Guess Who)
Aesthetic Gems of Sterling Hill.............. Ibid.
Mineral Treasures of Snake Hill.............. Ibid.
Liquid Rocks................................ (Ann Vitiello)
Diamond Prospecting in Newark, NJ. . . . (Anna Schumate)
Encyclopedia of Lepidolites............. (Vivien Gornitz)
Pet Rocks................................. (Ken Conn)
My Favorite Five-Color Franklin Fluorescents by Ray Charles
......................................... (An Evil Submitter)

On the Jewelry & Gem Shelf
Modern Natural Pearl Sources............... (Reema Keswani)
The Best of Men’s Jewelry.................... Ibid.
Crocoite Beads................................ (Alla Priceman)
Talc Necklaces............................... (Corinne Orr)
Amber from the Moon......................... (Susan Wilches)
Unenhanced Diamonds of Rodeo Drive. (E. Bawn-Hufford)
Worldwide Distribution of Moissanite...... (Anonymous)

In the Children’s Section
(Not quite “Very Thin Books”, but I liked the Suessian nature of the titles anyway – Editor)

Darn It Garnets............................... (Jane Kaplan)
Pearls and Curls.............................. Ibid.
Barrels and Beryls.......................... Ibid.
Sulfur and Eggs............................. Ibid.

On the Geology Shelf
Global Warming by Dr. Charles Merguerian... (Corinne Orr)
(This needs some explanation as to why this title is as clever as it actually is. At a recent club meeting, Dr. Charles Merguerian (CM) and Dr. Vivian Gornitz (VG) engaged in a friendly debate over this topic with VG expressing concern about its existence and cause and CM giving an opposite point of view and disputing its actuality. – Editor)

There were some other submissions but they were too dirty to put here (but still funny), didn’t really fit the topics (Elements, Quartz by the Quartz, Quicksilver Mercury), made no sense to me (The Skinny Druzy) or I can’t read what was written. Thanks to all participants. And additional submissions are welcome any time!
New York City Gem & Mineral Show
The NYMC has partnered with Excalibur Mineral Corporation as host of the show.

Show Theme Poems
These two poems were written by Mitch Cohen for the March 2004 NYC Gem & Minerals Show with Mitch Portnoy as an eager collaborator.

Tourmaline
A high-temperature and pressure mineral, found in igneous and metamorphic rocks.

After excavation from a pegmatite they turn up in dealer stocks.

Yet there is no mineral “tourmaline”!
It forms what we call a group.
Dravite, schorl, elbaite and others emerge from a complex chemical soup.

Its crystals can reach a yard(!) in length and be nearly triangular around.
It forms on every continent so localities abound.

There’s a diversity of colors, a rainbow of gemstones, true.
One sees red, yellow, green, black, brown, and it even comes in blue.

Tourmaline can be multicolored with stripes, just like our Nation’s flags.
Rockhounds like to collect them in their shoulder bags.

Another kind, when cut across, is green on edge and red inside.
It’s Nature’s wonderful loot.
For it resembles watermelon in every way, a permanent, gemstone fruit!

You know it’s used in jewelry, for a ring, a pin or a necklace.
But some electric properties make it useful in a laboratory apparatus.

So look around this Show my friend,
Most dealers will have specimens that stun.
Whether you’re buying minerals or jewelry Tourmaline belongs in your collection.

Garnet
Easily recognized by all rockhounds found in igneous and metamorphic rocks.
It’s also found in our Club’s emblem with a huge specimen with a size that shocks.

Yet there is no mineral “garnet”!
It forms what we call a group.
The group is further divided into two series. Upsetting you? Let’s try to recoup.

The first series is known as “pyralspite”, meaning pyrope, almandine and spessartite.
The second’s known as “ugrandite” – for uvarovite, grossular and andradite.

Crystals are very common with the shape of soccer balls.
Found everywhere, even New York City in the bedrock beneath our walls.

It occurs in almost every color, a rainbow of treasures, true.
There’s red, orange, yellow and green
But alas there is no blue.

Another curious fruit allusion with the garnet can be found.
For its name is based on “pomegranate”, when pronounced with an Old French sound.

A gemstone known since ancient times used in every sort of adornment.
But its hardness makes a good sandpaper, as a grinding and polishing agent.

So look around this Show my friend
That garnet is common’s no fiction.
Whether you’re buying minerals or jewelry Garnet belongs in your collection.

Miscellaneous Activities
Out-of-the-box thinking is critical to the future of mineral clubs.

Thinking Outside the Box: The NYMC at a Flea Market
By Mitch Portnoy

None of us is perfect. To make up for these shortcomings, it is worthwhile to surround yourself with friends with skills or traits that fill in these gaps. This is especially true for a management committee, whether for an immense commercial institution or for a much smaller mineral club. One of the traits that Rich Rossi brings as a director to the NYMC is his ability to “think outside the box.”

I have noticed over the past few years that the officers of many mineral-related organizations such as the EFMLS, AFMS, mineral clubs, show promoters, etc., do not have this ability. If they even acknowledge that there are any problems in our
hobby at all, they tend to retreat to outdated solutions that are now supremely ineffective. Another equally annoying reaction is to throw up their hands in the air (I mean this literally) and say nothing can be done. Well, not so for Rich.

He had noticed for a while that near the Museum of Natural History, where we meet, is a weekly flea market. This is a well-attended event that would not be filled with the same people who always attend the regular hobby events. Rather, they would be a fresh group to market the benefits of membership in the NYMC.

He contacted the promoters and, to make a long story short, the Club had a two-tabled booth at the Columbus Avenue Flea Market (at 77th Street) on Sunday, August 26, 2007. The goals were to advertise the club and attract new members and to make some money by selling our publications and minerals from the pile of donations that remain.

**Evaluation - First Try**

The activity was a success to some degree. Rain threatened but held off and it was never too hot, fortunately. Even our neighbor with whom we shared a tent was a nice guy.

We certainly attracted a lot of attention since no one had anything like what we had and it was out first time. I would not say it was a very well attended flea market but many people stopped to at least look, including a large number of tourists from around the world.

We did not sell any almanacs or ephemera that we had like patches or note cards. We did sell $250 worth of minerals and gemstones, however, reducing that pile of donations I keep talking about that occupies my hall closet. We did not sign up any new members there but MANY people took information about the club and our next meeting and said they would or might attend. This will be worth tracking in September. Also, Rich felt we were successful enough to give this flea market idea another try in two weeks.

**Second Try - Two Weeks Later**

The second attempt, two weeks later, was, again, a guarded success. The fair itself was not a busy but we still managed to sell $100 worth of minerals and again, MANY of the people who stopped to talk to us expressed surprise that we even existed.

I won’t spend a lot of time on this but being out in the public is a daunting task for someone as verbally direct as I can be – fortunately, Rich’s more easy-going nature was a big help. What could I say (actually nothing) to the woman who had a “major” mineral collection including marvelous quartz crystals that she had on her window sill and “were growing?” Or to the engineer who used to work at the “Smithsonian Institute” who was an “international expert” on “tribolites?” Or, lastly, to the man who wanted to know the value of the mica schist rock specimen he had found in the Park recently? Never a dull moment . . .

**Meeting Results – Success!**

Well, for me, the best results from this experiment occurred last night at the meeting. Three flesh and blood people who met us at the flea market attended. One, an enthusiastic gemologist, joined immediately. The two others, did not join immediately but took an application and I have every confidence we will see them again.

In conclusion, thinking outside of the box has its rewards.

**New Partnerships: More Thinking Outside the Box**

By Tony Nikischer

The recent New York City Spring Gem & Mineral Show featured a new, bold effort to educate and recruit new collectors. A new partner, The Hudson Institute of Mineralogy, developed a short course in geology and mineral identification aimed specifically at the Geology Merit Badge requirements for the Boy Scouts of America.

Michael Lamonica, a science teacher and former employee of Excalibur Mineral Corporation, developed the program at the Institute’s request. Club member Ken Swanson, Executive Director of BSA for Suffolk County, coordinated BSA scheduling, and Tony Nikischer, the Institute’s founder and chairman, arranged for specimens, equipment and space at the Show. As part of the mineral identification segment of the course, over 900 specimens were distributed free of charge to the scouts, all donated by the Institute and Excalibur. The Club added to the budding collectors’ new acquisitions by providing free zeolites to each as well.

Over sixty (60) Boy Scouts participated in three separate sessions. They, along with their accompanying parents and troop leaders, were admitted free to the show, and their uniforms were on view everywhere on Saturday! Some were seen again on Sunday as paying customers, coming back for more!

For a first time effort, this new activity was deemed a success despite some need for improvements in our level of Club volunteering and in the session timing. The program will be refined and offered again next Spring, hopefully drawing in new BSA Councils from the greater New York/New Jersey area.

**There are two important points here:**

- Thinking “outside the box” is critical to the on-going success of our Club. Forging new partnerships and new relationships to seek out non-traditional avenues of growth are needed. This year’s show attendance improved by approximately 15%, while not even counting the scouts and their chaperones, countering the worldwide trend of declining mineral show attendance. Finding new, innovative ways to educate and inform the general public about our hobby are critical. Do you have new ideas to share and time to spend to implement them?

- New collectors and new show attendees don’t just fall out of the sky. By extension, new Club members and the future of our hobby require work on OUR PART. We are the stewards of an old and venerable organization, and we have a responsibility to ensure a sound future for it. Spending a few hours once a year as a volunteer in this
activity is not a great burden, and it will help create new collectors and leaders in our hobby. Do your part!

Special Section: In Memoriam

Clifford Frondel (1907-2002)
By Various Internet Sources

Dr. Clifford Frondel, a Harvard mineralogist who was among the first people on earth to view rocks brought back from the moon, died on Tuesday, November 12, 2002 in a nursing home in Winchester, Mass. He was 95.

The cause was complications from Alzheimer’s disease, his wife said.

Dr. Frondel was an honorary member of the New York Mineralogical Club.

As a scientist recruited by NASA to study the moon rocks brought back by Apollo 11 astronauts, Dr. Frondel was present when a box containing 48 pounds of rocks from the Sea of Tranquility was opened in Houston on July 25, 1969.

“It’s basalt! It’s igneous!” Dr. Frondel exclaimed upon examining the rocks.

At the time, no one had known what to expect, Dr. Carl Francis, who succeeded Dr. Frondel as curator of the Harvard Mineralogical Museum in 1977, said.

“Basically, what he said means that you don’t have to start over to understand lunar geology,” Dr. Francis explained. “It’s similar to work we have done here on earth.”

Still, the authorities supervising the study were not taking any chances. When Dr. Frondel was exposed to lunar dust later that year while he was researching samples from the Apollo 12 mission, he was quarantined for two weeks.

“They worried that if there was some kind of life on the moon and it leaked into the environment, it could have devastating consequences,” Dr. Francis said.

But Dr. Frondel’s wife, Judith, 92, said she had not been worried about her husband’s health when told about the quarantine.

“I thought to myself: He only packed for three days. He doesn’t have enough underwear for two weeks,” she recalled in an interview.

Dr. Frondel, who was born in New York, married Judith Weiss in 1949. They had one daughter, Barbara Frondel, 52, who lives in Israel. Dr. Frondel is also survived by a sister, Martita van Ness.

Mrs. Frondel, also a mineralogist, said she had met her husband through work. Eventually, she helped in his laboratory at Harvard, where he was a professor from 1939 to 1977.

“He always believed that his teaching was as important as his research,” Mrs. Frondel said.

Over the years, Dr. Frondel was credited with discovering 48 new types of minerals. He has had two minerals, cliffordite and frondelite, named in his honor.

During World War II he worked with the Army Signal Corps to make quartz oscillator plates in walkie-talkies more efficient. The later application of that research is evident in the use of quartz timing devices in watches.

Dr. Frondel did influential work applying research methods used in mineralogy to other fields. He worked with Dr. Edwin L. Prien to develop a method of detecting kidney stones through X-ray technology.

Dr. Frondel also helped create spectrochemical methods to find art forgeries.

He was the third American geologist to be accepted to Italy’s national academy of science, and was recognized by the scientific community around the world.

“He is a giant in 20th-century mineralogy,” Dr. Francis said.

Carl Krotki (1914-2002)
By Judith Krotki Putterman

Every second Friday night for twenty years Edge Goldstein came to dinner. After the meal, the table was cleared and Edge emptied his pockets. Out came cut stones, cabochons, obscure gems, common amethyst, odd colors of garnet, sapphire, jade. Onto the dining table spilled a private graduate course in mineralogy and gems, taught to my father and all of us by the master himself.

Saturday nights were less intimate gatherings, with the apartment, first in the Bronx and then in Manhattan, packed with world class mineral collectors, out-of-town and local curators, bibliophiles, and just plain rockhounds. Neal Yedlin, Edge Goldstein, Joe Rothstein, Martin Walter, Joe Stromwasser, Walter Stone, Frank Chambers, Seymour Schweitzer, Sid Sterris were all regulars. Frequent guests included Fred Pough, Paul Desautels, Lou Moyd, Paul Seal, John S. White, John Sinkankas. Every evening started with show and tell. Guests unwrapped their latest finds of specimens, faceted gems, micromounts, old mineral books, mineral stamps, maps of localities. Then the screen came down and there was a slide show for at least an hour: the latest trip, the newest locality, the best photomicrography. The room was full of a joyous audience participation, comments about the crystal that got away, about the specimen carefully wrapped and left on a motel room table, about the trip cancelled because of a dead car battery. When the lights went on, guests left behind the world of minerals and entered my mother’s domain: it was time to eat.

Those were weekends at home. Long weekend trips away were frequently to mineral shows or conventions, where my father had work to do. For fourteen years he served as
treasurer of the Eastern Federation of Mineralogical and Lapidary Societies, working under fourteen presidents and aiding in the growth of the Federation from a few clubs to some 180 affiliates. Family vacations were to localities in Canada, North Carolina, New England, Utah. International vacations included stops in Laurium, Greece, Oro Preto, Brazil, a visit with Mary Leakey in East Africa, and Molinas de Aragon, Spain.

Carl was born in Salt Lake City in 1914. Carl's uncle Max Krotki, owner of the Krotki Iron Mines, sparked little Carl's interest with pyrite crystals. After my grandfather died in 1923, the family moved to New York City, where Carl attended James Monroe High School and met the great love of his life, my mother Shirley, to whom he was married for 61 years until her death in September, 2000. After earning a degree in accounting from the City College of New York and becoming a CPA, Carl served in the Navy during WW II. After the war, he earned a Doctorate in Jurisprudence from the Brooklyn Law School. In the late 1960's, my father's major client induced him to sell his accounting practice and become controller for Permag Corporation, a major manufacturer of permanent magnets that grew to have nine branches around the country. The strategic placement of Permag facilities made it possible for my father to be within striking distance of almost any mineral meeting in the country.

In the late 1950's, my brother Saul brought home rocks from a nearby highway dig and asked my father to identify them. That lead to trips to the American Museum of Natural History, to the purchase of some field guides, to a lifelong hobby. In 1958, Carl joined the New York Mineralogical Club, was chosen its treasurer, and served in that office for over fifteen years. He was also the president of the New York Gem and Lapidary Society.

Eventually my father's interest in minerals took a new turn: he became interested in antique books on minerals and gems, especially those with colored plates. In this field, his mentor was his beloved friend Neal Yedlin. My father was an eager pupil: he read about books, spent hours in the New York Public Library and in Neal's library, and studied auction catalogues from all over Europe and the Americas, keeping meticulous notes. Eventually it was commonplace for him to come home dirty, not with the mud of a quarry but with the dust of an old book barn. In bookstores around New York he was known as Mr. Mineral. By the mid-1970's, my father's library was called one of the 4 or 5 most complete assemblages in the country. Interested in sharing historical mineralogical data, he developed several slide shows on mineralogical literature, and gave talks at Federation shows and at local clubs along the eastern seaboard from Boston to Washington. A great story teller with a ready smile and a wonderful sense of humor, Dad was a real audience pleaser. The Carl Krotki Library of Gemology & Mineralogy, consisting of over 1,500 volumes, was auctioned at the Swann Galleries in New York on December 8, 1994. It was the largest private mineral library ever to come up for sale at the time, attracting bidders from around the world.

My father passed away on July 17, 2002 in his apartment in New York. I am struck now by the good times the mineral collectors had whenever they got together. United by a common love, they explored and continuously found new aspects of the mineral world to keep them fascinated. Their passion transcended religion, politics, the economy. The world of mineralogy enriched my father's life in many ways, but most especially in giving him the two most important friendships of his life: Neal Yedlin and Edge Goldstein, men he loved better than brothers, and in closing this remembrance of my father, I remember them, too.

Russell Joseph Buckingham, Sr. (1914-2003)

By Family Members

Russell Joseph Buckingham, Sr., 89, died of natural causes at the Lutheran home in Topton, Pennsylvania on October 23, 2003. He was a former resident of Yorktown Heights, New York. He was husband of the late Anne Schupak Buckingham, father of Russell Joseph Buckingham, Jr. and Mahala Buckingham Burns, and grandfather of William Cody Buckingham Burns.

Russ (as we called him) was educated at Fordham University. He was a professional photographer. He was a well-known mineral collector, micromounter and field collector, a regular to be seen collecting at Mt. St. Hilaire in Canada. He was twice elected an honorary member for his dedication to the Club over the years.

Russ was a veteran of WWII in the 45th Infantry Division, landing at Anzio and Salerno. Wounded at both Anzio and the Battle of the Bulge, he earned a Purple Heart with Cluster. He finished his service in the Monuments and Archives Division, helping to return the treasures and artwork stolen by the Nazis.

Russ' family and friends have fond memories of admiring his wonderful antiques and minerals, of listening to him playing the piano, and of being white-knuckled passengers in his car.

Russ lived a unique and passionate life. He was disciplined and single-minded with an abiding interest in art, history, music and science. His life was spent in the pursuit of knowledge and he never quit learning.

Julius Weber (1914-2003)

By Mel Pollinger

Julius Weber, 88 years, after being hospitalized for an unrelated illness, succumbed to a heart attack on March 9, 2003. He is survived by his beloved wife of 64 years, Mary S. Weber, sister Edythe, son Robert, daughters Lenore, Margaret and Nancy, grandchildren Marc, Eric and Zoe, great grandchildren Lee, Rebecca, Jennifer, Rachel and Daniel. The family and close friends gathered at the home of Mary and
Julius in Mamaroneck, New York on March 30 in remembrance of a loving husband, father, grandfather and wonderful friend.

Julius was a past, long-time member of the New York Microscopical Society and The New York Mineralogical Club. Renowned for his medical and scientific photography and noted for his images of the minerals he loved, particularly microminerals. Some of his best mineral photomicrographs may be found in The Encyclopedia of Minerals. Among his many outstanding technical contributions in medical photography was his early development of a technique for the staining of brain neurons (nerve cells). There did not seem to be any challenge in microscopy, photography or life in general that he would not meet and exceed.

I met Julius in 1968, right after I obtained my first stereomicroscope and began to peek at the microcrystals on some of the specimens in my beginner’s collection. One Saturday is all it took for him to show me the potential one has with a microscope. What a memorable afternoon was spent peering into his various types of microscopes, each with their own specific purpose. Some for high magnification of bacteria, others for surface analysis and others yet for stereo viewing and imaging of minerals. He seemed to have one favorite microscope for minerals, a Nikon that he had rebuilt, stretched and re-tooled to give him the extreme optical latitude he wanted for his micromounts.

Julius always made sure visitors came away with knowledge, minerals or both. He was a great storyteller, especially about his beginning work in many New York City hospitals; he was always learning, attending classes, practicing with new equipment, experimenting and developing new techniques for producing images to be used in diagnosing disease. He enjoyed his family and friends and with them happily shared his life. He will be missed, but always remembered.

Jay Lininger (1940-2004)
By Mitchell Portnoy

Jay Lininger, printer, mineralogist, historian, writer, singer and devoted family man passed away unexpectedly at his home in Dillsburg, Pennsylvania on Monday, October 18, 2004. He was only 64.

Jay was the publisher of the Matrix Magazine and books relating to the history of earth science and scientists. Lininger was himself an historian of mineralogy and owner of one of the finest mineral collections from his home state of Pennsylvania.

He and his wife, Paula, started their own graphics business, Matrix Publishing Services, in 1976. The first book published by the company, Lawrence Conklin’s The Correspondence of George Frederick Kunz, was an immediate success. This was soon followed by Lininger’s well-written and inspiring articles about the giants who make our own activities possible. The historic pictures were equal to the text.

Lininger had been interested in minerals since junior high school and became an avid collector in the early 1960’s. He helped fund the Pennsylvania Chapter of the Friends of Mineralogy, and co-published the important Reminiscences of a Mineralogist by Arthur Montgomery.

In addition to his comprehensive Pennsylvania collection, Lininger had a worldwide reference collection (both totaling six-thousand specimens) with many rare specimens. Mining memorabilia also have a prominent place in the Lininger collection.

Lininger was an active member of the York (PA) Mineral Club and had been active in the Eastern Federation of Mineralogical Societies. His talks on mineral history were as popular as his articles. He had been a guest speaker at the Rochester (New York) Symposium, the Friends of Mineralogy Symposium, the Wildacres retreat in North Carolina, the A.F. Seaman Museum in Michigan’s copper country, and at other prestigious events such as the Banquet of the New York Mineralogical Club (1995). His topic at that time was about the importance of early copper mining in the Eastern part of the USA and how that contributed to the Industrial Revolution.

Lininger was a regular at the Tucson gem and mineral shows where he met with mineral book and memorabilia collectors and visited with his many friends among mineral hobbyists and professionals.

One of Lininger’s friends, Professor Juliet Reed of Bryn Mawr College, wrote, “This was a talented man who stood out as an educator.” Writer Cathy Gaber said of Lininger, “There are few people who have had such a national and international influence in mineral communities.”

A timely example of Lininger’s exceptional contributions to mineral history is his excellent article published in 1999 about one of mineral’s most prominent figures, the late John Sinkankas, who died in 2002.

A particular talent of Lininger’s was to see important things that have been overlooked by others. This keen vision keeps many pieces of mineral history that would otherwise be lost forever alive for the rest of us.
Frederick H. Pough (1906-2006)
Club's Oldest Member, Dies at 99+
By Mitchell Portnoy

Dr. Frederick Harvey Pough, the Club’s oldest member died on April 7, 2006 while attending the Rochester Mineralogical Symposium. He was almost 100 years old.

I was informed of this fact a few moments ago by Bill Shelton, calling from the Symposium itself. His sentiments are worth repeating. “I guess if you are 100 and die while doing something you love, rather than sitting in a wheelchair in a home, your life was not so bad.”

To give you an idea about his longevity, mineralogically speaking, he knew George Kunz personally, when they were both members of the New York Club! He claimed that he and George used to have some pretty strong discussions regarding minerals and gems.

Fred was the guest speaker at the Club’s November banquet in 1996 when he was “only” 90. His topic was “Reflections of Sixty Years in Minerals.” He gave members a fun, highly entertaining look into his life and times as a mineral author, museum curator, consultant and mineralogist.

Pough’s father helped found the NYMC. Dr. Pough went on to amuse us with stories of his early years of mineralogy in Germany and Italy as a student at the University of Heidelberg. He touched on numerous other experiences including:
♦ Trips to the sulfur mines near Mt. Vesuvius;
♦ His life and times as Curator at the American Museum of Natural History;
♦ Important donations to the Museum;
♦ A story about a synthetic alexandrite and royalty;
♦ A story about a treated 104 carat blue diamond;
♦ A dangerous Mexican volcano visit.

We could have listened all night but time grew short. I am sure that those of us who attended this banquet will ever forget this experience!

Fred Pough was the curator of Mineralogy, and later of Physical Geology and Mineralogy at the American Museum of Natural History until 1952. After his retirement, he worked and traveled the world as a consulting mineralogist. He was a contributing editor to Lapidary Journal in which he wrote a monthly column on gem minerals.

Fred’s last published article (“The Rueppele Mine”) appeared in the October 2005 Mineral News. It was an essay about going into a mine as a child and how that experience affected his life.

As an author, he has written many articles and books, most notably the Field Guide to Rocks and Minerals, a classic reference book for all collectors. Among his many awards are: Mineralogist of the year in 1966 by the American Federation of Mineral Societies, the Carnegie Award for Mineralogy from the Carnegie Museum of Natural History in 1989. He is a Fellow of the Geologic Society of America.

Besides the omnipresent Field Guide (now in its sixth edition), Fred wrote many other books, many geared to children. This included The Story of Gems and Semiprecious Stones and All About Volcanoes and Earthquakes (1953).

Indeed, Fred really liked children and loved taking them on tours of the Museum’s mineral and gem collection personally when he worked there. He told me that educating the youth about rocks, minerals and geology was critical to the science and the hobby.

The mineral poughite [Fe₄(TeO₃)₃(SO₄) • 3H₂O] was named in his honor in 1966. It is a crumbly, yellowish mineral in the tellurium group. It can be found in Mexico and Honduras.

He was also instrumental of the discovery and naming of the modern gemstone brazilianite in 1945. Here are his words regarding the mineral:

“This was a remarkable mineral to turn up in a pegmatite so late in time. Seldom do new minerals first appear in conventional deposits in 6-in. (15 cm) gemmy and well-formed crystals. The first examples were of uncertain origin; Conselheiro Pena in Minas Gerais was reported to have been their source. It has subsequently been found in several other Minas Gerais pegmatites . . . and, strangely enough in New Hampshire in the already well-studied Palermo mine.”

He was friends with many of the “old timers” in the club (all now deceased), including Joe Arons and Russ Buckingham. He went collecting with Russ to Mt. St. Hilaire in Canada. Joe and he went to Brazil together on a collecting and buying trip in the 1960’s.

I first met Fred in 1996 in Tucson where I saw him sitting quietly in the lobby of the Executive Inn. I introduced myself to him and we chatted for a long while about the Club. Fred shared many memories with me then — I wish I had written some of them down! We developed a nice correspondence over the years. I have saved all of his letters to me as they contain ideas and thoughts he had regarding the Club, gems, minerals, mineralogy, and the Bulletin’s overall content and format. (He was extremely complimentary about it, by the way!)

He asked me to send him some of the famous Sayreville marcasite, famous for its quick disintegration for an experiment he was performing on it to see (1) what was causing the “contagion” as he put it and (2) if it could be halted. I never heard how it turned out.

Another topic we covered at the time was about the Club’s various honorary members. He remembered when Marie Curie was so honored but confirmed that Arthur Montgomery never was due to the prejudice against dealers at the time. I asked him was he was elected to be an honorary member — all he could say was, “A long time ago.” Oh well.

Later that same year he was our banquet speaker. I designed, printed and distributed a souvenir card (pictured below) to everyone at the banquet. I had mine inscribed as did MANY of the attendees. I hope members have preserved this souvenir in their ephemera collections!
In 1999 I began to research information for a paper and presentation about Mineral Day at the 1939/40 New York World’s Fair. Fred, as an important scientist at the American Museum, was on the day’s steering committee. (He was also involved, logically enough, in the Museum’s display in the New York City pavilion.)

June 17, 1940 was Mineral Day at the Fair. At 1:00 p.m. an address was given by Dr. Frederick H. Pough in the Hall of Metals. Alas, when I asked him about it he remembered nothing and the Museum’s archives was no help. I still have hope that someone, someday will be able to tell me what he spoke about.

Always the predatory curator (scavenger?) Fred managed to obtain for the Museum “pieces” of the Fair when it was over later that year. In a contemporary memo from Fred Pough:

“From the Copper and Brass Industry Exhibits we have received the model of the copper atom together with explanatory labels; plexiglass protective sheets and a sound apparatus, to explain the workings of the model, known as a Robophone.”

Based on another memo of November 13, 1940 from Pough regarding “specimens of material received from the... Brazil Building” after the fair closed, he obtained uraninite, samarskite, columbite, magnetite, euxenite, smokey quartz (one ca. 75 lbs.), rose quartz (ca. 200 lbs), aventurine quartz (ca. 75 lbs.), a barite crystal (ca. 50 lbs.) and several groups of white quartz crystals.

I hope I can fill the next 50 years of my life as well as Fred Pough did his. He should truly be considered for and named universally as the Premier Mineralogist of the Twentieth Century.

David R. Hargett (1954-2007)
By John Koivula, Ken Scarratt and Tom Moses

Gemologist, NYMC member and author David Hargett passed away recently in New York, the city he called his home for most of his adult life. He was only 53 years old.

Hargett worked for the GIA Laboratory in New York for 16 years as a colleague of now-GIA Laboratory and Research Senior Vice President Tom Moses and their gemological mentor, G. Robert Crowningshield. Hargett began his career with GIA in January 1977 after obtaining his Graduate Gemologist diploma in Santa Monica, California, and a bachelor’s degree from New York University.

Hargett served for several years as manager of the Gem Identification department at the East Coast GIA Laboratory, where he was instrumental in developing many of the techniques still used today to recognize synthetic and treated colored stones, as well as cultured pearls and enhanced diamonds.

The author or co-author of many Gems & Gemology (G&G) Lab Notes on unusual gem materials, he also co-authored the award-winning Koivula et al. article on “The Characterization and Identification of Filled Diamonds” in 1989.

Hargett was very fond of gemologically related travel, and he particularly enjoyed exploring the gem mining areas of Mexico and Central America. G&G published Hargett’s definitive paper on the jadeite deposits of Guatemala in the Summer 1990 issue. He left GIA in 1992 to start a consulting business, which allowed him to focus on areas of gemology he had come to enjoy.

He was a lifetime member of the New York Mineralogical Club.

Those who were fortunate enough to know Hargett as a friend remember him as a kind and generous person with an amazing sense of humor. Those who worked with him remember him as an excellent gemologist with a keen and curious mind.

Through his dedicated gemological research and an overall strong work ethic, he gained the respect and admiration of gemologists all over the world. He will be missed by many, both within and outside the gemological community.

Special Illustration:
Classic Publication of the NYMC
## Biblical Minerals

**By David Brand**

In a dusty corner of my local library, I came across a book titled “Gems and Minerals of the Bible”. It was published in 1970 and was written by Ruth V. Wright and Robert L. Chadbourne. No information is given about the authors’ background; however, it is quite possible that one was a biblical student and/or historian and the other had a mineralogical background. The source of the mineral references came from five different versions of the Bible including the King James Version. The latter served as the primary source of reference.

The book contains some astonishing facts. For example, in the King James Version of the Scriptures, there are 1,704 references to minerals and gemstones under 124 Hebrew and Greek names. These references have been translated into 62 names in English. Many of the minerals and gemstones referenced, particularly the ones of economic importance (gold, copper, jade, lapis lazuli), are readily identifiable in today’s terms. However, the identity of some of the minerals and gemstones, such as adamant or ligure, are uncertain or unknown.

Below is a list of the 62 minerals and gemstones cited in the book. There is a separate chapter in the book that is devoted to each; however, the table will only show a biblical reference in the King James Version of the Bible and the best guess on its current interpretation.

<table>
<thead>
<tr>
<th>Number</th>
<th>Mineral</th>
<th>Reference</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Adamant</td>
<td>Zechariah 7:12</td>
<td>Diamond, corundum or rock quartz</td>
</tr>
<tr>
<td>2</td>
<td>Agate</td>
<td>Exodus 28:15,17,19</td>
<td>Quartz</td>
</tr>
<tr>
<td>3</td>
<td>Alabaster</td>
<td>Mark 1:43</td>
<td>Gypsum</td>
</tr>
<tr>
<td>4</td>
<td>Amber</td>
<td>Ezekiel 1:4</td>
<td>Amber (Baltic?)</td>
</tr>
<tr>
<td>5</td>
<td>Amethyst</td>
<td>Revelation 21:19,20</td>
<td>Quartz</td>
</tr>
<tr>
<td>6</td>
<td>Antimony</td>
<td>Isaiah 54:11,4</td>
<td>Antimony</td>
</tr>
<tr>
<td>7</td>
<td>Asphalt</td>
<td>Genesis 11:3-4</td>
<td>Organic or mineral form of pitch</td>
</tr>
<tr>
<td>8</td>
<td>Beldium</td>
<td>Genesis 2:12</td>
<td>Opal (Maybe)</td>
</tr>
<tr>
<td>9</td>
<td>Beryl</td>
<td>Exodus 28:20</td>
<td>Beryl</td>
</tr>
<tr>
<td>10</td>
<td>Bitumen</td>
<td>Genesis 11:3</td>
<td>May be pitch or asphalt or tar/naphtha combination</td>
</tr>
<tr>
<td>11</td>
<td>Brass</td>
<td>Deuteronomy 8:7,9</td>
<td>Copper and zinc may be referencing bronze</td>
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<tr>
<td>12</td>
<td>Brimstone</td>
<td>Luke 17:29</td>
<td>Sulfur</td>
</tr>
<tr>
<td>13</td>
<td>Bronze</td>
<td>Mark 7:4</td>
<td>Copper and Tin</td>
</tr>
<tr>
<td>14</td>
<td>Carbuncle</td>
<td>Exodus 28:17</td>
<td>Red gemstones in general, ruby, garnet, and spinel</td>
</tr>
<tr>
<td>15</td>
<td>Carmelian</td>
<td>Revelation 21:19,20</td>
<td>Chalcedony quartz</td>
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<tr>
<td>16</td>
<td>Chalcedony</td>
<td>Revelation 21:19</td>
<td>Chalcedony quartz</td>
</tr>
<tr>
<td>17</td>
<td>Chalkstone</td>
<td>Isaiah 27:9</td>
<td>Chalk or limestone</td>
</tr>
<tr>
<td>18</td>
<td>Chrysolite</td>
<td>Revelation 21:19-20</td>
<td>The gemstone peridot or possibly topaz</td>
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<tr>
<td>19</td>
<td>Chrysoprasus</td>
<td>Revelation 21:19-20</td>
<td>Chrysoprase</td>
</tr>
<tr>
<td>20</td>
<td>Clay</td>
<td>Psalms 40:4:2</td>
<td>Feldspar, clay or coal</td>
</tr>
<tr>
<td>21</td>
<td>Coal</td>
<td>Deuteronomy 8:7,9</td>
<td>Most likely charcoal</td>
</tr>
<tr>
<td>22</td>
<td>Copper</td>
<td>Isaiah 6:6</td>
<td>Copper</td>
</tr>
<tr>
<td>23</td>
<td>Coral</td>
<td>Job 28:12,18</td>
<td>Used as a decorative stone</td>
</tr>
<tr>
<td>24</td>
<td>Crystal</td>
<td>Job 28:17</td>
<td>Quartz</td>
</tr>
<tr>
<td>25</td>
<td>Diamond</td>
<td>Exodus 28:18</td>
<td>Mentioned as a stone in Aaron’s breast plate</td>
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<tr>
<td>26</td>
<td>Emerald</td>
<td>Revelation 4:3</td>
<td>Green Beryl (from Sinai Peninsula)</td>
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<tr>
<td>27</td>
<td>Flint</td>
<td>Deuteronomy 8:15</td>
<td>Crypto-crystalline quartz</td>
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<tr>
<td>28</td>
<td>Glass</td>
<td>Revelation 4:3</td>
<td>Used as a gemstone</td>
</tr>
<tr>
<td>29</td>
<td>Gold</td>
<td>Job 28:1</td>
<td>Gold</td>
</tr>
<tr>
<td>30</td>
<td>Hyacinth</td>
<td>Exodus 28:15,17</td>
<td>Brown or reddish zircon</td>
</tr>
<tr>
<td>31</td>
<td>Iron</td>
<td>Deuteronomy 28:15</td>
<td>Iron</td>
</tr>
<tr>
<td>32</td>
<td>Jade</td>
<td>Revelation 21:19,20</td>
<td>Orange zircon</td>
</tr>
<tr>
<td>33</td>
<td>Jasper</td>
<td>Exodus 28:15,17,19</td>
<td>Nephrite or jadeite</td>
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<tr>
<td>34</td>
<td>Jasper</td>
<td>Exodus 28:15,20</td>
<td>Colored quartz</td>
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<tr>
<td>35</td>
<td>Lapis Lazuli</td>
<td>Revelation 21:19</td>
<td>Lazurite</td>
</tr>
<tr>
<td>36</td>
<td>Lead</td>
<td>Jeremiah 6:29</td>
<td>Extracted from galena</td>
</tr>
<tr>
<td>37</td>
<td>Ligure</td>
<td>Exodus 28:17,19</td>
<td>Colored zircon used as an alternate name for hyacinth or jacinth (?)</td>
</tr>
<tr>
<td>38</td>
<td>Lime</td>
<td>Isaiah 33:12</td>
<td>Calcium carbonate</td>
</tr>
<tr>
<td>39</td>
<td>Malachite</td>
<td>Revelation 21:18,20</td>
<td>Malachite</td>
</tr>
<tr>
<td>40</td>
<td>Marble</td>
<td>Revelation 21:11,12</td>
<td>Loosely applied to any limestone-like material</td>
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<tr>
<td>41</td>
<td>Niter</td>
<td>Jeremiah 2:22</td>
<td>Probably native</td>
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<tr>
<td>42</td>
<td>Onyx</td>
<td>Genesis 2:11</td>
<td>Chalcedonic quartz</td>
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<tr>
<td>43</td>
<td>Pearl</td>
<td>Matthew 13:45-46</td>
<td>Pearl</td>
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<tr>
<td>44</td>
<td>Pitch</td>
<td>Isaiah 34:9</td>
<td>Hydrocarbon bitumen</td>
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<tr>
<td>45</td>
<td>Quartz</td>
<td>Revelation 21:19,20</td>
<td>Quartz</td>
</tr>
<tr>
<td>46</td>
<td>Ruby</td>
<td>Exodus 28:17,18</td>
<td>Corundum</td>
</tr>
<tr>
<td>47</td>
<td>Salt</td>
<td>Matthew 5:13</td>
<td>Halite</td>
</tr>
<tr>
<td>48</td>
<td>Sapphire</td>
<td>Revelation 9:17</td>
<td>Corundum</td>
</tr>
<tr>
<td>49</td>
<td>Sardine Stone</td>
<td>Revelation 4:2,3</td>
<td>Colored quartz (?) or Sard (?)</td>
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<tr>
<td>50</td>
<td>Sardius (Sard)</td>
<td>Revelation 21:19,20</td>
<td>Orange chalcedony or carnelian</td>
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<tr>
<td>51</td>
<td>Sardonyx</td>
<td>Revelation 21:19,20</td>
<td>Mixture of onyx and sard resembling an agate</td>
</tr>
<tr>
<td>52</td>
<td>Silver</td>
<td>Genesis 23:16</td>
<td>Silver</td>
</tr>
<tr>
<td>53</td>
<td>Slime</td>
<td>Genesis 11:3</td>
<td>Bitumen or mixture of pitch and asphalt (?)</td>
</tr>
<tr>
<td>54</td>
<td>Solder</td>
<td>Isaiah 41:7</td>
<td>An alloy using a variety of metals</td>
</tr>
<tr>
<td>55</td>
<td>Sphic Stone</td>
<td>Jeremiah 4:30</td>
<td>Stibnite or possibly an antimony/sulfur compound</td>
</tr>
<tr>
<td>56</td>
<td>Sulfur</td>
<td>Genesis 19:23-25</td>
<td>Sulfur</td>
</tr>
<tr>
<td>57</td>
<td>Tin</td>
<td>Numbers 31:21-23</td>
<td>Tinplate with iron (?)</td>
</tr>
<tr>
<td>58</td>
<td>Topaz</td>
<td>Job 28:12,19</td>
<td>Topaz</td>
</tr>
<tr>
<td>59</td>
<td>Turquoise</td>
<td>Revelation 21:19,20</td>
<td>Turquoise</td>
</tr>
<tr>
<td>60</td>
<td>Vermilion</td>
<td>Jeremiah 22:13-14</td>
<td>Cinnabar</td>
</tr>
<tr>
<td>61</td>
<td>Ice and water</td>
<td>Deuteronomy 11:10</td>
<td>Ice is a hexagonal mineral</td>
</tr>
<tr>
<td>62</td>
<td>Zircon</td>
<td>Revelation 21:18-19</td>
<td>Zircon</td>
</tr>
</tbody>
</table>

### Here are some historical comments from book that were interesting:

**Which is the oldest precious gemstone mentioned in the bible?**

While there can never be a definite answer, these authors are saying that it was probably zircon. This is based on the fact that numerous carved zircons have been recovered from the earliest archeological sites.

**How did the minerals get moved to far away locations?**

Beginning in prehistoric time, trade routes were established by the second millennium B.C. over the land and on the water. Perhaps the first of the ancient gems to find its way thousands of miles from its place of origin was amber from the Baltic Ocean. Baltic amber traders are believed to have established trade routes more than 9000 years ago. About 3000 years later the Babylonian dealers in lapis lazuli (from Afghanistan) and the Egyptian traders bartering turquoise (from the Sinai Peninsula) established trade with other cultures. Even ancient glass was found more than 2000 mile from its source of manufacture. The Phoenician sailors brought tin from the British Isles to the Mediterranean countries. Ancient caravans brought gems and minerals from India and gold from Africa.
In 1988 the book was renamed “Crystals, Gems & Minerals of the Bible – The Lore and Mystery of the Minerals from Adamant to Zircon” and reissued by Keats Publishing Inc. 27 Pine Street, New Canaan Connecticut, 06840. It is currently out-of-print but used copies of the 1988 version are available through Amazon.com from an associated bookseller.

Black is Black
By Bill Shelton
(More on black diamonds, in Section IV: Topics in Gemology)

Generally we think about diamonds as being clear or occasionally colored and then they are used in jewelry. Most diamonds, in fact, are opaque and often dark colored, mainly black or close to it. Conversations with collectors generally indicate that they believe carbon inclusions cause the black color seen in many diamonds. This was, at least until recently, considered to be essentially correct by many people.

Research on a small sample of dark colored diamonds from Siberia caught my interest and this article will summarize those findings. (See Gems and Gemology, Vol. XXXIX, Fall, 2003.) Additional background will be included to make the entire picture complete. Historically, Maillard (1984) said dark regions were erroneously called carbon spots. This refers to any dark colored inclusions which are more properly identified as graphite (in part) by Gubelin (1979) and others. He also indicates other potential inclusions such as pyrrhotite, pentlandite, ilmenite, rutile, goethite, and hematite – all of which might appear to be dark. While Gubelin (1979) indicated graphite was not at all rare, he also noted pyrrhotite as notable (i.e., relatively widespread). Maillard (1984) lists similar dark minerals and chromite as potentially common diamond inclusions. So, the carbon spot idea was basically dismissed 25 years ago but seems to persist nonetheless.

Over 25 different mineral inclusions are given for diamond and some may be dark or black. Modern techniques allow for the researcher to pinpoint the identity without doing any damage to the gemstone. We can tell what the various inclusions are actually composed of with a high degree of certainty. The Siberian diamonds recently studied came from Yakutsk – they are attributed to the Mir pipe and Anabar placer deposit. The crystal appearance is typical while the coloration and opaque nature are not what some collectors of crystal specimens might hope for in their collections. Perhaps you will be surprised as I was to find out that the bulk of the inclusions were magnetite, hematite, and native iron. Graphite was extremely rare. (Titkov, et al. 2003) The authors correlated magnetite with the darkest black samples, while hematite and native iron were indicative of dark gray samples.

This does not mean all dark diamonds will have this inclusion assemblage present; however, for the time being it is probably safe to expect similar results in Siberian specimens of similar color. In other materials, it is certainly likely to expect different results. In fact, pyrrhotite in diamonds from Ghana (Gubelin, 1979) may have a similar appearance. Having observed some black diamonds, I do not know how you can be certain what inclusions are present since mere optics are insufficient in many cases to assure proper identification.

References

Calamine
By David Brand

Calamine is the historic name for an ore of zinc. Its name was derived from the Belgium town that was home to a zinc mine. The Flemish name of the town was Kelmis, however, the French name for the town was “La Calamine”. Calamine is primarily a zinc oxide with a touch (5%) of iron oxide. It is the main ingredient in calamine lotion, and for centuries it was used to treat sunburn, eczema, rashes, poison ivy, chicken pox and insect bites and stings. It was also used as an antiseptic to prevent infections that could be caused by scratching affected areas, and was used to dry up blisters or acne abscesses. It should be mentioned that in 1992 the U.S. Food and Drug Administration advised that there is no proof that the main ingredients in calamine lotion, zinc oxide and iron oxide, had any real therapeutic effect on rashes and itching. Since then, calamine lotion has become the dinosaur of dermatology.

Zinc is the 23rd most abundant element in the earth’s crust. The most heavily mined ores, such as sphalerite, tend to be roughly 10% iron as well as 40-50% zinc. In addition to sphalerite (zinc sulfide), minerals from which zinc is extracted include franklinite (a zinc spinel) and the two minerals that will be further discussed: smithsonite (zinc carbonate) and hemimorphite (zinc silicate).

Smithsonite, or zinc spar, is a zinc carbonate and a mineral ore of zinc. Historically, both smithsonite and hemimorphite were identified as calamine, before it was realized that they were two distinct minerals. The two minerals are very similar in appearance and using the same term for both led to some confusion as is the use of that term for the oxide. In 1802, James Smithson (1765-1829) proved that zinc carbonates were true carbonate minerals and not zinc oxides. The distinct mineral smithsonite was first described in 1832 and was named for James Smithson. Zinc spar (ZnCO₃) was renamed smithsonite posthumously in Smithson’s honor in 1832 by a French scientist. Smithsonite is a variable colored
trigonal mineral, which is rarely found in well-formed crystals. The typical habit is earthy botryoidal masses. Smithsonite occurs as a secondary mineral in the weathering or the oxidation zones of zinc bearing ore deposits.

Hemimorphite is a sorosilicate mineral that has been mined historically from the upper parts of zinc or lead mines and is chiefly associated with smithsonite. As mentioned previously, it was only in the second quarter of the 18th century that it was discovered that these two minerals were erroneously classified under the single name of calamine. The silicate was the more rare of the two and was named hemimorphite because of the hemimorph development of its crystals. This unusual form, which is typical of only a few minerals, means the crystals are terminated with dissimilar faces. Hemimorphite most commonly forms crystalline crusts and layers. It also can occur as granular, rounded or finely needle-shaped, fibrous crystals, and rarely as fan-shaped clusters of crystals. Some specimens show a strong green fluorescence in short-wave ultraviolet light and a weak light pink fluorescence in long-wave ultraviolet light.

More on James Smithson

There are not a lot of details on the life James Smithson. He was the primary benefactor of the Smithsonian Institution in Washington. However, the fire that destroyed the Smithsonian Institution Building in 1865 took with it Smithson’s scientific collections, notebooks, diaries and correspondence. Smithson was born in 1765 and his name was James Lewis Macie. He was the illegitimate son of Hugh Smithson the first Duke of Northumberland. In 1786 he received a Master of Arts degree under the name of Jacobus Ludovicus Macie. In 1787, he was elected as a Fellow in the Royal Society, and went back to using the name of James Lewis Macie. Smithson was only 22 when elected to the Royal Society and went on to become a noted English scientist who conducted research in chemistry, mineralogy and geology.

Around 1802, he changed his surname from “Macie” to his father’s name “Smithson”. In 1829, Smithson died in Genoa, Italy and his body was interred in the English Cemetery of San Benigo. Smithson published at least 27 papers in scientific journals. His topics include the chemical content of a lady’s tears, the crystalline form of ice and an improved method of making coffee. Smithson is credited with creating the term silicate. He was very sensitive about his illegitimacy, and felt it prevented him from getting the scientific and social recognition he deserved in Great Britain. When he passed away in Italy, he donated $508,318 (104,960 gold sovereigns) to the people of the United States. Oddly, he never set foot in the United States, nor appeared to have any close connections with the freshly independent country. The money was specifically designated to be used to fuel scientific progress in the democratic new world. In 1904, Alexander Graham Bell, then Regent of the Smithsonian Institution, brought Smithson’s remains from Genoa to Washington, where they were re-interred in the Castle Building of the Smithsonian Institution.

Carbuncle

By David Brand

(See Color Insert #1, plate 1)

Definition: Noun. 1a. A deep-red garnet, as a cabochon or unfaceted. 1b. Obsolete. A red precious stone. 2. A painful localized bacterial infection that looks like deep red cabochon. A carbuncle in its archaic or obsolete form is the name given to any red cabochon cut gemstone. While this definition included rubies and spinels, the name was applied in particular to a red garnet.

The etymology of carbuncle is from the Latin carbuncula, referring to a glowing ember or coal. The diminutive term carbo is in Latin referring to coal. The origin of the word “garnet” is from the name “pomegranate”. The later part of that term gernum referring to “seed”. It can be assumed that older civilizations saw a resemblance between garnet gems and certain types of seeds. Within the garnet family the most common red garnet is the almandine garnet. The term is derived from Alabanda, an ancient city in Asia Minor.

In myths, the stories of glowing embers prevailed. There was supposed to be a gem called the carbuncle, which emitted not reflected, but its own light. Ludovicus Vartomannus a Roman writer, reported “that the King of Pege (or Pegu) a city in India had a carbuncle of so great a magnitude and splendor, that by the clear light emitting from the stone, he might be seen in a dark room, as if the room had been illuminated by sunbeams”. This illusion to self-contained radiance was echoed by Saint or Bishop Epiphanius who said of this gem “that if it be worn, whatever garments it be covered withal, it cannot be hid”. In another reference he described the carbuncle as a “beautiful gem of red color found in the East Indies. When it is held up to the light it loses its deep tinge and becomes the color of a burning coal.” At times it was also referred to as the “firestone”.

Other ancient authors also said this stone radiated a internal light without reflection. They ranked it fifth behind diamonds, emeralds, opals, and pearls. It is described among gems ruled by the sun, possessing both male and female properties. The reference to male and female traits alludes to its expelling brightness, supposedly meaning that it borrows no color from any other gem (male), but instead imparts it own unique color (female).
Reference attributed to the carbuncle appears in works of Theophrastus (De Lap. 18) as anthrax. Theophrastus refers to its red color when held against the sun it resembles a burning coal. He states that the most perfect carbuncles were brought from Carthage, Marseilles, Egypt and “the neighborhood of Siena”. There are also reference by Pliny (Hist. Nat., XXXVII) as carbunculas. However, Pliny refers to lithizonites, or amethystizontes as Indian carbuncles, the color of which approached that of the amethyst. Most probably, Pliny applied the name carbuncle to several stones of varying color.

The word occurs in four places in the Bible. Each use originated from the Hebrew word bareqath (baw-reh-keth or hawrek-arh). It is usually taken as a reference to a red gemstone although the Hebrew definition is less definite and the precise color of the gems is not known. There are two references in Exodus (28:17 and 39:10), both referring to the carbuncles presence as the third stone in the breastplate of Aaron. In Ezekiel (28:13) there is a reference to the carbuncle’s being present in the Garden of Eden. Lastly in Isaiah (54:12) the carbuncle is used to convey the value of the Lord’s blessing on His faithful servants.

According to Carl Jung the carbuncle is a synonym for the lapis, fabled philosopher’s stone. The alchemist Johann Glauber in his book “Of Natural Salts”, the carbuncle is called corpus glorificatum. In the Rosicrucian literature, in Christian Rosencreutz’s “Chymical Wedding” he describes the bedchamber of Venus as being lit by carbuncles.

The curative effects attributed to the carbuncle include dispelling poisonous air, releasing luxury, preserving health of the body and reconciling differences among friends. There is no trace in Shakespeare’s works of any belief in the curative or talismanic effects of precious stones that was very much a prevailing, if not curious superstition in his day. However Shakespeare referred to carbuncles with some frequency.

The carbuncle first appeared in Hamlet, published in 1603, then in Cymbeline, Comedy of Errors, Anthony & Cleopatra, and Coriolanus, all published in 1623, and at various places in his poetry.

Other literary references include “The Great Carbuncle” by Nathaniel Hawthorne (1804-1864), “a party of adventurers were refreshing themselves, after a toilsome and fruitless quest for the Great Carbuncle”. And lastly in “The Blue Carbuncle” Sir Arthur Conan Doyle had Sherlock Holmes in hot pursuit to recover the Countess of Morcar’s blue carbuncle. Sherlock Holmes sat up with a whistle “By Jove, Peterson…you know what you have got”. “A diamond sir?...It cuts glass as though it were putty”.

Crocoite is Not the Only Tasmanian Mineral!

By Terry Evans

Australia’s island state of Tasmania is a picturesque and mountainous country with very few plains. Even when the mountains are absent the country invariably is undulating and rolling. The mountains rise to 5,250 feet above sea level and are scattered all over the island with a high central plateau. The island offers a wide range of geologically interesting and scenic landscapes but for the mineralogically interested, it is an untamed mineral treasure island. Its range of mineral types is enormous and as far back as 1799, cassiterite was first referred to by Governor Collins. Gold was first recorded in 1852, and by 1888 a report was presented to the Royal Society in Tasmania on the systematic account of the geology of Tasmania. It was followed by a catalogue of the minerals known to occur in that state. The catalogue had 356 entries, and when the report was revised in 1969, a total of 429 entries where recorded with 46 invalidated and 20 doubtful species being noted from the earlier report.

This information only touches the surface of an island approximately 26,000 square miles in area. Its dimensions are 186 miles wide from east to west, 155 miles north to south and with a coast line of 1988 miles comprising a maze of unusual geological formations of every age. It offers to the mineral collector a wealth of mineral types for every facet of the hobby. A true treasure island!

Aborigines, the Early Miners

The study of rocks in Tasmania held great interest for the aborigine who used stone tools for grinding cutting, scraping, skinning and other similar activities. These tools can be found in all districts especially on the old middens or old camping grounds. The tools were made from a wide variety of the available rocks including chert, quartzite, petrified wood, quartz, mudstone — in fact anything that had a conchoidal fracture and was tough enough to form a cutting edge. They had their favorite quarries. One such quarry of great interest is on the western coast and from it the aborigine obtained a unique rock which has been found over most of the island and used as knives, scrapers etc.

The aborigines also collected unusual mineral specimens, many of which can be found on middens on the northeastern coast.

European Discovery and Mining History

1642 — Abel Tasman, the Dutch navigator, first saw the mountains of the stormy west coast not far from Macquarie Harbor. However he only found it possible to make a landing on the east coast which has many sandy beaches.

Men from his two small ships Zeehan and Heemskirk collected plants and admired the large trees, although the only sign of civilization was smoke from aboriginal fires. Within
1772 — Captain Marion Dufresnnes from France sailed along the east coast and met up with the aboriginals. He only made notice of the weather: "It is remarkable that in coasting along Van Dieman's Land we met very bad weather on the west coast, but on the east coast we found clear skies and more moderate winds."

1773 — Captain James Cooks second ship under Captain Tobias Furneaux sailed down the east coast, but on this occasion neither ship landed.

1788 — The first fleet still thought Van Dieman's Land (Australia) as one big island, where in fact Bass Strait separates Tasmania from the mainland.

1799 — Bass and Flinders sailed around Tasmania.

1803 — U.S. sealer arrive.

1834 — The mining industry commenced with mining of coal using convict labor. Over 400 men toiled in the more than 5 miles of underground passages at Port Arthur. Within three years numerous other coal mines had opened up at Southport and coal river district. The Fingal valley area was discovered in 1886 and since then has been the main coal producing area of Tasmania.

Another early product was the Triassic sandstone for bridge and building works. The exploitation of limestone also began in the early days of settlement (burnt lime for mortar)

1852 — Discovery of gold near Mangana was the beginning of extensive mineral exploration and development. Most gold was won from alluvial fields in the Lisle district. In 1887 the richest gold mine, the mine at Beaconsfield was discovered.

1871 — Discovery of tin at Mount Bischoff (for many years the largest tin mine in the world)

This stimulated prospecting in the northwest and west resulting in the discovery of tin at Mount Heemskirk in 1876.

1874 — Meanwhile in northeast Tasmania alluvial tin was discovered and by the turn of the century alluvial tin miners were scattered throughout that area.

1882 — Silver lead ore discovered near Mount Zeehan, however the field was not developed until 1887-88 and by 1891 more than 150 companies held leases in the Zeehan field and exploration had extended outward to the neighboring Dundas field (now famous for crocoite).

Another important mine to open in 1882 was Tasmania's richest, the Mount Lyell, a mine first commencing as a gold mine then silver and by 1897 it became an important copper mine.

1919 — Zinc produced from the Zeehan Fields and by 1925 zinc was mined at Roseberry and Williamsford.

1956 — Detailed study of the Savage River area ultimately led to the mining of iron ore and forming it into pellets and piping it to the south coast for export to Japan.

Fossicking

Tasmania can roughly be broken up into four main fossicking groups: agate fields, mineral specimens, gem fields and fossil fields

♦ Agate fields. They are spread throughout the island and include such delicacies as blue lace agate, carnelian, serpentine, jasper, onyx, travertine, chalcedony, rhodonite, and petrified wood.

♦ Mineral specimens. The whole island offers a wide variety of materials that can very basically be listed as silver, lead, tin, gold, copper, nickel and iron mines, the standard minerals from these deposit types of course being well known.

A few other mineral types and localities include stichtite and barberonite, osmiridium, slate quarries, zeolites, tektites, darwin glass, wolfram mines (scheelite), antimony mines, and zinc mines.

♦ Gem fields. There are a few localities with small finds mostly in tin mining areas including diamond, zircon, sapphire, spinel, topaz, and alexandrite.

♦ Fossil fields. Marine fossils in several areas, fossilized leaves, and mollusks offer a good range of material.

The Field Trip

My family's second fossicking trip to Tasmania occurred during April 2003, which is the start of Australia's autumn. Regrettably, it rained all night and we had a 7:00 a.m. start. The two-hour drive of our convoy of two cars began from Ulverstone on the north coast through a fine, penetrating and cold rain which persisted for most of the day.

We had three locations to do in the day. The first was located seventeen miles off the main road on a forest track (in very good condition) and then a short walk down a gully and up the other side to a dolomite outcrop with masses of drusy quartz.

The rain (or was it sleet?) was relentless. The car heater was finding it tough going, but still we gallantly surged onwards, and onwards, forever onwards for, who can stop a field trip?

The second location, Mount Bischoff tin mine at Waratah, could have been a fascinating spot, but it was getting colder and of course the rain was making work difficult. Large areas of the mountain had been excavated away since the mine opening in 1873. Nevertheless, the fascinating rock outcrops blessed us with such juicy specimens as cassiterite, calcite, fluorite, vivianite, marcasite, pyrite and many more.

The Magnet silver-lead mine area was to be our last stop. This mine opened in 1894 but the town and plant have long since gone. This area is well known to mineral collectors for its diversity of mineral species including anglesite, crocoite, cerussite, dolomite, mimetite, silver, rhodochrosite, etc.
The mud seemed to get on your clothes even before getting out of the car, and as my marriage was looking precarious, we moved on fairly quickly.

With our day all but done, we broke the convoy, that is, after clearing some of the snow from the windscreen, throwing a few snowballs and saying farewell to host for the day. Regrettably, we had to rush through Roseberry and Renison Bell areas. (I could have cried, but the tears would have frozen, and I would have been killed by the family.)

Normally we used on-site caravans but this night we took a cabin and with all the heaters on, we attempted to dry our clothes and all the wet gear in the back of the van. Nice hot showers and a meal at the local pub concluded a most enjoyable but wet and cold day.

For more information on Tasmanian minerals, see Section IX: A Closer Look (Krotki).

**Diamond and Adamant**

*By David Brand (See Color Insert # 1, plate 3)*

**Ezekiel 3:9** - As an *adamant* harder that flint….

**Zechariah 7:12** - Yea, they made their hearts an *adamant* stone, lest they should hear the law…

**Jeremiah 17:1** - The sin of Judah is written with a pen of iron and with the point of a diamond; it is graven upon the table of the heart and upon the horns of your altars.

These verses can be found in the Old Testament of the King James Version of the Bible. Both terms, diamond and adamant, are rooted in the Greek word *adamas* meaning “the invincible.” The term diamond is now used to define the hardest gemstone. In medieval mythology “adamant” was a hypothetical impenetrable hard mineral, and is still occasionally referenced in fantasy fiction. The current contemporary usage of adamant is usually in reference to resistance to reason, firmely determined or inflexible. The increasingly archaic adamant has mostly a poetic or figurative connotation, but it is still in use in its adjective form adamantine, as in “adamantine luster” and is used to describe a diamond-like luster on minerals.

The reference to adamant in Ezekiel 3:9 is for a very hard rock or very hard mineral and it was possibly translated from the Hebrew term *shamir*. *Shamir* describes something very hard but with no connection to *adamas*. The reference to *shamir* recalls the Hebrew legend in the Talmud of a miraculous instrument, “*the shamir*,” which Aaron used to cut the stones for the high priest’s breastplate. The diamond was named as the third stone of the second row in the breastplate of the high priest. It is speculated that it might be rock crystal (quartz) as diamonds have never been found in the treasures uncovered from archeological digs dating from biblical times.

Diamonds have been treasured as gems and were used as religious icons in India from at least 2500 years ago. Also dating from early Indian history came references to diamonds being used as drill bits and engraving tools. The earliest diamonds came exclusively from India until the beginning of the eighteenth century when African diamonds were discovered. Many famous diamonds are from India including the Koh-I-Noor (British Crown Jewels) and the Hope diamond (Smithsonian).

It is recorded that Marco Polo upon his return from Cathay (China) was the first to bring diamonds in any quantity into Western Civilization. However, there are references that predate Marco Polo. The Roman poet Manilius recorded the first definite reference to a diamond about 12 AD. Later, Pliny the Elder (AD 23-79) described unmistakably a newly acquired, extremely hard, bipyramidal (octahedral) crystal from India in his famous work titled, “Natural History.”

Speculation has attached a number of minerals to the biblical reference to adamant. Pliny mentions a possibility when he referred to *adamas siderite* in “Natural History.” Siderite is an iron compound (iron carbonate), and was mentioned by one of Pliny’s predecessors. The Roman poet Virgil referred to the doorposts of *Avernus*, an entrance to the lower world as “solid adamant,” possibly meaning iron or steel. Some later authors seem to have considered adamant to be magnetite or loadstone as in Shakespeare’s, “A Midsummer’s Night Dream” where he wrote, “You draw me, you hard-hearted adamant.”

With no known archeological substantiation from biblical times, the references to diamond are not the gemstones known today. Nor were the references to adamant in biblical times likely a synonym for diamond. There is nothing to indicate that the diamond was used or even known during Old Testament biblical times. There is considerable doubt that the diamond was familiar to early New Testament writers as well.

Among the archeological treasures of the Middle East, the minerals found and gemstones identified consisted of turquoise, lapis lazuli, emeralds, sapphires, rubies and rock crystal. Since diamonds have never been uncovered in archeological digs, the theoretical consensus is that these biblical references to a stone harder than flint could be corundum. Corundum is second only to diamond on the Mohs scale and was a familiar mineral and gemstone (sapphire and ruby) in early biblical times. [Also see articles about diamonds in Section III: The World of Minerals (Gornitz) and Section IV: Topics in Gemology (Jarrett)].
Gold and Gold Minerals

By David Brand

Gold has been recognized from at least 4000 BCE. Since the dawn of civilization humans have been obsessed, haunted, intoxicated, humbled, and exalted by the allure of this metal. It has inspired works of art, provoked terrible acts of violence and driven men to endure life-threatening hardships in the hope of finding instant wealth. Gold has been establishes as an icon for greed, a vehicle for vanity and at times a monetary standard.

Its name comes from the Anglo-Saxon word gold and its symbol Au from the Latin aurum. Its atomic number is 79. Gold crystallizes in the isometric system. It can be found as rounded octahedral, cubic, dodecahedral crystals, more often as flattened plates or nuggets and rarely as wires. The color is a rich yellow and its streak is shining yellow. It is opaque and its luster is metallic. Gold’s hardness is only 2.5 to 3.0 and its density is 15 – 19.3 g/cm3. It has a relatively low melting point (1063° Celsius) and has the highest malleability and ductility of any element. Gold has long been prized for its beauty, it being unaffected by air, water, its resistance to chemical attack and workability.

Over a hundred years ago, John Ruskin, the Victorian poet, artist and social critic told the story of a merchant who was relocating. He converted all his belongs into a large but portable bag of gold coins and boarded a ship bound for his new destination. After a few days on board a terrible storm came up and the call came to abandon ship. Our merchant strapped the bag of gold around his waste, went up on the deck and jumped overboard and promptly sank to the bottom of the sea and drowned. At this point, Mr. Ruskin asks the philosophical question, “Now, as he was sinking had he the gold? Or had the gold him?” Such is the allure of gold.

Gold is a very select neighbor and will associate with other chemical elements on a relatively limited basis. The following is a list of the known mineral species that contain gold (Au), the Dana group assigned to the mineral and the percentage of gold present in the mineral. It should be noted that Dana group 1-Native Element and Dana Group 2- Sulfides prevail. Although gold does not meld well with sulfur (S) preferring tellurium (Te), antimony (Sb) and selenium (Se) it is classified as being part of the Sulfide group. Criddleite the one Dana group 3-Sulfosalt is valid but, auroanimonite is generically classified in Dana group 37-Phosphates but actual status of this mineral is still in doubt.

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Formula</th>
<th>Dana Group</th>
<th>Au %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anyuanite</td>
<td>Au(Pb,Sb)2</td>
<td>1.14</td>
<td>34.64</td>
</tr>
<tr>
<td>Aurocpiretite</td>
<td>Cu3 Au</td>
<td>1.12</td>
<td>50.82</td>
</tr>
<tr>
<td>Auroantimonite</td>
<td>AuSbO3</td>
<td>37.00 (5)</td>
<td>53.71</td>
</tr>
<tr>
<td>Auroantimonite</td>
<td>AuSb</td>
<td>2.12</td>
<td>44.72</td>
</tr>
<tr>
<td>Bezmetrotavite</td>
<td>Au(Cu,Pb)</td>
<td>2.15</td>
<td>78.56</td>
</tr>
<tr>
<td>Bihumskite</td>
<td>Au Cu,PbTe</td>
<td>2.16</td>
<td>50.06</td>
</tr>
<tr>
<td>Bogdonanovite</td>
<td>(Au,Pb)Fe3</td>
<td>2.23</td>
<td>33.23</td>
</tr>
<tr>
<td>Backhornite</td>
<td>Au(Pb,Bi,Sb)</td>
<td>2.11</td>
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<td>43.56</td>
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<td>3.91</td>
<td>23.18</td>
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<tr>
<td>Electrum (Gold w/</td>
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<td>29.03</td>
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<tr>
<td>From Brand</td>
<td>AgAu2Se</td>
<td>2.43</td>
<td>29.03</td>
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Iridium, the Element

By David Brand

Iridium is a chemical element that has the symbol Ir and an atomic number of 77. It is a dense, very hard, brittle, silvery-white transition metal in the platinum group. Iridium is used in high strength alloys that can withstand high temperatures. It occurs in natural alloys with platinum and osmium. Iridium is most notable for being the most corrosion-resistant element known. The British scientist Smithson Tennant in London, England discovered iridium in 1803, along with osmium. The element was named after the Greek word “iris” (for rainbow) because its salts are brightly colored.

There are two sources of iridium. The main source comes from outer space in the form of cosmic dust, which is constantly showering the planet. The second source is from the Earth’s core when there are eruptions of certain types of volcanoes. It is believed that iridium was carried down and concentrated into the Earth’s core while the earth was still molten. There is evidence to support the two-source theory that explains the presence of iridium in clay layers from either an asteroid strike or a massive volcanic eruption. A thin stratum of iridium-rich clay, marking the border between the Cretaceous and the Tertiary era in geological time, identified the K-T boundary of 65 million years ago.

A team led by Luis Alvarez (1980) proposed an extraterrestrial origin for this iridium, attributing it to an asteroid or comet impact. Other scientists argue that the iridium may have been of volcanic origin. (The consensus now favors Alvarez’ hypothesis.) The Earth’s core is rich in iridium. For example the Piton de la Fournaise volcano on Reunion Island in the Indian Ocean is still releasing iridium today.

There are only 21 mineral species that contain iridium and all are quite rare. With regard to the Dana Classification, all the iridium minerals are classified as either Native Element (Class 1) or Sulfides (Class 2). The luster on all the minerals is metallic and their color range is from gray to steel to black. Iridium in some of the minerals have formulae with “lists”, i.e., “Iridium (Ir, Os, Ru) meaning iridium is present and one should expect to find osmium and ruthenium present within a natural sample. A Russian specimen contained 77% Ir, 20% Pt, and 1% Pd which looks unlike the formula David Brand provided last month (and in parenthesis above.)

Iridium Has Friends

By Bill Shelton

There are six other similar metals similar to iridium. They are all located near each other on the periodic table. The other metals are ruthenium (Ru), rhenium (Re), palladium (Pd), rhodium (Rh), osmium (Os), and platinum (Pt). Some properties are similar for many of these seven metals; yet each has a remarkable story of its own. Sometimes the metals are considered part of the platinum group but a clear similarity exists among all of them. They are very often found in the same minerals and low percentages of them are common enough in platinum and, often, we see the minerals have formulae with “lists”, i.e., “Iridium (Ir, Os, Ru) meaning iridium is present and one should expect to find osmium and ruthenium in some lesser quantities present within a natural sample. A Russian specimen contained 77% Ir, 20% Pt, and 1% Pd which looks unlike the formula David Brand provided last month (and in parenthesis above.)

CUPROIRIDSITE CuIr$_3$S$_4$ – Alkaline-ultramafic localites in the Alden Region, Yakutia, Russia
FERRORHODSITE (Fe,Cu)(Rh, Pt, Ir)$_3$S$_4$ – Gold and platinum placers located in massifs located in Yakutia-Saha, Russia
GAOTAIIITE Ir$_x$Te$_y$ – near the village of Gaotai by the Luan River, northeast of Beijing, China
HEXAFERRUM (Fe, Ru, Os, Ir) – Chiryansky Massif, Koryak Mountains, Kamchatka Peninsula, Russia
INAGLYITE PbCu$_2$(Ir, Pt)$_3$S$_6$ – Platinum deposits in the Alden Region, Yakutia, Russia
IRARSITE Ir$_x$Ru$_y$Rh$_z$Pt$_w$As$_p$ – Onverwacht Driekop mines Bushveld Complex, South Africa
IRIDARSENITE (Ir, Ru)As$_q$ – Alluvial alloy grains in Papua, New Guinea
IRIDIUM (Ir, Os, Ru) – Type locality unknown
KASHINITE (Ir, Rh)$_2$S$_4$ – Platinum deposits in the Ural Mountains and in river placers from western Chukotka Russia
KONDERITE PbCu$_2$(Rh, Pt, Ir)$_3$S$_6$ – Konder alkali-ultramafic massif, Alden Shield, Siberia, Russia
MALANITE Cu(Pt, Ir)$_3$S$_4$ – Malan Valley, east of Beijing, China
MAYINGITE IrBiTe – found near the village of Maying, north-northeast of Beijing, China
OSMIUM (Os, Ir) – Type locality is unknown
RUTHENIRIDOSMINE (Ir, Os, Ru) – Type locality is unknown
RUTHENIUM (Ru, Ir, Os) – Horokania, Mikasyama-muro, Sorachi-gun, Hokkaido, Japan
SHUANGFENGITE Ir$_x$Te$_y$ – Near the village of Shuangfeng in China
TOLOVKITE Ir$_x$Sb$_y$ – found in the Tolovka River Basin, northeastern Russia
XINGZHONGITE (Pb, Cu, Fe)(Ir, Pt, Rh)$_3$S$_4$ – Named after an unspecified locality in China
An ideal formula for iridium is simply Ir – this will not be likely to be found in nature. By way of comparison, a Japanese sample was 50% Ir, 22% Pt, 24% Ru, and 2% Os with traces of other metals, namely copper and iron. What you will hopefully take away from reading this is the idea that many samples are actually natural alloys of variable composition and published formulae are suggestive of what might be present. According to the IMA rules, if the sample is a metallic alloy nugget with 50% or more iridium present, then it should be labeled iridium. Yet, the formula for osmium has been given as (Os, Ir) and one Russian sample was 99% pure; that’s a very rare exception proving the rule about alloys.

Curiously, other areas have produced specimens with high percentages such as 85% and 94% osmium. Also, iridosmine with the same formula (Os,Ir) has over 50% Os and over 40% Ir; all other components are small quantities (approx. 1% or less). These formulae and analyses are from the Handbook of Mineralogy, Anthony et al., 1990. Compare osmiridium (Ir, Os) with 55% Ir, 27% Os, 2% Rh and 6% Ru. By current standards, osmiridium might be labeled iridium and iridosmine might be labeled osmium. Platinum, isoferroplatinum and tetraferroplatinum may also be of interest – check the data if you like.

And now, a few facts of interest about these rare metals:

- **Rhenium** – besides not occurring as a free metal like some of the others, it has a very high melting point.
- **Palladium** – infamous for its use in the failed “cold fusion” experiment of 1989, it is a catalyst used in converters.
- **Rhodium** – used in catalytic converters; it makes optical coatings with excellent reflectivity.
- **Osmium** – the densest metal of all; useful as a catalyst.
- **Platinum** – used in jewelry and catalytic converters; it was once confused with silver (1500’s).

So, there you have it– a little bit about the metals similar to iridium. By the way, they are all among the rarest elements along with the noble gases and odd elements like As, Ac, Fr, Po and others.

### Iron Mines of the Highlands

By David Brand

The term “the Highlands” is associated with the area of northeastern New Jersey and southeastern New York. This region contains an abundant quantity of iron ore, which lies just below the surface of the ground. The ore is mostly black magnetite and also some brown hematite. The availability of the ore, and the vast forested areas, which could be used for charcoal, and flowing streams to provide waterpower attracted mining entrepreneurs in pre-colonial times. The first European explorers in the 17th century were searching for mineral wealth in gold and silver. To their disappointment only minute traces could be found and were of no economic importance. However disappointing, the explorers quickly found an attractive alternative in mining the iron ore. Cornelius Board is credited with developing the first iron deposit economically around 1740. He opened forges at Ringwood, New Jersey and Sterling Lake, New York. Soon other proprietors followed, most notably was the Ogden Family from Newark, New Jersey, who developed the east Jersey area.

Between 1735 and 1749, Charles Clinton surveyed the area and from his notebook comes the following quote “iron ore was discovered by the Indians and appears plentiful.” The local Indian tribes showed the early entrepreneurs the outcroppings of black rock, which were quickly recognized as magnetite. This greatly assisted the entrepreneurs in locating the productive areas to mine for the iron ore. Many of the mountain peaks in the area reflect the early discoveries with geographic names such as Black Mountain and Black Rock. From the mid-18th century until the end of the 19th century numerous mines, furnace and forges were established in the Highlands. Later prospecting during the mining era was accomplished using only a compass or a tilt needle to locate the magnetite. Some mines were successful producing profits for the owners while others failed. The principal reasons for the failures were impurities in the ore, which made smelting difficult and costly. To this day the hills and valleys of the Highlands contain abandoned iron mines, their shafts filled with rocks or water and with iron tailings as reminders of the past.
The Spanish Silver mine is one of the legendary mines of the Highlands. Located on summit of Black Mountain, it is more than 1200 feet above sea level. It is located southeast of Silvermine Lake in Harriman State Park. Hikers can still explore the adit located in the cliff face below the summit. The shaft is 10 feet wide, nine feet high but is only 15 feet deep. The initial ownership and start-up date of the operation of the Spanish Silver mine is unrecorded, unknown and remains a mystery. More is known from the legends associated with the mines then actual facts.

In 1699, Captain Kidd set sail from the West Indies with a ship supposedly loaded with treasures from his pirating exploits. But when Kidd arrived in New York and was arrested the treasure was missing from the ship. Kidd was eventually sent back to London, was tried and hung in 1701, taking the secret location of the treasure to his grave. Various locations where the treasure was buried are rumored from Georgia to Connecticut. One of these that enjoyed some popularity was that of the tale of Captain Kidd's sail up the Hudson River presumably to hide his treasure in the Highlands. In the New York Historical Society building located on 77th street and Central Park West there are two 19th century historical site maps of the Hudson River on display. These maps were used by tourist sailing up the Hudson River, a popular summer pastime to get away from the heat in New York City. The 1847 version of the map drawn by William Wade and published by J. Disturnell, shows the location on the Hudson River between Jones Point and Peekskill where “Kid's (sic) vessel supposed rest”. In the 1894 version of the map drawn by Wallace Bruce, published by Bryant Union as a fold out tourist map of historical sites, the landing spot is called Kidd’s Point and is located in the area of the Caldwalls, just north of Jones Point. According to the legend, the treasure was taken on top of Black Mountain and buried in or near the Spanish mine. However, it must be noted that on the 1890 Dunderberg Railroad map and on the Army’s Engineers map of the Peekskill quadrangle from the same period, these maps not catering to tourists, the same locality is called Kidd’s Humbug.

Another legend attached to the mine is attributed to R. H. Torrey, the founder of the New York-New Jersey Trail Conference and tells the tale of a Spanish ship sailing up the Hudson with a Spanish crew and landing at Jones Point in 1735. The crew, it is told, made several trips to a mine up on Black Mountain and carried out heavy sacks of ore. The crew spent some of its leisure time drinking at a local tavern and boasting about the silver ore they had mined. On their final journey from the mine one of the crew mysteriously disappeared. The rest of the crew quickly boarded their ship sailed off and was never heard from again. Later the body of the Spanish miner/crew member was found dead in an abandoned cabin on the mountain.

It is unlikely that Kidd’s treasure will ever be found in or anywhere near the Spanish Silver Mine. It is also unlikely there ever was any silver in the Spanish Silver mine. Silver has never been found in any commercial quantities in the area, but hikers frequently report of finding silver substances on the ground near the abandoned mines. These findings are almost always identified as graphite and not silver. A Spanish canon from the 18th century was found in the river close to Jones Point. If there was a Spanish ship sailing up the Hudson in 1735, were the Spanish sailors/miners fooled by appearances and sailed away with a boatload of graphite?

The Zeolite Group

By Mitch Portnoy

At the recent Club Benefit Special Sale in January we had a large quantity of zeolites available for purchase mostly coming from the huge Rosa Donation. Those of us who have been involved with minerals during the past few decades surely became fluent with that term due to the inundation of magnificent zeolite specimens flowing in from India. Older, more mature members might also remember the earlier decades in which they personally collected zeolites in the trap rocks of New Jersey. But I discovered that many of the newer collectors in the Club were unfamiliar with this term so I decided to write a brief introduction to zeolites here.

Zeoites is a group name or family of silicate minerals related in composition, structure, occurrence and (unfortunately) in appearance. The group includes about 50 members ranging alphabetically from amicite to yuwaralite (mindat.org lists 45). There is even one, willhendersonite, named after William A. Henderson, who was the guest speaker at a club banquet ten years ago! Many, with names such as heulandite, stilbite, chabazite, natrolite and analcime are common and you probably already have them in your collection. There are other minerals often found associated with zeolites including andradite, apophyllite, calcite, cavanisite, prehnite, epidote, quartz, pyrite, clay minerals, etc. These minerals differ too much in composition to actually belong to the family but are often sold as zeolites by dealers. (Perhaps this is most true of the gemmy samples of apophyllite that we all know, own and love. Apophyllite is not a zeolite but is still worth collecting, of course.)
Chemically, zeolites are compounds composed of, in various proportions, of an active alkali metal(s) (calcium, sodium, potassium) with aluminum, bonded with a silicate-style ion (SiO)x y all hydrated with water in varying amounts. They form best in cavities in lava flows, probably as late deposits either from water dissolved in the lava itself or from later water solutions flowing into the lava. They can also form in plutonic rock crevices.

Because of this type of formation and their similar chemistries and crystallography, many of the different zeolites CANNOT be easily (i.e., by quick visual) identified without tests too complicated for the beginner. Few of us will be able to distinguish natrolite, scolecite and mesolite, for example.

Zeolites occur in many places around the world. In the United States, Oregon, Washington, Idaho and Virginia have them but the greatest classic location for them is certainly the Paterson, New Jersey region near New York City. These zeolites are regularly donated to the club and put into the raffles and auctions. More recently, zeolites found in the new water tunnels for the water system of NYC have been available to us.

Internationally, Iceland was the first great zeolite location. Australia and Canada (Nova Scotia) were also players BUT nothing can compare to the quantity, quality and variety of zeolites cascading from the vast Deccan Traps of India, near Bombay. These are the zeolites you see at every mineral show and these are the ones you probably purchased at the recent benefit sale.

Much has been written about these Indian zeolites and splendid photographs of them exist in any mineral book that pictures aesthetic minerals. I could not add much to any of this. If you want to learn more about Indian zeolites, I recommend getting yourself a copy of the issue dedicated to them produced by the Mineralogical Record (Jan-Feb 2003 – Vol 34 No.1).

All minerals pictured are in the collection of the author. Thanks to Rob Doherty for taking the pictures.

These are the members of the Zeolite Group:

The Analcime Family:
- Analcime (Hydrated Sodium Aluminum Silicate)
- Pollucite (Hydrated Cesium Sodium Aluminum Silicate)
- Waïrakite (Hydrated Calcium Sodium Aluminum Silicate)
- Bellbergite (Hydrated Potassium Barium Strontium Sodium Aluminum Silicate)
- Bikitaite (Hydrated Lithium Aluminum Silicate)
- Boggsite (Hydrated calcium Sodium Aluminum Silicate)
- Brewsterite (Hydrated Strontium Barium Sodium Calcium Aluminum Silicate)

The Chabazite Family:
- Chabazite (Hydrated Calcium Aluminum Silicate)
- Willhendersonite (Hydrated Potassium Calcium Aluminum Silicate)
- Cowlesite (Hydrated Calcium Aluminum Silicate)
- Dachiardite (Hydrated calcium Sodium Potassium Aluminum Silicate)
- Edingtonite (Hydrated Barium Calcium Aluminum Silicate)
- Epistilbite (Hydrated Calcium Aluminum Silicate)
- Erionite (Hydrated Sodium Potassium Calcium Aluminum Silicate)
- Faujasite (Hydrated Sodium Calcium Magnesium Aluminum Silicate)
- Ferrierite (Hydrated Sodium Potassium Magnesium Calcium Aluminum Silicate)

The Gismondine Family:
- Amicite (Hydrated Potassium Sodium Aluminum Silicate)
- Garronite (Hydrated Calcium Aluminum Silicate)
- Gismondine (Hydrated Barium Calcium Aluminum Silicate)
- Gobbinsite (Hydrated Sodium Potassium Calcium Aluminum Silicate)
- Gmelinite (Hydrated Sodium Calcium Aluminum Silicate)
- Gonnardite (Hydrated Sodium Calcium Aluminum Silicate)
- Goosecreekite (Hydrated Calcium Aluminum Silicate)

The Harmotome Family:
- Harmotome (Hydrated Barium Potassium Aluminum Silicate)
- Phillipsite (Hydrated Potassium Sodium Calcium Aluminum Silicate)
- Wellsite (Hydrated Barium Calcium Potassium Aluminum Silicate)

The Heulandite Family:
- Clinoptilolite (Hydrated Sodium Potassium Calcium Aluminum Silicate)
- Heulandite (Hydrated Sodium Calcium Aluminum Silicate)

(Continues next page)
Zeolites as Gemstones

Thomsonites, one of the rarer zeolite minerals, have been collected as gemstones from a series of lava flows along Lake Superior in Minnesota and to a lesser degree in Michigan, U.S.A. Thomsonite nodules from these areas have eroded from basalt lava flows and are collected on beaches and by scuba divers in Lake Superior.

These thomsonite nodules have concentric rings in combinations of colors: black, white, orange, pink, red, and many shades of green. Some nodules have copper inclusions and rarely will be found with copper “eyes.” When polished by a lapidary the thomsonites sometimes display chatoyancy.


Available (FREE!) Literature about Zeolites

The famous Zeolites of the World book by Rudy W. Tschernich is now available at Mindat.org as a free download.
Inside the Hidden World of Crystals (Part I):
Patterns of Growth

How Crystals Grow

Collectors admire the sculptural quality and vivid colors of well-formed crystals. Yet, inside most crystals lies a hidden world that reveals the circumstances under which they were created in nature. In Part 1, we unravel the sequence of events in a crystal’s history recorded by zoning and skeletal textures. Part 2 unlocks important clues about the crystal’s growth environment offered by inclusions.

The birth of a crystal begins with the development of a small nucleus (or seed) of atoms or ions in a saturated solution or a freezing magma. The crystal continues to grow by adding layer upon layer of atoms or ions to the expanding surface. How fast it grows depends on a variety of factors, including the temperature, pressure, and degree of saturation of the surrounding solution. The growth process can be sloppy and numerous flaws can appear at all scales, ranging from atomic-level structural defects to eye-visible inclusions, zones, and skeletal forms. Furthermore, the chemical composition and temperature of the solution or melt rarely remain constant throughout the growth of the crystal. Fluctuations in these external conditions cause successive layers to vary slightly in chemistry or numbers of inclusions, forming bands or zones of different color and/or clarity. Minerals in which zoning occurs frequently include fluorite, amethyst, tourmaline, corundum, feldspar, zircon, and diamond.

Growth Marks

Zoning represents step-wise stages and pauses during the growth of a crystal. The crystal habit may also change during the course of crystallization. The phenomenon of zoning is also closely related to overgrowths and to phantom growth (see below). For example, a specimen of calcite from Chihuahua Province, Mexico began growth as scalenohedrons (“dogtooth spar”), that were then coated by a thin layer of hematite. The calcite subsequently developed overgrowths of clear rhombohedrons.

Sector zoning results from differences in the deposition of impurities or compositional changes between selected crystal faces, such as the “Maltese cross” pattern due to preferential incorporation of sediment on cube faces in halite, the cross-like arrangement of carbonaceous inclusions in the chiastolite variety of andalusite, “hour-glass” inclusions in gypsum, or the three-fold alternation of purple amethyst and yellow citrine on the rhombohedral faces of ametrine, as viewed in slices cut perpendicular to the c-axis. Bluish-green amazonite from the Pikes Peak region of Colorado occasionally develops overgrowths of white, buff-tan, or brownish orthoclase (or sanidine) on alternating prism and pinacoid faces. “White caps” are crystals of amazonite with white overgrowths of K-feldspar on their (001), or basal pinacoid faces.

Few minerals rival the gaudy color zoning of liddicoatite tourmaline from Anjanabonoina, Madagascar. In slices cut perpendicular to the c-axis, these crystals typically exhibit dark trigonal stars surrounded by pink and green hexagonal bands (prisms), or successive combinations of pink, green, brown, and yellow triangles (trigonal pyramids) encased in narrowly-banded, multi-colored hexagonal prisms (Fig. 1).

Quite striking also are the strongly-zoned corundums from Mong Hsu, Myanmar (Burma). The characteristic crystal habit of Mong Hsu rubies consists of two hexagonal dipyramids (n, ω), rhombohedron (r), and pinacoid (c) faces (Fig. 2). Within the crystal, one or two violet cores are enveloped by clearer, bright red areas. For gem purposes, the stones are usually heat-treated to eliminate the dark cores, thereby brightening the color of the rubies. Closer inspection of sections cut parallel to the c-axis shows that growth began as violet sapphire parallel to the c, n, and r faces. The slower-growing ω faces ultimately dominated the external crystal form at this early stage of development. This was followed by an overgrowth of ruby along the c, r, n, and ω faces, a mixed zone, another violet zone, and finally a sheath of clear ruby (Fig. 3). The color zones also reflect chemical differences: the violet cores are generally higher in chromium, vanadium, and titanium than are the red rims.
Phantoms and Skeletal Growth

In some minerals, outlines of earlier-formed crystals appear embedded within the crystal. This usually results from an interruption in the continuity of deposition, due to fluctuations in the composition of the enclosing solution, or deposition of impurities on the crystal faces. Thin layers of included foreign material, such as chlorite in quartz, outline the earlier crystal shapes. The shape and color of the phantom generally correspond to the outer crystal, although differences in both habit and color are known. Examples of habit change during growth include the Chihuahua calcite and liddicoatite. Examples of color changes in phantoms include amethyst in quartz, and watermelon tourmaline (reddish-pink core and dark-green rim). Other minerals that often show phantoms include calcite, fluorite, and halite. “Cloud” formations occur in some diamonds. They can be diffuse or mimic the external crystal morphology. Other phantom “clouds” display Maltese cross, octahedral, hexoctahedral, and trisoctahedral habits. They are created by light-scattering from sub-microscopic particles, whose exact makeup is still unknown.

When crystals grow rapidly at elevated temperatures or high levels of supersaturations, atoms are deposited faster at the edges and corners than at the centers of crystal faces. This produces deep, stepped depressions at the centers of the affected faces (Fig. 4). Such hollow crystals are called hoppers. Halite, pyromorphite, vanadinite, native gold, quartz, and occasionally diamond are some minerals that produce hopper crystals.

Another manifestation of rapid growth is the dendritic or skeletal habit typically exhibited by such minerals as the native metals (gold, silver, copper), pyrolusite on limestone, chlorite in moss agate, and snowflakes. These crystals have developed a branching, dendritic (tree-like) habit. A snowflake beautifully illustrates the extent to which the hexagonal symmetry controls the overall shape of the crystal. In the snowflake, the dendritic branches lie parallel to the 3 a-axes. Growth on the side branches hinders deposition of water vapor near the centers. The shape of the resulting snowflake is highly sensitive to slight variations in temperature and water vapor density. Therefore, snowflakes show an incredible diversity of forms and no two are exactly alike, although they all conform to the six-fold symmetry imposed by the atomic structure of ordinary ice.

The patterns of crystal growth, sometimes resulting in wildly colorful zoning and shape-shifting changes of habit, can disclose the life story of crystals from nucleation to the final forms found in nature. Zoning and phantoms record successive stages in the ever-changing environment to which minerals are exposed as they develop. Finally, skeletal or dendritic habits reveal rapid growth under agitated, disequilibrium conditions.

Further Reading


Inside the Hidden World of Crystals (Part II): Tell-Tale Inclusions

The Nature of Inclusions

In a perfect world, crystals would be absolutely clear and flawless. But in the real world, growing crystals often incorporate solid or liquid impurities, making them cloudy or opaque. Yet these inclusions provide geologists with invaluable information about the earth’s interior and the physical conditions under which minerals form. They tell the gemologist whether gems are natural, whether they have been enhanced, and possible sources of the gemstone.

Inclusions take many forms. Solid inclusions can be the same species as their host (e.g., diamond in diamond), or be totally different (e.g., rutile in quartz). Fluid inclusions are tiny droplets of the fluids from which the mineral precipitated. They occupy internal cavities. A two-phase inclusion contains both liquid and vapor; adding a solid produces a three-phase inclusion. Common fluid phases include water (liquid and/or vapor), carbon dioxide (gas), methane (gas), and oil (liquid). Multiple daughter phases can also co-exist in the same inclusion, as for example in quartz from the copper deposit at Bingham, Utah (Fig. 1). Impurities that have been trapped at the time of crystallization are termed primary inclusions; those that develop later, as fractures heal,
are secondary inclusions. Primary inclusions delineate the original circumstances of crystal growth, whereas secondary inclusions illustrate subsequent events in the crystal’s history.

Initial inspection of inclusions begins with routine microscopic examination. Fluid inclusions are often heated, using a special apparatus attached to a microscope stage, until fluid phases—vapor and liquid—merge or homogenize. The fluid was initially trapped by the growing crystal at much higher temperatures. As the fluid cools and shrinks, a gas bubble separates from the liquid. In the laboratory, the process is reversed by heating, until the bubble disappears and homogenizes with the liquid. The temperature at which this happens is called the homogenization temperature. For primary inclusions, it provides an estimate of the original temperature at which the fluid was first incorporated into the crystal. By cooling fluid inclusions and measuring the temperatures at which they freeze, one can also determine the salinity of the solution or the presence of carbon dioxide.

The chemical makeup of solid inclusions that occur near the surface is analyzed with an electron microprobe. Inclusions are also identified, non-destructively, using laser Raman spectroscopy. This technique measures scattered radiation from groups of atoms or ions in a mineral that display characteristic sharp peaks at specific energies, thus providing a spectral fingerprint of the material being tested.

On the Trail of Inclusions

Inclusions abound in minerals from all geological environments. Examples from several crystal habitats are described below: pegmatite pockets, Mississippi Valley-type ore deposits, and diamonds from the earth’s upper mantle. Pegmatite Pockets (See Color Insert #2, plate 1).

Toward the late stages of crystallization of a pegmatite, volatile constituents are concentrated in cavities or “pockets”. Among these components are water vapor, carbon dioxide, fluorine, as well as beryllium, lithium, boron, niobium, tantalum, uranium, thorium, and rare earth elements. Crystallization starts at temperatures as high as 750°C going to as low as 300°C. In addition to large crystals of quartz, feldspar, and mica, rare minerals such as pollucite, columbite-tantalite, samarskite, uraninite, and thorite occasionally line the pockets. Pegmatites also furnish many gems, including tourmaline, beryl (aquamarine, morganite, heliodor), topaz, spodumene (kunzite, hiddenite), spessartine garnet, and quartz (clear, smoky, rose, amethyst). Fluid inclusions in these crystals represent remnants of the hot, watery solutions from which they deposited. Two-phase fluid inclusions and solid inclusions are common. Topaz tends to be more inclusion-free than most other pegmatite crystals, yet it commonly displays two-phase fluid inclusions and also thin rutile needles. Aquamarine often houses black tourmaline, apatite, quartz, and feldspar. Multiple phases are also found in pegmatite crystals. For example, a fluid inclusion in topaz from the Volynia pegmatite, Ukraine, contains halite (NaCl), sylvite (KCl), elpasolite (K_{2}NaAlF_{6}), and an unnamed Zn-Al chloride, plus several unidentified solid phases (Fig. 2). Fibrous inclusions or hollow growth tubes may develop parallel to the c-axis in tourmaline and aquamarine. Such stones, when appropriately cut and polished exhibit chatoyancy, or a cat’s-eye effect.

Mississippi Valley-Type Deposits

Lead and zinc deposits from the Mississippi Valley contain galena, sphalerite, barite, fluorite, calcite, dolomite, and lesser amounts of pyrite, marcasite, and chalcopyrite. The minerals have concentrated along faults, veins, and in solution collapse structures in nearly horizontal carbonate rock formations. Similar deposits occur in many different parts of the world.

Fluid inclusion in sphalerite, calcite, and fluorite indicate that these minerals deposited at temperatures below 200°C, generally between 100° and 150°C. The solutions are brines with a salinity usually above 15% by weight, and high in Na⁺, Cl⁻, also Ca²⁺, K⁺, Mg²⁺, and SO₄²⁻. They often contain oil droplets and methane. The evidence from the inclusions points to brines resembling those that have transported petroleum to its reservoirs.

Diamonds

Diamonds form at high temperatures (900° to 1300°C) and at depths of 100-300 km. in the earth’s upper mantle. Diamonds did not crystallize in the kimberlite or lamproite rocks in which they are found. Rather, these rocks have merely acted as “elevators”, conveying the diamonds to the surface. Careful dating of mineral inclusions reveals that diamonds are generally much older than their host rocks—as much as 3 to 1 billion years old—whereas the kimberlite pipes go back several hundred million years or less. Solid inclusions in diamonds show that they originated in two other types of rocks, namely in peridotite (containing olivine and pyroxene) and eclogite (a garnet-pyroxene rock). Inclusions such as chrome-bearing purplish pyrope garnet, pale green or brown olivine, bright green chrome-diopside, black chromite, and spinel point to a peridotite source rock. The presence of pale-green omphacite (jadeite-diopside) pyroxene, orange-red almandine-pyrope garnet, and blue kyanite inclusions indicate eclogite. Other inclusions present in diamond are graphite, sulfides (pyrite, pyrrhotite, chalcopyrite), and even diamond.

A curious feature of diamond inclusions is that of xenomorphism or xenohedry, whereby captive inclusions exhibit diamond’s morphology. This occurs because of the strong, rigid structure of diamond, which forces the inclusion to conform to its crystal form.
Dissecting Gemstones

Inclusions play an important role in gemology. They color many gems: green fuchsite mica in aventurine (quartz), reddish copper in Oregon sunstone (labradorite), blue-green chrysocolla or reddish-brown hematite (carnelian) in chalcedony. Optical phenomena, such as chatoyancy or asterism are created by oriented fibrous inclusions or channels. For example, the striking cat’s-eye in chysoberyl is produced by parallel needles of rutile. In star sapphires or rubies, fine rutile needles are arranged in three intersecting sets at 120° to each other, in a plane perpendicular to the c-axis.

The presence of inclusions affects the transparency of a crystal and hence its desirability as a gemstone. The overall clarity, based on the number, size, and distribution of inclusions and other internal flaws, represents an important factor in determining the value of diamond. Inclusions furthermore furnish the gemologist with important clues as to the natural vs. synthetic origin of a gem, the presence of enhancements, and in some cases the source of the stone. Man-made crystals often betray features of their laboratory birth, such as tiny round bubbles, veins of flux in synthetic ruby or emerald, traces of iron flux in synthetic diamond, curved growth lines in corundums, or particles of platinum (from the crucible) in lab-grown emeralds. Rubies and sapphires whose color has been “improved” by heating may show partially dissolved rutile needles and discoid tension fractures surrounding minute solid inclusions.

Characteristic inclusions in certain gem crystals can point to particular geological environments, thus narrowing down choices as to the geographic source. For example, rubies from alkali basalts typically contain garnet, pyrrhotite, or apatite inclusions. These types of deposits occur in Australia, Cambodia, Thailand, and southern Vietnam. Marble-hosted rubies have calcite, dolomite, rutile, pyrite, and phlogopite inclusions. These come from Afghanistan, Myanmar (Burma), Pakistan, and northern Vietnam. Colombian emeralds are known for their three-phase inclusions of water vapor, brine, and halite; also solid inclusions of carbonates, pyrite, and parsite (Fig. 3). Emeralds from schists, such as those in the Urals, Brazil, and Africa contain phlogopite-biotite, amphiboles, feldspar, talc, and chlorite, among others. Inclusions can help identify gems from different geological settings. But overlap among inclusion assemblages usually makes it difficult to pinpoint the exact locality, except in some favorable cases. Attempts to characterize the provenance of diamonds by means of characteristic inclusions and other diagnostic features remains an even more elusive undertaking (see for example Unlocking diamond sources, Bulletin of The New York Mineralogical Club, Nov. 2002).

Further Reading

Pyrite – The Golden Seed of Life

Introduction
A hellish scene at the bottom of the ocean may have greeted the first awakenings of life, around 3.8 billion years ago. At a submarine hydrothermal vent, hot, acidic, metal-laden solutions mixing together with noxious gases such as ammonia, hydrogen cyanide, hydrogen sulfide, and carbon dioxide may have created the witches’ brew that led to our origins. Pyrite, or other similar iron sulfides such as pyrrhotite, may have played a key role in triggering the whole process. This harsh scenario contrasts sharply with the long-prevailing view that life originated in benign, shallow tidal pools. The Warm Tidal Pool

Experiments by Nobel Prize-winning chemist Harold Urey and his then graduate student Stanley Miller, attempted to simulate conditions on the early earth by mixing an “atmosphere” of methane, ammonia, water, and hydrogen in a flask and then sparking the mixture with an electrical current, simulating lightning. The reddish, tarry goo that formed turned out to be rich in amino acids—the building blocks of proteins. Other similar experiments produced molecules that are components of DNA. These results were widely interpreted as showing that life arose near the Earth’s surface, in warm, shallow tidal pools.

However, in the early days of the Solar System, the Earth along with the Moon, and other rocky planets, were heavily bombarded by an onslaught of asteroids or comets that scarred their surfaces with craters. Such a barrage would have destroyed any primitive life emerging at the Earth’s surface.
Also, the Early earth’s atmosphere more likely consisted of a mixture of carbon dioxide and nitrogen, rather than the methane and ammonia assumed by the early experimenters. Recent findings reveal that hardy microbes can thrive in the most extreme environments: rocks miles deep, boiling hydrothermal pools in Yellowstone National Park, or at hydrothermal vents on the ocean floor. These “extremophiles” are among the most primitive forms of life, relying on chemoautotrophy – the use of chemical energy derived from volcanic gases such as carbon dioxide or hydrogen sulfide, and dissolved metallic minerals to synthesize the organic molecules they need for food and metabolism.

The Role of Pyrite

The first steps leading to life probably relied heavily on the presence of minerals. Porous minerals or rocks such as vesicular basalt or pumice that were riddled with cavities inside of which simple atoms or molecules such as carbon dioxide, methane, nitrogen, sulfur, and phosphorus could interact and link into chain-like polymers. The layered structures of clay minerals trapped organic molecules and provided the scaffolding on which they could be assembled into more complex bio-molecules. Iron sulfide minerals, such as pyrite or pyrrhotite, acted as catalysts and energy sources for the synthesis of organic molecules.

Günther Wächterhämmer, a German organic chemist and patent lawyer, was one of the first scientists to recognize the importance of iron and nickel sulfides in life’s beginnings. He proposed that the positively-charged flat surfaces of pyrite crystals, such as those commonly found at hydrothermal vents, could have stimulated chemical reactions producing acetic acid. With the addition of another carbon atom to acetic acid, pyruvic acid is formed. It is a key component in the citric acid cycle—central to life’s metabolism—and also reacts with ammonia to form amino acids, which in turn join up into proteins. Lab experiments have now duplicated a number of these crucial steps. Recent studies by Robert Hazen and his colleagues at the Carnegie Institution of Washington, D.C. have shown that under hydrothermal conditions (i.e., at elevated temperatures and pressures) sulfide minerals begin to dissolve, releasing metal atoms or ions which activate the chemical reactions that build up more complex organic molecules.

The most comprehensive synthesis to date of the iron sulfide theory is that developed by William Martin of the Heinrich-Heine University of Düsseldorf, Germany and Michael Russell of Scottish Universities Environmental Research Centre, Glasgow. They propose that life actually began at the deep-sea hydrothermal vents, where “black smoker” chimneys form as hot metal-sulfide laden waters encounter the cool ocean. Although these chimneys can tower as high as 30 to forty feet above the ocean floor, they are also fragile and highly porous structures. When seen under the microscope, the iron sulfides form a honeycomb of small cell-like cavities. Martin and Russell suggest that these tiny chambers allowed the basic ingredients of life to concentrate and interact within a small, confined space. The walls of these compartments acted as the original cell membranes. Not only did the iron, nickel, and copper sulfide minerals provide the room for organic synthesis but also the energy. The sulfides supplied a steady stream of electrons as well as catalytic surfaces that facilitated biochemical reactions. A number of proteins in living cells still contain iron-sulfur components that could be the vestiges of the primordial pyritic wellspring. At some point however, several billions of years ago, the ancestral life-form broke free of its mineral cage and developed an organic cell membrane, perhaps even aided and abetted by the catalytic properties of pyrite. The long evolutionary pathway to humankind had begun.

Further Reading


Minerals in the Ancient World

The Roots of Civilization

(See Color Insert #2, plates 2,3)

Long before the dawn of civilization, our human ancestors made hunting tools and weapons from chert, flint, quartzite, and obsidian. Axes and mauls for hammering, pounding, and grinding were shaped from tough, hard, massive rocks like basalt (or diabase), diorite, gneiss, granite, and jade. Powdered hematite, ochre, and manganese oxides (or charcoal) served as pigments for realistic and well-executed Ice Age cave paintings. Mineral resources contributed greatly to the development of ancient technology. Starting with the Bronze Age, metals, initially derived from the native elements – gold, silver, copper, and meteoritic iron – and later from various ores, were crafted or cast into tools, weapons, jewelry, and coins. Clays were molded and fired into pottery and ceramics. Quartz sand and other naturally-occurring ingredients were fused into glass. Attractive, colorful crystals and stones were used for adornment, healing, and status.

Ancient Gemstones (See Color Insert #2, plates 2 & 3)

Gemstones, such as chalcedony, carnelian, sard, agate, amethyst, quartz, as well as the more exotic lapis lazuli, turquoise or hematite were polished into beads and other ornaments. Gem seals were intricately and skillfully engraved with mythological scenes using hard abrasives, such as corundum and magnetite. Ancient lapidaries avoided unnecessary cutting in order to preserve the weight (and value) of the stone and its presumed mystical powers. Color often held greater significance that the actual stone itself.
Much of King Tutankhamen’s magnificent gold jewelry, for example, is inlaid with colored glass or faience—a bluish-green ceramic material—instead of genuine stones. To the ancient Egyptians, red (carnelian, jasper, or red glass) variously represented fire, blood, sun, hence life itself, but also anger, destruction, and the desert. Blue symbolized heaven, the primordial flood, water, thus life, rebirth, and fertility. Lapis lazuli was the primary blue gemstone, often simulated by blue glass or faience. Green (malachite, bluish-green turquoise, amazonite) indicated vegetation, life, and resurrection. Yellow (gold, electrum—a gold-silver alloy, also ochre or orpiment pigments) signified the sun. White (chalk, gypsum, shell) symbolized purity. Black (obsidian) stood for the night, death, destruction, and the underworld, but by association with the dark, fertile soil of the Nile Valley also connoted fertility and resurrection. Hematite amulets and seals, to the Assyrians and Babylonians, gave power over one’s enemies, presumably because of hematite’s red streak that evoked blood and fire. However, hematite (and ilmenite) slabs were polished into mirrors in Pre-Columbian Mexico.

Altered or manufactured stones have a long history. The Romans, by heating light-colored chalcedony, converted the limonite or goethite inclusions in microcrystalline silica to a darker, more desirable reddish-brown hematite (a treatment still performed today). Agates and other porous stones were dyed by boiling in acidic honey, a precursor to the sugar-acid process perfected in Idar-Oberstein, Germany in the 19th Century. The Egyptians baked steatite (soapstone or talc [H 1]), transforming it into enstatite (H 5 1/2) for scarabs and other amulets. Egyptians, and later Romans, frequently substituted glass or faience for turquoise and other gemstones. Precious minerals were traded over long distances. For over 5,000 years, nephrite jade derived from sources near Khotan and Yarkand in central Asia made its way into China. Lapis lazuli from Badakhshan, Afghanistan spread across the Near East from Mesopotamia to Egypt. Deposits in the Sinai Peninsula supplied ancient Egyptian turquoise. Persian lapis lazuli was the primary blue gemstone, often simulated by blue glass or faience. Green (malachite, bluish-green turquoise, amazonite) indicated vegetation, life, and resurrection. Yellow (gold, electrum—a gold-silver alloy, also ochre or orpiment pigments) signified the sun. White (chalk, gypsum, shell) symbolized purity. Black (obsidian) stood for the night, death, destruction, and the underworld, but by association with the dark, fertile soil of the Nile Valley also connoted fertility and resurrection. Hematite amulets and seals, to the Assyrians and Babylonians, gave power over one’s enemies, presumably because of hematite’s red streak that evoked blood and fire. However, hematite (and ilmenite) slabs were polished into mirrors in Pre-Columbian Mexico.

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6500 B.C. Lead artifacts of comparable antiquity were collected at Yarim Tepe, Iraq, and somewhat younger lead objects surfaced in Iran and Egypt. Laurion, Greece and Rio Tinto, Spain were classic lead mines. The Romans found multiple applications for lead, including inscribed tablets, coffins, coins, pewter, glass, weights, and even as preservatives and sweeteners in wine, undoubtedly provoking serious medical complications.

**Ceramics, Glass, and Pigments**

Non-metallic minerals served as the foundation for ancient ceramic, glass-making, and pigments industries. Pottery dates back over 8,000 years in the Old World, and around 4,000 years in the Americas. Clays, such as kaolinite, illite, and montmorillonite provide the raw materials for ceramics. Before firing, the clay is tempered by addition of coarser-grained materials like quartz sand, rock or shell fragments, calcite, mica, volcanic ash, and even crushed potsherds. Glazes, consisting of silica and a flux to hasten fusion, comprise sodium or potash salts (e.g., NaCl, KCl, natron [a hydrated sodium carbonate], or alkali oxides). Additives of iron, manganese oxides and copper carbonates provide color. Alumina (Al₂O₃) helps stabilize and bind the flux to the clay. A deep cobalt blue glaze (probably derived from cobalt arsenates, e.g., erythrite) was common throughout the Near East into China by the Middle Ages. Porcelain, first discovered in China around 2,000 years ago, is manufactured from pure kaolinite and feldspar, and fired at high temperatures.

The oldest glass, from ancient Egypt, dates back 7,000 years. Glass is made from silica (sand) and a flux, usually sodium, potassium, calcium, or lead oxides, with additions of transition metals for color (e.g., manganese [purple to brown], iron [green], cobalt [deep blue], copper [blue-green], chromium [green]). Faience, a ceramic material made from quartz, lime, potash, and soda was produced in Egypt and the Near East, starting around 6,000 years ago.

Minerals also supplied pigments (see Table on next page). Many are widely distributed and could be used directly without further treatment. Others required additional processing. The “Egyptian Blue” pigment of ancient Egypt, made from a mixture of silica with copper and calcium oxides, is identical to the rare mineral cuprorivaite (CaCuSiO₆), found at Mt. Vesuvius, Italy and Sattelberg, in the Eifel volcanic district, Germany. “Mayan blue”, a very resistant material, consists of palygorskite (attapulgite), sepiolite (meerschaum), and indigo dye. The experimentation needed to establish the manufacturing techniques eventually led to the development of alchemy, and much later to modern chemistry.

The use of minerals goes hand-in-glove with the growth of human civilization from the earliest stone tools to the onset of metallurgy, ceramics, brick and glass-making, not to mention their countless decorative, artistic, medicinal, and status applications. We cannot fail to marvel at the ingenuity of our ancestors, not only in discovering mineral deposits, but also in fabricating beautiful as well as practical objects from them, using simple tools and technologies that often require a complex series of steps from raw material to finished product.

**Further Reading**


**Fossils as Gemstones**

Since the dawn of history, gems have been appreciated for their intrinsic beauty, as adornments, and as prestige items. While most gemstones are minerals, some are created by biological processes. Familiar examples of such “organic” gemstones include pearls, coral, amber, and ivory. The popularity of new and unusual gem materials has expanded tremendously in recent decades, thanks to the flourishing craft movement. Among these unconventional gems are fossils, occasionally mounted intact, as for example small trilobites, but also fashioned into cabochons. Fossil materials incorporated into jewelry include “ammolite” (from ammonites), walrus and mammoth ivory, amber with insect and other inclusions, and petrified wood.

*From Ancient Seas (See Color Insert #2, plate 4)*

“Ammolite” is the trade name for the iridescent, nacrous layer of shell of certain species of ammonite, in particular Placenticeras sp., an extinct type of marine mollusk that lived 70-75 million years ago in a sea that once covered much of today’s Alberta, Canada. Ammonites were related to the living nautilus and to squids. The gem ammonites are found in the Late Cretaceous Bearpaw Formation of southern Alberta.

The layers of ammolite are generally quite thin (only 0.5 to 8 mm thick) and composed of soft aragonite (H3 ½-4), yet yield lively, vibrant colors when polished. In addition to varied iridescent colors, the ammolite usually displays a characteristic pattern resembling stained glass windows, due to many narrow fractures present in the shell. In general, the more colors and more intense the iridescence, the more valuable the ammolite. Preferable are pieces with little or no fractures. The colors are caused by an interference phenomenon arising from the finely-layered microstructure of the aragonite crystals comprising the nacre. Under high magnification, the nacreous layers appear as stacks of aragonite sheets. Variations in the thickness and size of the crystals give rise to the different colors.

(Continues)
Table: Mineral Pigments of Antiquity

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Chemical Formula</th>
<th>Color</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Azurite</td>
<td>Cu(CO$_3$)$_2$ • (OH)$_2$</td>
<td>Blue</td>
<td>Paint pigment</td>
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<tr>
<td>Celadonite</td>
<td>K(Mg,Fe)(FeAl)Si$<em>6$O$</em>{18}$(OH)$_2$</td>
<td>Pale green</td>
<td>Ceramic glaze</td>
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<tr>
<td>Chalk</td>
<td>CaCO$_3$</td>
<td>White</td>
<td>Paint pigment</td>
</tr>
<tr>
<td>Chrysocolla</td>
<td>CuSiO$_4$H$_2$O</td>
<td>Blue-green</td>
<td>Pigment, eye coloring</td>
</tr>
<tr>
<td>Cinnabar</td>
<td>HgS</td>
<td>Red</td>
<td>(Vermilion), paint, lacquer, cosmetics</td>
</tr>
<tr>
<td>Cuprite</td>
<td>Cu$_2$O</td>
<td>Reddish, blue, green</td>
<td>Colorant in glass and glazes</td>
</tr>
<tr>
<td>Egyptian blue</td>
<td>CaCuSi$<em>4$O$</em>{10}$</td>
<td>Blue</td>
<td>(Cuprorivaite); paint pigment</td>
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<tr>
<td>Galena</td>
<td>PbS</td>
<td>Dark gray</td>
<td>Ceramic pigment, eye-liner</td>
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<td>Br.-yellow</td>
<td>Paint pigment (ochre, sienna, umber)</td>
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<td>Gypsum</td>
<td>CaSO$_4$.2H$_2$O</td>
<td>White</td>
<td>Paints, plaster</td>
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<tr>
<td>Hematite</td>
<td>Fe$_3$O$_8$</td>
<td>Red</td>
<td>Paints, glazes, glass, ceramics</td>
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<tr>
<td>Kaolinite</td>
<td>Al$_2$SiO$_3$(OH)$_4$</td>
<td>White</td>
<td>Ceramics, glazes</td>
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<tr>
<td>Lapis lazuli</td>
<td>Mixture of lazurite, calcite, pyrite</td>
<td>Blue</td>
<td>Paint pigment</td>
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<tr>
<td>Limonite</td>
<td>FeO(OH) • nH$_2$O</td>
<td>Br.-yellow</td>
<td>Pigment, colorant in glazes, glass, ceramics</td>
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<tr>
<td>Litharge</td>
<td>PbO</td>
<td>Yellow</td>
<td>(Massicot), paints, glazes</td>
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<tr>
<td>Malachite</td>
<td>Cu$_2$CO$_3$(OH)$_2$</td>
<td>Green</td>
<td>Paints, cosmetics, eye-liner</td>
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<tr>
<td>Orpiment</td>
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<td>Yellow</td>
<td>Paints, cosmetics</td>
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<td>Pyrolucite</td>
<td>MnO$_2$</td>
<td>Black</td>
<td>Paints, ceramic glazes, cosmetics</td>
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<td>Realgar</td>
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<td>Stibnite</td>
<td>Sb$_2$S$_3$</td>
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<tr>
<td>Ultramarine</td>
<td>(See Azurite)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Adapted from Rapp, 2002, *Archaeomineralogy.*

Because of the fragility of ammolite, it is often stabilized with epoxy and made into doublets. Triplets are prepared by sandwiching a thin layer of ammolite between a quartz or spinel cap and a shale rock backing, then trimmed to the desired size and shape.

**Relics of the Last Ice Age**

Native peoples of the Arctic have traditionally used walrus ivory to make harpoons, snow goggles, various utilitarian objects, and animal amulets. Even today, Alaskan natives carve small ivory animal figurines for sale to tourists. Fossil walrus and mammoth ivory, dating from the end of the last Ice Age over 10,000 years ago, is now substituted for elephant ivory, which can no longer be legally sold. Fossil ivory is used in making beads, pendants, brooches, and other jewelry items. In faraway Bali, it is intricately carved into mythological beasts.

The walrus, an aquatic mammal related to seals, possesses two large downward-projecting canine teeth or tusks which form the ivory. The granular core of the tusk is surrounded by a smoother, denser exterior. This texture is unique to walrus ivory. Elephant ivory, in contrast, displays a pattern of thin, intersecting curved lines in transverse section. Fresh walrus ivory, essentially composed of hydroxyl apatite, is off-white to pale cream in color. After burial for thousands of years, the ivory turns different shades of tan, brown, and near black, due to contact with minerals in the permafrost soil. Such stained ivory is polished into attractive pendants and cabochons. The woolly mammoth, an extinct relative of modern elephants, also possessed long spirally curved tusks, many specimens of which were extracted from permafrost in Siberia and Alaska. Much of this material is too darkly-stained and brittle for use in jewelry, although small quantities have been worked.

**Forever Sealed**

Amber, used as a gem for millennia, is fossilized tree resin, tens of millions of years old, in which the organic compounds have become cross-linked and polymerized. Amber is quite soft (H2) and heat-sensitive, softening above 150°C and melting around 250-300°C. It is also very light (S.G. ~1.08) and will float in a saturated salt solution. Much younger material, which has not yet undergone these chemical transformations, is called copal. Major amber deposits occur along the eastern shores of the Baltic Sea, the Dominican Republic, Mexico, and Myanmar (Burma). Baltic amber, 40 million years old, was derived from trees in the pine family; Dominican and Mexican amber, 40 million years old, was formed from resins of extinct species of *Hymenaea* trees, whose modern relatives grow in tropical rainforests. *Hymenaea* trees produce copious amounts of resins, and are the source of South American copal.
The almost perfect preservation in amber of insects, leaves, feathers, even small lizards, frogs, and other fossils attracts the attention of scientists and collectors alike. Dominican amber is famous for its rare and well-preserved inclusions. Pendants with eye visible insects or other fossils can be fashioned into exquisite, one-of-a-kind pieces of jewelry. A striking example is a Victorian pendant of Baltic amber with spider and cricket inclusions, mounted in gold and diamonds, now in the Natural History Museum, London.

Forests Turned to Stone

In northern Arizona’s Petrified Forest, giant rainbow-hued logs weather out of the 220 million year-old Triassic Chinle Formation. The fossil trees, some over 100 ft long and 10 ft in diameter, may be extinct relatives of the modern Araucaria, although this interpretation has recently been questioned. The wood has been replaced by chaledony, agate, or jasper, stained yellow and red by iron oxides, and black by manganese oxides and hydroxides. During the 1930s and 1940s, Navajo silversmiths occasionally substituted petrified wood for the more expensive turquoise in the jewelry they sold to tourists. Today, polished slabs are made into table tops, bookends, paperweights, and assorted knickknacks. Cabochons are set into belt buckles, bola ties, rings, and bracelets.

The intriguing patterns and textures present in petrified wood offer ample inspiration to creative lapidaries and jewelry designers. For example, petrified wood from Australia is riddled with former worm holes that now appear as white, light tan, and pale pink circles and ovals on a dark-brown background, on which the fine wood grain is faintly visible. Polished slices of petrified pine cone from Argentina display small, tightly-packed, rounded compartments, resembling alligator skin. These represent the scars of the scales once surrounding the cone. Closer inspection reveals that wavy layers of silica have deposited in the compartments, much like agate. Colors span a pleasing range of earth tones from beige, to yellow-brown and reddish-brown.

Fossil materials contribute to the growing list of gemstones now available to the imaginative jeweler. Among the more popular ones usually cut into cabochons are ammolite, with its opalescent play of colors, fossil walrus ivory, amber with insects and other inclusions, and various kinds of petrified wood. Small fossils, such as trilobites, ammonites, and opalized snails or clams can even be mounted intact.

Further Reading


Fiery Ice: Looking at Methane Hydrate
The Ice That Burns

Methane hydrate is one mineral not likely to be found in most collections. A form of ice with an open cage-like structure that can accommodate methane and other gases, it is stable only at low temperatures and high pressure. It therefore only occurs under the ocean floor and deep within polar permafrost. When brought to the earth’s surface, the white veins, nodules, and lenses rapidly disintegrate with a loud pop, hiss, or sizzle. Although essentially frozen, this mineral is combustible, burning with a reddish flame (Fig. 1). While at first glance methane hydrate may appear to be an oddity of nature, it is important for three reasons. First of all, vast quantities of methane, exceeding all other sources of natural gas, are believed to be locked up as methane hydrate. Thus, as our reserves of fossil fuels dwindle, this may become an important future energy resource. Secondly, recent geological evidence implicates methane hydrate in a sudden warming episode that occurred 55 million years ago, and possibly at other times in the geologic past as well. Concerns have been expressed that future global warming could destabilize methane hydrate in the deep ocean, triggering off vast underwater landslides and releasing huge quantities of methane to the atmosphere, which could accentuate the greenhouse warming. Finally, such giant submarine landslides would pose the now all too familiar threat of tsunamis.

Methane hydrate (also called “gas hydrate” or “methane clathrate”) is a solid, crystalline form of ice in which various “guest” gas molecules are housed within cage-like structures. The dominant form in nature is a cubic structure (cubic structure I) of water molecules arranged in a framework of two pentagonal dodecahedra (each consisting of 12 pentagonal faces) joined to six larger pentagonal dodecahedra that have two extra hexagonal faces, this in order to fill space without undue strain (Sloan, 2003). The size of the cages dictates which gas molecules can occupy them. For structure I, the most common gas in nature is methane, but small amounts of carbon dioxide or hydrogen sulfide can also fit. If all the cages are filled with methane, the composition is $\text{CH}_4: \text{H}_2\text{O} = 1 : 5.3/4$. A very rare hydrate, cubic structure II, consists of 16 pentagonal dodecahedra linked to 8 pentagonal dodecahedra that have 4 extra hexagonal faces. Structure II can accommodate larger molecules, such as ethane, propane, and heavier hydrocarbons.
A Potential Future Energy Resource

Methane hydrate occurs in continental polar regions at depths below 150-200 m and temperatures below freezing. It is also found in sediments beneath the seafloor at ocean depths below 300 m, where water temperatures are near 0°C (Kvenvolden and Lorenson, 2001). As of 2003, gas hydrate had actually been recovered from 21 locations worldwide, and its presence was inferred from various geophysical indications at over 70 other locations (Fig. 2). Most known or inferred gas hydrate deposits are oceanic. Estimates of total amounts of gas hydrates vary widely, but a consensus value lies near 10 trillion metric tons of carbon as methane (Kvenvolden and Lorenson, 2001). This quantity exceeds by several-fold the known reserves of conventional natural gas accumulations (Collett, 2004). However, recovering the methane will present some awesome engineering challenges, since this resource is not only widely dispersed in extreme polar and deep-sea environments, but also potentially explosive unless handled carefully. Drilling for methane hydrate would be similar, in some respects, to regular drilling for oil or gas in the ocean from a platform or a drill ship. While the drill head would be lubricated by a heavy fluid as in ordinary drilling, it would also need to be kept cool in order to prevent dissociation of the hydrate. Gradual depressurization of the gas reservoir may be an economically promising approach for extracting the methane.

Methane from hydrates is already being recovered from the Messoyakha gas field in northern Russia, and production tests have been conducted at the Mallik site in the Mackenzie Delta, northern Canada in 2002 (Collett, 2004). The U.S. Department of Energy and the U.S. Geological Survey, in collaboration with private industry, are also undertaking feasibility studies on the North Slope of Alaska and in the Gulf of Mexico. Other countries, such as Japan, Canada, India have initiated large gas hydrate research and development projects, while China, Norway and others are considering setting up similar government-sponsored programs.

Role in Sudden Climate Change

Methane is a greenhouse gas, like carbon dioxide, and traps infrared radiation that emanates from the earth’s surface, preventing it from escaping into space. This, together with the effects of other greenhouse gases, can lead to a warming of the earth’s atmosphere. Studies of tiny gas bubbles trapped in ice cores from Greenland and Antarctica show that levels of methane and carbon dioxide have varied markedly over the past 400,000 years, and quite likely the past 700,000 years, decreasing and increasing in synchrony with the waxing and waning of the ice sheets during the Pleistocene Ice Ages. Around 55 million years ago, a massive outpouring of methane occurred which appears to have produced a sudden, brief extremely warm period in the earth’s history (Dickens, 2004). This event, known as the Paleocene-Eocene Thermal Maximum (PETM) was recognized by the presence of unusually high amounts of the lighter $^{12}$C isotope relative to the heavier $^{13}$C isotope in sedimentary rocks of this age. This isotopic signature is a sign of biological origin. Most methane in gas hydrate has formed by bacterial action. Bacteria in ocean floor sediments rapidly decompose the remains of marine creatures that have sunk to the seafloor, breaking down complex organic molecules into simpler compounds, such as carbon dioxide, which other bacteria then convert chemically into methane. Since bacteria show a preference for $^{12}$C over $^{13}$C, the lighter isotope becomes enriched in the methane, which is subsequently stored as methane hydrate. It has been proposed that only a sudden, voluminous influx of methane released by the rapid decomposition of submarine methane hydrates could account for the observed carbon isotope anomaly. Some triggering event, possibly a warming of the ocean bottom due to submarine volcanism, may have destabilized the buried hydrates, releasing huge volumes of methane into the ocean and ultimately the atmosphere. The methane subsequently oxidized to carbon dioxide, which then led to the earth’s warming 55 million years ago. The PETM appears to have coincided with significant biological changes, including a marked extinction of deep marine organisms and widespread diversification of mammals (Dickens, 2004). Similar episodes may have occurred at other times in the geologic past, but evidence for these other events is not quite as compelling.

Could it happen again? Although climate models suggest that the highest temperature increases from future greenhouse gas emissions will occur at high latitudes near the poles, the bulk of the world’s hydrate deposits lies offshore trapped in marine sediments off the continental shelves and slopes. The Arctic clathrates lie beneath at least 150-200 meters of permafrost, and while the permafrost is already showing signs of melting, it is not yet clear how much (or even if any) of this surface warming will reach the buried hydrates, making them dissociate. Even if the atmospheric warming propagates into the deeper oceans, causing a warming of several degrees and some release of methane, again it is not clear whether this release would occur fast enough or in large enough volumes to instigate a major climate change. However, smaller quantities

Figure 2. Map showing the distribution of known and inferred methane hydrate occurrences. Courtesy Keith Kvenvolden, USGS & Geotimes.
of methane (and ultimately carbon dioxide from oxidation of the methane) could leak out from these underwater sources, adding to the greenhouse gases produced by human activities. 

A Tsunami Threat off the East Coast?

A number of large, submarine landslides are closely associated with methane hydrate deposits, for example the Storegga slide off the coast of Norway and the Cape Fear slide off the Carolinas coast (Nisbet and Piper, 1998). These underwater avalanches could be triggered off by earthquakes, such as the Grand Banks earthquake of 1929, which severed a number of submarine telegraph cables, or by the lowering of sea level, hence reduction in the overlying water pressure, that occurred during the Ice Ages. Ocean warming could also destabilize methane hydrate. Once a slide is initiated, the rapid decomposition of the hydrate would generate an expansive release of methane gas (by a factor of 180 time the hydrate volume [Sloan, 2003]), causing a massive slurry of gas- and water-laden sediment to race rapidly downslope. If the volume of displaced sediment (and the overlying water column) is sufficiently large, a tsunami could result.

Several years ago, a series of cracks was discovered along a 40 km-long stretch of the outer continental shelf off southern Virginia and North Carolina in water depths of 100-200m (Driscoll et al., 2000). These faults lie at the head of the Baltimore-Accomac and Albemarle-Currituck submarine slides, near buried gas hydrate fields. The depth to the top of the landslide area is near the top of the stability zone for methane hydrate. Driscoll et al. suggest that destabilization of gas hydrates due to ocean warming during interglacial periods may have provoked the slope failures. On the other hand, Booth et al. (1994) associate the slope failures with the 100-130 m sea level drop of the last Ice Age, over 20,000 years ago. Regardless of triggering mechanism, the discovery of these fissures off the Virginia-North Carolina coast, in an area sculpted by submarine landslides in close proximity to known or inferred gas hydrate deposits, raises concerns over possible future underwater slope failures and their tsunami-generating potential.

Further Reading


Cerrillo Turquoise – Past and Present (Part I)

Introduction

The Cerrillos district occupies a special place in North American mining history, revealing evidence of extended activity spanning over 1000 years from prehistoric times to the present. A variety of minerals have been extracted at various times by different groups, but the Cerrillos district is best known for its turquoise. Cerrillos was long presumed to be the main source of the large quantities of turquoise found at Chaco Canyon, a major Anasazi site, located approximately 100 miles northwest of Santa Fe in northwestern New Mexico. Much of this turquoise may have been transported south, deep into Mexico, through trade. While recent research is revealing a more complex picture of prehistoric turquoise sources and trade routes, nevertheless Cerrillos stands out because of the extensiveness of its ancient mine workings and its prolonged tri-cultural history.

Geologic Setting

The mining district is located north of the town of Cerrillos, around 20 miles south-southwest of Santa Fe (Fig. 1). Igneous rocks, invading late Cretaceous to Cenozoic sedimentary rocks, constitute the core of the Cerrillos Hills. The first major pulse of igneous activity occurred around 34 million years ago, resulting in the formation of quartz andesite-latite porphyry sills.

Around 30 million years ago, quartz-poor latite and monzonite intrusions uplifted and tilted the sedimentary country rocks. Small accumulations of copper and thin veins of copper, lead, zinc, and silver deposited in northeast-trending fractures within a million years after the last intrusions. Subsequently, volcanic rocks were erupted from vents on the northeastern side of the Cerrillos Hills. Between 30 and 3 million years ago, a series of down-faulted basins developed along the Rio Grande Rift Valley, and erosion gradually filled them with sediments. Further erosion within the last few million years led to the deepening of the Rio Grande Valley and its tributary arroyos, such as the nearby Galisteo Creek (Maynard, S.R., Consulting Geologist).
Cerrillos turquoise occurs in a classic porphyry-copper-type setting, similar to many other copper deposits in the American southwest. In this type of deposit, ore minerals such as chalcocite, bornite, galena, molybdenite, and more rarely, gold, precipitate at shallow depth from solutions heated by the cooling magma. Ore minerals are finely disseminated throughout the host rock. Chemical reactions between magmatic to high temperature hydrothermal fluids and the enclosing host rocks transform the latter into zoned alteration assemblages. At the core, closest to the intrusions, lies the Potassic Alteration Zone, which consists of K-feldspar, biotite, phlogopite, and chlorite. It is surrounded by the Argillic Zone, dominated by kaolinite, illite, smectite, and other clays derived from the breakdown of plagioclase. The outermost Propylitic Zone contains chlorite, epidote, zeolite, montmorillonite, illite, and carbonates (Phillips et al., 2004).

The turquoise at Cerrillos is a late-stage hydrothermal mineral that has concentrated in veins and fractures together with illite and quartz. Heated solutions have leached out the Cu from finely-disseminated sulfides, Al from feldspar, and P from apatite to form turquoise [Cu Al_2(PO_4)(OH)•4H_2O]. The copper produces the blue-green color of turquoise, but iron commonly replaces copper in the crystal structure. The higher the iron content, the greener the stone. Although it usually occurs at shallow depths, rarely below 100 feet of the surface, turquoise is not a supergene mineral as generally assumed, because it is largely absent from the oxidized zone that is exposed to downward percolating rainwater (Phillips et al., 2004). Turquoise in the oxidized zone alters to a chalky, bleached material containing pyrophyllite.

Prehistoric Turquoise Mining

To the Native Americans, the blue-green hues of turquoise evoke the sky above and especially water—a precious substance in arid lands. The green color furthermore symbolizes vegetation, fertility, abundance, and hence life itself. Turquoise still plays an important role in the mythology, ceremonies, and economic well-being of the southwestern Indians. The use of turquoise in the Southwest reaches back over 1000 years. The huge quantities of turquoise beads and other artifacts recovered from the ruins at Chaco Canyon suggests that a major turquoise processing and trade industry existed there c. 900-1150 A.D. It was long assumed that Cerrillos supplied much of the turquoise used not only in the prehistoric Southwest, but in Mexico as well, since “no other sources are known at all adequate to account for the quantities employed” (Pogue, 1915, 1974, p. 52; also p. 104). New Mexican turquoise was even said to have reached as far east as the West Indies. Recent archeological excavations in the West Indies, although confirming occasional finds of turquoise beads, do not support a southwestern origin, in that the sites pre-dated the start of southwestern turquoise mining (Murphy et al., 2000).

Harbottle and Weigand (1992) maintained that Cerrillos was a major source of prehistoric turquoise, furthermore asserting that the people of Chaco Canyon controlled mining at Cerrillos and the turquoise trade into Mesoamerica during the 12th century (Weigand, 1992). The discovery of turquoise elsewhere broke the Chaco monopoly and presumably led to its decline. Harbottle and Weigand based their conclusions by matching trace element compositions among specimens from Cerrillos, Chaco Canyon, and Mexican artifacts using neutron activation analysis (NAA). Critics point out, however, that sampling may not have been sufficiently extensive, nor does the NAA method produce a unique enough chemical fingerprint to pinpoint the sources of turquoise precisely (e.g., Powell, 2005; Milford, 1995a). Promising new research suggests that analysis of oxygen, hydrogen, lead, and copper isotopes may provide a better approach for identifying turquoise sources (Fayeck et al., 2002; Joan Mathien, priv. comm., 2006) and resolving some of the unanswered questions regarding the role of Cerrillos in southwestern prehistory.

Mount Chalchihuitl was the site of the largest prehistoric mine workings. Based on analysis of over 900 potsherds from the Cerrillos district, Warren and Mathien (1985) found that there were two major prehistoric mining periods, the first between 1000 and 1150-1200 A.D. when the Chaco culture was at its peak, and somewhat later, between 1350-1375 to 1689 A.D. During the second period, mining of galena was also undertaken for use in ceramic glazes. The number of prehistoric sites rose dramatically from 1175 and 1325 and also from 1325 to 1540. Warren and Mathien (1985) conclude that since the major period of mining activity at Cerrillos occurred after the decline of the Chaco Canyon culture, the Chacoans, as well as other Anasazi, probably utilized various other sources and trade routes for their turquoise. (Note: Mount Chalchihuitl was named after the Nahuai word for blue-green stones, including turquoise and jade. Pueblo and Navajo Indians used “chalchihuitl” exclusively for turquoise.)

A sharp decline in Native mining followed Spanish colonization, although Native Americans continued to extract limited amounts of Cerrillos turquoise well into the early 20th century. Present-day Indians from nearby Santo Domingo Pueblo can still recall grandparents obtaining their turquoise from Cerrillos (Owen, A., in Chalker, 2004).

The Historic Period

After the arrival of the Spanish, circumstantial evidence suggests that some minor mining for silver and lead was undertaken at Cerrillos beginning around 1600, interrupted by the Pueblo revolt of 1680 (Milford, 1995a, #7). Sever accounts refer to a mine collapse at Cerrillos that killed a number of Indians as having been responsible for the 1680 revolt (e.g., Kunz, 1892, p. 56; Pogue, 1915, 1974, p. 53; Northrup, 1959, p. 532; Simmons, 2005, p. 26). No firm evidence has yet been found to substantiate this claim (Murphy, 1962). However, silver and lead mining by the Spanish and Mexicans continued sporadically (Mathien, 1998; Milford, 1995a).

By 1879, with the coming of the railroad, interest in the mining potential of the Cerrillos Hills grew tremendously. A minor silver and gold rush ensued, fueled by misleading reports that grossly exaggerated the precious metal content of the ore (Milford, 1995b). Even eminent geologists, such as Prof. Benjamin Silliman, Jr. of Yale, were not immune to
hyped the area’s gold potential—which was marginal at best (Milford, 1995a). While nothing even much came of gold or silver mining in the district, turquoise enjoyed a brief burst of productivity in the 1890s, continuing into the early 1900s.

Until the 1890s, American turquoise “had only trinket value” (Milford, 1995a). Kunz (1892), for example, stated that Cerrillos turquoise was fit only for mineral specimens or possibly as an ornamental stone. However, in the Appendix to his book, he described mining for turquoise stones, starting in 1890, which though not equal to the finest Persian “were yet fine enough in quality to make them worth more than a hundred thousand dollars”. Annual U.S. turquoise production figures, most of which came from Cerrillos, averaged only $2000-$3000/yr prior to 1889, but soared to $28,675 in 1890, $175,000 in 1892, and remained fairly high through the first decade of the 20th century (Milford, 1995a). Facing growing competition from other southwestern turquoise mines, the Cerrillos district began to decline after 1910.

Cerrillos Turquoise – Past and Present (Part II)

Of interest is the possible role played by George F. Kunz in stimulating the Cerrillos turquoise boom of the 1890s. Kunz, a noted gemologist, was working for Tiffany and Company of New York at the time, actively promoting U.S. gemstones (e.g., Kunz, 1892, 1968). He also prepared a series of gem and mineral report for the U.S. Geological Survey during the 1880s through1890s, and had visited the Cerrillos district. Tiffany’s very likely bought Cerrillos turquoise, but did not own or operate the productive Tiffany Mine on Turquoise Hill, in the northern part of the Cerrillos district (Murphy, 1962). Nor was Tiffany’s a major stockholder in the American Turquoise Company, which did own that mine and other nearby properties. At most, Tiffany’s at one time held a few shares of stock in the mining company “in partial payment of a debt which was owing us” (Murphy, 1962). Undoubtedly, the name of Tiffany Mine was chosen to convey the impression of preciousness and high value associated with the products of the well-known jewelry company.

Cerrillos Turquoise Today (See Color Insert #2, plate 5)

Aside from a small section in the south, which is part of the Santa Fe Country Cerrillos Historic Park, which opened in 2003, most of the historic mining areas remains in private hands. One landowner, however, is attempting to preserve the Cerrillos mines from encroaching development and large-scale mining. Douglas Magnus, a Santa Fe jewelry designer and craftsman, was captivated by the beauty of the panorama, the unique history, and the special blue-green hues of the turquoise. As a result, he bought the Tiffany, Castilian, and Alicia Mines on Turquoise Hill, once among the most productive (Voynick, 2005). He retrieves small, bright, clean blue fragments from the mine dumps and cuts out pieces of thin veins that crisscross the host rocks. The cut and polished stones are then set into fine gold jewelry together with diamonds. Magnus’ exquisite, hand-crafted jewelry is for sale at Packards Gallery, on the Plaza in Santa Fe. He plans eventually to leave his mines to an appropriate preservation-minded organization for historical, archaeological, and mineralogical study.

Mt. Chalchihiuitl, one the site of major prehistoric mining activity, is pretty much worked out. But low-grade pale-blue turquoise encrusted rocks are still abundant on the old mine dumps (See figure above).

Bibliography


http://www.cerrilloshills.org/mines/turq01.htm


http://www.cerrilloshills.org/mines/real01.htm


the connection between the famous Tiffany Mine, which triggered this sudden interest in turquoise? What, if any, was throughput the 1890s and early 1900s (Milford, 1995b). What to 1889, soared to $175,000 in 1892 and remained fairly high production, which had averaged only $2,000-$3,000/yr prior to mining for silver and lead took place. The years 1879-1884 saw a short-lived mining boom for silver and gold, spurred by an earlier disappointing non-discovery of precious metals. The Allure of Turquoise – The Kunz and Tiffany Connection (Part III)

The Cerrillos District, around 20 miles southwest of Santa Fe, New Mexico, is the site of some of the oldest mines in North America, spanning a period of over 1000 years. The Anasazi Indians began mining turquoise by at least 900 AD. By 1325, galena was also extracted for use in ceramic glazes. After the arrival of the Spanish in the late 1500s, some sporadic mining for silver and lead took place. The years 1879-1884 saw a short-lived mining boom for silver and gold, spurred by misleading reports that greatly exaggerated the precious metal content of the ore (Milford, 1995a).

But prior to the 1890s, only the Native Americans valued turquoise, which they used in their jewelry and for ceremonies. Yet within a few years, annual U.S. turquoise production, which had averaged only $2,000-$3,000/yr prior to 1889, soared to $175,000 in 1892 and remained fairly high throughout the 1890s and early 1900s (Milford, 1995b). What triggered this sudden interest in turquoise? What, if any, was the connection between the famous Tiffany Mine, which yielded some of the finest quality Cerrillos turquoise, and the New York jewelry company of that name? Until recently, the facts were obscured by conflicting, often inaccurate stories from period newspaper clippings and magazine articles. But thanks to a new book, some of these once murky connections are now much clearer.

"Tiffany Blue" by Patricia McCraw (2006) presents an insider’s view of the late 19th century turquoise boom. Ms. McCraw is the great-granddaughter of James Patrick McNulty, superintendent of the American Turquoise Company mines, including the Tiffany Mine, between 1892 and 1913. Her account is pieced together from personal correspondence, meticulously-kept mine records, and newspaper articles.

The American Turquoise Company (ATC) was initially financed by the Pinkertons (of the detective agency), the New York City Bank, and Charles Lewis Tiffany of Tiffany and Co. Charles Rutt Andrews, the first president of the ATC, was a former jewelry manufacturer at Tiffany’s and also a major stockholder of ATC. Joseph G. Doty, who supervised the cutting, polishing, and sales of turquoise for ATC, also had prior connections to Tiffany’s. However, turquoise would have remained a stone with only trinket value, had it not been for George F. Kunz, gemologist, who worked for Tiffany’s at that time, and who envisioned the gem potential of Cerrillos turquoise.

Kunz took a strong interest in promoting North American gemstones, as summarized in his book “Gems and Precious Stones of North America” (1892, 1968). Curiously, in Chapter III, he mentions only “desultory” mining at Cerrillos by Indians or local lapidaries (p. 54-56). The value was considered quite low, fit only for cabinet specimens or ornamental inlay. Only flawless (i.e., no matrix) deep sky-blue or “robin’s-egg” blue stones from Persia were considered suitable for jewelry. However, in the Appendix, he describes turquoise of superior color from the Castilian Mine that had been opened in 1890, and subsequently acquired by the ATC in 1892. This new material must have vastly surpassed any turquoise previously mined in the area. Kunz maintained that the stones “although not equal to the finest Persian, were yet fine enough in quality to make them worth more than one hundred thousand dollars” (p. 342-343). A local newspaper article in 1892 stated “Mr. George Kunz, the noted expert of Tiffany, New York, and the highest American authority on gems, says...’Is not that an exquisite blue? It is the blue of a sky upon a perfect June day. That is a turquoise, far and away the finest in America, and it came from these new mines in New Mexico. It is worth $4,000...it is probable that gems to the value of $200,000 a year may be obtained from this mine’” (McCraw, 2006, p.6). Such an endorsement by an eminent gemologist sufficed to stimulate a turquoise boom in the district, soon erasing the memory of the earlier disappointing non-discovery of precious metals.
Tiffany and Co. was one of the main purchasers of the mines’ output and demanded the “perfect blue”—still a favorite company color in their packaging to this day! The Tiffany Mine (also known as the Muñiz claim) was one of the most productive in the Cerrillos district. But as with many mines, its heyday was short-lived. The death of Charles Lewis Tiffany in 1902 was a major blow. While his son, Louis Comfort Tiffany continued in his father’s business, he had little interest in the blue stone and devoted much of his energy on creating art glass. Furthermore, legal disputes over land claims, declining production of high-grade ore, growing competition from other turquoise mines, and changes in fashion all contributed to the decline and ultimate demise of the ATC.

“Tiffany Blue” illuminates the roles of G. F. Kunz and the Tiffany jewelry company, which had been clouded by some confusion. Favorable assessments by George Kunz helped launch the late 19th century turquoise boom. Kunz was also an ATC shareholder. Tiffany’s never actually owned the Tiffany Mine in New Mexico, nor did it have controlling interest in the American Turquoise Company, which did own and operate this mine. However, it was among the mining company’s main financial backers, especially during the initial mining phase and almost certainly was a major purchaser of the turquoise rough. The first president of the ATC had once worked at Tiffany’s. Clearly the connections between the Tiffany Mine and the jewelry company ran much deeper than naming the mine after a well-known Eastern-based luxury company in order to enhance the value and prestige of New Mexican turquoise.

Further Reading

Mining the Deep Sea
A new frontier is opening up on the bottom of the ocean as mining companies target extinct deep sea hydrothermal vents in the hopes of harvesting huge metal deposits, rich in copper, zinc, and iron. Earlier attempts to retrieve manganese nodules from the ocean floor were thwarted by the high costs of ore recovery. However, recent skyrocketing metal prices due to increasing demand from the growing economies of China and India, as well technological advances in underwater operations, are stimulating renewed interest in exploiting deep sea orebodies.

The deep sea hydrothermal vents are products of volcanic activity along mid-ocean ridges where tectonic plates spread apart and also around volcanic arcs where one ocean plate dives beneath another. Turbulent black clouds spewing out of chimney-like structures at active vents (“black smokers”), were discovered as recently as 1979 by researchers descending to the ocean bottom in the Alvin submersible. The black clouds, it turned out, were fine particles of metal sulfides raining down toward the seafloor and building up into delicate, towering pinnacles, some as high as 100 feet. Black smokers form as cold seawater seeps into heavily fractured and porous subsurface rocks, is heated by underlying magma chambers, and is transported upward, carrying dissolved minerals. The sharp temperature drop from 350°C (660°F) in the hydrothermal fluids vs 2°C (36°F) of the surrounding seawater causes anhydrite (calcium sulfate) to precipitate out. (Unlike most minerals, anhydrite is less soluble at higher temperatures than at low temperatures). Next to deposit is chalcopyrite (copper iron sulfide), followed by a mixture of chalcopyrite, sphalerite, and pyrite. Chimney walls are thin and fragile, as a result of rapid deposition due to steep gradients of temperature, pressure, and metal concentrations. The active vents also shelter strange, exotic creatures, such as giant tubeworms, plate-sized clams, and eyeless shrimp. The deep sea vents are teeming oases in an otherwise relatively sparsely-inhabited environment. These ecosystems are not merely scientific curiosities, but are potentially valuable sources of new drugs and biotechnology applications.

Black smokers are just the tip of the proverbial iceberg, however, sitting on top of metal-rich mounds which have accumulated over thousands of years, as a consequence of multiple cycles of chimney build-up, collapse and fragmentation, followed by renewed hydrothermal circulation and deposition. One submarine orebody in the making lies 12,000 feet deep in the middle of the Atlantic Ocean. The TAG hydrothermal field is located just east of the Mid-Atlantic Ridge at 26°N. The mound structure is around 200 m in diameter and 50 m high. Estimates of massive sulfides run as high as 2.7 million metric tons above the seafloor and roughly another 1.2 million metric tons below. These figures compare favorably with land-based massive sulfide deposits. Initial sample analyses indicate bulk ore copper contents of 1-2 wt%, which translates into 30-60 thousand metric tons of copper. The orebody is heavily brecciated and mineralized with pyrite, chalcopyrite, sphalerite, anhydrite, and silica. In its geological structure, the TAG mound closely resembles ancient volcanic-hosted massive sulfide deposits such as those found in Cyprus, Oman, and Newfoundland. However, its great depth even given today’s soaring metal prices and current state-of-the art underwater technology, still presents obstacles to profitable exploitation.
The mining companies are eyeing more promising metal deposits at shallower depths. Nautilus Minerals, based in Vancouver, Canada, is exploring several areas, with particular focus on the Manus Basin north of Papua New Guinea. Another mining company, Australia-based Neptune Minerals, is actively exploring a number of regions, including northern New Zealand. So far, Nautilus is in the lead, having raised $300 million in funds and hoping to begin mining by the end of 2009, once it obtains the necessary environmental permits from Papua New Guinea. Nautilus plans to work at 1,600 m (5250 ft) depths, stripping the upper 20 meters of seafloor, breaking copper- and gold-bearing ore into smaller chunks, and pumping the slurry onto ships. This will not be the first commercial ocean bottom operation. De Beers, for example, has been scooping up diamonds from the seafloor off the coast of Namibia and South Africa since the 1990s, at depths of several hundred meters. Offshore oil drilling technology already reaches the depths needed for deep sea mining. A third of the world's oil now comes from offshore drilling, with some drills reaching 1,500 meters (4900 ft) depth off the coast of Brazil, and even as much as 2,500 meters (8200 ft) deep in the Gulf of Mexico.

The possibility that mining activities could adversely impact unique ecosystems has raised environmental concerns. Mining, however, will focus on older, extinct vents or mounds that have more massive metal accumulations, since not only are active vents literally too hot for the mining equipment to handle (temperatures up to 350°C, 660°F), but due to their fairly small size they do not contain enough ore to extract profitably. Mining underwater would reduce the pollution that would be generated by similar activities on land. Deep sea ore grades are generally much higher than those on land and could return yields equivalent to that obtained from 40 times more material on shore. Thus less energy would be needed to produce the same amount of metal from raw ocean ore than on land. Furthermore, because seafloor sediments are fairly soft, extensive drilling and blasting will be unnecessary. On the other hand, mining could produce turbid sediment plumes or alter circulation patterns that bring essential nutrients to the vent inhabitants. Some mining may be fairly close to active vents. But black smokers can grow as fast as 30 cm a day and therefore are a potentially renewable resource. (On the other hand, it would take a much longer time to re-accumulate enough metals to become economically worth extracting).

Benthic communities living on the seafloor along a portion of the mid-ocean ridge were devastated by a recent eruption of lava, but images taken from submersibles showed rapid recovery to near pre-eruption levels within a few years. The hydrothermal vent habitat is an extremely dynamic environment. Organisms living under such conditions are undoubtedly adapted to sudden, violent change. By human standards, the chemistry of active vents is quite toxic already. Nevertheless, Nautilus is making an effort to act responsibly by stating its intent to set aside large portions of its lease area as a nature preserve. The pristine area can then be compared to the mined area to assess any environmental damages.

Further Reading

New Diamond Developments – Part I
Diamond in Zircon: A Window into the Ancient Earth

Zircon is a hardy mineral. Thanks to its physical properties – its hardness and resistance to chemical attack–it survives most geological upheavals, making it a unique window into the early Earth. Zircons hold the record as the earth’s oldest mineral. Tiny 4.4 billion year old grains of zircon have been found in the Jack Hills quartz pebble conglomerate of the Narryer Gneiss Terrane, Western Australia. Inclusions of quartz, feldspar, micas, and other minerals show that these grains were eroded from a granitic host rock. This in turn implies that a granitic crust had already differentiated (separated) from the mantle at an early date. (The Earth is around 4.56 billion years old). Furthermore, the zircon has oxygen isotope ratios characteristic of magmas that have reacted with liquid water at fairly shallow depths. The titanium content of zircon is highly sensitive to temperature and indicates that the zircon crystallized at around 700°C, consistent with other geochemical evidence pointing to a fairly shallow, wet origin in the earth’s crust. Therefore, the recent discovery of diamond inclusions in this ancient zircon has introduced some wrinkles into this simple picture of the evolution of the early Earth, because diamond is normally formed at the high pressures and temperatures found in the upper mantle.

Among the solid inclusions examined in 1000 randomly selected zircon grains from the Jack Hills formation, only 45 grains contained diamond, mostly associated with graphite, quartz, and apatite. Older inclusions found in the zircons include rutile, biotite, amphibole, feldspar, xenotime, and monazite—an assemblage characteristic of granitic to granodioritic rocks. The diamonds were identified by Raman spectroscopy. The diamond inclusions are rounded to hexagonal, oval, and even angular to needle-like in shape. Graphite often surrounds diamond crystals, implying an inversion to the lower pressure polymorph as the pressure dropped. The possibility of contamination by diamond
polishing powder has been ruled out, because some diamond inclusions are entirely surrounded by zircon, their grain size—ranging between 6 and 70 micrometers—is much larger than the powder, and graphite is present with most diamond inclusions but not in the powder.

Most of the diamond-bearing zircon grains are 3.2 to 3.4 billion years old, with a handful over 4 billion years old. These are the oldest known terrestrial diamonds, breaking the previous record once held by 3.3 billion year old diamonds from the Finsch and Kimberley pipes in South Africa. The host zircons were dated by measuring lead isotope ratios resulting from the radioactive decay of uranium using a highly sensitive ion microprobe and mass spectrometer.

The origin of these diamonds remains a mystery. The most likely geological setting where tiny diamonds are found included in zircon is from metamorphic rocks that were subjected to ultra-high pressure conditions. But no other high pressure minerals other than diamond were found in the zircons. Nor is there any sign that the associated quartz (a strange mineral association!) was originally coesite–the high pressure polymorph of silica. The diamonds may have formed in a separate, unrelated event (or events) in the mantle before being incorporated into the zircon. Alternatively, graphite may have been deposited in fractures in the zircon, and then rapidly dragged into the mantle by subduction, inverting to diamond under the high pressure regime, then partially inverting back to graphite on the return journey.

Further Reading

New Diamond Developments – Part II
Glowing Diamond Fingerprints

A new, fairly inexpensive and non-destructive technique is now capable of distinguishing natural from synthetic and treated blue diamonds. Given the flood of treated, colored diamonds now on the market, especially the once-rare, but highly desirable blue, this new development is certainly welcome. The technique relies upon the unique phosphorescence behavior of blue diamonds. Phosphorescence is the phenomenon whereby a mineral, or any substance, glows in the dark even after the source of ultraviolet or visible light has been turned off. It is similar to the more familiar process of fluorescence, except that in the latter case the mineral glows only as long as it is exposed to ultraviolet light.

Sally Eaton-Magaña and her colleagues recently tested 67 natural blue diamonds, including the world-famous Hope Diamond and stones from the Aurora Butterfly collection on temporary loan to the Smithsonian Institution. In addition, the team examined one natural, but treated, and three synthetic diamonds that had been doped with boron to produce the blue color. In an experiment, the stones were exposed at room temperature to broad band UV light at 215 to 400 nanometers (1 nm = 1 billionth of a meter) attached to a sensitive spectrometer that records the spectral changes that take place as time elapses. The researchers discovered that, rather than being a rare occurrence, the vast majority of blue diamonds (93 percent of the stones tested) actually phosphoresce in the orange-red (~660 nm), but that the red color is often masked by green-blue phosphorescence (~500 nm). They recorded how the intensities of the two phosphorescence peaks—at 500 nm and 660 nm—changed over time. The red peak turned out to be much more persistent, while the blue-green peak faded away more rapidly. Thus, most natural blue diamonds appear to glow greenish-blue initially, while the red glow can show up only after a lag of several to tens of seconds. Moreover, each stone had its unique combination of the relative strengths of the red and green-blue peaks and the rates at which the light at these two wavelengths faded. Of the handful of natural blue diamonds whose luminescence properties deviated from the majority, a couple showed no phosphorescence at all, and the remainder luminesced in the green or yellow. These latter stones did not contain boron, the usual source of the blue color in diamond.

Unlike the natural blue diamonds tested, the three synthetic stones showed phosphorescence only in the green-blue, but not the red. One natural gray diamond had been heated at high temperatures and pressures to turn it blue. The treated stone, like the synthetic ones, also glowed only in the green-blue and not the red.

The distinctive phosphorescence behavior of blue diamonds can be used not only to identify individual gemstones, but differentiate between natural, synthetic, and treated diamonds. The application of this new fingerprinting technique holds great promise in a market crowded with treated, colored diamonds and the threat of improved synthetics that are barely distinguishable from their natural counterparts. (A description of gem-quality synthetic diamonds will appear in Part III).

Further Reading

New Diamond Developments – Part III
Gem-Quality Synthetic Diamonds
(See Color Insert #2, plate 6)

Until quite recently, only kings, millionaires, and movie stars could afford diamonds. Lately, however, the market has been flooded with fairly inexpensive, lower-grade natural stones. An even greater challenge to the jewelry industry looms on the horizon—the production of gem-quality synthetic diamonds that are difficult to distinguish from their natural counterparts.
Synthetic, or lab-grown, diamonds were first produced by General Electric in 1954. Subsequently, other companies have manufactured diamonds, simulating the high pressures and temperatures (HPHT) conditions in the Earth’s upper mantle where natural diamonds form. But growth rates are quite slow, hampering large-scale production. Although some yellowish crystals are in the 1-3 carat range, most are tiny and suitable mainly for abrasives.

Diamond’s unique set of physical properties has spurred numerous attempts to grow larger and more perfect crystals. Diamond is the hardest known substance, possesses the highest thermal conductivity at room temperature, resists most chemical reagents, and is transparent to electromagnetic radiation over a wide span of visible and infrared wavelengths. Described as the “ultimate engineering material”, synthetic diamond is used in the optical and semiconductor industries, but the tiny HPHT-grown material is not of gem quality.

By the late 1980s, a new way of growing diamonds was developed. In the chemical vapor deposition (CVD) method, diamond layers deposit on a solid substrate from a gaseous hydrogen (95-99%) and methane (1-5%) mixture at high temperatures (at least 800°C to 1000°C) and low pressures. Until a few years ago, CVD-created diamonds were thin, polycrystalline films used mainly as abrasives or protective film coatings on silicon, metal, or diamond. Polycrystalline films are harder, but difficult to polish and furthermore lack the desirable clarity of a gemstone. To make gem-quality diamonds, the hot gaseous reagents are passed over a single-crystal diamond seed, on which carbon atoms deposit as epitaxial overgrowths (that have the same atomic arrangement and alignment as the substrate). Since the seed crystal is usually cut parallel to a cube {100} face, the new growth occurs upward in this direction, forming tabular crystals with faces parallel to {100}. The initial batches of crystals were thin and flat due to the pronounced tabular morphology. Within the last year or two, significant improvements have prompted Apollo Diamond Inc. of Boston, Massachusetts to begin sales of its gem-quality CVD-grown diamonds on the open market. These new, improved synthetic diamonds are larger, clearer, and more attractive in color, matching high-quality natural gemstones.

The Gemological Institute of America (GIA) Laboratory has recently examined a representative suite of 43 CVD synthetic diamonds loaned by Apollo Diamond. The stones ranged in weight from 0.13 to 1.20 carats and varied in color from colorless, or nearly so (67%), to “fancy” orange and pink (26%), and various shades of brown (7%). A substantial proportion (29%) earned a very high clarity rating (VVS) and another 39% were only very slightly included (VS). Most stones had only minor fractures or tiny inclusions. When exposed to UV light, the colorless stones showed no reaction or fluoresced very weak orange. The brown ones were inert, and the orange to pink ones fluoresced a weak orange. Under crossed polarized light, the CVD diamonds displayed a strong birefringence, a sign of high internal strain. The spectral properties of the specimens were also investigated and a number of distinctive absorption features were discovered in the visible and near-infrared. The GIA report concluded that a combination of standard gemological and spectroscopic tests will be needed to correctly recognize CVD-grown diamonds and that one should not rely on any single feature.

As bigger and better lab-grown diamonds enter the marketplace, jewelers, gemologists, and consumers alike will need to be evermore vigilant in spotting these “created” gems.

Further Reading:

Note: Since this article was written, more information on gem-quality synthetic diamonds has become available. Blue, near-colorless and pink HPHT-grown diamonds are being produced, in addition to the more common yellow. CVD-grown diamonds range in color from near-colorless to brown, even black. These crystals are treated by an HPHT process to lighten the color.

Some of the major producers of HPHT diamonds include AOTC, Ottawa, Canada; Chatham Created Gems & Diamonds, San Francisco, CA; and Cremesis Corp, Sarasota, FL. Apollo Diamond, Inc., Boston, grows diamonds using the CVD method.

Further Reading:
Special Original Section: The Minerals of Mars

Mapping Martian Minerals

Mars is a planet of dramatic contrasts: heavily-cratered southern highlands like the Moon, towering volcanoes, vast canyons dwarfing the Grand Canyon (e.g., Valles Marineris--2000 miles long and 12,000 feet deep) deep channels gouged by floods of biblical proportions, dune fields rivaling those of the Sahara, and smooth, sparsely-cratered plains in the northern hemisphere. However, the red planet, is now bone dry and frigid (Table 1). Its thin, mostly carbon dioxide atmosphere has a surface pressure less than one percent that of the Earth. Surface temperatures range from near freezing during the southern hemisphere summer to -190°C at the poles in winter. Liquid water cannot exist at the surface today--it either seeps into the ground and freezes, or it evaporates. Yet large volumes of water once carved out dendritic (or branched) river valleys--now dry--across much of the cratered southern highlands. Catastrophic floods streamlined teardrop-shaped “islands” in giant outflow channels. Meandering, deeply-incised channels (e.g., Nanedi Vallis – see figure bottom right and notes on page 61 ) resemble the Goosenecks of the Colorado River near Moab, Utah; others have fan-shaped delta-like deposits at their mouths (see figure top right). These river-like landforms demonstrate that the climate of Mars was once substantially wetter and warmer, and hence more hospitable for life.

Table 1. MARS AND EARTH COMPARED

<table>
<thead>
<tr>
<th>Basic Properties</th>
<th>Mars</th>
<th>Earth</th>
<th>Mars/Earth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass (x10^24 kg)</td>
<td>0.64</td>
<td>5.97</td>
<td>0.11</td>
</tr>
<tr>
<td>Average radius (km)</td>
<td>3396</td>
<td>6378</td>
<td>0.53</td>
</tr>
<tr>
<td>Average density (g/cm^3)</td>
<td>3.91</td>
<td>5.52</td>
<td>0.71</td>
</tr>
<tr>
<td>Highest to lowest point (km)</td>
<td>36</td>
<td>20</td>
<td>1.80</td>
</tr>
<tr>
<td>Average surface temperature (°C)</td>
<td>-55</td>
<td>15</td>
<td>–</td>
</tr>
<tr>
<td>Orbital period (days)</td>
<td>687.0</td>
<td>365.3</td>
<td>1.88</td>
</tr>
<tr>
<td>Rotational period (hours)</td>
<td>24.62</td>
<td>23.93</td>
<td>1.03</td>
</tr>
<tr>
<td>Tilt of axis (deg)</td>
<td>25.19</td>
<td>23.45</td>
<td>1.07</td>
</tr>
<tr>
<td>Distance from sun (10^6 km)</td>
<td>228</td>
<td>150</td>
<td>1.52</td>
</tr>
<tr>
<td>Surface air pressure (mb)</td>
<td>6-9</td>
<td>1013</td>
<td>0.007</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Atmospheric Composition %</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon dioxide</td>
<td>95.3</td>
<td>0.04</td>
<td>2382</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>2.7</td>
<td>78.1</td>
<td>0.03</td>
</tr>
<tr>
<td>Argon</td>
<td>1.6</td>
<td>0.93</td>
<td>1.72</td>
</tr>
<tr>
<td>Oxygen</td>
<td>0.13</td>
<td>20.9</td>
<td>0.006</td>
</tr>
<tr>
<td>Water vapor</td>
<td>0.01</td>
<td>~1</td>
<td>~0.01</td>
</tr>
</tbody>
</table>

Finding evidence for life has motivated recent space exploration. “Follow the water” is NASA’s chief guideline for examining Mars as a possible abode for life--past or present. Minerals reveal important clues about past environments and climates of a planet and its potential habitability. Most informative are those minerals, such as clays or evaporites, that deposit at or near the surface by interaction with water. Recent orbiting and surface space probes have discovered the presence of sheet silicates, sulfates, and crystalline iron oxides. These minerals formed very early in the history of Mars, at an epoch when water was more abundant. Furthermore, geologic mapping shows that not only are the sheet silicates much older than the sulfates, but that they formed under markedly different geochemical environments. Despite a concerted search effort, detailed satellite spectral mapping uncovered virtually no signs of carbonates on Mars until quite recently. The overall scarcity of carbonates was a surprise, in that CO₂ is the main constituent of the Martian atmosphere, carbonates generally precipitate from CO₂ - H₂O solutions, and evidence for past surface water and aqueous alteration abounds.

Carbonate-bearing rocks have been recently reported from the Nili Fossae region, closely associated with clay and olivine-rich formations. Opaline silica has also been detected, expanding the mineral diversity of Mars.

Two recent spacecraft--the orbiting European Space Agency’s Mars Express and NASA’s Mars Reconnaissance Orbiter--carry instruments designed to investigate the surface geology and mineralogy of Mars (Table 2). OMEGA, on board Mars Express, is a visible-infrared spectrometer that operates between 0.35 to 5.1 micrometers (µm) in 352 channels with a spectral resolution of 7 to 20 nm and ground resolution of 300 m to 4 km. CRISM on the Mars Reconnaissance Orbiter “sees” in the visible to infrared between 0.36 µm and 3.92 µm in 544 wavelengths at 18 meters per pixel. Other instruments on these and older orbiters image
surface landforms, measure topography, and probe the subsurface (e.g., the Mars Express MARSIS radar altimeter). On the ground, NASA’s two Mars Exploration Rovers (Spirit and Opportunity) have also been actively analyzing the chemical and mineral makeup of Martian rocks and soils (Table 1). Both Rovers are equipped with an Alpha Proton X-ray Spectrometer (APXS) which determines the chemical composition by bombarding the surface with alpha particles from a radioactive source. Backscattered alpha particles, protons, and x-rays are produced, whose energy levels are characteristic of specific elements. Alpha particles detect lighter elements (e.g., sodium, magnesium, aluminum, silicon) whereas x-rays pick up heavier elements such as iron, nickel, or cobalt. The Rovers also carry a mini-Thermal Emission Spectrometer (TES) which obtains infrared spectra, and a Mössbauer Spectrometer which identifies iron minerals.

Table 2. CURRENT MISSIONS TO MARS

<table>
<thead>
<tr>
<th>Launch Date</th>
<th>Spacecraft</th>
<th>Main Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/7/96</td>
<td>Mars Global Surveyor</td>
<td>Orbiter, surface topography &amp; composition, atmospheric properties.</td>
</tr>
<tr>
<td>4/7/01</td>
<td>Odyssey</td>
<td>Orbiter, maps surface composition and water.</td>
</tr>
<tr>
<td>6/2/03</td>
<td>Mars Express</td>
<td>Orbiter, high resolution geologic images, mineralogic and atmospheric composition, subsurface mapping.</td>
</tr>
<tr>
<td>6/1/03</td>
<td>Spirit</td>
<td>Lander/rover, geological imaging; surface mineralogy and chemistry.</td>
</tr>
<tr>
<td>7/7/03</td>
<td>Opportunity</td>
<td>Lander/rover, geological imaging; surface mineralogy and chemistry.</td>
</tr>
<tr>
<td>8/05</td>
<td>Mars Reconnaissance Orbiter</td>
<td>Orbiter, high resolution geologic images, mineralogic and atmospheric composition, subsurface mapping.</td>
</tr>
</tbody>
</table>

The orbiting satellites have detected igneous silicates, such as pyroxene, olivine, and feldspar, that crystallized from a molten magma (Table 3). These minerals are common constituents of basaltic lavas on Earth and the Moon, as well as on Mars, and are also found on stony meteorites. More importantly, the OMEGA and CRISM spectrometers have also discovered several sheet silicates, sulfates, crystalline iron oxides, and carbonates in a number of locations (Table 3). Although these minerals occur in many different geological settings and can have diverse origins, they all require the presence of water. They are now described in greater detail.

Table 3. THE MINERALS OF MARS

<table>
<thead>
<tr>
<th>Silicates</th>
<th>Oxides, Sulfates, Carbonates, Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silica (Hydrated)</td>
<td>Opal, CRISM</td>
</tr>
<tr>
<td>Pyroxene</td>
<td>Clinopyroxene, Orthopyroxene, TES, mini-TES, OMEGA</td>
</tr>
<tr>
<td>Feldspar</td>
<td>Labradorite, TES</td>
</tr>
<tr>
<td>Olivine</td>
<td>Nontronite (iron-rich smectite), OMEGA</td>
</tr>
<tr>
<td>Phyllosilicates</td>
<td>Montmorillonite, OMEGA, CRISM</td>
</tr>
<tr>
<td></td>
<td>Saponite, OMEGA</td>
</tr>
<tr>
<td></td>
<td>Chamosite, OMEGA</td>
</tr>
<tr>
<td></td>
<td>Illite/muscovite, CRISM</td>
</tr>
<tr>
<td></td>
<td>Kaolinite, CRISM, OMEGA</td>
</tr>
<tr>
<td></td>
<td>Chlorite, CRISM</td>
</tr>
<tr>
<td></td>
<td>Serpentine (?), OMEGA, CRISM</td>
</tr>
<tr>
<td>Iron Oxides</td>
<td>Magnetite, Mössbauer spectrometer</td>
</tr>
<tr>
<td></td>
<td>Hematite, TES, Mössbauer spectrometer</td>
</tr>
<tr>
<td></td>
<td>Goethite, Mössbauer spectrometer</td>
</tr>
<tr>
<td></td>
<td>Amorphous Fe oxides, OMEGA</td>
</tr>
<tr>
<td>Sulfates</td>
<td>Kieserite, gypsum, polyhydrated sulfates, jarosite, mini-TES, OMEGA, CRISM, Mössbauer spectrometer</td>
</tr>
<tr>
<td>Carbonates</td>
<td>Magnesite, TES, CRISM</td>
</tr>
<tr>
<td>Chlorides</td>
<td>Halite, APXS, mini-TES</td>
</tr>
</tbody>
</table>

APXS: alpha proton x-ray spectrometer, MER Rovers. TES: thermal emission spectrometer, Mars Global Surveyor. Mini-TES, Mössbauer Spectrometer, MER Rovers. THEMIS: thermal emission imaging system, Odyssey. OMEGA, Mars Express Orbiter. Sources: Bandfield et al., 2003; Hoefen et al., 2003; Christensen et al., 2003, 2004; Ruff, 2002; Squyres et al., 2004; Bibring et al., 2005, 2006, 2007; Goetz et al., 2005; Poulet et al., 2005, 2007; Ehlmann et al., 2007; Roach et al., 2007; Ehlmann et al., 2008.
Sheet Silicates

Phyllosilicates, or sheet silicates, include the clay minerals, micas, chlorites, etc. Clays, in particular, form through chemical weathering of rocks by water and are the dominant constituent of terrestrial sedimentary shales and mudstones. Clays on Mars are recognized by characteristic spectral absorption features near ~1.4 µm and ~1.9 µm, due to stretching and bending of -OH bonds, and 2.2–2.4 µm absorptions caused by metal-OH vibrations (Table 4). The latter range is particularly diagnostic: the 2.2 µm band indicates Al-OH, 2.28 - 2.29 µm marks Fe-OH, while bands > 2.30 µm indicate Mg-OH (Poulet et al., 2005). Spectra from selected target areas are usually ratioed against those from nearby “neutral” areas in order to enhance or sharpen spectral features of interest.

OMEGA has now mapped at least 90% of the Martian surface at a scale of 1.5 to 5 km and >5% of the surface at less than ½ km resolution (Bibring et al., 2006). OMEGA’s observations are supplemented by those of the CRISM imaging spectrometer. The spectral mapping shows that clay minerals appear in numerous scattered localities over the ancient cratered crust, with greater concentrations in the Syrtis Major/Nili Fossae region and around the Marwth Vallis outflow channel. On the basis of their spectral properties, the following phyllosilicates have now been identified on Mars (Table 4):

1. Iron-rich smectites (e.g., nontronite)–common
2. Aluminum-rich smectite (e.g., montmorillonite)
3. Chamosite (iron/magnesium chlorite)
4. Illite/muscovite
5. Kaolinite
6. Chlorite
7. Serpentine (?)

Of these, the Fe/Mg phyllosilicates are the most widespread. Sheet silicates are confined to the oldest cratered terrains on Mars. In general they do not occur together with younger sulfate minerals or crystalline hematite deposits (see below). This observation highlights a major environmental change that happened early in Mars’ history.

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Spectral Features, µm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nontronite (Fe-smectite)</td>
<td>1.41 ~1.9  2.29-2.30  2.40</td>
</tr>
<tr>
<td>Saponite (Mg-smectite)</td>
<td>1.4  1.9  2.28-2.30</td>
</tr>
<tr>
<td>Montmorillonite (Al-smectite)</td>
<td>1.41 ~1.9  2.21  2.35 (weak)</td>
</tr>
<tr>
<td>Chamosite (Fe/Mg chlorite)</td>
<td>1.41 ~1.9  2.35</td>
</tr>
<tr>
<td>Illite/muscovite</td>
<td>1.40  1.9  2.2  2.35</td>
</tr>
<tr>
<td>Kaolinite</td>
<td>1.41  1.91  2.16-2.21</td>
</tr>
<tr>
<td>Chlorite</td>
<td>1.4  1.9  2.26-2.30  2.34-2.35</td>
</tr>
<tr>
<td>Serpentine (?)</td>
<td>1.4  1.9  2.29-2.30  2.34-2.35</td>
</tr>
<tr>
<td>Opal</td>
<td>1.38-1.39(1.91-1.92) 2.21  2.25-2.26</td>
</tr>
</tbody>
</table>

Sources: Poulet et al., 2005, 2007; Bibring et al., 2007; Mustard et al., 2007; Ehlmann et al., 2007; Milliken et al., 2008.

Opal

The CRISM spectrometer has detected opal (hydrated silica) at a number of locations, based on spectral absorption features at ~1.38-1.39µm, (~1.91-1.92µm), 2.21µm, and 2.25-2.26 µm (Milliken et al., 2008). (The 1.91-1.92µm band indicates the presence of H₂O). The opaline silica occurs scattered in a number of craters throughout the ancient highlands and in outcrops exposed along and within Valles Marineris. The opaline deposits lie beneath iron sulfates, such as jarosite and ferricopiapite. Opal has also been found by the Spirit rover at Gusev crater (Squyres et al., 2008). The opal may have been produced by chemical weathering of in situ basaltic lava or volcanic ash, deposition of altered material from elsewhere, or precipitation of silica as a pore-filling cement.

Sulfate Minerals (See Color Insert #2, plate 7)

Sulfate minerals are recognized by near-infrared spectral absorption features between 2.2 µm and 2.5 µm, often with other bands at around 1.4 and 1.9 µm, that like the clays are associated with water or hydroxyl ions (Table 5). The minerals that most closely match laboratory reference spectra are kieserite (MgSO₄.H₂O), gypsum (CaSO₄.2H₂O), and also undifferentiated “polyhydrated sulfates”, which could include epsomite (MgSO₄.7H₂O), copiapite (Fe²⁺Fe⁴⁺₄₄(SO₄)₆(OH)₂.20H₂O), or halotrichite (Fe₄Al₂(SO₄)₂.22H₂O). Jarosite (KFe₃(SO₄)₂(OH)₆) has been identified by the Opportunity Rover’s Mössbauer Spectrometer in Terra Meridiani and also by CRISM south of Melas Chasma in the Valles Marineris region.

Kieserite occurs in layered rocks of eastern Terra Meridiani near the region where the Rover Opportunity landed. It also appears in light-toned layered deposits in Valles Marineris, associated with polyhydrated sulfates. Gypsum occurs in layered deposits of Juventae and Capri Chasmata, north of Valles Marineris, in the chaotically jumbled terrains of Margaritifer Terra, east of Valles Marineris, and also in dark dunes surrounding the north polar cap (Bibring, 2007). Sulfates are found in Aram Chaos as well.
Partially dehydrated ferricopiapite \( (\text{Fe}^{III},\text{Fe}^{II})_4 (\text{SO}_4)_6 (\text{OH})_{20}\text{H}_2\text{O}) \) has been identified west of Juventae Chasma (Milliken et al., 2008).

### Table 5. SULFATES ON MARS

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Spectral Features, µm</th>
</tr>
</thead>
</table>
| Kieserite         | ~1.6, 1.75, 1.94, ~2.1,
|                   | 2.22, 2.26, 2.42, ~2.4 |
| Gypsum            | ~1.4, ~1.9, ~2.4      |
| Polyhydrated sulfates | ~1.93-1.94, 2.23, ~2.4 |
| Ferricopiapite    | ~1.95, ~2.26          |
| Jarosite          | ~2.3                  |

Sources: Bibring et al., 2007; Roach et al., 2007; Milliken et al., 2008.

**Iron Oxides (See Color Insert #2, plate 8)**

Ferric iron oxides spotted by OMEGA display a sharp absorption edge between 0.4 µm and 0.75 µm, an absorption band at ~0.9 µm, and a rise in reflectance toward 1.3 µm (Bibring et al., 2007). Some spectra also show characteristic sulfate bands at ~1.9 - 2.1 µm and 2.4 µm. These spectral features are shared by a number of ferric iron oxides including hematite \( (\alpha-\text{Fe}_2\text{O}_3) \), goethite \( (\alpha-\text{FeO(OH)}) \), lepidocrocite \( (\gamma-\text{FeO(OH)}) \), and ferrihydrite \( [\text{FeO}_{1.5/9}(\text{H}_2\text{O})] \) (Bibring et al., 2007). The sharpness of the spectral features strongly depend on particle size or degree of crystallinity. For example, the 0.86 µm absorption band of hematite is weak or absent for particles smaller than ~10 nm.

The iron oxides are often found together with the layered sulfate deposits mapped by OMEGA inside Valles Marineris, Terra Meridiani, and Margaritifer Terra (Bibring et al., 2007a). These crystalline iron oxide deposits are distinct from the thin veneer of nano-crystalline hematite that covers most of the Martian surface and gives it its characteristic red color. Instruments on board the Opportunity Rover demonstrated the existence of hematite in the form of small, round bead-like concretions (nicknamed “blueberries”) embedded in sulfate layers at Terra Meridiani. Hematite probably occurs in a similar fashion elsewhere.

**Carbonates**

The CRISM spectrometer has spotted carbonates in the Nili Fossae of Mars, associated with clay minerals (Ehlmann et al., 2008). The observed spectral features at 2.3 and 2.5 µm best match magnesite, or magnesium carbonate \( (\text{MgCO}_3(\text{OH})) \). Weak absorptions at 3.45 µm and 3.9 µm, characteristic of carbonates, are also present. A broad absorption band near 1.1 µm \( (\text{Fe}^{II}) \) suggests that some iron may be replacing magnesium, or alternatively, that olivine may also be present. The carbonate-bearing rocks occur together with the clay minerals and basalt discussed above. The carbonates lie stratigraphically at the same horizon as olivine-rich rocks, but overlie Fe/Mg smectites and in turn are covered by Al-rich clays and a basaltic cap rock. The carbonates could have formed in several different ways, for example by alteration of mafic rocks by groundwater percolating through fractures, or by interaction of hot volcanic lavas with wet, clay-bearing rocks. They could also form by surface weathering of olivine-rich basalts in a cold, dry environment similar to Antarctica.

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**Sketch of the Mineral History of Mars**

- Surface volcanic activity
- Mars global change
- Clays
- Sulfates
- Anhydrous ferric oxides

<table>
<thead>
<tr>
<th>Noachian</th>
<th>Hesperian</th>
<th>Amazonian</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.56</td>
<td>3.7-3.5</td>
<td>2.0-1.8</td>
</tr>
</tbody>
</table>

Age, billion years (after Bibring et al., 2006)
What the Minerals Tell

What tale is told by the Martian minerals? Clay minerals are, for the most part, confined to the oldest period of Martian history—the Noachian Era (~4.56 to 3.7-3.5 billion years ago). This era was characterized by intense meteorite bombardment and cratering, but rocks were also exposed to water over prolonged periods, altering to clay minerals. The clays minerals, particularly nontronite or chamosite, developed under neutral to alkaline pH conditions. The rare outcrops of carbonates, closely associated with clays, also date to this era. A major episode of volcanism occurred toward the end of the Noachian and beginning of the Hesperian Era. (The Hesperian lasted from 3.7-3.5 to ~2.0-1.8 billion years ago). Most of the sulfates were deposited during the early to middle Hesperian. Sulfate minerals and crystalline iron oxides (e.g., “grey” hematite) are found close together and presumably both mineral types formed within the same period. Unlike the clays, the sulfates precipitated in an acidic, water-rich environment. The acidic conditions would have largely prevented carbonates from precipitating. The dramatic global change from clay formation to sulfate deposition was likely triggered by extensive release of sulfurous gases and water related to the massive volcanic build-up of Olympus Mons—the largest volcano in the Solar System—and other giant volcanoes on the Tharsis Ridge. Subsequently, as volcanic activity waned and atmospheric gases escaped to space, Mars evolved into the dry and cold planet we know today. Minor surficial oxidation of iron by trace atmospheric peroxides have slowly reddened the face of Mars ever since the end of the period of sulfate deposition.

(This article has been specially adapted and updated from a series of articles that originally appeared in Mineral News, as cited below. A more comprehensive bibliography of articles listed in tables 3-5 is given therein. V.G.).

Further Reading

Additional Notes: MOC image 8704 (page 57 ) shows a portion of the meandering canyons of the Nanedi Valles system—one of several valleys that cut through the smooth and cratered plains of the Xanthe Terra region of Mars. The valley is about 2.5 km (1.6 mi) wide. The floor of the valley in the upper right corner of the MOC image exhibits a small, 200 m (660 ft) wide channel that is covered by dunes and debris elsewhere on the valley floor. The presence of this channel suggests that the valley might have been carved by water that flowed through this system for an extended period of time. In other words, instead of a massive, catastrophic flood, this valley might have been incised in a manner similar to rivers on Earth. The valley itself would have widened by a variety of processes in addition to the water flowing along the bottom of the channel—slumps and landslides, wind, and perhaps groundwater flow could have all contributed to these processes.

1893 ad from a Chicago newspaper for “Kirk’s Soap”. The ad plays on the opening that year of the Yerkes Observatory’s 1-meter (40-inch) refracting telescope (the largest of its type in the world), and the idea that Mars was populated with intelligent life.
Biography of Vivien Gornitz

Dr. Vivien Gornitz is a geologist and special research scientist with the NASA Goddard Institute for Space Studies and Columbia University Center for Climate Systems Research.

Vivien Gornitz grew up in Queens and New York City, but spent a few formative years in Switzerland, where exposure to the Alpine scenery stimulated a lifelong interest in geology and mineralogy. She earned her Ph. D. from Columbia University in Geology / Mineralogy / Geochemistry and her B.A. from Barnard College in Chemistry. Two of her professors (Paul F. Kerr and Ralph J. Holmes) were former members of the New York Mineralogical Club. She is currently examining the impacts of sea level rise and extreme climate events on the metropolitan New York region.

Vivien is also interested in evidence for water and past climate changes on Mars. Previously, she has investigated the effects of human-induced hydrologic transformations on sea level, as well as recent and Holocene global sea-level change. In addition, she edited the Encyclopedia of Paleoclimatology and Ancient Environments (2008, Earth Science Series, Springer).

Vivien has surely been the most important and prolific contributing writer for the Bulletin of the New York Mineralogical Club during the past decade. Her articles appear in virtually every issue – and this has been true for at least twelve years. These articles are regularly reprinted in mineral clubs’ bulletins throughout the USA. Numerous trophies, given to her by both the EFMLS and AFMS, have acknowledged their unrelenting high quality. In addition, Vivien wrote two information books about minerals for the club, both now out of print and was recognized a few years ago for all her educational activities with the Each One, Teach One award given annually by the EFMLS.

Personally, Vivien retains a keen interest in minerals, jewelry and gems (turquoise!). She also enjoys working with stones and setting them in silver.

Full View of Mars
The History of Jewel Collecting

Did any of us need much encouragement to begin our jewel collection? Some of us devote a great deal of time completing our collection—ah the passion for finding the next great stone. Just one more and it will be complete. No it won’t, there will always be one more, or good heavens...let’s just start another collection altogether. Oh why not?

We may collect by species, type, color, you name it. There’s no limit to the ways in which we decide how to assemble a wonderful collection of gemstones. Some people I know collect gems by the region of the world. An all-Asian collection may have peridot, jade, serpentine, pearl, coral, lapis and the like. But how in the world did all this get started?

Let’s go back to Marco Polo’s travels—that’s the 13th century. He wasn’t just looking for spaghetti—or fire crackers, although those Chinese trophies made for interesting dining and entertainment. He brought back jewels. Ditto for Genghis Kahn, and Alexander The Great. Jewels, and plenty of them, filled their treasure troves in pre-souvenir store days-gone-by when world travelers brought home all things exotic from distant lands.

Since ancient times, traders went in search of rare gems to satisfy the voracious appetites of the wealthy European aristocrats. Men were bejeweled up to their crowns in bygone days. And what an appetite they had for “bling”—putting to shame the modern hip-hop stars who adorn themselves with oversized neckwear, featuring rude words spelled out in diamonds.

To meet this extravagant taste, adventurous explorers set out for parts unknown in search of exotic jewels to grace the robes of royalty. In so doing, they graced their own lives with super-star status in their day.

The Portuguese, and later the Italians traveled across Europe, through Russia, into Persia and finally to India in search of the largest and finest jewels mined in Golconda, India: the world’s first diamond site.

Enter Frenchman Tavernier. In the 17th century, he set himself apart as a prince of a jewel trader. Jean Baptiste Tavernier (1605-89) undertook six voyages, which took him as far as the East Indies and Java.

He was an intelligent man, speaking all the known languages of Europe at the time. Renowned for his honesty and good character, he was embraced by the people in the Orient. There he amassed a fortune in the trade of precious stones. Later portraits of him reveal a robust elder statesman in full Oriental garb, complete with a splendid turban, wide pantaloons, and curl-toed slippers.

Ennobled (1669) by French King Louis XIV, he took the title Baron d’Aubonne after an estate he bought near Geneva. It is said that he died on a seventh journey, which was to take him to Asia by way of Russia. His book, beloved by gem historians, *Six Voyages en Turquie, en Perse et aux Indes* (1676-77) contains a wealth of information and has been frequently reprinted in several languages.

Romantic stories say that Jean-Baptiste Tavernier stole the blue stone from the eye of a Hindu god statue, and because of that theft, the diamond was forever cursed. Tavernier was then bilked out of his fortune by a nephew and mauled to death by a pack of wild dogs in India.

N-a-a-ah—I don’t think so; good story though. The diamond in question made its first documented appearance in 1642 when Jean-Baptiste Tavernier purchased a blue diamond weighing 112 3/16 carats, and was believed to have come from Golconda. Tavernier was not cheated out of his fortune and he lived to the ripe old age of 84. While there remains no documentation of how he died, I imagine he was quite the raconteur back at the castle in his final days.

This most famous 17th century gem merchant, Tavernier, used the phrase “gem of the finest Water” in describing the finest diamonds and pearls he saw on his six voyages to India. Although he is long since gone, his impact on the way we communicate gemstones remains.

In the 21st century, one can pick up a copy of the Dictionary of Gems & Gemology published by GIA. In it, gemologist Shipley defines water as a term occasionally used “as a comparative quality designation for color and transparency of diamonds, rubies and other stones.” Color and transparency together equal “water.”

Ah yes, Tavernier had a gift for acquiring and communicating about gems. And we owe him and his colleagues a great debt of gratitude for introducing the world to the timeless beauty of gems. Now that’s romancing the stone.
**Quick Change Artist – Chameleon Diamonds**  
*(See Color Insert # 3, plate 6)*

While laboring on a tedious cataloging project with a large and unremarkable jewelry lot, a co-worker provided me with a most welcome interruption.

The facility where I worked funneled mass quantities of closeout goods through their doors. Interspersed amongst these rather pedestrian items, were hidden the occasional trophy. This merchandiser was stumped with a nicely manufactured ring. The center stone, a well-cut marquise was a diamond she determined, but an ugly colored one in her estimation.

I had already developed a reputation as the Name Queen at this particular company. By creating evocative names for products that were languishing in the back rooms, those jewels suddenly took flight.

What would I possibly call this odd khaki colored stone, she wondered? It could not be categorized as champagne, or yellow or even chocolate. It was, for sure, a weird color. I et a biscuit. Say bree-oh-lay. Think Frito-Lay. It’s not meant to be pronounced like that for heaven’s sake. Remember high school French? The French language is much more exacting with its French? The French language is much more exacting with its

A week earlier, I had researched the little known subject of Chameleon diamonds. So I conducted an experiment with the ring in question. Sure enough, it turned out to be a true color change or Chameleon diamond. It sold immediately to a collector who paid a substantial price for it without quibbling.

What separates a Chameleon diamond from other color change gems? Alexandrite will change color in different types of lighting; specifically daylight and artificial lighting. Andalusite, is a color shift stone which exhibits different colors depending on the direction you are holding it (pleochroism). It has nothing to do with a change in the light source.

Chameleon diamonds are fascinating, and very little has been written about them. These diamonds were first documented in 1943 according to the GIA Diamond Dictionary (1993). Since then, few articles have tackled this phenomenon. A clear description was recently offered in Solitaire magazine from September 2005.

“An interesting type of fancy color diamond is the Chameleon, which possesses the rare property of repeatable color change, hence the name. The color-change occurs when the diamond is heated, or kept in a dark environment for extended periods of time. The most common Chameleon diamonds are greenish yellow, also called Olive.”

Their rarity is documented, but their appeal for the most part is to the connoisseur. The trade journal *Gems & Gemology* (Spring 2005) notes that the color change is more dramatic when subjected to heat than when it’s been in dark storage. Nevertheless both changes are astounding.

A Chameleon diamond may occur in various colors. The stable color is the one present under normal conditions. It may be the Olive mentioned, or as an appealing cool green, not unlike the famous Dresden diamond. It might, however, appear as a pretty yellow. The unstable color is the one that results after subjection to heat, (150° C) or prolonged periods of dark storage. Those reactive colors can be a warm yellow, peachy brown-yellow, or orange-yellow.

I have heard that some Argyle (Australian) diamonds have proven to be Chameleons as well. Those colors change between pinky-rose to cool blue-grey-violets under similar conditions.

Adding to the mystique is the cause of the color change in the diamonds. The *Gems & Gemology* laboratory research concluded, “At present, we can only speculate about the cause of color change in classic chameleon diamonds. The results here point toward a defect involving hydrogen combined with the 480 nm band, which is related to isolated single nitrogen atoms.”

That explanation may not be of interest to your clientele. My eyes are glazing over a bit at the moment, too. However, they will be happy to know that this phenomenon is infinitely repeatable in their Chameleon diamond. It’s like getting a ring with a side show.

Chameleon diamonds are not flooding the market. But they do turn up with some careful research. You may find this to be just the ticket for a discriminating client who “has everything”. Once you apprise them of the unique capability of this diamond, and that this characteristic is natural, you’ve piqued many an interest.

In our highly competitive industry, we are constantly on task to stimulate the consumer’s imagination. We must also show that we are head-and-shoulders above the competition. This specialty item may be the key in showcasing your expertise and increasing loyalty from your customers.

[Note: This was Diana’s favorite column over the years!]

**A Case for Briolettes**  
*(See Color Insert # 3, plate 1)*

With all the hubris surrounding briolette cut stones of late, one might mistakenly think they’ve just been invented. Actually they have an ancient and colorful pedigree in the complete history of cut gems.

First of all, how do you pronounce the word briolette? If you listen to many people who like—and sell the cut, you hear bree -oh- lay. Think Frito-Lay. It’s not meant to be pronounced like that for heaven’s sake. Remember high school French? The French language is much more exacting with its pronunciation rules than English. Any word ending in “ette” must be pronounced as “et”. I et a biscuit. Say bree-oh-let; pronounce that “et”.

Both French and English dictionaries date this French noun to 1865, defining the word as “an oval or pear-shaped...”
gemstone cut in triangular facets.” It also requires the pronunciation of the final “t”.

The most notable difference between briolette and all other cuts of gemstones is the fact that it is faceted to be viewed and worn in any direction. There is no front and back with this cut.

Classic briolettes are teardrop-shaped and composed of triangular facets. Rectangular or hexagonal facet briolettes, which are rarer, are a variation. It could be said that they are in the family of rose cuts- like a hybrid of a bead cut and a pear cut.

Years ago, I got my first up-close-and-personal encounter with the briolette cut in New York. I wasn’t even in the jewelry industry then. While wasting a bit of time on Madison Ave and 53rd Street, early for an appointment, I wandered into an antiques store. The friendly Middle Eastern proprietor struck up a conversation with me about jewelry.

Although he knew I was not going to buy, he graciously began showing me things he thought would appeal to me. From a drawer in the back of this cluttered narrow shop, he carefully brought out the most exquisite five tiered collar style necklace of briolette cut rubies. I was hooked. Today I am still fascinated by the workmanship and fantasy of this cutting style.

Some historians believe the briolette cut owes its’ origin to the Middle East. Numerous ancient briolettes are amongst the prestigious Crown Jewels of Iran. There is also evidence of briolettes having been used since Roman times, most likely evolving into their faceted form from rounded or tube shaped beads.

The legendary “Briolette of India” is a 90.38 carat diamond. If the fables surrounding it are true, this may be the oldest diamond on record, predating the Koh-I-Noor Diamond. Eleanor of Aquitaine, the 12th century Queen of France and later England, brought the stone to Britain. Then stories say her son, Richard the Lionhearted, carried it on the Third Crusade.

It disappeared for four centuries, only to re-surface in 1950. Famed New York jeweler, Harry Winston, bought it from an Indian Maharajah. It was subsequently sold and then re-purchased by Mr. Winston, 10 years later.

The briolette cut next appeared in the 16th century when Henry II of France gave one to his blonde mistress, Diane de Poitiers. When I’m hot on the trail of discovering the provenance of an ancient jewel, I resort to researching ancient royal portraits. Museums and rare libraries are some of the places that provide me with a jewels roadmap through history. I found this famous briolette was indeed painted into a portrait of her while at Fontainebleau.

By the 17th century, the French gem trader Tavernier was writing about this exotic cut. From his epic travels to India, he returned to Europe with many briolette cut gems. Tavernier observed Mogul emperors and maharajahs who sewed briolettes into their turbans and clothing. He adopted this elaborate style of dress for himself. Portraits of him reveal a portly and proud man arrayed in Oriental garb, complete with a tall gem-studded turban. Many magnificent ruby, sapphire, diamond and emerald briolettes can be traced back to this time and culture.

This fanciful style of cutting had many other devotees as well. Louis IV, Marie Antoinette, Henry Philip Hope, former owner of the Hope diamond, and English royalty all owned beautiful gems cut en briolette.

Earrings or necklaces fashioned in briolette gemstones were very popular at the French courts during the time of Napoleon. Napoleon presented a fabulous diamond necklace to Empress Marie Louise containing 10 diamond briolettes, each weighing more than 4 carats. See it on display at the Smithsonian Institution in Washington, DC.

By the 19th century, as diamond cutting techniques evolved, many historic traditions fell victim to progress. Gem cutters abandoned such historic cuts, turning to versions of the modern table crown and pavilion cuts we now have today. Traditional historic cut gemstones like the briolette disappeared as they were recut to the new standards. This ancient art form lay dormant for many years.

It wasn’t until the Victorian and later Art Deco periods that briolettes enjoyed a resurgence in popularity. This trend then faded with the Depression and later post-war years of the 20th century. Briolettes were thought to be a wasteful use of gem rough.

But if you’ve been to jewelry shows lately, or grabbed a trade magazine recently, you’re aware of a huge turnaround in thinking. With a renewed appreciation for history and classic design, briolettes are enjoying center stage once again. Besides being the subject of numerous articles in trade journals, briolettes are being incorporated into the jewelry of many top designers. Their appeal is proving to be timeless.

Despite its colorful history and pedigree, the briolette now appears to be identified with fresh and youthful fashion. Designers like to incorporate the briolette into their line because the cut is fully orbed, allowing for maximum creativity.

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I was astounded at the amount of briolettes at every end of the spectrum at a recent Tucson gem fair. It appeared in everything from diamonds to quartz, loose goods to elaborately crafted one-of-a kind creations. If you haven’t folded the briolette into your lineup, now is as good a time as ever. Your customers will thank you, as they become walking advertisements for your style savvy selection.

Carved in Stone

All idioms have an origin; ancient ones often predate the written word. Did you ever wonder where the saying that something is “carved in stone” came from? Language scholars concur that its root lies with the Biblical Ten Commandments, which were carved in stone. Works for me. Additionally, we know that early cultures, including the Persians, Medes, Egyptians, East Indians, Mayans, and Aztecs left a permanent message for future generations with stone carvings. That’s the fascinating stuff which spawned the likes of Romancing the Stone.
The rich history that follows stone carvings is not limited to Egyptian pyramids or Mayan temples. Consider this; jewels spanning from ancient to contemporary times have often employed this aged technique as well.

Many carving methods are utilized in jewelry design, and some of these might be just the ticket for your jaded clientele who really believe they “have it all” by now. Here’s a look at various carving styles known as cameos and intaglios.

**Cameo** designs were popularized by the Greeks as far back as the 6th century BC. Classic cameo subjects were a female profile, an important political leader, or a deity. Traditionally, cameos were created by bas-relief carving upon a shell or banded agate.

Bas-relief creates a raised carving. In other words, areas are carved away from the subject leaving a raised design, such as a female profile. The use of a natural shell is ideal since the uppermost surfaces remain a creamy white, and the deeply etched out areas are pink, coral, or brown which is an underlying color in the shell material. Banded agate produces the same effect, since carving away at certain areas results in a background of one color and the raised carving will be another.

The annual Tucson Gem and Mineral shows are a great destination for one-stop-gem-shopping, and are where stone-carvers show off their talents. Included in one year’s Tucson gem cutting competition was an impressive tour de force. A large finely carved cameo ring was created from a luminescent moonstone cabochon. The result was stupendous—an ingenious marriage of an ancient technique interpreted in a flamboyant contemporary stone.

Commercially, cameos are enjoying a comeback in our industry. It’s because artisans are on task to better define their brand and thus opt for unpredictable materials. This gives rise to the use of sunstone, rose quartz, blue chalcedony, aventurine, and even opal as a modern cameo choice.

**Intaglio** is another gemstone carving technique seen in early times. The expression that something worthy is described having a “seal of approval”. Ancient Roman rings made for a man’s index finger often featured an intaglio carved stone on top. Intaglio is the reverse of a cameo. A flat stone tablet of agate, carnelian, onyx, bloodstone, lapis lazuli, or hematite was carved down into while the stone itself remained flat on top.

The subjects of classic intaglio design include animals of strength—a lion for example, or symbols which later evolved into family crests, or some unique ‘signature’ icon of the owner. The intaglio was a useful tool for conveying authority with the impression it left upon a drop of hot wax. That’s where “seal of approval” originates. Very old legal documents bore a hardened wax lump into which the person of authority had pressed his intaglio ring while the wax was hot—thus leaving his personal ‘stamp of approval’ on it.

Ancient Persians inscribed emeralds, diamonds and other valuable stones with Arabic script, often honoring a mogul’s reign, or with an Islamic proverb. Recently, on Larry King Live, Elizabeth Taylor, spoke animatedly about her celebrated love of jewels. One of her prize possessions is an ancient inscribed large Golconda diamond tablet. In an Arabic intaglio carving, it identified the ruler who once owned this priceless stone.

Intaglio is well suited for both men’s and lady’s jewelry. And goldsmiths wishing to distinguish their wares from mass manufactured goods favor both cameos and intaglios. Cufflinks and men’s rings are an obvious choice for intaglio. For women, a cameo or intaglio pendant or enhancer and earrings will stand out from everything else. Why not consider adding these expressive, individual looking goods to your inventory.

Today’s educated shopper thinks through their purchases—in other words they buy on purpose. Something of value must have personal meaning for modern consumers. Enjoy passing on the rich tradition that both cameos and intaglios have in the world of fine jewelry. Your clients will relish the knowledge that what they are attracted to has roots as old as time.

### Champagne for Starters
*(See Color Insert #3, plate 4)*

Way back in the seventies you couldn’t persuade a customer to buy a brown diamond at gunpoint. But that was then, this is now. In the mid 80’s when the Argyle Mines in Western Australia began unearthing browns from more than 72% of their total diamond production, things changed forever. Champagne diamonds were “born” from an aggressive marketing campaign performed on those brown diamonds. Since then, the flood of such merchandise purveyed on TV shopping programs and seen dangling from celebrity earlobes has resulted in champagne diamonds becoming very well known.

But what exactly is a champagne diamond, and how can we convey their intriguing past to a customer who has not yet cultivated a taste for these beauties? Plainly spoken, champagne diamonds are a subset of the larger group of brown diamonds, distinguished by their attractive champagne colored hue. Brown diamonds occur in almost all diamond deposits around the world, but Argyle’s disproportionately immense production has resulted in champagne diamonds becoming very well known.

Brown diamonds occur in almost all diamond deposits around the world, but Argyle’s disproportionately immense production of such stones demanded a shift in thinking about these diamonds.

The 2001 spring issue of *Gems & Gemology: Discovery and Mining of the Argyle Diamond Deposit, Australia* included a table that compared traits found in brown, near colorless and pink-to-red diamonds. The brown group and the colorless ones were both Type 1A, but they had significantly different levels of nitrogen content. The brown stones contained 100-500 ppm, contrasted to the near colorless diamond’s...
nitrogen content of 500-1000 ppm. The pink-to-red group, incidentally had 10-100 ppm nitrogen. It also noted that a random group of Argyle colored rough had a relatively small proportion of octahedral or macle shapes. The colored roughs were more often found irregularly shaped or abundantly rounded.

Eventually, the champagne campaign paid off big time and created a call for more precise demarcation of the color varieties. So, Argyle developed a seven level color code to convey the range of color for Champagne diamonds. From the lightest tone, C1 or Light Champagne, to the darkest level, C7 called Fancy Cognac, buyers and sellers could better express the exact depth of brown in their diamond. Pretty stones need pretty monikers, and as a result we hear Vanilla diamond, and Chocolate diamond used occasionally as well.

In the 21st century, the champagne diamond holds court amongst other world renowned natural colored diamonds. The Golden Giant is an immense Champagne colored diamond, weighing in at a goliath 407.43 carats. It is owned by Glick of New York. On the deeper end of the champagne spectrum, the privately-owned Earth Star, a pear shape Cognac diamond weighs a magnificent 111.59 carats.

Your client might be unaware that champagne diamonds are untreated. In an era when laboratories create a mesmerizing array of vividly colored created diamonds, these were formed miles below the earth’s surface in secret.

Champagne diamonds demand center stage as a featured player in highly dramatic wear, but they also add pizzazz to colored stone rings. Champagne diamonds fare equally well in men’s goods as in women’s jewelry. Their warm tones compliment all skin tones, and look especially appealing with hot summer fashion. This year it’s all about rose gold, the darling metal of high end designers. Pairing rose gold with champagne stones is without doubt the smartest way to compliment both the metal and the luminous warmth of champagne diamonds. You’ll be ready to toast with a glass of the bubbly when you witness the response your clientele shows to these natural wonders. Cheers!

Total Blackout
(See Color Insert # 3, plate 8)

At one time, pairing the words black with diamond would have seemed an oxymoron. For most diamond lovers, the whiter the better, with the adulation over fancy colored diamonds being the exception to that rule.

But diamond mining has always produced black material, with superior specimens going directly into private collections. Since diamonds were first mined in India centuries ago, black diamonds routinely appeared in the muddle. Thereafter, unattractive blackish diamonds were downgraded to industrial application, called carbonado. This type of black diamond is distinguished by irregular shaped and undefined rough, porous less dense crystals, and generally a dull, dead looking appearance.

However, when a black diamond is discovered to be rich, tough, and elegantly opaque, another story unfolds. The Amsterdam Black Diamond, originally earmarked for industrial use was soon determined to be much tougher when sawn, than other industrial diamonds. This is one trait of a gem quality black diamond, so the African black crystal of 55.85 carats was cut into a 33.74 carat pear shaped stone. When it went on Christie's auction block in 1973, it set a world record for the highest price fetched for a black at auction-a cool $352,000 US dollars.

Exactly what is meant by black diamond? Its apparent blackness may be the result of crisscrossing fissures in the diamond structure itself. With black sulfide deposits on them, they emerge as opaque. A truly semi-transparent or translucent black stone rarely occurs. Gem quality black diamonds are actually a range of very dark toned semi-opaque stones described as: charcoal or pale black; gun metal, a bright lustrous black; and ink black, an onyx-like appearance, possibly with a lighter saturation.

The “tougher” trait in gem quality black diamonds contributes to a superior polish. While the intense black appearance renders the finished stone nearly opaque, this property produces glamorous highly reflective facets, and razor sharp facet junctions. Well cut black diamonds in large carat sizes offer the best viewing opportunity of this distinguishing feature.

Public recognition often drives the demand and the soaring prices placed on such distinctive jewels. Before attracting international acclaim, the celebrated Black Orloff Diamond sported a lesser known epithet, the Eye of Bramha. When New York gem dealer Charles F. Winson owned it, he valued it at $150,000. Conflicting reports say he valued it at $50,000. In 1969, the stone was sold for $300,000. Inexplicably, it resold in 1990 at Sotheby's for $99,000. The 67.50 carat oval cut “very dark gunmetal colored diamond” had been meticulously fashioned into a diamond and platinum combination brooch-necklace at Cartier. And in 2006, it was purchased from a private collector once again at a jaw dropping $1.5 million US dollars.

A review of black diamonds must make mention of famed Swiss jeweler Fawaz Gruosi who is credited for fueling the current enthusiasm for black diamond jewelry. His luxurious jewels beautify celebrities who grace red carpet events, causing one young star sporting borrowed black stud earrings to gush—“I didn’t even know diamonds came in black.” Gruosi’s self-named heart shaped black diamond might be the largest black diamond of such cut in the world, weighing a hefty 115.34...
Marble. The outstanding black heart is the focus of a necklace with 58.77 carats of smaller black diamonds, hundreds of white diamonds, and tsavorite garnets fashioned in white gold.

The dictionary defines black as: “That which is destitute of light or whiteness; the darkest color, or rather a destitution of all color.” Applied to today’s black diamond supply, destitute hardly describes its impression made on goldsmiths and consumers. The black beauties elicit metaphors such as smart, sleek and cosmopolitan. Black diamonds are ideal for men’s and women’s jewelry. They add class to important neckwear and they bring a contemporary twist when paired with color stone goods.

Currently black diamonds in all carat weights are seen in luxury goods, and each artisan makes his own statement with these dramatic stones. “Less is more” define Paolo Piovan’s Phantom of the Opera black diamond ring. Even the white diamond encrusted shank does not upstage the impressive black oval solitaire. There are only three diamond laden prongs on his snazzy piece.

Contrastingly, the oeuvre accomplished by renowned jeweler Stenzhorn in his wildly exciting black diamond swan brooch deserves kudos for the successful use of midnight colored diamonds in interpreting this lyrical design.

Things of beauty unchain genuine inspiration as evidenced with custom jeweler Sheryl Jones. Her innovative take on classical forms refresh the eye of jewelry lovers. Her offerings are both modern and chic. Using high quality black diamonds in stylish white gold cuff links, Jones makes good use of black diamonds’ very uptown look.

Black diamond’s star is undeniably on the ascent as public perception of this natural gemstone evolves. Appreciation for its colorless place in diamond history has yet to be fully realized. But with pacesetters on task to exploit the sultry stones’ particular elegance, we’ll be seeing black for some time. (For more on black diamonds, see Section II: Mineralogical Miscellany)

Heads Up!
(See Color Insert # 3, plate 5)
Reason is God’s crowning gift to man
Sophocles 496–406 BC

The phrase “the crowning gift” or “crowning touch” is uttered when something reaches perfection. And it appears that actual crowns, tiaras and diadems were also created to portray that symbolism. They served as emblems of achievement, a sports victory, part of religious garb, a sign of sovereignty, or to identify a deity. All three types of headgear share ancient roots, but each name identifies a distinctly separate topper.

From its beginning, the majestic crown played a role of tremendous import in inestimable societies. They were essential to royal regalia. Middle Eastern and early Egyptian crowns in particular were impossibly tall and funnel shaped headgear. Perhaps the extreme height in itself served a purpose. During those early times, elaborate rituals were conducted before an entire nation. The huge headgear made it possible for thousands of people to see the leader from afar. And throughout its long evolution, a crown is still distinguished by entirely covering the dome of the head, and is often enclosed.

Consider just how gargantuan early crowns were by reading this ancient Biblical account:
“David took the crown from the head of their king—its weight was found to be a talent (75 pounds) of gold, set with precious stones—and it was placed on David’s head.” 1 Chronicles 20:2

Modern crowns are created to be elaborately jewel-studded golden headwear. However for early crowns, the use of precious metals and gemstones were an occasional or later addition. For example, The Assyrians fixed a pair of bull horns on crowns for embellishment, and to symbolize authority. A circle of short feathers was added to their ancient tiaras. As these regal caps developed over time, they transformed into magnificent gear, flaunting the nation’s power and wealth.

Modern society associates diamonds with crowns and tiaras, but a surprising number of other gemstones have been employed in designing majestic headwear. The 13th century Russian Crown of Monomakh looks like a golden fur trimmed beanie decorated with pearls and colored stones. The 19th century tall domed shaped French crown of Charlemagne is encrusted with cameos all around.

Another example of surprising gem choices for posh head coverings occurs in an opulent turquoise and diamond crown Napoleon I gave to his consort Empress Marie Louise. The silver crown contains 950 diamonds and 79 large rare Persian turquoise stones cut en cabochon. They replaced emeralds originally set in that crown, and it attracts great attention to its display at the Smithsonian Institute’s Museum of Natural History.

In 1967, celebrated jeweler Van Cleef & Arpel created an extremely complex crown for the then Empress of Iran. Massive, intricately carved emeralds and sapphires dominate the corona piece also featuring natural pearls, diamonds and rubies.

Diadems, first made for male regalia, and as a mark of distinction, were awarded to the victors at Greek games, and were a woven ring of leaves. Early royal diadems were fashioned from long strips of silk or other fine fabrics about

The late Princess Diana wears the Spencer family tiara
two inches wide. They were placed as a band wrapped tight and low about the forehead, with the long strands falling across the shoulders where it tied at the back of the neck. Diadems later evolved into arched front gold headbands worn low, eventually eliminating the long flowing strips. Yes, Lynda Carter’s Wonder Woman of the ‘70s, wore a classic diadem placed across her forehead.

A beautiful young Princess Diana thrilled onlookers years ago as she danced with Prince Charles at a ball honoring their official visit to Australia. To complete her regal ensemble that evening she chose an elaborate emerald encrusted necklace worn low across her forward in true diadem fashion, creating an unforgettable fashion statement.

Tiaras, now so associated with beauty pageants that the dictionary defines them as “an ornamental, often jeweled, crown-like semicircle worn on the head by women on formal occasions.” Historically though, their function and form were much more purposeful. Popes wore—and still wear richly embroidered fabric tiaras while performing religious duties. Online encyclopedia www.wikipedia.com cites that ancient male rulers wore tiaras described as “a high crown, often with the shape of a cylinder narrowed at its top, made of fabric or leather, and richly ornamented. It was used by the kings and emperors of ancient people in Mesopotamia.”

While religious figures still use tiaras of highly embellished fine fabrics, the contemporary feminine tiara is a semi-circular bejeweled head decor usually of fine metal with diamonds or other precious stones, often secured to the head with small metal combs at each end of the tiara, which shall disappear under the coiffure.

Victorian jewelry is renowned for its complicated look or multi-functional ability. One such item in the collection of wholesale antique jeweler eFiligree, is a rare 1840s bracelet-tiara combo. This unusual piece was fabricated from diamonds set in gold overlaid with sterling, a common practice of that era. It functioned as a tiara-shaped bracelet, and while small, it served as a diminutive tiara on occasion.

When important diamonds are embedded in stately headwear the effect is jaw-dropping. The late Princess Margaret’s historic Poltimore Tiara went up for auction at Christie’s London in June 2006. Designed in 1870 by Garrard for the wife of second Baron Poltimore, Christie’s estimated its value at US $370,000. Princess Margaret wore the famed tiara at her wedding. When the furious bidding was over, the hammer came down with $925,000 pounds for an elated anonymous Asian collector.

If anyone can trump the attention paid to bona fide royalty, it would be Hollywood celebrities. A young Elizabeth Taylor wore a diamond tiara given to her by producer husband Michael Todd one year to the Oscars. Although she demurred that they were a bit out of style at the time, Todd called her his queen and she could hardly refuse to acknowledge his romantic gesture.

Today’s young stars are once again giving preference to these splendid embellishments.

When raven haired beauty Catherine Zeta-Jones married Michael Douglas in 2001, she opted to finish her look with an Edwardian tiara. And TV chat show personality Star Jones headed straight to legendary jeweler Fred Leighton for one of his opulent diamond tiaras when she tied the knot in 2004.

Florida artisan Karen Tweedie received an unusual request from a client recently asking for something completely unlike her tropically inspired contemporary fashion jewelry. His wife’s milestone birthday warranted an especially creative present. When younger and less affluent, he would often tease that she should wear her tiara on date nights. Now he wanted to actually give her one. So Tweedie produced a modern tiara in freshwater and cultured pearls, with white and golden topaz faceted stones set in sterling, to the delight of the recipient.

With so few occasions actually requiring crowns diadems and tiaras nowadays, one turns to beauty contests when the urge for coronet-ogling occurs. Indian pageants rank supreme when it comes to extraordinarily imaginative tiaras. For example, the Miss India-Earth tiara for 2004 is a delicate feathery spray of white, blue, and green transparent faceted stones artfully arranged to represent a showy peacock.

Crowns, diadems, and tiaras have a come a long way since their humble, leathery animal horned beginnings. Most of us who will never actually own an actual regal headpiece can still appreciate their ability to transform the wearer into becoming something out of this world.

Rutilated What?
(See Color Insert #3, Plate 7)

This material has long fascinated sculptors who view this stone as elegant and expressive, with randomly placed crystal needles contributing toward an entire design.

Beauty, durability, and rarity top a short list for sought after gemstones. That’s why rubies and sapphires towered above other color gemstones for centuries.

However, an explosion of interest in color stones lately has driven miners to search for new varieties of colored stones, and to reintroduce existing gems, which have been relegated to obscurity through negligence.

Rarity or price alone doesn’t necessarily translate to beauty, does it? Let’s look at rutilated quartz again with a “new” eye. The glimmering golden needles seen inside rock crystal or smoky quartz are rutile crystals, a titanium mineral that formed in place prior to the transparent quartz (SiO₂ – silicon dioxide) being crystallized around them.

This material has long fascinated sculptors who view this stone as elegant and expressive, with randomly placed crystal needles contributing toward an entire design.
Michael Scott, the renowned gemstone collector loans his world-class collection to museums around the world. When his mammoth rutilated quartz sculpture, Metamorphosis VI, executed by master cutter Bernd Munsteiner was exhibited at the Bowers Museum in Southern California, it warranted its own staging area. Mounted over its under-lit base, viewers could best appreciate the rutile needles traversing the human torso size 213.4 pound or 485,461 carat carved rutilated crystal quartz. It is believed to be the world’s largest faceted gemstone, hewn from a one-ton quartz boulder at Bahia, Brazil.

A few years back, one could acquire this naturally occurring oddity at publicly attended mineral and gem shows on the touring circuit. Visiting a flea market or summer craft fair? There it was—languishing in boxes casually strewn around by rock hounds or wired wrapped in costume jewelry. The stone was polished en cabochon or tumbled into freeform nearly natural shapes, with little regard placed on its final size. It was cheap—and under-appreciated.

But a revitalization has taken place with this material, and its about time. No two stones are alike, the inclusions are naturally occurring, and look again—it’s beautiful. Really beautiful. Rock lovers know that quartz is plentiful, and this aspect has erroneously led to the conclusion that rutilated quartz is not precious.

Everywhere from custom manufacturers at JANY (Jewelers of America New York Trade Show), to the Tucson gem fair, to regional trade shows like Atlanta, rutilated quartz has found a new and well-deserved audience. Lately this stone is favored in high-end goods, and at handsome prices. Rutilated quartz compliments the warmth of yellow gold, and it contrasts beautifully with diamonds and color stones. Bold designers view it with “new eyes”, and pair it with valuable accent stones in precious metals. Creative jewel artisans will turn out a custom pendant or ring featuring rutilated quartz in the $2,500 range (retail) and buyers are lining up.

Seen in today’s rutilated quartz are well thought out cuts designed to show off the inclusions, precise calibrated shapes, and available in specific carat sizes. Previously, freeform unrepeatable cuts were all that were required to market this stone to hobbyists and amateur collectors. Now the trend is towards calibrated sizing in quantity, albeit large carats for maximum viewing of the needles. Stylish sugarloaf cabs are a handsome choice for many translucent to opaque stones and are created with the intent to wow both the owner and the observer with its beauty and display of carving skills.

Hand-carved Nubian female profile cameo brooch (Source: August Mayer)

Technically, cameos and carved gemstones made for jewelry and object d’art can be separated into a few categories. Traditional cameos are miniature bas-relief sculptures that are made by carving down into a shell or agate or some other hardstone. Those materials which are naturally layered with color banding are ideally suited since they project a greater impression of depth to the carving. The image being carved raises up to the viewers eyes.

Cameo Appearance

(See Color Insert # 3, plate 3)

Ok. Let’s make a quick word connection—think cameo. “Grandma” is your answer? Try again. The ancient art of cameo making, old as it is, has undergone a sensational make over in recent years. And jewelers at every price point are serving up sumptuous carved treats to their insatiable clientele.

The ancient skill of cameo carving is deeply rooted in prehistory. After all, early Neanderthals were found to have scratched graffiti on the walls of caves at Lascaux, France. Man has been fascinated with carving onto or into stones ever since. By 900 B.C. the Etruscans took the lead by making splendid carved gemstones set in intricate gold mountings that still leave contemporary jewelers scratching their heads.

Each culture has had its own version of the cameo. While every epoch has utilized time-honored methods of carving, it was their subject matter that changed over time. Cameos used to honor heroes, real or mythological. They also served as a means of storytelling—so there are certain cameos which are called appropriately “story cameos” because they depict an historical or traditional event. Victorian era cameos served to communicate hidden meanings from the suitor to the object of his affection. Modern cameos for the most part are created with the intent to wow both the owner and the observer with its beauty and display of carving skills.

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Another type of cameo is the intaglio, (just say in-tall-yo) which is carved from any kind of stone, shelf, or colored gem. The difference with this carving process is that the surface, either flat or cut en cabochon is etched down into the gem and
so the design recedes away from the surface and the eye of the viewer. In effect, this is reverse image, and early intaglios whether set in a ring or simply as a seal were used as official “signatures” of the owner. They served to authenticate a document, or prove who the author of a letter was. Intaglios can also be carved from the underside of a transparent stone. That way the viewer looks through the top of the stone seeing a dimensional carving seemingly frozen inside the stone, rendering a highly dramatic effect.

Lastly, a shell, hardstone or any kind of transparent or solid gemstone can be carved completely on all sides, and that is called a glyptic carving. When set in jewelry, the mounting will always accommodate viewing of all sides of this piece. If you’re going to study glyptic carvings, you might as well start with the best. Perennial award winning carver Dalan Hargrave created a stunning Lady profile in 235 carats of Lightening Ridge opal, Montana sapphire and diamonds set in 18k gold. Now that’s attention to detail.

Everything old is new again—and that phrase suits the cameo genre perfectly. While persons of a certain age may recall grandma sporting a prim little cameo on her bodice—today’s cameos have little in common with those matronly vintage adornments.

From couture jewelers like Gurhan to popular mass merchandised clothing designers like Jessica McClintock, the cameo has found its new audience—and they are applauding. The JCK Vegas show and New York’s JANY this year included cameos at many exhibitors’ booths. The modern take on cameos is directed to today’s savvy shopper. The proportions fit contemporary fashion, and the stones themselves are best fit for knowledgeable women who can buy anything they like. It doesn’t hurt when celebrities are caught wearing a prominently placed bauble either. Sex in the City maven Sarah Jessica Parker is said to have caused spiked sales in cameos for months after being photographed wearing a sizeable shell cameo brooch to a glitzy event.

Trendy SoHo designer Alexis Bittar applies tongue-in-cheek humor in his cameo collections which show carved ladder back chairs and old clapboard school houses carved on his shell cameos for a hip clientele. Idar-Oberstein master-carver Hans-Ulrich Pauly uses the same superb technique on traditional subjects as he does on his whimsical little snow skiing polar bear. Torre de Greco cameo company CASCO hand carves classic themes like Bacchante or Medusa but with a twist by carving the female portraits so convincingly modern that one believes they could actually meet the person that was carved. CASCO also tell us that their top market for the past few decades has been Japan, of all places. Meeting the needs of that market includes creating edgy skull rings for the Goth crowd. Italian Designer Giuseppe Zanotti didn’t miss a step this season with his sky-high heeled black booties sporting a lovely classic lady’s profile cameo embedded in the heel.

Before any jewelry hits the mainstream, it’s often first previewed in award winning designs in Tucson at AGTA Spectrum Competitions. For the last few seasons, richly colored transparent gemstones carved into ethereal portrait cameos like those from carver Chu-Alice Chan, have been turning heads and walking away with accolades at this competition. Whether it’s from the volume manufacturer or couturiere jewelry, it seems like every designer is making a cameo appearance now.

Analyzing the Aftermath—the JADE Act

Embargo on gemstones originating from Myanmar, formerly Burma, is nothing new. But the backlash, and divisive commentary in the wake of the latest officially implemented ban is bound to polarize many members within the gem trade. And oddly enough, all those voices have a point—and a valid one.

Aimed at penalizing the Burmese ruling junta through embargo, the US government had banned products coming from Burma since 2003. However the broad language of that earlier sanction permitted the importation of Burmese-origin gems that were cut or polished elsewhere. On July 30, 2008 President George Bush signed into law the Tom Lantos Block Burmese JADE Act, restricting the import of precious Burmese gems and stones.

Some observers claim the previous sanctions had a loophole. Others argue it was no loophole—that the earlier ban simply expressed a different set of parameters for gemstone importation. So unlike The former embargo, the JADE Act ban now clearly states that Burmese-origin jadeite and ruby including those which have undergone “substantial transformation” elsewhere are to be banned from coming into the US. The only exception would be Burmese gems brought in for “personal consumption.”

While the industry contemplates these new developments, the global gemstone community already voices disparate opinions. Director of Public Affairs for Jewelers of America (JA), Peggy Jo Donohue assured that the JA will make certain that its members clearly understand that no rubies or jade mined in Burma may be imported legally into the U.S. And, Donohue added, to be certain, “Jewelers should seek written
assurance from their suppliers that they will not knowingly supply these banned gems.”

The comprehensive nature of the JADE Act spelled out in lengthy legalese may appear to be a daunting task when it comes to sorting it all out. But the Jewelers Vigilance Committee (JVC) has streamlined this concern with information clearly spelled out on their website for those interested. www.jvclegal.com

It’s impossible to prove some stones have been in the US prior to the implementation of the JADE Act, certain dealers worry. Old stock—really old stock may not have the paper trail that the current legislation demands in order to sell existing stock that may have come from Burma—or not. Proving the origin is a hotly debated topic where this new ban is concerned.

Some people mistakenly believe the determination of origin—not how long it has been in the US, is at least a done deal. Inclusions and fluorescence clues some feel, are failsafe and will tell if a ruby originated in Burma. Not so fast, warns Christopher Smith, vice president and chief gemologist, of American Gemological Laboratories (AGL).

Burmese rubies are found in three major deposits; the Mogok Valley, Mong Hsu and Namya Zeik. Yes it’s true that a number of indicators can assist in separating ruby from Burma and ruby from other sources around the world. These indicators are various inclusion and spectroscopic features, internal growth structures, and chemical composition.” Still, since there are ruby deposits in other locales whose geologic environs almost mirror that of Burma, in many instances, “distinguishing these sources from Burma ruby can range from straightforward to very difficult.”

Noted ruby and sapphire authority Richard Hughes believes that the statistics involving the sale of Burmese ruby are grossly misleading. “Claims that the junta earns $300 million a year from the sales of gems are based upon gross gem auction proceeds, but in reality many of the lots sold at auction are owned by private parties, not the junta,” Hughes states.

Time will tell whether this law which intends to send a punitive message to the brutal ruling junta of Myanmar achieves its desired effect. No one as Douglas Hucker, CEO of American Gem Trade Association (AGTA) understand it, wants to see the innocent victims of this legislation become the fall guy to this ban “My concern, Hucker stressed, “is that this Bill is going to hurt the wrong people like the artisanal miners, instead of the junta.”

The ripple effect of the Burmese ban spreads to Thailand, and surrounding nations which traditionally cut these stones. Gem dealer Bill Larson, president of Palà International, spends a great deal of time in Asia. “These are independent (Burmese) miners who supply the Thais; and the dealers all come to Thailand unofficially,” Larsen points out. So he feels that ruby sales do not enrich the Burmese government. “Who it will affect are the thousands of Thais in the cutting and jewelry industry.”

Montreal-based gem dealer Pramendra Baid of La Pierre Precieuse Inc., sees a closer-ranged unintended consequence. Baid forecasts a flood of Burmese goods having entered the US ahead of the ban enforcement, resulting in an unwanted price hike for Burmese goods. The residual challenge, Baid predicts will be in serving the upper tier of the market. Nothing else quite looks like Burmese ruby, he says. Ruby from other countries lacks the color saturation and clarity as fine Mogok ruby. Baid also foresees difficulties with implementing the new documentation requirements for Canadian-based importers and manufacturers who sell to the US because “origination documentation for previously purchased rubies (both Burmese and non-Burmese) will be difficult if not impossible to obtain.”

In the end, all of these well founded concerns are mitigated by the cohesive unity of trade members not wishing to support a government whose human rights abuse records are so abysmal. And the various voices all make their point. JA Director of Public Affairs Donahue affirmed, “Until genuine democratic reform becomes a reality in Burma, such sanctions are necessary to send a clear message from American jewelers to the ruling military regime.”

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**Biography of Diana Jarrett**

Award-winning journalist and gemologist Diana Jarrett has penned The Story Behind the Stone in Southern Jewelry News and Mid-America Jewelry News since 2005. Diana began her career in the jewelry trade while living in Southern California and working in the TV and film industry. But her lifelong interest in the natural beauty of gemstones evolved into another profession and she soon found herself working at Sotheby’s in Beverly Hills, and writing for luxury designers there while attending Gemological Institute of America (GIA).


Diana shares her home in rural Tennessee’s horse country with Baileys Irish Dream, her own rescued Schnapso - a mini-Schnauzer Lhasa Apso mix.
Periodic Chart of the Elements

Elements & Mineralogy was a series of articles written by Bill Shelton that dealt with the relationships between elements and minerals, including data about rarity and occurrence in nature. (See Color Insert # 4, plates 1-8)

Introduction

One hundred twenty-five years ago, a collector might have become interested in elements and minerals and perhaps joined the newly-formed New York Mineralogical Club. He would have had very few books to reference; perhaps only the 6th edition of Dana was available to him. My copy, from 1892, says “First Thousand” and it will be referenced here briefly. Therein, one can find diamond, graphite, sulfur, selenium, tellurium, arsenic, antimony, bismuth, zinc (?), gold, silver, copper, mercury, lead, platinum, iridium, palladium, and iron. A few other alloys, etc. are also listed. The list of elements and alloys, etc. is longer today partly due to high-tech equipment available to researchers. Many of the newer species do not present themselves in specimens that suit many collectors – microprobe mounts are all that exist for some species.

A few elements have either no known species that appear in the ideal formula, or only a very few known examples. Rubidium, polonium, astatine, francium, actinium and praseodymium serve as examples of such elements.

In the series that follows, you will find associated data for the rarity of elements and the number of species for the elements with common examples of collector-type minerals, many of which you are probably already familiar. Recent re-examination discounts some previous mineral species that would be considered elements or alloys but that is a separate issue. All mineral species are counted here and some will be counted more than once. For example, corundum is an oxide, an aluminum-bearing mineral, and an oxygen-bearing mineral. The totals are subject to some changes and could be interpreted in other ways, but this is merely one method you might choose in order to become more familiar with minerals based solely on chemical composition. From a base of 92 naturally occurring elements, we can demonstrate the existence of more than 4,000 mineral species today. Perhaps one or two hundred minerals comprise the bulk of many collections held by private individuals.
**Part I: Native Elements**

Native elements will be covered first since they are the vast exceptions in nature; almost all elements occur in a combined state.

*Native Element –* An element found uncombined with any other and forming naturally in the earth’s crust.

There are ten elements that I consider to be the most common native elements. One of these, carbon, occurs as two very different minerals: diamond and graphite. The remaining ones share their mineral name with their elemental name; that is to say sulfur is used as both a mineral and elemental name. As you will see below, the number of minerals noted for each element does not correlate well with the relative rarity. Compare the data for platinum and bismuth and you will notice a fairly dramatic difference. A similar comparison between carbon and sulfur will also illustrate this same concept. Iron and sulfur shows a barely believable situation based on rarity. There is a difference factor of 200 in rarity but only 15% for the number of minerals.

<table>
<thead>
<tr>
<th>Element</th>
<th>Symbol</th>
<th>No. of Minerals</th>
<th>Relative Rarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold</td>
<td>Au</td>
<td>28</td>
<td>0.004 ppm</td>
</tr>
<tr>
<td>Silver</td>
<td>Ar</td>
<td>126</td>
<td>0.07 ppm</td>
</tr>
<tr>
<td>Copper</td>
<td>Cu</td>
<td>437</td>
<td>55 ppm</td>
</tr>
<tr>
<td>Platinum</td>
<td>Pt</td>
<td>37</td>
<td>0.01 ppm</td>
</tr>
<tr>
<td>Iron</td>
<td>Fe</td>
<td>883</td>
<td>5% (50,000 ppm)</td>
</tr>
<tr>
<td>Arsenic</td>
<td>As</td>
<td>387</td>
<td>1.8 ppm</td>
</tr>
<tr>
<td>Antimony</td>
<td>Sb</td>
<td>195</td>
<td>0.2 ppm</td>
</tr>
<tr>
<td>Bismuth</td>
<td>Bi</td>
<td>148</td>
<td>0.2 ppm</td>
</tr>
<tr>
<td>Carbon</td>
<td>C</td>
<td>272</td>
<td>200 ppm</td>
</tr>
<tr>
<td>Sulfur</td>
<td>S</td>
<td>761</td>
<td>260 ppm</td>
</tr>
</tbody>
</table>

In terms of collector knowledge, most, if not all of these minerals should be familiar to you. The most common element in the crust and listed above is, of course, iron, but as a native element it is fairly rare. It generally occurs in compounds; there are hundreds of examples. All of the remainder are rare and comprise a very tiny amount of the Earth’s crust. Chemically, many of the elements are classed as metals; this includes gold, silver, copper, platinum and iron.

Arsenic, antimony and bismuth are examples classified as semi-metals while sulfur and carbon are considered to be non-metals. Carbon is commonly found among carbonate minerals while much sulfur occurs within sulfides and sulfates. Both carbon and sulfur are elements used to name major mineral groups (only a dozen elements are noted in this category). This matter will be covered in part II.

Antimony occurs in stibnite, kermisite and also as a native element. Arsenic occurs in arsenopyrite, orpiment, and also as a native element. Bismuth occurs in bismuthenite, bismite, and also as a native element.

Since many collectors select native elements for their collections, they are disproportionately represented in most cases. A casual survey at shows implies that the rarity of minerals is totally irrelevant in terms of what you find offered for sale. Museums, like collectors, seem to prefer certain minerals – again, unrelated to rarity or importance in, say, industrial processes.

**Gold on quartz, Sutter’s Mine, California**

**Part II: Mineral Groups**

Some elements are notable in major mineral group names; they obviously occur there quite often but not necessarily nowhere else. Recall the comments in Part I regarding carbon and sulfur. Other elements may be incorporated, notably oxygen as you can see in the chart below. A name for a group tells you what the major element(s) you should expect to find will be for the group, e.g., boron and oxygen in the borates. (See chart on next page).

**Diamond and graphite, forms of carbon**
<table>
<thead>
<tr>
<th>Group Name</th>
<th>Element of Name</th>
<th>Other Elements (In Name)</th>
<th>No. of Minerals</th>
<th>Relative Rarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfides</td>
<td>Sulfur</td>
<td>None</td>
<td>~600</td>
<td>260 ppm</td>
</tr>
<tr>
<td>Oxides</td>
<td>Oxygen</td>
<td>None</td>
<td>350</td>
<td>47%</td>
</tr>
<tr>
<td>Halides</td>
<td>See below**</td>
<td>None</td>
<td>160</td>
<td>950 ppm (F)</td>
</tr>
<tr>
<td>Carbonates</td>
<td>Carbon</td>
<td>Oxygen</td>
<td>200</td>
<td>C 480 ppm</td>
</tr>
<tr>
<td>Borates</td>
<td>Boron</td>
<td>Oxygen</td>
<td>150</td>
<td>B 10 ppm</td>
</tr>
<tr>
<td>Sulfates</td>
<td>Sulfur</td>
<td>Oxygen</td>
<td>350</td>
<td>S 260 ppm</td>
</tr>
<tr>
<td>Chromates</td>
<td>Chromium</td>
<td>Oxygen</td>
<td>10</td>
<td>Cr 100 ppm</td>
</tr>
<tr>
<td>Tungstates</td>
<td>Tungsten</td>
<td>Oxygen</td>
<td>30 (inc. below)</td>
<td>W 1 ppm</td>
</tr>
<tr>
<td>Molybdates</td>
<td>Molybdenum</td>
<td>Oxygen</td>
<td>30 (inc. above)</td>
<td>Mo 1.5 ppm</td>
</tr>
<tr>
<td>Phosphates</td>
<td>Phosphorus</td>
<td>Oxygen</td>
<td>400</td>
<td>P 1,000 ppm</td>
</tr>
<tr>
<td>Arsenates</td>
<td>Arsenic</td>
<td>Oxygen</td>
<td>230</td>
<td>As 1.5 ppm</td>
</tr>
<tr>
<td>Vanadates</td>
<td>Vanadium</td>
<td>Oxygen</td>
<td>75</td>
<td>V 160 ppm</td>
</tr>
<tr>
<td>Silicates</td>
<td>Silicon</td>
<td>Oxygen</td>
<td>1050</td>
<td>Si 28%</td>
</tr>
</tbody>
</table>

**Halides** – a group of related elements including fluorine (F), chlorine (Cl), Bromine (Br), and iodine (I). Cl has a relative abundance of 130 ppm. There are very few common minerals with these elements present in large percentages. Fluorite is the most common example.

Part III: Common Elements

What are the most common elements? It depends on which source you look at: the general consensus is similar and presented in the chart below.

<table>
<thead>
<tr>
<th>#</th>
<th>Klein</th>
<th>Wenk-Bulakh</th>
<th>Emsley</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>2</td>
<td>Si</td>
<td>Si</td>
<td>Si</td>
</tr>
<tr>
<td>3</td>
<td>Al</td>
<td>Al</td>
<td>Al</td>
</tr>
<tr>
<td>4</td>
<td>Fe</td>
<td>Fe</td>
<td>Fe</td>
</tr>
<tr>
<td>5</td>
<td>Ca</td>
<td>Mg</td>
<td>Ca</td>
</tr>
<tr>
<td>6</td>
<td>Na</td>
<td>Ca</td>
<td>Na</td>
</tr>
<tr>
<td>7</td>
<td>K</td>
<td>K</td>
<td>Mg</td>
</tr>
<tr>
<td>8</td>
<td>Mg</td>
<td>Na</td>
<td>K</td>
</tr>
</tbody>
</table>

For positions 1-4, all are in agreement; beyond that point the same elements are selected but in a different order. Another interesting situation occurs when one looks at atomic percentages. In this case, there is a major difference: O, H, Si, Al, Na, Mg, Ca, and Fe are the first eight elements with K in position 9. One could conclude that hydrogen is in fact very important in minerals, but due to the low weight of the element it does not register in the weight percentage table (at least not in the first eight positions.) [Most of the H is probably locked up in water and ice. You can consider ice to be a mineral.]

**Hydrogen** – the lightest element; the most abundant in the cosmos; second only to oxygen in the number of minerals. A major component of water and all living things.

It is very sensible to realize most of the bulk of the crust will be silicates with aluminum and some iron. Which minerals are the most likely choices? Feldspars, quartz and some rock-forming pyroxenes and amphiboles seem most likely. Olivine, garnet and cordierite are other very common examples. For specific species of, say, pyroxenes, one can consult any general reference book.
Collectors may want to try and amass a sub-collection of well-crystallized and perhaps aesthetic common rock-forming minerals. On occasion, collectors have worked to form a suite of feldspars that show variations in crystal form, twinning, and various localities (even Dana Localities) known for these species. Museums often choose to show relatively few examples of the most common species. Part of the mission for some museums is to serve as a repository for many species including the exceedingly rare ones. These and some common ones as well are not seen by the visitor unless you get to see the storage behind the scenes.

Some minerals are essentially composed of only the eight elements listed above. They include ruby and sapphire (corundums), hematite and magnetite. Wollastonite, a silicate, fits here too. Ilmenite, the garnets, pyrope, grossular, almandine and andradite also belong here. Kyanite and andalusite are other examples. Enstatite, aegirine, jadeite and diopside join nepheline as additional representatives. Can you tell whether analcime or leucite belongs here? Are they both representative of the eight elements?

**Part IV: Group IA**

There are several ways to handle the elements. A decision to follow the periodic table arrangement by group is the pattern that will be utilized. Group IA includes the very common elements sodium and potassium. Some others are interesting from the mineralogical point of view.

<table>
<thead>
<tr>
<th>Element</th>
<th>Symbol</th>
<th>No. of Minerals</th>
<th>Relative Rarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen</td>
<td>H</td>
<td>1,921</td>
<td>1,500 ppm</td>
</tr>
<tr>
<td>Lithium</td>
<td>Li</td>
<td>65</td>
<td>20 ppm</td>
</tr>
<tr>
<td>Sodium</td>
<td>Na</td>
<td>560</td>
<td>2.3 %</td>
</tr>
<tr>
<td>Potassium</td>
<td>K</td>
<td>288</td>
<td>2.1 %</td>
</tr>
<tr>
<td>Rubidium</td>
<td>Rb</td>
<td>1</td>
<td>90 ppm</td>
</tr>
<tr>
<td>Cesium</td>
<td>Cs</td>
<td>10</td>
<td>3 ppm</td>
</tr>
<tr>
<td>Francium</td>
<td>Fr</td>
<td>-</td>
<td>Extreme</td>
</tr>
</tbody>
</table>

Hydrogen occurs in a huge number of minerals and a list would be pointless. You may find water within a mineral structure or the widespread OH structural unit known as hydroxyl. Considering its rarity, there are a huge number of species. Lithium, really quite rare (# 31 amongst the elements) compared to some others in this group, has a small number of species but many are important and desirable to collectors. Spodumene, lepidolite, petalite, and amblygonite are some of the most common examples. Sodium, extremely prevalent in both mineral count and relative rarity for elements, is noted in such common minerals as feldspar and mica (which are, of course, groups and not separate mineral species). Perhaps you know it is present in common salt; the mineral name is halite. Curiously, potassium has a lot less minerals in spite of being close to sodium in relative rarity. Orthoclase, a feldspar, along with sylvite, carnallite and alunite are some examples; it is perhaps better known in the numerous silicates like certain mica group members.

**Rubidium and Rarity** – The unusual appearing data is explained by its usual occurrence in K minerals substituting, for some of the potassium.

Poor rubidium is the middle member in rarity but only one mineral is found where Rb is a major component. This may seem odd but see the chart for more. One author suspects that Rb might be even more abundant (albeit dispersed) than the data suggests. Cesium, rare in both respects, is very interesting to collectors. Pollucite, perhaps the most common mineral example, is known from many areas, but recent crystals from Afghan and Pakistani areas are quite fine. The mineral rhodizite is also very desirable amongst collectors. Both cesium and lithium can be found in small amounts in beryl. This situation helps us understand why some elements appear to have virtually no mineral species, at least in which the given element is a dominant member in the mineral. The dispersal of a few elements is in and of itself an interesting phenomenon. Francium is not an element of concern in this article.

**Part V: Group IIA**

One of my favorite elements is found in Group IIA. Many collectors are fond of some of the minerals that are major species bearing these elements (like calcite, barite and beryl). Beryllium, my favorite, occurs about as often as cesium (see the previous article) but has 19 times as many mineral species. Beryl, chrysoberyl, helvite, herderite, hambergite and bertrandite are some of the more common species that contain beryllium.

<table>
<thead>
<tr>
<th>Element</th>
<th>Symbol</th>
<th>No. of Minerals</th>
<th>Relative Rarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beryllium</td>
<td>Be</td>
<td>71</td>
<td>2 ppm</td>
</tr>
<tr>
<td>Magnesium</td>
<td>Mg</td>
<td>555</td>
<td>2.3%</td>
</tr>
<tr>
<td>Calcium</td>
<td>Ca</td>
<td>867</td>
<td>4.1%</td>
</tr>
<tr>
<td>Strontium</td>
<td>Sr</td>
<td>74</td>
<td>370 ppm</td>
</tr>
<tr>
<td>Barium</td>
<td>Ba</td>
<td>142</td>
<td>500 ppm</td>
</tr>
<tr>
<td>Radium</td>
<td>Ra</td>
<td>—</td>
<td>0.6 ppt</td>
</tr>
</tbody>
</table>

A few collectors have actually chosen to collect only beryllium minerals. Be is the 47th element in rarity, placing it near the mid-point of the 92 elements. You should notice that beryllium is 250 times rarer than barium. In spite of the rarity, it has only half as many minerals noted according to the sources referenced for this series. Some factors that explain this away are chemical reactivity and geologic isolation of some elements.

Magnesium is a common element represented by many species in carbonates like dolomite and magnesite. Other common species that contain magnesium include pyrope,
spinel, pyroxenes and amphiboles, chrysotile, micas, serpentines and talc. Calcium is very important: the largest number of species with few exceeding it proves the point. Fluorite, calcite, dolomite, feldspar, pyroxenes, wollastonite, amphiboles, garnets, scapolite, vesuvianite, datolite, epidote, prehnite, ilvaite, many zeolites, titanite, microlite, apatite, anhydrite and gypsum are some of the numerous relatively common calcium-bearing species known to collectors. Scheelite, which is a collector favorite, also belongs here. At least one collector I know has a vast sub-collection of scheelite from worldwide localities.

Calcium combines with a diverse group of elements, some as radical groups, and forms fluorides, phosphates, carbonates, sulfates and silicates. It is everywhere in the mineral world. Calcium is vital to living things, notably in bones and shells. The diversity of its minerals makes this element very significant to collectors.

Strontium can be found in strontianite (its namesake) and celestite, another collector favorite. Ancylite, brewsterite and goyazite are others, however they are less common. Barium, with a namesake barite is the last mineralogically important element in this group. Collectors very often have a number of barites in their collections. Witherite, a carbonate, is also fairly widely known; less common examples include bromlite, celsian (a feldspar), brewsterite, harmotome and benitoite, another very desirable species amongst collectors. Radium is not an element of concern in this article.

### Part VI: Groups III through VII A

This multiple group (III to VII A) has a lot of elements along with a few related common collector minerals. Information on some is less readily available but here is some of the best data found about them. No common minerals exist for some of these elements; a couple of elements have none that were listed in the sources reviewed for this series. So, not all of these are covered in the article.

Yttrium, rather rare but found in many minerals, sometimes in small amounts, is of interest due to xenotime, a phosphate, gadolinite, euxenite, polycrase, and steenstrupine among others. Mineralogically, titanium is very important and has a large number of species including titanosilicates. The namesake, titanite, is the most common member here while other species include ilmenite, rutile, anatase, brookite, benitoite, neptunite, perovskite, pseudobrookite and pyrochlore. Zirconium, notably in the mineral zircon, also occurs in baddeleyite, elpidite, catapleiite and eudialyte. Notice that Ta has nearly the same number of species but is almost 100 times rarer. Vanadium, while it has quite a few species, is rarely found as a main component in collector minerals. As examples that one may find, vanadinite is the only really common one. Others are descloizite, carnotite and tyuyamunite.

Titanium, a very important collector species, is one of a few minerals with two commonly used names. It is also known as sphene.

<table>
<thead>
<tr>
<th>Element</th>
<th>Symbol</th>
<th>No. of Minerals</th>
<th>Relative Rarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scandium</td>
<td>Sc</td>
<td>8</td>
<td>16 ppm</td>
</tr>
<tr>
<td>Yttrium</td>
<td>Y</td>
<td>+TR 160</td>
<td>30 ppm</td>
</tr>
<tr>
<td>Lanthanum</td>
<td>La</td>
<td>—</td>
<td>32 ppm</td>
</tr>
<tr>
<td>Titanium</td>
<td>Ti</td>
<td>196</td>
<td>0.44%</td>
</tr>
<tr>
<td>Zirconium</td>
<td>Zr</td>
<td>65</td>
<td>190 ppm</td>
</tr>
<tr>
<td>Hafnium</td>
<td>Hf</td>
<td>2</td>
<td>3.3 ppm</td>
</tr>
<tr>
<td>Vanadium</td>
<td>V</td>
<td>133</td>
<td>160 ppm</td>
</tr>
<tr>
<td>Niobium</td>
<td>Nb</td>
<td>104</td>
<td>20 ppm</td>
</tr>
<tr>
<td>Tantalum</td>
<td>Ta</td>
<td>69</td>
<td>2 ppm</td>
</tr>
<tr>
<td>Chromium</td>
<td>Cr</td>
<td>69</td>
<td>100 ppm</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>Mo</td>
<td>33</td>
<td>1.5 ppm</td>
</tr>
<tr>
<td>Tungsten</td>
<td>W</td>
<td>28</td>
<td>1 ppm</td>
</tr>
<tr>
<td>Manganese</td>
<td>Mn</td>
<td>416</td>
<td>1,000 ppm</td>
</tr>
<tr>
<td>Technetium</td>
<td>Tc</td>
<td>—</td>
<td>Extreme</td>
</tr>
<tr>
<td>Rhenium</td>
<td>Re</td>
<td>2</td>
<td>0.2 ppb</td>
</tr>
<tr>
<td>Actinium</td>
<td>Ac</td>
<td>—</td>
<td>Extreme</td>
</tr>
</tbody>
</table>

Niobium and tantalum are so common together in minerals that they are covered that way. Pyrochlore, fergusonite, columbite-tantalite, microlite, samarskite, euxenite, polycrase and betafite are the main examples. Some people think they are particularly interesting species to collect.

Chromium, in chromite and crocoite, are probably among the best known minerals to collectors that belong here. It is notable that uvarovite, a garnet is here while some species have color due to minor impurities of this element. Molybdenum is noted in its namesake, molybdenite, along with wulfenite (another collector favorite) and powellite. It may be surprising to you to see more than 30 species indicated. Tungsten, another element in relatively few species, is perhaps best known in scheelite, wolframite and ferberite. Manganese is perhaps the most important element here and can be found in a large number of species. Pyrolusite, manganite (a namesake), rhodochrosite, rhodonite and spessartine (a garnet) are a few widely known examples. Like calcium, manganese is found in many diverse groups including sulfides, chlorides, oxides, carbonates, silicates, phosphates and sulfates. Perhaps one of the most important things to remember is that iron and manganese freely substitute for one another in many mineral pairs.
Part VII: Group VIIIA

Recall that iron is extremely prevalent and often occurs in mineral pairs where Mn can substitute freely for it. The most important member of this group is a major cause of color in numerous minerals. Iron occurs in sulfides, oxides, silicates, carbonates, phosphates, arsenates, and sulfates. One can say iron is present in all the major mineral groups. Pyrite, hematite, almandine, siderite, etc. are but a few examples.

<table>
<thead>
<tr>
<th>Element</th>
<th>Symbol</th>
<th>No. of Minerals</th>
<th>Relative Rarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron</td>
<td>Fe</td>
<td>883</td>
<td>4.1%</td>
</tr>
<tr>
<td>Ruthenium</td>
<td>Ru</td>
<td>12</td>
<td>1 ppb</td>
</tr>
<tr>
<td>Osmium</td>
<td>Os</td>
<td>9</td>
<td>0.1 ppb</td>
</tr>
<tr>
<td>Cobalt</td>
<td>Co</td>
<td>56</td>
<td>20 ppm</td>
</tr>
<tr>
<td>Rhodium</td>
<td>Rh</td>
<td>13</td>
<td>0.2 ppb</td>
</tr>
<tr>
<td>Iridium</td>
<td>Ir</td>
<td>17</td>
<td>3 ppt</td>
</tr>
<tr>
<td>Nickel</td>
<td>Ni</td>
<td>142</td>
<td>80 ppm</td>
</tr>
<tr>
<td>Palladium</td>
<td>Pd</td>
<td>47</td>
<td>0.6 ppb</td>
</tr>
<tr>
<td>Platinum</td>
<td>Pt</td>
<td>37</td>
<td>~1 ppb</td>
</tr>
</tbody>
</table>

Cobalt, the 32nd element in rarity, has relatively few minerals. Often found with nickel, which is more common, a few minerals may be familiar to collectors, i.e., cobaltite (a namesake), roselite, smaltite, linnaeite, and erythrite.

Nickel, 23rd in rarity, has quite a few species and millerite, niccolite, pentlandite, and josephinite are some examples collectors will be likely to recognize.

The Platinum Group is a very interesting topic in and of itself. Various nuggets, grains and even the occasional crystal found in nature are perfect examples of natural alloys. The actual composition can, and does, vary tremendously among species, even from the same locality.

All the rest are similar and share rarity with the relative lack of very many mineral species. They occur in parts per billion (ppb) or even parts per trillion (ppt). Other than native elements, especially platinum, and sperrylite they may be unknown in collector-type minerals if you exclude ultra-rare species. Many of these are known from probe-mounts and cannot be seen except with an electron microscope. In nature, significant amounts of several of these elements are mined as by-products; notably from Pt and related minerals.

Platinum. In many ways, gold is similar, notably rarity and number of species. But platinum commands a higher price and seems to be much rarer, especially in mineral collections.

Part VIII: Groups IB and IIB

Here in Groups IB and IIB, one will find several very familiar metals and numerous minerals of great interest to many collectors.

Copper is very important because of the popularity of this element and its minerals amongst collectors. Native copper, cuprite, azurite, malachite, chalcopryrite and numerous others serve as examples. Its significance to mankind is hard to ignore. Silver, one of the “precious” metals, is possibly one of the most desirable native elements. Besides being a by-product of copper mining and lead mining (in galena), it is known in the minerals acanthite, andorite, proustite, stephanite, pyrargyrite, and polybasite: all of these are desired by collectors. Many of the species are sulfides or sulfo-salts. Gold, one of the most widely recognized elements that occur as a mineral, is popularized by gold rushes and stories about huge nuggets. In Quartzite, Arizona, a 5-ounce nugget was reportedly found in January of 2008. A few minerals occur but most are not very well known. Petzite, nagyite, sylvanite and calaverite are some examples.

Precious Metals – We all know which ones they are; most of them are in this group. The history of man would be very different without them.

Zinc, while being 24th in rarity, has a moderate representation among minerals - the most widely known to collectors are sphalerite, wurtzite, zincte (a namesake), smithsonite, franklinite, hemimorphite, hydrozincite, willemite, adamite and descliozite. It is believed that other than greenockite, no minerals of concern are known for cadmium. It is always subjective to say something like this but look at mineral books and collections and decide whether or not these ideas hold true.

Mercury, a unique liquid metal at room temperature, has a long list but collectors usually know about it as native mercury, cinnabar and perhaps amalgam and related species of Hg and Ag. In response to a question that many may pose, a mineral is generally said to be solid. Therefore, one can make a case for mercury not qualifying as a species. In one respect, I think of it in the same terms as ice and water. Ice qualifies and water doesn’t, at least from one perspective.

Part IX: Non-Metals – Groups IIIB and IVB

Finally, we reach some of the elements called non-metals. They are chemically opposite to the metals, which include any materials commonly thought of as a metal (tin, gold, iron, etc.) and many more that are less obvious (i.e., sodium, calcium, and barium). The first one here is boron, which is rather rare but
very significant and important in terms of mineral collectors due to its being a key component in tourmaline, axinite, datolite and danburite along with many others. It is the 38th element in relative rarity but about 23rd in terms of the number of species. Recall, that the namesake group exists (borates) and note the various borosilicates too. Boron is far more desirable (so it seems) to us as a silicate.

**Non-Metals** – About 15 elements are classed as non-metals; they are on the right side of the periodic table.

Aluminum is a key component of the crust. Aluminosilicates, like the feldspars, along with corundum, spinel, topaz, kyanite and staurolite are a few of many examples. Carbon, a key to life, is notable in the group carbonates as well as graphite and diamond. Silicon is very prevalent as silicates and can be found in many lists under rock-forming minerals. There are too many to even begin a list here. Select a book or website of your choice to get a partial or complete list.

Tin, the 49th in relative rarity as an element, is especially familiar to many collectors as cassiterite. Stannite, cylindrite, and franckeite are some examples of less familiar species that contain tin. It is interesting to me to note that tin and beryllium are about equal in rarity and the number of minerals. A few elements show this similarity, but only a few! Lead, like copper, seems to have a lot of species for the rarity of the element. Besides the very rare occurrence of native lead and widespread presence of galena, one finds anglesite and wulfenite. Most others are rare but collectors focus in on cerussite, pyromorphite, mimetite, vanadinite, and phosgenite, which are relatively common in collections.

### Element Symbol | No. of Minerals | Relative Rarity
--- | --- | ---
Boron | B | 179 | 10 ppm
Aluminum | Al | 714 | 8.2 %
Gallium | Ga | 2 | 18 ppm
Indium | In | 7 | 0.1 ppm
Thallium | Tl | 34 | 0.6 ppm
Carbon | C | 272 | 480 ppm
Silicon | Si | 906 | 28 %
Germanium | Ge | 16 | 2 ppm
Tin | Sn | 78 | 2 ppm
Lead | Pb | 371 | 14 ppm

**Part X: Groups VB through VIIIB**

There are 15 elements included here but some of them are not very important in the mineral world. Note the number of minerals for some of them as an indicator. Many are really rare; some do seem to be in a lot of minerals considering their rarity. Oxygen is so prevalent that more than 68% of all minerals are oxygen-bearing; as we previously said most major mineral groups are oxygen-based. Sulfur is very widespread and has two groups to claim: sulfides and sulfates. From pyrite to barite, there are a lot of them. It is very important as a source of collector species – many are found here.

<table>
<thead>
<tr>
<th>Element</th>
<th>Symbol</th>
<th>No. of Minerals</th>
<th>Relative Rarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen</td>
<td>N</td>
<td>70</td>
<td>25 ppm</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>P</td>
<td>398</td>
<td>1,000 ppm</td>
</tr>
<tr>
<td>Arsenic</td>
<td>As</td>
<td>387</td>
<td>1.5 ppm</td>
</tr>
<tr>
<td>Antimony</td>
<td>Sb</td>
<td>195</td>
<td>0.2 ppm</td>
</tr>
<tr>
<td>Bismuth</td>
<td>Bi</td>
<td>148</td>
<td>48 ppb</td>
</tr>
<tr>
<td>Oxygen</td>
<td>O</td>
<td>2,709</td>
<td>47%</td>
</tr>
<tr>
<td>Sulfur</td>
<td>S</td>
<td>761</td>
<td>260 ppm</td>
</tr>
<tr>
<td>Selenium</td>
<td>Se</td>
<td>82</td>
<td>50 ppb</td>
</tr>
<tr>
<td>Tellurium</td>
<td>Te</td>
<td>117</td>
<td>5 ppb</td>
</tr>
<tr>
<td>Polonium</td>
<td>Po</td>
<td>Very few</td>
<td>Extreme</td>
</tr>
<tr>
<td>Fluorine</td>
<td>F</td>
<td>221</td>
<td>950 ppm</td>
</tr>
<tr>
<td>Chlorine</td>
<td>Cl</td>
<td>220</td>
<td>130 ppm</td>
</tr>
<tr>
<td>Bromine</td>
<td>Br</td>
<td>12</td>
<td>0.4 ppm</td>
</tr>
<tr>
<td>Iodine</td>
<td>I</td>
<td>16</td>
<td>0.14 ppm</td>
</tr>
<tr>
<td>Astatine</td>
<td>At</td>
<td>Very few</td>
<td>Extreme</td>
</tr>
</tbody>
</table>

Phosphorus, as in the phosphates, includes notables such as monazite, apatite, pyromorphite, vanadinite, amblygonite, olivenite, libethenite, lazulite, phosphophyllite, erythrite, turquoise and childrenite. That may explain, in part, the popularity of this group as a sub-collection or specialty collection with so many people. Arsenic, while being more than 500 times rarer, has nearly the same number of species as phosphorus. Among collectors, native arsenic, arsenopyrite, orpiment and realgar are probably most widely known; also there is an entire chemical subgroup called arsenates.

**Sulfur** – the only element beside oxygen to be recognized in the name of a mineral group; it is very significant. The groups are the sulfides and the sulfates.

Fluorine, in its namesake fluorite, is one of the most widely known collector type species. Much F is found in minerals sometimes substituting for the OH radical, producing mineral pairs such as hydroxyl and fluorapatite. Chlorine, except for common salt (halite) may not ring a bell: there are silver chlorides, and also atacamite, boleite and creedite, however. Bismuth is very rare: 70th in the list and it has a huge number of minerals for such a rare element. Native bismuth, bismuthinite, bismite, bismutite and others are known to
collectors. It has the most species of any element classed as very rare (less than 0.1 ppm) and there are over twenty of them. Selenium and tellurium are also classed as very rare elements; they have unusually high numbers of species noted. It would appear that these elements (Groups VB – VIIIB) are indeed important in our study of mineralogy. More than 2,500 minerals contain one of these elements (and that’s excluding oxygen from the total). Some overlaps will occur in the totals where two or more elements are present in the same species; one example is arsenopyrite where arsenic and sulfur are both present. These minerals show up in the total count for both elements.

Silver, Kongsberg, Norway

Bill holding the famous “Boot of Cortez” gold specimen

Sulfur, Sicily, Italy

Platinum, Russia

**Conclusion**

Some readers tell me they have read and enjoyed this series of articles. For those who didn’t especially like them, you can rejoice as this is Part X, the final installment. Your suggestions for additional articles are always welcome and I will try to answer your questions with future articles.

**Rarity List for Elements**

(Increasing Rarity →)

<table>
<thead>
<tr>
<th>O</th>
<th>Si</th>
<th>Al</th>
<th>Fe</th>
<th>Ca</th>
<th>Na</th>
<th>Mg</th>
<th>K</th>
<th>Ti</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>Mn</td>
<td>F</td>
<td>Ba</td>
<td>C</td>
<td>Sr</td>
<td>S</td>
<td>Zr</td>
<td>V</td>
<td>Cl</td>
</tr>
<tr>
<td>Cr</td>
<td>Rb</td>
<td>Ni</td>
<td>Zn</td>
<td>Ce</td>
<td>Cu</td>
<td>Nd</td>
<td>Y</td>
<td>La</td>
<td>N</td>
</tr>
<tr>
<td>Li</td>
<td>Co</td>
<td>Nb</td>
<td>Ga</td>
<td>Sc</td>
<td>Pb</td>
<td>Th</td>
<td>B</td>
<td>Pr</td>
<td>Sm</td>
</tr>
<tr>
<td>Gd</td>
<td>Dy</td>
<td>Yb</td>
<td>Er</td>
<td>Hf</td>
<td>Cs</td>
<td>Be</td>
<td>U</td>
<td>Sn</td>
<td>Eu</td>
</tr>
<tr>
<td>Ta</td>
<td>Ge</td>
<td>As</td>
<td>Mo</td>
<td>Ho</td>
<td>Ar</td>
<td>Tb</td>
<td>W</td>
<td>Tl</td>
<td>Lu</td>
</tr>
<tr>
<td>Tm</td>
<td>Br</td>
<td>Sb</td>
<td>I</td>
<td>Cd</td>
<td>Ag</td>
<td>Se</td>
<td>Hg</td>
<td>In</td>
<td>Bi</td>
</tr>
<tr>
<td>Hg</td>
<td>Te</td>
<td>Au</td>
<td>Ru</td>
<td>Pt</td>
<td>Pd</td>
<td>Re</td>
<td>Rh</td>
<td>Os</td>
<td>Ne</td>
</tr>
</tbody>
</table>

The Rarest: Ac, As, Fr, Po, Pm, Pa, Rn, Tc.

**Biography of Bill Shelton**

William (Bill) Shelton received his B.A. from the University of Bridgeport and his M.A. in Oceanography from Western Connecticut State. He was a long time state (CT) school teacher whose primary students were those who were severely emotionally disturbed youths. Bill is now retired and lives in Tucson, Arizona.

Bill has been a mineral collector “since antiquity” and has had a special interest in minerals from the former Soviet Union. Future plans include donating his comprehensive collection to the A. E. Seaman Museum at Michigan Tech although some of the collection has already been transferred to that institution.

He currently likes unusual, rare and obscure mineral objects and is predominantly seeking very old pieces of historical mineralogical value.

He has been a frequent contributor to the Bulletin of the New York Mineralogical Club and a familiar mineral club meeting speaker around the Northeast. You can usually see him at mineral shows run by Marty Zinn (Springfield, Costa Mesa, Denver, etc.).
Minerals in Sports: Clay Surfaces
Via USGS

Clay is used on baseball and softball fields in the base paths, batters’ boxes, bullpens, pitchers’ mounds, and practice areas. Clay and clay composites are also used on bocce courts, tennis courts, horseshoe pits, track-and-field event areas, and on horse racing tracks and bridle paths.

Clay, by itself, is not an ideal surface for play. In the early days of baseball, for example, the clay infield would become as hard as concrete in the summer heat, and a slippery quagmire after a rain storm. Without constant care, deep ruts would form in the base paths, in the batter’s box, and on the pitcher’s mound.

A better clay surface is made up not just of clay, but of a mixture of clay, sand, and silt; the mixture can be screened and blended to optimize its performance. When first introduced, this clay/sand/silt mixture represented a vast improvement over the older solid clay surface used on playing fields and tracks, although it still tends to form ruts and can become slick when wet. This mixture is the most popular clay topping in use today.

Another improvement in the evolution of field clay is calcined clay, which is clay that has been heated in a furnace at about 2,000° F. Once calcined, the clay is ground into a powder that readily absorbs water, reduces soil compaction, and will not stick to cleats or hooves. This type of product is used as an infield conditioner and to dry wet spots on a field or track quickly. Flakes of the mineral vermiculite that have gone through the process of exfoliation—a rapid heating process similar to the one for calcined clay (and frequently sold under the more common name, “kitty litter”)—may also be used to dry wet spots quickly.

On the best playing fields, a clay composite product is used. This product is made of clay and polymer layers that are formed around individual grains of sand. Vermiculite may also be added as a soil conditioner. The resulting material is non-abrasive, compacts easily, does not stick to cleats or hooves, and dries fast. It is often used in heavy-wear areas.

For more information about clays, see the USGS minerals information website at: http://minerals.usgs.gov/minerals.

Sources:

Jeweler Sues Over Ruined Roger Clemens Diamond Ring Deal
By Samuel Maull, Associated Press, February 25, 2008
NEW YORK - A jeweler who says a rival ruined his sale of a 2.5-carat pink diamond ring that Roger Clemens was buying for his wife to celebrate his return to the New York Yankees has sued his competitor for $5.1 million.

Marshall Asnen Inc.’s court papers say Clemens had agreed to pay $750,000 for the ring until dealer Charles Krypell “knowingly and maliciously made false and defamatory statements” about Asnen to the major league pitcher and his wife.

Krypell, who also has done business with Clemens, told the couple Asnen “was gouging them and making a killing at a price of $750,000,” court papers say.

The lawsuit, filed Monday in Manhattan’s state Supreme Court, accuses Krypell of interfering with Asnen’s business by undervaluing the stone and telling the Clemenses that Asnen salesman Joshua Hyman “had taken unfair advantage of them.”

The lawsuit says Krypell “sold Clemens a pink diamond shortly after (Krypell) interfered with and upset the contract.” It does not name Clemens as a defendant.

Krypell said of Marshall Asnen, whose company is named after him, “He’ll be taken care of by my attorney. My lawyer will answer him. He doesn’t have a leg to stand on.”

Asnen’s papers say Clemens, who had pitched for the Yankees from 1999 to 2003, decided to buy the ring after he announced in May 2007 that he had agreed to return to the team following a stint with the Houston Astros. Soon after, Clemens called Hyman to say he wanted to buy a ring for his wife.

Hyman met Clemens in Trenton, N.J., to show him the oval, purplish-pink 2.51-carat diamond. The stone was later set in platinum, and when Debbie Clemens saw it in Asnen’s shop, she said she was “thrilled,” court papers say.

“Clemens shook Hyman’s hand and said they had a deal in the presence of three other people in the room,” say court papers.
The papers add that the right-hander told Hyman to send an invoice for $750,000 to his assistant and that he invited everybody in the room to join him and his wife for dinner at a midtown Manhattan restaurant.

In June, court papers say, Clemens killed the ring deal.

Court papers say Asnen believes “Krypell’s wrongful conduct caused the client to dishonor his promise to pay for the ring.”

Besides the $5.1 million in compensatory damages, Asnen’s lawsuit asks unspecified punitive damages.

**Giants Tout “10-Table” Super Bowl Ring**

Associated Press, March 4, 2008

Big Upset. Big Super Bowl ring.

The New York Giants unveiled the design of their Super Bowl championship ring on Tuesday, a white gold sparkler that will feature about 1.5 carats in diamonds.

The new ring will even make seven-time Pro Bowl defensive end Michael Strahan happy.

Shortly after New York won the championship with a 17-14 win over the previously undefeated New England Patriots, Strahan said he wanted a “10-table ring.”

Loosely defined: He wanted a ring that could be seen 10 tables away in a restaurant.

“There was some discussion about maybe one of the rings was too big,” said center Shaun O’Hara, who was among group of players and team executives who designed the ring with officials from Tiffany and Co.

“I threw out the fact that it was a big win, it was a huge win, so the ring should be designed accordingly,” O’Hara said. “Michael said it best when he said he wanted a 10-table ring. I think everybody is going to be very pleased with the design. It is very clean, very classy, but at the same time it is very strong.”

The ring’s top is covered in diamonds and features three Super Bowl trophies accented with marquise diamonds signifying the Giants’ Super Bowl XXI, XXV and XLII victories. The team’s “NY” logo is in bead set round diamonds, while “World Champions” is emblazoned in raised letters on the top and bottom bezel, with channel set diamonds on left and right bezel.

The ring’s shanks celebrate the Giants’ season, noting the team’s “Eleven Straight on the Road,” an NFL record; the NFL shield; and player name, along with player number in raised letters appear on one shank.

The final score, “Super Bowl XLII,” date (02.03.08) and “AZ” appear on the other shank.

Giants spokesman Pat Hanlon would not disclose the price of the ring.

Tiffany has previously created Super Bowl championship rings for the Washington Redskins and Tampa Bay Buccaneers. The company annually creates the NFL Vince Lombardi Super Bowl Trophy at its workshop in Parsippany, about 30 minutes from Giants Stadium.

The rings will be presented to the Giants players and coaches at a ceremony later in the spring.

**Hokie Stone:**

**Virginia Tech’s Stone of Tradition**

By Mitchell Portnoy

On March 19, 2008 the New York Yankees played an exhibition game at Virginia Polytechnic Institute, the site of the infamous massacres and murders a year ago. It was announced that Joe Girardi and his supporting staff were all given nameplates made from Hokie Stone. Before the scrimmage, the entire team visited a memorial that used 32 different decorated Hokie Stones to symbolize the victims of this tragedy.

I had to find out what that was, of course!

Hokie Stone is a medley of different colored limestone, often including dolomite. Each block of Hokie Stone is some combination of gray, brown, black, pink, orange, and maroon. The limestone is mined from quarries in southwestern Virginia, Tennessee, and Alabama.

The stone is used in most of the 100-plus buildings on the main campus of Virginia Polytechnic Institute and State University in Blacksburg, Virginia, USA. The stone takes its name from “Hokies,” which is the official name for the university’s sports teams. The university has operated a Hokie Stone quarry since the 1950s.

Every building surrounding the Drillfield uses Hokie Stone, including the iconic Burruss Hall. Notable buildings that are not sheathed in the stone include Whitemore, Derring, Wallace, Litton-Reeves, Squires, Hillcrest, the entire Upper Quad (old campus), and several others. Though these buildings have brick or modern exteriors, they often incorporate Hokie Stone somewhere on the building, usually near the foundation or as architectural accents. This inspired John Rocovich, Rector of the VPI&SU Board of Visitors, to make the use of Hokie Stone on all new buildings imperative. However, Hokie Stone is more expensive than many modern building materials. McComas Hall, completed in 1998, was scaled back in planning to 118,225 square feet (11,000 m²) to allow the entire building to be covered in Hokie Stone, rather than just the facade.

Sources:

Fortune Smiles on Dodgers’ White: Journeyman Reliever Ends Up with Wildly Valuable Property
By Ken Gurnick
VERO BEACH, Fla. – Who’s the wealthiest Dodger? Jason Schmidt? Jeff Kent? Frank McCourt?
It could be Matt White.
Who?
White is a 29-year-old left-handed journeyman pitcher in camp on a Minor League contract who’s pitched a total of 9 2/3 Major League innings in nine professional seasons and he’s sitting on a gold mine.
Actually, it’s a rock quarry.
Four years ago, White bought a 50-acre piece of property in Massachusetts from his ailing Aunt Josephine, who was going into a nursing home. He planned to build a house on the property, but discovered it to be absolutely covered with rock.
A geologist determined the property was loaded with mica schist, a slate-like shiny metamorphic stone used for patio decks and other construction.
“’I never built the house and instead started selling the rock,” said White, whose father runs the business. “It turned out to be a blessing in disguise. The geologist said I’ve got 24 million tons of it and it sells for $100 a ton.”
So, according to White’s math, he’s sitting on a $2.4 billion mountain of rock. That’s billion, with a “B.” The property cost him $50,000.
He could parlay the fortunate real estate play into buying, say, a baseball club. It’s been known to happen. So, why still bother with baseball on the player end, especially with the likelihood of cracking the Dodgers’ deep Major League pitching staff no better than remote?
“This is fun,” said White, who has played with Boston, Seattle and Washington. “I wouldn’t retire. What else am I going to do?”
A teammate of Billy Koch and Kris Benson at Clemson, White was originally drafted by Cleveland and was twice taken in the Rule 5 draft. He spent the 2006 season at Philadelphia’s Triple-A affiliate at Scranton/Wilkes-Barre, where he was 7-9 with a 3.58 ERA, and played winter ball in Venezuela.
Source: mlb.com

Platinum, Titanium and Lance Armstrong’s Winning Ride
By Elisabeth G. Newton
Last July, the entire world cheered as American cyclist Lance Armstrong rode to his sixth victory in the Tour de France. The historic event made for a great opportunity to observe directly the close relationship that exists between mineral resources and contemporary society. In very different ways, two metals — platinum and titanium — were essential to Armstrong’s Tour de France win.

The role platinum played in assuring Armstrong’s success truly supports its traditional designation as a “precious metal.” Eight years ago, a chemotherapy treatment that uses platinum literally saved Armstrong’s life when he was diagnosed with advanced testicular cancer. The most effective treatment for advanced cancers of the reproductive system, such as Armstrong’s, are drugs known as platinum coordination compounds.

The first so-called platinum drugs were developed in 1964 at the Institute of Cancer Research and the Royal Marsden Hospital in London. These platinum drugs have the ability to prevent cell division, a very important aspect of cancer treatment, because rapid and random cell division is the hallmark of cancer growth. The treatment of testicular cancer with platinum drugs was pioneered in the United States by Dr. Lawrence Einhorn at the University of Indiana Medical Center, where Armstrong received his chemotherapy. There are now about six or so platinum drugs in use, with several more in development. Armstrong’s cancer was treated with one of the first generation of platinum drugs, Carboplatin, the brand name for platinum diammine, introduced in the United States by Bristol-Myers Squibb in 1986.

The actual quantity of platinum consumed per patient per treatment is minuscule and varies according to a patient’s physical condition and the severity of the disease. The annual consumption of platinum as a chemotherapeutic agent is about half a ton, but it differs from other uses of platinum in that it is neither recyclable nor reusable. Given the life-promoting capacity for platinum when used as a chemotherapeutic agent, this annual “waste” of one-half ton of a rare and scarce precious metal may well be considered the mineral’s most important, if nonrecoverable, end-use.

The role the second important metal, titanium, played in Armstrong’s victory is not nearly so complex and involved. In fact, it’s rather straightforward: Armstrong’s custom-built racing bikes are made out of that wonderful very hard, lightweight, durable metal.
The attributes of titanium racing bikes are now well-known, with such high-performance bikes the envy of every racing cyclist wannabe who ever lived. Armstrong, however, also “wears” a titanium plate in his skull to cover the scars of his cancer-related brain surgery of eight years ago. In his 2000 memoir, It’s Not About the Bike: My Journey Back to Life, Armstrong expresses his enthusiasm for the titanium skull plate, which he especially appreciates because of his past experiences with titanium in his racing bikes.

In contrast to his declared fondness for titanium, the always straight-talking Armstrong declares a real loathing for the platinum content of his life-saving chemotherapy drugs, because of the harsh and very painful side effects associated with platinum-based chemotherapy. Armstrong, however, who currently serves as a spokesman for Bristol-Myers Squibb (the manufacturer of Carboplatin), obviously does appreciate the remarkable properties of platinum.

Most of us hope we will never need to become acquainted with platinum as a chemotherapeutic drug, lifesaving though it may be, and some of us may covet a titanium bike. But all of us can appreciate the real human value of mineral resource applications in our ever developing and complex society. It is important that society’s use of its mineral resources always be about the journey of life and not “just about a bike.”

In 1877, an insignia that would become the famous New York Yankees “NY” logo was struck on a medal of honor by Tiffany & Co. and issued to the first NYC Police Officer shot in the line of duty. The Yankees adopted the logo in 1909.

In the early years, the players made their own bats, all from wood. Eventually, bat makers found that the best style of bat was long and slender, tapered, with a carved knob at the end of the bat for better control.

Although the first metal bat was patented in 1924, players did not start using metal bats until the first aluminum bats were developed in the 1970’s. Aluminum (of which the United States is one of the world’s leading producers) is derived from bauxite ore. Bats made of aluminum became an instant success. They were light, durable, and easy to use, and players could hit the ball much farther than with a wooden bat. Unlike the wooden bat, a metal bat temporarily flexes when hit with the ball, and springs back, transferring more energy to the ball than a rigid wooden bat. This so-called “trampoline effect” is the secret of the metal bat’s superior performance over a wooden bat.

Titanium bats were first introduced in 1993 but were later banned from official play because there were concerns that the bats were too dangerous. Various aluminum alloy bats were also introduced in the 1990's. The most successful of these was the scandium-aluminum bat. Scandium is a mineral that, when alloyed with aluminum, greatly increases the strength and resilience of the aluminum without adding to the weight. Scandium occurs in minute quantities in more than 800 minerals, and is usually obtained as a byproduct of refining uranium. Today, most high-quality metal bats are made from scandium-aluminum alloy.

The design of bats also continues to evolve as manufacturers search for ways to magnify the trampoline effect and increase the size of the bat’s “sweet spot” (the optimal place on the bat for hitting the ball). One design introduced in the late 1990's is a double-walled bat; this design comprises an outer wall of scandium-aluminum, an inner wall of a composite material (often graphite), and a “filling” of rubber or a thick fluid between the two walls. Another design structures the scandium-aluminum shell of the bat around a series of flexible arches.

For more information on the minerals used in bat making, see the USGS minerals information website at http://minerals.usgs.gov/minerals.

Sources:


Section VII: Picture Essay – NYC Mineral Show Souvenir Cards

Beginning in March 1996, the New York Mineralogical Club has partnered with the Excalibur Mineralogical Corporation (Tony Nikischer, President) to produce the New York City Gem & Mineral Show. Each year, the Club produced a special “souvenir card” in honor of the show and these were given to the public for free.

The inspiration for creating these cards comes from the hobby of stamp collecting where similar cards have been produced, commemorating various shows and other philatelic events, for more than one-hundred years. This is not surprising as both Tony and I are avid stamp collectors. Indeed the hobbies of stamp collecting and mineral collecting share many commonalities and it is extremely common for people to engage in both. (See related article in this Almanac.)

Beginning in 2006, Tony expanded the number of mineral and gem shows in New York City to two, one each in the spring (March) and fall (November). Thus, two different cards have been produced each year ever since.

All of the cards exist both in a black and white version, used for general distribution, and a special full-color edition which was given as gifts to show dealers, speakers, volunteers, exhibitors and club members.
Your Hobby & the Internet as an Information Resource
By Anna Schumate

*Surfin’ U.S.A.* Unfortunately, it’s not the kind of surfing in the Beach Boys’ song but it’s still pretty neat! I get many calls and emails requesting information about jewelry supplies from metal stock to gemstones, beads findings, tools and equipment. People also ask about various classes, organizations and publishers. Here’s the surfing part. Just about every supplier of jewelry making materials has a website where you can view the merchandise and order online. The May 2003 issue of Lapidary Journal contains their Annual Buyer’s Directory where you can learn how to contact literally hundreds of these companies. At www.lapidaryjournal.com you can view the Buyer’s Directory and also listings for upcoming gem, mineral and bead shows through 2004.

When it comes to classes and online instruction, you can find a wealth of education online. This website offers free information and many links: http://www.ganoksin.com. Go to www.Stepbystepjewelry.com for Lapidary Journal’s new and archival projects. Revere Academy (www.revereacademy.com) has information about their classes in San Francisco and some very useful jewelry making tips at their site. GIA, www.gia.org offers the Accredited Jewelry Professional program entirely online. You can even do most of your Graduate Gemologist program online, although you must complete Diamond Grading, Colored Stone Grading and Gem Identification labs at workroom sessions around the country. The Fashion Institute of Technology has business, merchandising and advertising classes online. Starting a Small Business, Introduction to Business Law, Consumer Motivation and Introduction to Direct Marketing are a few other courses.

There are many trade, professional and amateur organizations with websites that are rich in educational resources. The Geological Society of America (www.geosociety.org), the American Geological Institute (www.agiweb.org) and the Mineralogical Society of America (www.minsocam.org) all sell educational publications. Bob’s Rock Shop (www.rockhounds.com) has information and links to many other related sites. The American Craft Council (www.craftcouncil.org) sponsors shows and events. Their website has a calendar of these events, research resources and a gallery of craftwork. The Jewelers of America (www.jewelers.org) has valuable guidance for those entering the jewelry industry. There is a wealth of practical information on educational and training resources, organizations and publications and employment seeking. These are really only a small sampling of the numerous sites now on the Internet. You will undoubtedly find many to add to your list of Favorites.

Stamp & Mineral Collecting Commonalities
By Mitch Portnoy

Introduction

One of the first thing I noticed after joining the NYMC was how many members, including me, collected BOTH minerals and stamps. Could this be a mere coincidence? After giving it lots of thought for many years, it became obvious to me that the two hobbies have many, many traits in common. I thought about coming up with a list of the ten commonalities. I came up with 36! (Sorry!) Maybe there are even more. Let me know what you think.

The Collection

1. Geography and locality are involved in both hobbies; “dead” countries are involved.
2. Provenance is important and we speak of “old” collections.
3. Color is important.
4. Condition/overall quality is important; dings vs. flaws
5. Aesthetics come into play.
6. Rarity comes into play.
7. There is ephemera related to the mineral/stamp hobby that is also collected.
8. There are man-made minerals/cinderellas (non-postal labels) that some people collect.
9. One must beware of fakes and fraudulent specimens in both hobbies.
10. Irregularities/errors are prized.
11. Collections can be both globally comprehensive or highly specialized or narrowly focused.
12. New material (finds or printings) regularly come on to the market.
13. Display, storage and preservation are important.
14. There is an investment side (somewhat) to stamps/minerals.
15. A collection’s ultimate disposition should be addressed in your will.

The Collectors

16. Both hobbies are highly international in terms of demographics.
17. There is a wide range of collectors from rank beginners to highly-experienced hobbyists.
18. Children can be collectors.
19. The Scouts give a merit badge for mineral collecting (actually geology) and stamp collecting.
20. They are both, nevertheless, hobbies of an aging group.
21. Identification skills are important.
22. I would characterize both groups of collectors as loving organization, categorization and structure.
23. I would characterize both groups of collectors as loving education, reading, learning, and knowledge.
24. Often there are trading partners.
Outside the Collection
25. There are clubs and regional or national organizations focusing on the mineral/stamp hobby.
26. There are public museums housing mineral/stamps collections.
27. There are mineral/stamp shows.
28. There are mineral/stamp auctions.
29. There is specialty insurance available for mineral/stamp collections.
30. There are specialized appraisers for mineral/stamp collections.
31. Both hobbies use magnifying glasses, microscopes and fluorescent lamps.
32. Books/guides/catalogs are important.
33. Each hobby has a few national periodicals available for subscription.
34. The Internet has recently grown in importance to each hobby.

Conclusion
35. No surprise - one of the most popular hobbies is collecting minerals/gems on stamps.
36. Both hobbies are fun!

Below: Scout Merit Badge Patches

Stones for Everyone
By Multiple Authors
For Laundresses, the Soapstone
For Architects, the Cornerstone
For Cooks, the Pudding Stone
For Politicians, the Blarney Stone
For Borrowers, the Touchstone
For Policemen, the Paving Stone
For Stockholders, the Curbstone
For Shoemakers, the Cobblestone
For Burglars, the Keystone
For Tourists, the Yellowstone
For Beauties, the Peach Stone
For Motorists, the Milestone
For Editors, the Grindstone
For Meteorologists, the Sunstone
For Zoologists, the Zebra Stone
For New Mothers, the Loadstone
For Cartoonists, the Flintstone
For Undertakers, the Tombstone
For Citrus Growers, the Limestone
For Doctors, the Kidney Stone
For Depressives, the Bluestone
For Gardeners, the Rosetta Stone
For Lunatics, the Moonstone
For Patriots, the Flagstone
For Germans, the Rhinestone
For Sun Bathers, the Sandstone
For Queens Residents, the Whitestone
For Preachers, the Brimstone
For Social Climbers, the Stepping Stone
For Clammers, the Cherrystone
For Dairy Farmers, the Breakstone
For Cheapis, the Freestone
For Saints, the Holystone
For Genealogists, the Bloodstone
For Anglophiles, the Gladstone
For Cheerers, the Hailstone
For New Yorkers, the Brownstone
For Roger Clemens, the Pitchstone
For Taunters, Sticks and Stone
For Swimmers, the Whetstone
For Hairdressers, the Curling Stone
For NYMC Members, the Gemstone
Ten Indoor Winter Activities
By Mitchell Portnoy

It’s about to get cold outside here in the Northeast. Field collecting will become difficult, if not impossible. There might be no mineral shows on a particular weekend nor any club activities. The weather could go from raining frigid slush to a full scale nor’easter. You feel you are trapped indoors yet you are hungering for some mineral-related recreation. Here are some suggestions to help you satisfy this intense craving.

<table>
<thead>
<tr>
<th>Primary Activity</th>
<th>Associated Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Read a chapter</strong> or two from a mineral or gem book up in your bookcase. You know you’ve been meaning to for quite some time. They’ve been sitting there calling out to you for a long time. Answer the call.</td>
<td>Select a book to give away. There are certainly volumes that you no longer need, have outgrown or you wonder why you have it in the first place. Find a better home for them!</td>
</tr>
<tr>
<td><strong>Similarly, re-read or go through a magazine or periodical that you originally read many years ago. It’s been so long, it will seem like a new issue anyway.</strong></td>
<td>Subscribe or re-subscribe to one of the major periodicals.</td>
</tr>
<tr>
<td><strong>Work on your inventory.</strong> It’s time to enter the items you bought over the last few months that have been sitting in a pile or hidden in a drawer so you are not being reminded of what you have to do. Get going!</td>
<td>Start an inventory. Any software program will do. There are some good articles on the internet with suggestions or just call one of the more advanced collectors you know and they will give you good advice.</td>
</tr>
<tr>
<td><strong>Create a sub-collection.</strong> Go through your entire collection and isolate specimens that belong together. Some ideas might be pseudomorphs, localities, Dana categories (“native minerals”), or a specific mineral (“quartz”). Put them together in a drawer or flat.</td>
<td>Think about how this smaller grouping could form the basis of an exhibit at your club’s next mineral show.</td>
</tr>
<tr>
<td><strong>Re-curate a display</strong> you have in your home. I know you have some display shelves that could use some re-arranging or some dusting. Just do it.</td>
<td>Adjust your wantlist for items to look for at the next mineral show to add to this display.</td>
</tr>
<tr>
<td><strong>Fix, create, or edit a label</strong> attached to a specimen in your collection.</td>
<td>Design your own personal label.</td>
</tr>
<tr>
<td><strong>Attractively mount or remount a specimen.</strong> You surely have some specimens sitting around that you have been meaning to mount on a stand, put in a perky box, etc. Do a few of them. You’ll be glad you did.</td>
<td>Learn how to create an inexpensive clay base for one of your favorite (and aesthetic) specimens. Your local art supplies store has a kind of colored clay that can be baked in only 10 minutes!</td>
</tr>
<tr>
<td><strong>Look over your collection and cull out specimens that are no longer needed. They may be multiples, second rate examples or items you really don’t collect any longer. They can be donated to your club’s benefit auction, given to a new collector or be used for trade.</strong></td>
<td>Actually get rid of something. By this I mean put it into the trash. I know this is the hardest thing to do. But I KNOW you have rocks sitting around that are unlabeled, meaningless specimens. OUT!</td>
</tr>
<tr>
<td><strong>Write an article</strong> for your mineral club’s newsletter. Or at least write a list of possible topics/titles that you could compose in the future.</td>
<td>Consider how this article could form the basis of a lecture of program for your mineral club if translated into a PowerPoint presentation.</td>
</tr>
<tr>
<td><strong>Reorganize/organize</strong> a drawer or flat in which you have your minerals stored. For example, I have all my thumbnails together in 5 flats. I’ve been meaning to alphabetize them for years. This would be a good time.</td>
<td>Remove duplicates. See primary activity #8.</td>
</tr>
</tbody>
</table>

I think with these ten suggestions in mind, you will have something to do on each and every weekend during the coldest of winters. But remember, these activities are not limited to winters only!
Why Micromounts?
By David Brand

Many amateur mineralogists begin their interest in collecting as a hobby by being fascinated by a beautiful crystal. Maybe it was a hand-held specimen of Arkansas quartz that could be taken home and shown to admiring friends and relatives. Curt Segeler, a noted NYMC micromounter, once remarked that only about 400 out of the total of over 4,000 known mineral specimens are available in hand-sized specimens. The opportunity to collect good specimens in the field has been limited. Many localities have been denuded of fine specimens or have been closed to collectors because of liability concerns. It has become an expensive investment to obtain hand-held or cabinet-sized specimens. Not so with micromounts. They offer a less expensive alternative means of collecting and offer a greater variety of minerals to collect.

What is a micromount? Neal Yedlin, another NYMC micromounter, defined them as “any specimen which requires magnification to see it properly.” Smaller crystals have a better chance of achieving perfect crystallization in the more common minerals as well as the rarer mineral specimens. In addition to their beauty, there is the benefit of saving space. Many micromounters might add to that definition by pointing out that the specimen fits or is made to fit in small paper or plastic boxes. Typically these boxes are an inch or less square, however, the size of the box, paper or plastic is a matter of personal preference. By using one-inch boxes, 144 specimens will fit into a square foot. So even a very large collection can be stored in a relatively small space. Another big advantage is that the many specimens can be purchased at prices that won’t strain the pocketbook.

The major deterrent that keeps collectors from becoming micromounters is the high cost of a stereo-binocular microscope. Initially, a magnifying glass or jeweler’s loop will suffice, but the investment in a good scope with zoom lenses and good illumination soon becomes a necessity. Used “scopes” are available, but are still relatively expensive. With the high resale value, the expense of a microscope can be justified as an investment. Another Curt Segeler quote: “The pleasure derived from its (microscope) use will repay the buyer many times over. One look at a good micromount usually makes a convert.” The savings in buying smaller and cheaper crystals specimens will make the collector an enthusiast.

Part of the joy in collecting micros is concentrating on minerals of a particular theme. There are collectors specializing in collecting all species, just zeolites, or just sulfides. Others collect lead or silver minerals, or they might select a particular locale such as Franklin, New Jersey, or Tsumeb, Namibia or New York State. To some enthusiasts, collecting type localities or just trying to accumulate as many specimens of a particular species that become available can be a goal. It was reported that Lou Perloff, a NYMC micromounter, had 1,400 diamond mounts in his collection. The point is that by collecting small specimens, many common or obscure species become available from a variety of localities. Many micromount collectors may be pursing one or more themes in their collections at any given time.

You don’t often see micros for sale at mineral shows because they are too inexpensive. It would be difficult for a dealer to cover his initial expenses at setting up his display at mineral shows. Micromounters have their own meetings, symposiums or workshops where mounts are freely traded or are available at little cost. There is also an “International Directory of Micromounters” published by the Baltimore Mineral Society. It is complete with names and addresses of individual collectors from every state and from over 30 countries. Many of individuals listed are more than willing to swap specimens via the mail.

Micromounters have their own “Hall of Fame”. It was organized and is still run by the Baltimore Mineral Society. Its purpose is to honor those who have served this hobby to the highest degree. They may have built up large collections but more importantly have earned and deserved a worldwide reputation among micromounters. Some familiar names of NYMC members in the Hall of Fame include Lazard Cahn, Clarence Bement, Lou Perloff, Neal Yedlin and Curt Segeler.

A comedian once noted about food, that rice is great when you are hungry and want 2,000 of something. Well, collecting microminerals is a great hobby when you feel like collecting a lot of something. Micromounting opens the way for the greater enjoyment of collecting by offering a huge variety of minerals from many localities. With the lower acquisition cost of micromount specimens, a beginner can compete with the expert on an equal footing in building an extensive and varied collection.

This was David’s last column for the Bulletin of the New York Mineralogical Club, written a few months before he passed away in 2009. It was awarded a Trophy by the EFMLS in their annual bulletin article contest. – Editor.
Of Rocks and Music
By Mike Kessler

It’s real easy to talk about my life. I’ve been playing that part for years. It consists of my rock phase and my performing career. What performing career? I never earned a living just performing. I was one of those people who needed a steady source of income. I owed my own home at 22 and had a mortgage to feed. Performing just never paid me enough. So I must talk about things outside of my music that paid the bills.

Midway through the 1940s I was born to Al and Ann Kessler in Brooklyn, New York. Al was a salesman with a great singing voice, and Ann was an artist who taught ballet. I heard them sing together quite a bit, and they considered music for their kids a requirement. Mom and dad were famous for their tango. Carol, my sister and I started taking dance, voice and music lessons outside of regular school. We attended the Jackson Studio of Music and Art in Brooklyn, New York where my mother taught. Our instructor for the piano was John Motley. John later became the head of the department of music for the Board of Education of the City of New York. My voice training came from operatic star Therman Bailey. Therman performed at the Amato Opera House in Greenwich Village when he wasn’t teaching. Therman very often wore an ascot to keep his throat warm like many singers of the times. I still wear a neck warmer to this day even when I sleep. Today a neckerchief is one of my trademarks. By age 12, I had performed operettas at The Madison Club, Brooklyn College and the Brooklyn Academy of Music (BAM). Getting me up onto a stage was no problem. It was more of an addiction.

When I was nine, a neighbor and her son invited me to their New Jersey farm for a weekend. It was there I discovered the world outside the City. I picked up my first stone with crystals in it, and a fascination for the earth’s treasures grew. My curiosity in stones continued right through college where I mastered in geology and minored in education. My extra curricular activities included Do Wop singing with friends. I started writing music as soon as I learned some guitar. At 15, I was helping out the sound engineer, Jerrold Borenstein, at Mercury Recording Studios on 57th Street, Manhattan so I could use the studio in its off hours. It was there I met Miles Davis, Burt Bacharach, Chuck Mangione et. al. At fifteen, I was singing with a group called the Illusions, and another called Bobby and the Shadows. My manager was Neil Bogats, singer of “Itsy Bitsy, Teeny Weeny, Yellow Polka Dot Bikini”. Our agent, Al Greiner, also was the agent for Connie Francis at the time. I remember coming out of our practice sessions at the ABC Building and running into the members of the Four Seasons after their rehearsals in the next room. The Illusions produced several recordings, which never made the charts, My Magic Phone, an original tune by Johnny O’Toole, and our Do Wop version of Saint James Infirmary.

I never ended my academic career because that’s what paid the bills. I became a teacher of science. The job lasted for 35 years. I had a day job teaching earth science, biology, physics, chemistry and math at Marine Park, and a night job teaching Geology for the City University of New York twice a week. On my other nights I wrote songs and went to sing them at the open mics in New York clubs. I disliked that people used my music as background, and I remained unfulfilled. I wanted their attention; so I tried comedy. People listened to comedians. In comedy school I performed with Howard Levy, and Ed Hochstein. Howard was my percussion teacher. People were finally listening to me. I became good at comedy. My songs and my comedy eventually merged. I was even asked to teach comedy at Brooklyn College. At the same time my geology interests continued and I attended weekend field trips with the many rock clubs I joined. The more clubs I joined, the more field trips I took. I even merged the rock collecting with my music in a piece called, “A Rock Song”.

I met Anita in 1973, and I married her in 1979. She loved my music, and that inspired me. My music writing continued both serious and comedic. I was getting jobs at the clubs more. Many comedians hired me to warm up the audiences for them. Rodney Dangerfield, Paul Riser, Dennis Wolfberger, Carol Leiffer and Charlie Tuna, were some comedians for whom I opened. Somewhere amongst these years I also started a screen-printing business with Carol that lasted for 8 years. I wanted something to do when I retired. Both of us inherited mom’s art talent.

Anita loved rock collecting as well. She encouraged me, and I took on the job of president of the Brooklyn Mineralogical Society. I joined the New York Mineral Club, and attended every meeting. With my background in geology, I was able to give lectures at many clubs. I have always been a workaholic. I wrote over 50 scientific articles that were published and won national awards. To date, I have given lectures to over a dozen mineral clubs. I won awards for my writing from the EFMLS, and the AFMS, but the most important award to me came as a New York State Teachers Presidential Award in 1985. I was selected as one of the best 100 teachers that year. For six years, I have been the regional vice president of the Eastern Federation of Mineral and Lapidary Societies. Recently with the president of the Monroe County Earth Science Association (MCESA), Mike Rose, we have been instrumental in getting MSHA safety certifications to over 50 people for field trips. Today I conduct a trading program across the United States and Canada. I am still the secretary of the Mineralogist’s Guild, and go on field trips almost every weekend in the collecting season. I just started teaching again at the Northampton Community College in Bethlehem, PA for the humanities and social science department.
In 2007, and 2008, a PBS station on channel 13, aired several pieces of my music and interviewed me as part of their “Arts in the Valley” series. I talked about my music and my rock collecting. They have been asking me to return, and recommend other performers who write their own music. I finally had the opportunity to display my rocks, my writing and my music. I still perform my music 4 nights a week. One night a month I advise the local club here in Stroudsburg, Pennsylvania, capital of Devonian fossils. In one year’s time it grew to a membership of over 40 people. I have been writing their newsletter called, “The Crystal Courier”, and publishing a music magazine at the same time called, “NEMO” for the North East Music Organization with Chris London and Scott Flax. I am presently playing percussion for a band called Full Circle, and also for a band called The Pocono All-Stars. On Monday nights, when the All-Stars take their break, I get to play my original music by myself because it’s an open-mic. Most of the time before I’ve finished, they’ve all joined me playing my stuff. It’s a good thing that happens.

I have three sons who all play guitar, and all write music. It is a joy for me to hear them play together. All three sons, Mark, Justin and Robin also have some knowledge of minerals and have their own collections. Robin, the youngest, has started playing with two bands, and works with the Shawnee Theater. My last musical project was with the Wishmakers, a group of musicians, artists and businessmen raising monies for the Monroe County Children and Youth Services. You can see our video of music on: http://www.youtube.com/watch?v=UwlhxL1ZTw&fmt=18. I’m the one wearing the cowboy hat.

People in the Pocono area call me the “Rockman”. I have been enjoying the title. Folks stop me everywhere I go, and ask if I have any rocks for them. So now I always carry rocks to giveaway. Life with rocks and music has been good.

Kenneth Heintz, the instructor, joins Mike T Rose and Michael Kessler at the Grist Mill in Whitehall, PA for the Safety Seminar.
Hunting for Herkimer Diamonds

(See Color Insert # 5, plate 1)

As I read Claude H. Smith's provocative handbook, “Let’s Hunt for Herkimer Diamonds” (1950), his suggestion, that you could probe cracks and crevices in which were hidden pockets of Herkimer Diamonds, stirred my imagination. It left me sleepless the night before our family expedition to Middleville, New York, in 1956. I was fourteen years old.

As soon as we paid our fees at the Ace of Diamonds property in Middleville, and set the family picnic in place, I slipped off into a ravine feeding the West Canada Creek with my prober, which was an ordinary kitchen knife. My mind flooded with dream images of crystals rolling out of the cliffs like macadamias pouring down the shoot at the nut bin in the health food store.

As it was, hours of examining the dolomite cliffs yielded nothing. I probed one hundred cracks and crevices repeatedly finding my kitchen knife coldly rejected. I tried reaching into the stream, climbing the cliffs, and crawling along the ruble at the base of the outcrops. Over and again I found one side of a suspicious opening cemented closed to the opposite side.

In the afternoon I returned to the center of the Ace of Diamonds property, had lunch reluctantly, and continued my ritual probing.

An expanse of bed rock about half the width of a city sidewalk had been exposed in the center of the diggings bounded by a vertical ledge of Little Falls dolomite about seven feet high. Two robust men in their thirties were dropping heavy sledges from above their heads to drive points and chisels into the bedrock. Subsequently, they would crowbar out large sections of rock. In exchange for hours of persistent sledging and wedging, an occasional crystal vug three to six inches in diameter would be uncovered, each containing several brilliant clear double-terminated quartz crystals up to one inch.

Their example provided a great mining lesson for me which would serve my needs in the future. On that day, however, my singular mission was to continue mapping every exposed ledge of dolomite with my kitchen knife, as though I was dowsing for water in the desert with a forked stick.

The exposed cliff in the center of the diggings sloped down on the right where it gradually became shorter and shorter and finally disappeared under the soil. A pipe stretching from a water well higher on the hill ended in a spigot that was in constant use which resulted in the ground becoming muddy in this area.

Approaching five o'clock, having probed for seven hours without finding a single crystal, I nevertheless remained locked in my ritual trance. Now near the water pipe, back in crawling position, I probed the short end of the cliff. As though entering a dream, with no reaction of surprise, I watched as my knife sank full length into the mud.

Had the dripping water created a bed of accumulated mud? Could this possibly be a clay pocket? Within minutes of pinching out small clay clods, I found myself digging deeper and deeper into a pipe-like passage about the width of my wrist. “First comes the clay, then come the crystals,” I said loudly. I quickly gathered a crowd though I had not as yet discovered a single crystal.

Perhaps I was too optimistic for in the next moment I encounter what seemed to be a setback. A chard of an old broken bottle cut my finger and now blood mixed with the smooth clay. Then, suddenly an egg of mud held in the sun, revealed under the rub of my thumb, a smooth brilliant face of a one inch crystal. The moment of discovery! Realizing that I was in a significant crystal filled clay pocket, it was all I could do to contain my excitement, stay focused, and keep digging.

It was not broken glass that had cut my finger, but the naturally sharp crystal termination of Herkimer Diamond! Five inches into the tube like opening, significant crystals began to emerge, one after another. We formed a team. My father bucketed clay which I removed from the pocket with the hope of later separating small hidden impacted crystals. My mother and sister took charge of the larger crystals and washed them clean of clay at the water spigot.

I held forth at the pocket and continued to pull out clumps of muddy clay which contained aggregates of more and more crystals. I mined several individual crystals each up to two inches in length. There were crystals that grouped together in radial clusters, crystals with yellow and red stains, and others with black organic inclusions (anthraxolite). The photo example shown here is a 1.5” crystal cluster from this pocket.

In all, three dozen well-formed large crystals, each over one inch, were found. There were no broken crystals. Each crystal was doubly terminated, often with contact points where other crystals fit, some of which I later assembled like a three-dimensional jigsaw puzzle. The clay itself yielded more than five hundred finely formed micro crystals each between one and three millimeters. Examples of the various forms found in these micros are presented here in line drawings.

A Closer Look was a monthly feature written for the Bulletin of the New York Mineralogical Club with text, drawings and photographs by Saul Krotki that revealed the beauty and mineralogical surprises of a microscopic view of minerals. Here are the best articles from 2003-2007 selected by Saul himself and in the order that he requested.
After working the pocket for three hours, darkness approached. With my arm in the pocket up to its length I could no longer reach any clay. My fingers were cut so badly that I could no longer use my hands. We could not widen the pocket entrance without hours of overburden work. It was time to return to the city.

Clay pockets had been found in Middleville before my discovery. I dreamed of the nests of crystals only after reading Smith’s accounts. Nevertheless, my discovery marked the beginning of an expansive clay layer at the Ace of Diamonds that was formerly unknown. When we visited again months later, we could see the results of subsequent excavations. An expansive horizon forty or fifty feet across at the base of the dolomite outcropping now exposed a discontinuous series of emptied pockets, each approximately eight inches high and two or three feet wide. It would not be long before the rumble would be bulldozed back into the hollows. Out of sight, out of mind.

Years later, of necessity, I would learn to drop my sledge from over head onto chisels and points. I would always locate, however, a probe or a kitchen knife to be an essential tool on any mineral hunting expedition.

Crystals from the Land of Oz
(See Color Insert # 5, plate 2)

Not far from the childhood home of Lyman Frank Baum, the author of *The Wonderful Wizard of Oz*, a housing development provided local collectors an opportunity to gather small geode-like nodules abundant in micro minerals. Up until the day that cement was poured for foundations, collectors could visit the Cicero mud flats, just north of Syracuse, New York, and collect in the late afternoon, after construction work ended for the day.

I am grateful to our fellow club member, Jerome Ulinsky from New York Mills, New York, for providing numerous samples which he collected in 1979 just before the little known Cicero locality was cemented over and forgotten.

Crystallized minerals, mostly 1.0 mm to 2.0 mm, are plentiful and include barite, calcite, goethite, gypsum, marcasite, and pyrite. The goethites and marcasites are both unusual as they each display a wide variety of orthorhombic crystals habits.

Free-standing terminated goethite crystals, unusual from worldwide localities, are plentiful in the Cicero vugs where they are found nestled between calcite crystals. (Fig.1) The goethite crystals of approximately 1.0 mm appear to the unaided eye as tiny wood splinters, but under the scope exhibit sharp pyramidal terminations, as well as a variety of orthorhombic chisel shaped tips. (Fig.2, sketched from direct observation). Also extraordinary is the tendency for the goethites to germinate from the tips of calcite crystals making porcupine-like sprays 1.0 mm in diameter. (Fig.3)

Marcasite occurs as flat wafers, pyramids, and heavily striated cyclic twins. Some of the marcasites have a highly reflective metallic luster, while others coated with an earthy yellow goethite, make an excellent subject for photomicrography. (Fig.4)

One may wonder if collecting at this unique locality is still possible? As it happened, Dorothy’s house, was picked up in Kansas and set down, very gently—for a cyclone—but directly over the most productive collecting spot in the Cicero mud flats. At that moment the Wicked Witch of the East who had been out digging met her demise as she was crushed to death between the newly laid foundations and Dorothy’s house. Relieved of the witch’s tyranny, Munchkins quickly bought up all the land and built houses over the entire mud flat. Alas, the only way to dig at this locality is to buy a house on the yellow brick road and dig your way to Oz in your own basement!

Bismuthenite

The Tazna Mine, Potosi Department, Bolivia, is one of the world's largest deposits of bismuth. Some countries, such as Russia, for example, have no native bismuth and so must rely on imports for this essential element.

Important for its use in medicine, bismuth is the only fully effective element used to treat bacterial inflicted ulcers.

Dana and Ford, 1932, list only twenty-two bismuth minerals in the Textbook of Mineralogy. Many of those species were described as “earthy incrustations,” “half globular,” and “pulverulent” or occurring as dust or fine powder. Today the list of bismuth minerals is much longer but the species are described by the same adjectives. Species of bismuth, which form notable crystals, are very rare. Bismuthinite, bismuth sulfide, is among those most rare minerals to occur as handsome orthorhombic crystals.

Our fellow club member, Alfredo Petrov, collected the micro crystals presented here during his travels in Bolivia. His
carefully written label reads, “Bismuthinite – all the crystals look like stibnites (there is no stibnite here). Crystals of bismuthinite are rare elsewhere in the world – it’s usually massive.” Indeed when the bismuthinite faces are brilliant black, they may on first impression be confused with stibnite.

Crystals from the Tazna Mine are often encrusted with marcasite which may entirely envelop and obscure the black lustrous crystals. (Fig 1. Bismuthinite from the Tazna Mine.) The crystals shown here are a few millimeters in length. Bismuthinite from the Tazna Mine which occur in crystals several centimeters in length are highly prized mineral specimens.

Other localities, including the mines of Cornwall, England, and Vastmanland, Sweden, characteristically offer bismuthinite in acicular micro crystals only. Note the curious parting or indication of twinning parallel to the c axis shown here in Fig 2.

How many bismuth minerals from Dana’s original list of twenty-two can you name? Do you have any in your collection?

**Lamellar Hematite**  
(See Color Insert #5, plate 3)

Years ago, if you were lucky enough to gain permission from a local farmer and if you didn’t get your car bogged down in mud, you might return from the old dump at Chubb Lake, New York, with some remarkable hematite specimens. Described here are specimens from Carl Krotki’s field collected material. Shown in the left frame of figure 1, is a close view of a two inch specimen, in which are stacked hexagonal 3.0 mm plates of hematite forming a lamellar structure. “Lamellar” is defined as being composed of thin plates, layers, or scales. The term, incidentally, is also applied to Medieval armor, where plates of metal, bone, or leather are tied together to create a flexible body defense.

A “hematite rose” is created when crystal laminae or plates stack nearly parallel, or off parallel, but around a common center. By comparison, when the plates or laminae are thin and separable, the structure is said to be foliated, as in the mystery mineral that I have presented in the right frame of figure 1. What species do you think it is? Go on, make a guess!

In the Chubb Lake specimens shown in figure 2, the stacks of hematite roses, orient in the third dimension, again around a common center, dramatically forming structures which do indeed resemble concentric flower petals.

The striking example of a foliated structure shown in the right frame of figure 1 is a 1.0 mm biotite from Laacher See, Germany. Mica crystals are, of course most deserving of the ultimate descriptive adjective for a mineral forming in plates or layers, “micaceous”! But here we do not find lamellar elements of a rose, so to speak, but rather in the customary vernacular of Mica Group minerals, we find the creation of a book!

For a comprehensive photographic essay on hematite variations world wide, as well as numerous other species, see John Betts’ remarkable contribution at [http://mindat.org/].

### Alfredo Petrov’s Bolivian Amesite
(See Color Insert #5, plate 4)

The dumps at Cerro Sappo are located 100 miles north of Cochabamba, Bolivia. The arduous journey through extremely rough terrain, inhabited by somewhat hostile locals, takes eight to twelve hours. In spite of the unfriendly setting, it is here that Alfredo Petrov has been known to spend a day hammering on boulders in search of rare species. Alfredo was kind enough to send me a thumbnail sodalite specimen from these digs, with arrows pointing to a few easily overlooked tiny vugs, that bore amesite crystals.

The amesite crystals were found in a 1,000 year old pre-Inca sodalite mine in an ankerite-sodalite-barite carbonatite dike. The dike is one-to-five meters thick and about two kilometers long, and dips almost vertically to unknown depths. The sodalite is worked in a number of small quarries for decorative stones such as those used in floor tiles and bathroom fixtures. Alfredo tells me that on a good day he has found as many as six amesite vugs, while on other days he found none.

Amesite is a triclinic pseudohexagonal Kaolinite-Serpentine Group species. Under the scope, tips of the minute crystals exhibit a distinctive sixfold sector twinning. In parallel clusters, viewed from above, the twinned amesite terminations present a delightful constellation-like pattern. Designer micromounts!

Most of the crystals from this locality are extremely tiny and are not visible to the naked eye. The star-shaped terminations shown here are only 200 microns across. The crystals measure only 500 microns in their longest dimension. It was a struggle at 100 X magnification to orient the crystals, and apply precisely focused fiber optic illumination, in order to achieve a few good photographs.

I taped my best amesite prints to the wall where they joined images of two dozen other species. I was delighted to find that the delicate apple green amesite crystals stood out among more
April at Washington Pass: The Year's First Field Trip  
(See Color Insert #5, plates 5 and 6)

News came mid winter of huge boulders crashing down a steep ravine and grinding their way across Highway 20 cutting off the town of Diablo, Washington. I immediately imagined the entire North Cascade Mountain range shaking loose and leaving crystals of quartz, zircon, and rare earth minerals along the road shoulders for miles.

My anticipation of making an immediate field trip left me in agony as the road remained closed throughout the late winter months. Quite to my surprise, on the 7th of April, the announcement came that the road had opened.

My wife, Eileen and I were driving up the North Cascade Highway within forty eight hours of the announcement. The geological marvel of the huge rock slide had been matched by the highway department's efficiency at removing the gigantic erratic boulders from the road bed. This rock consisted of fine-grained banded metamorphic limestone, decorative enough, but entirely lacking in cavities and crystals. The traditional Washington Pass collecting area was another thirty miles. With no collecting opportunities at the great rock slide, we set off for the summit gaining elevation through the smooth switch backs on the dry clear roadway.

As we passed Rainy Summit at 4800 feet, the look of the land changed auspiciously. Gradually a little snow on the road shoulders swelled to snow banks at places higher than the roof of the car! Turnouts to hiking trails were closed and no scenic lookouts were open. I began to wonder if the road was in fact open all the way to the summit.

Driving on through the narrow passage between the snow drifts we soon passed the Washington Pass summit (5652'). In a few more miles, to our relief, we found that the Silver Start turn out, one of the traditional collecting areas, had been cleared for safe parking.

There was no sign of any rock slide or fresh talus at this location. In fact, there were no rocks! There was snow to the north, south, east, and west, but hardly a boulder showing anywhere. (Fig.1. The view of the Liberty Bell collecting area at WA Pass, taken from the road, and looking back at the road, which is hidden by the snow banks, 10-Apr-04).

Exploration began with some trepidation. I found that I could walk on top of the snow drifts. The surface seemed densely packed enough to support my weight. Like walking on water, I thought! But I was wrong!

Rounding a curve just out of sight from Eileen, I reached the perimeter of the relatively safe zone and suddenly fell through the snow up to my arm pits. The snow instantly melted and then refroze around my boots. I could not wiggle my legs free. After a frightening moment, verging on panic, I remembered that I had a crow bar in my right hand. I dug my way back to safety.

Meanwhile, Eileen had found a group of boulders that the highway department had exposed, near where they had been clearing a cul-de-sac. These few boulders then became the limited subject of our heavy hammer operations. We filled two buckets with likely granite samples bearing miarolitic cavities, which we hauled home for trimming.

Later in the springtime I would return most of the seventy five pounds of rock to the mountain. I retained only five pounds, which I patiently split down to smaller and smaller samples with my hydraulic rock trimmer. As it would turn out, examination under the microscope would make up for the disadvantage of encountering such a limited exposure of rock in the field.

Remarkably, we found a well-formed crystal which glowed an eerie blue in short wave fluorescent light. We had brought home our first fine specimen of the rare sodium lithium zirconium silicate, zektzerite! (Fig.2. The gemmy, 3.0 mm, orthorhombic, zektzerite, forming a cluster of stacked, pseudo-hexagonal plates.)

The favorite collecting areas at Washington Pass are right alongside of the road and stretch 4.5 miles. For the cautious hiker, down slope talus with granite bearing miarolitic cavities, extends anywhere from 0.5 miles to 1.5 miles from the shoulders of Highway 20 to the opposite valley slopes. And this is only a small exposure of the Golden Horn Batholith. During the summer months, over one hundred square miles of alkaline granite are accessible for exploration and collecting.

I enthusiastically invite members of the New York Mineralogical Club to join us for an expedition. All that is required is profound respect for the National Forests. This collecting trip was made possible due to the efforts of the Northwest Chapter of the Friends of Mineralogy. Their Washington Pass Annual Roadside Cleanup has set the best example on behalf of inspired mineral collectors, as well as for those concerned with sensitive preservation of the forest lands.
See the Washington Pass gallery at mindat.org for a full color photographs of many of the rare species which have been collected at this locality.

**Scepter Quartz from the Dugway Range, Utah**

In John S. White’s *Rocks and Minerals* article, “Scepters or ‘Descepters’” (R&M V78, Mar-Apr 2003), he explains that scepters and reverse scepters can occur side by side, both resulting from primary crystallization. The crystals may form a thickened scepter perched on a narrow base, or in the case of the reverse scepter, thin stem-like terminations which extend from relatively thick prism bases. White includes one of my drawings which illustrates a quartz specimen from the Dugway Range, Utah, which is thick at the base and then extends into two well-formed long narrow scepter terminations. One crystal with two heads! Here I present a few additional illustrations of other unusual Dugway scepter quartz forms.

As an artist I search for those forms in nature that are a delight to draw. A baffling array of enticing subjects was provided by an unusual find of thumbnail sized Dugway geodes, discovered and mined by Mike Sprunger in the early 1980's. To their credit, Mike and his wife Sandy, persistently get off the beaten path and often succeed in making fresh discoveries. In this find, side-by-side scepter and reverse scepters were only the beginning of the myriad exotic forms encountered. The quartz in many of these small geodes was unusually vitreous as compared to the typical finds of rather milky Dugway quartz.

These quartz forms pinch in and form narrow waists, then widen out along their length, waist-in again, and finally terminate with scepters or reverse scepter heads. (Figure 1.) Photographs of these glistening micro crystals produce disappointing results. Lights jump from the highly reflective glassy planes, while water-clear transparency adds confusion to the subtlety of the external forms.

To offer more clearly defined illustrations, I set out to draw the variations in pencil from direct observation under the binocular scope. Toggling between the scope and my small drawing pad, I turn each subject specimen freely, changing slightly the perspective of a given oriented view as I progress. I endeavor in this way to solve problems of effective overlapping and crucial plane turns. Drawing solutions require this kind of pecking around edges, something that is not possible when illustrating from photographs. I made a decision to forego the transparency and render the clusters as though they were wood crystal models so that I could fully grasp the morphology. Later, I would enlarge my small original drawings and develop some as full color-paintings or larger drawings. (See R& M, V77, Sep-Oct 2002, pages 344-345.)

Not only are the crystals from the Sprunger find astounding in their variations, but so are the variations in treatment that an artist inspired by these forms can present. Here for your viewing pleasure is my “Candelabra Triplet.” (Figure 2.) Gem clear terminations extend from within hopper-like scepter forms!

While it is curious that we observe scepters and reverse scepter forms growing side by side, it is equally curious that we find three crystals, each mimicking the other, and each obeying the same laws of crystallization! But what might these mysterious laws be, and how do they effect such unique differences?

**Conquering Bloody Nose Boulder**

(See Color Insert # 5, plate 7)

At Washington Pass, Okanogan County, Washington, the whitest boulders usually yield the most interesting microminerals. These are the granites that are most alkaline in composition and the least altered. There are thousands and thousands of suitable white boulders to choose from. Yet, at milepost 164, everyone’s eyes invariably settle on the same gleaming truck-sized boulder a short distance down the steep embankment. Chipped at and hammered on for twenty years, the White Boulder has come to resist all hammer blows. Even my best star-drill left nothing more than a sand-filled dimple on the surface of the great vault of sequestered micromounts.

Discouraged by my futile efforts, I turned my attention to a smaller boulder hidden in a grove of trees. Although this boulder was also rounded, I was able to stand over it, enabling my ten-pound sledge to crash down with the advantage of gravity. Chips flew off sailing down the canyon out of reach. One smack sent a shard, shooting like an arrow, into the side of my nose just under my safety glasses. Blood poured forth. Eileen took immediate action. After all, opening the emergency first aid kit is every bit as exciting as capturing a vug full of zircon crystals! With such a large bandage on my nose, positioned at the edge of the precipice, it became too perilous to continue. I had to stop hammering for the day.
In the months that followed, I returned to my Bloody Nose Boulder four more times, each day getting very little for my persistent efforts. A conspicuous one-inch pegmatitic vein locked in at the equator of the rounded boulder teased me and served as an incentive to continue. Only total destruction of the boulder would liberate the potential treasures locked within.

Progress was slow and frustrating. I would occasionally break loose a chunk which would offer an unusually large cavity with fine micro treats. Figure 1 shows one such freshly opened 1.5" cavity in which albite, zircon, fluorite, and magnetite crystals were found. This kind of surprise would keep me hammering for hours until the recalcitrant boulder would finally exhaust me.

Early in October, I drove the four hours once again, this time with my good friend and veteran Washington Pass species collector, Robert O. Meyer. He concentrated his collecting near the White Boulder, while I set out to work exclusively on the smaller Bloody Nose Boulder. This time my first sledge hammer swing greeted me with a flying chard to the forehead!

Ten years ago Robert was hammering away at this very same boulder. It was then about the size of a two-drawer file cabinet. You could not roll it over or move it in any way. He continued to drop his ten-pound sledge on the boulder, encountering much frustration only to crush the surface and knock off a few useless chips. Bob Boggs, older and more experienced at WA Pass, pensively paced about, his kindness barely concealing his impatience.

Finally Robert asked Bob if he would like to have a try. Bob stepped up to the boulder with his smaller sledge. “These rocks kinda’ have a grain to ’em.” Bob broke into motion and with light hammer blows soon busted the boulder in half. That day, thanks to Bob Boggs, Robert went home with a fine specimen of kainosite, the rare yttrium cerium silicate.

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The remaining section of the Bloody Nose Boulder endured for ten years. It had become a smoothed egg, now the size of just one file cabinet drawer. Like the Excalibur of Camelot, this boulder was resistant to all collectors’ hammers. Yet I was determined to break through and gather the hidden micromounts.

Listening to the guidance handed down from Bob Boggs, I found the most effective combination of light and heavy blows and soon split the Bloody Nose Boulder. I captured an eighteen-inch slab full of miarolitic cavities in which I could see a well-formed crystal of unaltered siderite without a lens. (Fig 2. A honey-yellow siderite crystal measuring 3.0 mm across.) As much of the siderite from WA Pass is altered to opaque brown goethite, this unaltered translucent crystal was a very good sign that other well preserved species would be found. I soon crushed the boulder to small fragments leaving nothing behind. The Bloody Nose Boulder had been conquered!

I will have an ample supply of this promising material to study this winter. Snow will close the highway in mid November. It will be springtime before the forest invites us to return. I have thus far looked over only a few of the cavities. I was thrilled to find the fine cluster of bastnäsite-(Ce) measuring 1.0 mm across shown in Figure 3.

I am already imagining the conquest of the great White Boulder for the 2005 collecting season! Come and join me!

Thomsonite

Thomsonite, generally thought of as a lackluster species, is rarely shown in photographs. As I examined articles from a list of 300 references which stretch over twenty years, I found most only included thomsonite in an alphabetical locality listing but provided no photos and no report of its occurrence.

One photograph which accompanies Jules Bernhardt’s fine article, “The Unusual Zeolite Species,” made the cover of Rocks and Minerals magazine, volume 55-1, January-February 1980. The cover photo is, however, a rather sleepy, colorless, botryoidal thomsonite from Beech Creek, Oregon.

A noteworthy thomsonite discovery story can be found in Joe Peters’ “Triassic Traprock Mineral of New Jersey,” RM, V. 59-4, page 157: “Perhaps the finest crystallized thomsonite in existence has been collected at Prospect Park Quarry. In 1979 Jim Kaufman discovered a pocket at Prospect Park that contained pearly white sheaves of thomsonite, more than 2 cm across, associated with light green prehnite and radiating hemispheres of pectolite.” The article goes on to say that the best specimens are preserved in the Paterson Museum.” Here a disappointing black and white photograph of the prized specimen again portrays thomsonite as a rather dull species.

Hand-sized specimens of thomsonite have been described as “white fibrous coatings”, “globular aggregates,” and as “minute white hemispheres.” Contrary to this rather bland press, thomsonite distinguishes itself as a species of great variety and interest when examined under the microscope. Here thomsonite is seen as rosettes of bladed chisel-tipped crystals, as well as botryoids which sprout randomly extended arborescent growths of exotic beauty. Sometimes two or more distinct habits representing different stages of crystallization can be observed in one micromount specimen.
Thomsonite often supports seed crystals in gravity-defying sculptural combinations. (Fig. 1 from Goble, OR). Here as a popsicle stick thomsonite supports a chabazite which looks as if it just popped out of the ice cube tray! Where might unusual thomsonite micro specimens be found?

The list of localities providing fine “extended growth” micro-thomsonites is not long. In Oregon they have been collected at Beech Creek and Ritter in Grant County, and at Goble, in Columbia County, Oregon. (See Tschernich, Zeolites of the World, figures 587, 588.) My list of good finds is slowly growing. Here are a few photographs (Fig. 2) of new specimens added to my collection from this summer’s explorations in Elmore County, Idaho. On the left, an arborescent forest of thomsonite grows both on a base of an earlier stage of thomsonite and also on needles of mesolite. (Field of view 3.0 mm.) On the right, from the same locality, a 1.5 mm sphere of thomsonite showing sputnik-like extended growths.

For a complete account of the successive generations of thomsonite see one of the all time best zeolite articles, “Zeolites and Related Minerals from the Table Mountain Lava Flows,” Kile and Modreski, MinRec V. 19, May-June 1988.

Thomsenolite and Pachnolite: A Study of Dimorphs

I was delighted to have received a small parcel of micromounts from my good friend and fellow micromounter, OT. Ljostad of Elverum, Norway. Included were several samples of rather rare alumino-fluorides from Ivigtut, Arshuk Fiord, Greenland. Not only did I not have these minerals in my collection, I was also unfamiliar with thomsenolite and its dimorph, pachnolite, the subjects of this discussion.

Thomsenolite, generally known for steep pyramidal monoclinic crystals, also occurs as blocky, nearly cubic forms. I had to look twice at 40X to recognize that the crystals were in fact not cubic. Turning the minute crystals under the scope, I soon found a representative cluster of crystals that would reveal the true monoclinic symmetry (Fig. 1). The crystals are approximately 0.6 mm on an edge.

Thomsenolite occurs with its dimorph, pachnolite. At first impression the two species are almost indistinguishable by sight identification. Optically, thomsenolite is biaxial (-), while pachnolite is biaxial (+). Without optical instrumentation, I searched, instead, to find another reliable distinguishing characteristic that would be accessible to sight identification.

OT. sent along a bit of quaint wisdom from Norway. As he said, “Where the two minerals occur together, you will find smaller pachnolite crystals growing out of a larger thomsenolite forms.” I zoomed in on such a cluster, photographed it, and then generated the simplified line drawing shown in Fig 2. which represents a field of view of 1.0 mm.

One has to ask, “Did I reach the correct conclusions and label the species correctly?” It is very difficult to tell them apart. Doubts set in. An exemplary specimen photographed by Bill Henderson looked very much like my pachnolite, but Bill’s specimen was labeled thomsenolite. (MR V12 p 385, fig. 19.) Yet the arrangement of crystals in his photograph look much like those in my drawing.

Another photograph of a magnificent specimen, (MR, Minerals of Greenland, V24, p33, Fig 49), shows pachnolite as long prismatic crystals with short pyramidal terminations. In the same article, Fig. 48, crystals with long steep pyramids, are labeled, thomsenolite. My crystals formed no pyramids and looked like neither of these photographs. Again, I found myself doubting my identification. In fact the more photo images and diagrams that I found for these species, the more reasons for doubt I found.

My study, however, soon turned productive. I spent an afternoon at the University of Washington library where I found the key in Goldschmidt’s Atlas Der Krystallformen. In a small diagram representing a cross-section view, looking down the c axis, the significant morphological distinction between these two closely related species is clarified.

As it turns out, the angles for thomsenolite, when viewed down the c axis are nearly 90° at the corners. In pachnolite, on the other hand, the shape of the cross section, is distinctly rhomboid. Otherwise, the morphological habit of the two dimorphs can be nearly identical.

In fact, there are thomsenolites that look very much like the specimens show here in my pachnolite diagram (Fig.2). Often, the best specimens for both species show pyramidal forms. But there are also well formed crystals for each that

Fig. 1. Thomsenolite

Fig. 2. Pachnolite
develop with no pyramidal faces as in the crystals that I am presenting in this article.

Back under the scope at 40x, I made certain of the cross-section distinctions and thereby verified the identification of each species.

When studying species under the scope, reference to ideal drawings along with photographs of the world’s best specimens can make comparisons difficult. For rare species, we are left with too few comparison images to gain fully comprehensive impressions of the possible crystal forms, especially were highly variable habits occur. Where SEM images are provided, yet more unfamiliar variations of the habits are found.

When all is said and done, without optical analysis and verification by X-ray diffraction, some doubt as to the validity of the identification remains. But for the moment, I will put that aside and try a few more drawings!

**A Tasmanian Zeolite Report**

Terry Evans, in his “Crocoite is Not the Only Tasmanian Mineral,” (See Section II in Almanac), presented an informative chronology of the discovery of minerals in Tasmania. I am pleased, in presenting this brief report on a Tasmanian zeolite occurrence, to join Terry in his effort to increase our awareness of Tasmanian mineralogy.

I am grateful to my good friends Brian and Beryl Carney, who provided specimens for this report that they collected at Don Hill, on the northern coast of Tasmania, in 1986. The minerals were found abundantly as the result of a road widening project which cut into a zeolite bearing Tertiary basalt. The site, 6 km west of Devonport, is now covered by the roadway. (See “Minerals of the Road Cutting, Don Hill, Tasmania, Carney, Microprobe V 8-2,11/95.)

Crystal bearing cavities were known to occur at this location as large as two meters across. The cavities that I have on hand for examination are, however, only 1.0 cm in diameter. What follows then, is an observation of microminerals.

Most of the cavities are lined with phillipsite crystals, often with subsequent deposition of chabazite and siderite. The phillipsite crystals are remarkably sharp and show distinctly twinned forms. It is a great delight to photograph these crystals as they are truly “textbook” examples. Two views of one such phillipsite, measuring 1.0 mm in length, is shown in Fig. 1.

Late stage siderite crystallization includes quaint formations resulting from the coating of previously existing species, along with well formed, individual, rhombohedral crystals. The formations shown in Fig 2, have been determined to be siderite on gonnardite/natrolite intergrowths. Field of view 1.5 mm. Several variations of habit are observed in the siderite crystallization. Fig. 3 shows a twinned chabazite surrounded by well formed rhombohedra of siderite. The siderites range in color from light tan to darker, pinkish, or rusty brown. In some vugs, the siderite occurs as minute hemispheres. Others form twisted half bowties reminiscent of the bowtie siderites of Cornwall, England. The chabazites also show a great range of habit from nearly single crystals, simple twins, and then more and more complex interpenetrations, finally resulting in forms which appear to be essentially botryoidal.

I have presented only a glimpse of the great variety of species and crystal habits found in the minerals of Tasmania.

For history, maps, localities, and comprehensive studies of zeolites and other minerals of Tasmania see Steve Sorrell’s www.crocoite.com. Steve is an inspired member of the Mineralogical Society of Tasmania.

**Portraits of Tyuyamunite Crystals**

(See Color Insert # 5, plate 8)

A box of micromounts labeled, “Photograph Next,” sits awaiting my attention in the shadows of my study. When studied beneath the binocular scope, each micromount in this box promises a photomicrograph of revelatory significance. I hope to at least get to some of them soon!

Crystallized uranium minerals are one category of aesthetic favorites that are over and again among the first to be selected from the box. In my NYMC feature last month, I presented uranium mineral beauties from the Musonoi Mine in the Republic of South Africa. This month I would like to share some images of the calcium uranyl vanadate hydrate, tyuyamunite, from the Marie Mine, Carbon County, Montana.

The Marie Mine specimens came to my attention four years ago via the internet which made it possible to acquire several
thumbnail specimens at very reasonable prices. (At eBay, see “Rare Species” under “Rocks, Fossils, Minerals.”) When the specimens arrived, I was taken aback by how small the crystals actually were! Sellers had advanced quickly into digital photography and thereby routinely magnified the smallest crystals to the point where they gave the pictorial impression of monumental cabinet specimens! I had overlooked the measurements specified in the descriptive text. The largest of the crystals measured far less than 1.0 mm!

Back then my optical equipment consisted of a Nikon F film camera mounted on a Spencer binocular microscope. The images that I achieved rendered the tyuyamunite specimens as nothing more than indistinct rounded yellow clusters. I could perceive the elegant morphology of the individual crystals under the scope, but I could not photograph them effectively. The high quality of the digital photography that was being presented on the internet was entirely bewildering to me. I filed the poor photographs and threw the specimens back into my “Photograph Next” box where they have been waiting four years for my attention.

Having taken the steps to update my optical equipment, I now rely on a Nikon Coolpix 4500 mounted on a video zoom tube. This setup provides a magnification and resolution of the minute crystals far superior to what the Nikon F microscope setup would let me achieve. I am delighted to be able to present close up portraits, so to speak, of the individual minute tyuyamunite crystals.

The crystals shown here are each just under 1.0 mm in their longest dimension. The morphology of the orthorhombic crystals range from stacks of relatively flat scale-like growths to those crystals which exhibit more of a hopper-like growth habit. (Figure 1. Relatively flat habit. Figure 2. Deeply cupped hopper or rosette habit. Figure 3. Interpenetrating cluster.)

These fascinating micromount specimens from the Marie Mine are still available at very reasonable prices. Be aware, if you acquire some, that they are rather delicate and should be subject to as little cleaning as possible. Even an air can will blow some crystals right off the matrix.

There is some question as to whether or not these micromount treasures will be available much longer. See Rocks and Minerals, May 1999, “Minerals of the Pryor Mountain Uranium District, Carbon County, Montana.” As noted, “The U.S. Forest Service has a program to close and reclaim sites within their jurisdiction, but collecting is currently possible.”

Enjoy these photomicrographs in full color at Saul Krotki’s photo collection found at www.mindat.org. Also check the specific “Tyuyamunite Gallery” where you will find corresponding matrix specimens presented by our fellow club member, John H. Betts.

A Respectful Goodbye

(The following essay was written by Saul Krotki as an “introduction” to his first column. It seemed appropriate to me to reproduce it here in our 125th Anniversary Almanac – Editor)

Some Reflections on the Early Years at the New York Mineralogical Club

I infected my family with mineral collecting in the early 1950’s. I combined frequent visits to the mineral and gem hall at the American Museum with my own version of neighborhood organized field trips in the construction sites of the Major Deegan Expressway, and thereby synthesized my early mineralogy education. My mother wanted to throw out my box of feldspar cleavages, but my father said emphatically that such a great collection of minerals should not be inhibited.

Family and friends surrendered and joined forces with my father’s ambitious expedition plans in support of my mineral collecting excitement. In the summer of 1957 we crossed the country with Peter Zodiac’s old Rocks and Minerals locality notes in hand. We traveled over a thousand rising and falling hills through a blinding locust storm in South Dakota that miraculously did not completely choke off the radiator on the
At that show you could buy a hand sized, nicely crystallized specimen of many different common minerals for $4 each. I quickly obtained a fluorite, calcite, and an amethyst. What was more notable about this Federation event was the daily carefully organized field trips that went on for a week. Park Rangers arranged for streams of cars fifty and more long to park on the shoulder of the scenic highways. Then they guided us to nearby localities. You can bet that you would be thought of as an ecoterrorist were you to park your car and collect there today. I collected gem grade kyanite at Balsam Gap and my father hit a big pocket of almandine at the Little Pine Garnet mine. These were extraordinary collecting days.

Carl’s garnets just rolled out of the hill once he opened the pocket. Every specimen was euhedral, though partially covered with chlorite. Some were more than three inches in their longest dimension. Most of the crystals were quite distorted. Some were long and slender and others were flat. You would have to be a sharp crystallographer to judge the angles and recognize that these were isometric crystals. In the fall of 1958 we took along samples of the garnets and for the first time went to a meeting at Columbia University of the New York Mineralogical Club. We have been members ever since.

Here, of course, we encountered a fully astute society were one could find inspired guidance from each and every member of the club, minute by minute. Frank Chambers quickly ran down the hall to get one of the mineralogy professors and show him the flattened garnet crystals. Joe Rothstein happened to have hit a pocket up at Herkimer and handed me a large quartz crystal to keep. I was astounded. Within a few months I followed through and also opened a large pocket in Middleville. I was still in high school.

At that time many member of the New York Mineralogical Club were also members or speakers at the New York Gem and Lapidary Club. We formed an ad hoc field trip committee with members of both clubs, among them: Joe Stromwasser, Joe Rothstein, Frank Chambers, Walter Stone, Edge Goldstein, Seymour Switzer, Fred Pough, Carl Krotki and myself. There were weekly excursions to the New Jersey trap rock quarries. Visits to the dumps at Franklin. Summer excursions to the Ontario and Quebec localities where we collected an astounding array of minerals including beta-fite, apatite, scapolite. There was one find of terminated oligoclase which came along with gigantic predatory black flies.

We joined forces with Lou Moyd to collect giant nphelinite crystals and splendid fluorrichterites in hidden localities in the woods which Lou Moyd called “dinkies.” We went in the winter and reconnoitered by counting paces in the snow to successfully collect chrome grossular and chrome diopside at Brompton Lake, Quebec. We made another trip to Utah and drove a rented car across the old Pony Express road through cow pastures and hours of blinding dry desert dust to successfully dig tiny red beryls out of the Topaz Mountain amphitheater. This was a long time before the fine red beryl crystals appeared at the Violet Claim in the Wah Wah Mountains. We fell under Fred Pough’s tutelage and joined him on the original field trips to the Jeffrey Mine in Asbestos, Quebec. Our finds of gem grossular and purple vesuvianite were among the first donated to the Smithsonian mineral collection from the Asbestos occurrence.

Carl Krotki, my father, became close friends with Neal Yedlin and with Fred Pough. They journeyed to the Pacific Micromount Symposium and to the Baltimore symposium. This introduced yet another dimension of mineral awareness. Inspired by Neal Yedlin we each soon had a fine binocular scope. Neal taught me how to align the lenses in the old Spencer binocular microscopes. I spent many hours in Neal’s basement where he left me alone to study his micromounts.

Biography of Saul Krotki

Above is an abbreviated glimpse of the kind of personal networking and flux of activity that was going on among the members of the New York Mineralogical Club through the 1960’s and early 1970’s. Of course, I was only privileged to see just my part of it. Here we are talking about annual Brag Nights which would attract the likes of John Sinkankas, Fred Pough, Kurt Segeler and many others.

As I mentioned, my family and I have been members of the New York Mineralogical Club since 1958! My father’s work as Treasurer of the Club for fourteen years as well as treasurer of the EFMLS is a matter of history.

In my life I have studied broadly in both science and arts. I completed a major in art and in mineralogy and was a National Science Foundation intern at the Smithsonian in mineral science were I worked with John S. White, George Switzer, and Paul Desautels. I am a Master of Fine Arts graduate from the State University of New York. I am also a Certified Laser Electro Optic technician.

In the most recent ten years I directed a Fine Arts program for “children at risk in Seattle.” I now teach adult Arts programs. I collaborate with Bart Cannon at Cannon Microprobe in Seattle in various mineral projects and Electron Microprobe Analysis. I am a micromounter, photographer and illustrator of landscapes and mineral specimens. A presentation of my art work, “Seattle Mineral Artist,” was published in Rocks and Minerals magazine Volume 77, September/October 2002, along with my article, “Examination of Crystallized Turquoise,” also illustrated with one of my paintings.
The image below is a scanned reproduction of the description of the minerals pictured on the frontispiece from Familiar Lessons on Mineralogy and Geology, 3rd Edition, 1821, by John Mawe with the illustrations by James Sowerby, which was used for the cover of this Almanac. For a biography of Mawe, see page 116 later in this almanac.
The Metropolitan Mineral Area of New York City
Excerpts from “The Minerals of New York City and Its Environs”, by James G. Manchester,
Bulletin of the New York Mineralogical Club
(From Rocks and Minerals, Vol 6. No 3., September 1931 – Magazine’s Size Actual)
The Metropolitan Mineral Area of New York City

By
JAMES G. MANCHESTER

"One of the most interesting mineral districts in the world is contained in the territory lying within a radius of fifty miles (80 km.) of New York City. This area, commonly known as the Metropolitan District, comprises portions of three states, occupying a very small part of the southwesterly section of the State of Connecticut, the southeastern portion of New York State, and the northwestern part of the State of New Jersey. This area, with the exception of a few scattered sections in the outermost portions, is the territory at present receiving serious attention on the part of the Regional Planning Committee formed to study the future growth of New York City and to recommend certain civic improvements to meet the same.

This region having been subjected to vast rock movements through the uplifting and submerging that took place when this part of the continent was in the making, many veins, dikes, veins and pockets were formed and it is here that Mother Nature throughout these millions of years has wielded her magic wand to produce these beautiful mineral crystals which are so much admired. The pre-Cambrian gneisses of the hills covering a large part of this area, the Triassic red sandstones and shales in the Newark series, the diabase and basic trap ridges of the Palisades and the Watchung Mountains, the serpentines and limestones which appear in a number of well defined deposits, are all rich in mineral content.

"In addition to this vast movement resulting from earth making the rocks have suffered subsequent disruption by man. Probably no like area on the face of the globe has been subjected to such intensive artificial removal of rock through engineering enterprises. The first settlers, almost as soon as they had erected shelters, were obliged to look about for materials to use in the arts and industries, for it is from the earth's crust that those materials which are necessary for life and happiness are drawn. Much prospecting has been done in the search for ores and many mines have been operated. To provide water for its millions of inhabitants, reservoirs and aqueducts have been established. For the erection of gigantic buildings extensive excavations have been made in the rock floor. To facilitate transportation miles of streets, tunnels and railroad cuts have been constructed, in many instances through solid rock.

"One usually associates mining activities with the open country and the wilds of distant mining camps. The fact that such operations have been conducted almost within the confines of a great city is not generally known to many of the inhabitants thereof.

"In looking over the past history of the district we find that in this area over 300 iron mines and more than twenty copper mines have been operated at one time or another, but the discovery and opening up of new fields in the West and in foreign countries created a competition which could not be met, so that at present no copper mines have been in operation for twenty years or more, and only a few iron mines are producing at this time. Many of these iron mines, however, have never been worked out and if their ore (magnetite) ever becomes scarce in other regions the many abandoned mines in the district may once more take their place in the industry and be made to supply large quantities of ore for an indefinite period. The limonite ore mined on Staten Island and in East Brunswick, New Jersey, was used for blast furnaces and partly to produce red ochre paint.

"The white limestone occurring in this area has been worked extensively for flux..."
for use in the many iron works, for burning into lime and also for agricultural purposes. The remains of abandoned lime kilns may be seen at various places throughout the district. Today much of the limestone is reduced to a fine powder for use as a light abrasive and for the making of artificial stone. Extensive operations of this kind are now underway in Westchester County.

"Several mines rich in zinc and manganese in the Franklin Furnace district of New Jersey have been in operation for seventy years and are big producers at the present time. The Franklin ores are chiefly valuable as a source of zinc, but also on account of the manganese and iron they contain. From them is made a high grade spelter (commercial zinc); zinc oxide, used as white paint and in the arts; and spiegeliron (an alloy of iron and manganese) used in the production of steel. It is reported that about 1830 Dr. Fowler, then owner of the mine, produced a "bluish-white powder" from the ore that he used as a substitute for white lead with which he painted his house, which was perhaps the first time oxide of zinc from the ores of an American mine was used for house painting. It was about 1818 that the first metallic zinc made in the United States was reduced from zincite ore furnished by these mines. This metal was used in preparing brass for the first set of standards and weights and measures ordered by the Congress.

"Emery, a variety of corundum, used as an abrasive, is being taken out of the rocks in the Peekskill region and at certain periods in the past has furnished a goodly portion of the ore consumed in this country; here, too, foreign competition has slowed up this industry.

"Feldspar, quartz and mica mines are being operated quite extensively at the present time in a number of localities a few miles north of New York City in Westchester County. One of these mines at Bedford has been in continuous operation for fifty years and over one million tons of ore has been taken out. The ore is crushed to a fine powder and is afterwards shipped to various industrial plants. The quartz is used as a wood filler, for silica paint and as a constituent for scouring soaps. The feldspar is used in the manufacture of china and porcelain ware, setting the fine glaze on that material. The production of mica, despite the fact that it is an important mineral in the rocks of this vicinity, has never attained the basis of a settled industry, the material being of such a quality as would not permit its use for sheet mica purposes. It was formerly allowed to accumulate on the dump; recently a market has been found, with the result that this side of the mining operations is receiving considerable attention at the present time.

"Beryl, which is occasionally met with in large crystals weighing several hundred pounds each, has been collected as a by-product and for years shipped to Germany where a ready market was to be had. The chief use of beryl in industry has been and still is as a constituent of enamels for enameled steel ware. Beryl contains the rare metal beryllium (also known as gold-nium), discovered in 1828 by Wohler, but it is only quite recently that methods have been discovered to isolate it on a semi-commercial scale. This has stimulated the interest in possible sources of beryl which could be relied upon as adequate for commercial production of this metal. Beryllium is a hard and brittle metal and for this reason few uses for it have been found. Herefore, it has had but a single commercial use, being employed for the windows of certain X-ray tubes. Most of the research on beryllium has been conducted in Germany with a view to its use as an alloying metal with iron, copper and nickel. The recent discovery that beryllium has all the qualities of aluminum and at the same time is a lighter metal has created a demand for beryl and this mineral is now given a prominent place in the products of the Bedford quarries.

"The rose-colored quartz at Bedford is not only best known to collectors but to the neighbors of the quarries, for in driving about the vicinity this mineral will be found on display in the front yards and along the roads. Shipments of this material have been made to Europe and the Orient to be carved into ornaments, no doubt much of the finished product finding its way back to the United States. "Several years ago the newspapers carried the announcement of the discovery by the Danish chemist, Georgy, of Hevesy, of the new metal hafnium, and later when a small amount of one of its salts, "two little pinches of white powder, sealed in tiny glass flasks," was received in this country, considerable inter-
est was aroused. Few people, other than members of the chemical profession and local mineralogists know that we have within the borders of the Metropolitan District a rich source of available ore carrying this new element, for it has been determined that the Bedford crystalline dolomite contains 5.9 per cent of tritium, HTO. This mineral as yet has not been found in commercial quantities at Bedford, but the extraction procedures would be sufficient to produce fifty pounds of this new element. The uses to which it can be put are yet to be applied, although they parallel closely those of its sister element, zirconium.

Graphite, used as a lubricant and for the manufacture of "lead" pencils, was successfully mined years ago at Bloomington, New Jersey, the output at that time finding a ready market. "Pyrrhotite occurs at Anthony's Nose, on the north side of the Hudson River, just north of Peekskill. This deposit was worked for a number of years, the product being used locally for the manufacture of iron."

"Arsenopyrite has been mined periodically in the northern part of Westchester County for the arsenic it contained. A prospect on which considerable work has been done is located on the Brown farm, between Edenfield and Maury Adam in Orange County."

"Several lead mines have been operated, one at Sparta, New York, about one mile (1.6 km.) south of Ossining, where galena and other lead minerals occur in the limestones. It is also reported that a copper and silver mine was at one time worked here; native silver was discovered in 1825 and a company was formed to operate the mine in 1827 and some work was done but the enterprise was soon abandoned."

"Tungsten ores were mined many years ago at Trumbull, the industry being revived during the world war. The sepentine deposits on Staten Island have been mined for asbestos."

"Garnet and topaz, used for abrasive purposes, were mined in a number of localities in the Fairfield County, Connecticut, section of the district."

"Mineral deposits useful as a fertilizer are present in large quantities in the green marl belt extending from Sandy Hook to the southwest, the larger part of this belt lying within the district. These deposits are known to contain potash, lime and phosphate, and the marl has been marketed on a small scale as a fertilizer for many years. The potash is contained in the mineral gluconite, a hydrous silicate of iron and potassium, which makes up the green sand of the marl. Although it has been estimated by competent investigators that this belt contains 256,000,000 short tons of potash (K2O), enough to supply the needs of the United States for one thousand years, the commercial exploitation of the deposit is not economically possible in view of the established domestic (Searle's Lake) and foreign sources of supply."

"Great, indeed, are the resources of the Metropolitan District in numerous quarries of the most durable as well as beautiful building stone. Many varieties of stone used in the construction and decoration of buildings within the district have been quarried and are being quarried at the present time. These include the granites of various colors—just now brown granite is being cut at Mohawk, in Westchester County, for use in the construction of the new Federal building on Morningides Heights. The red and brown sandstone of the Newark series of rocks is represented by dwellings and public buildings on Manhattan Island erected many years ago—the present Trinity Church on low Broadway is of this material; this stone, however, lost its popularity, because the builders laid the stone on edge, with bedding planes vertical, which occasioned its rapid scaling and flaking. The various gneisses have been used to a considerable extent; one of the best examples of the use of this stone is in the College of the City of New York, whose campus buildings present an imposing spectacle in the northerly section of the city. In the past many quarries in the district provided fine white marble for numerous buildings. For decorative purposes, the serpentines of Staten Island and Monteville and the limestones in the Westchester section, when polished, have furnished beautiful examples for interior decoration; the most recent of the limestone is represented in the marble finish of the New Colonial room at the Metropolitan Museum of Art, the million black granite belt extending from Mr. Bottley and to his new company and we hope and trust that Gregory, Bottley & Co., will continue to prosper and for many, many years.

E. P. Bottley of Lyell House, Shelton Lock, Derby, England, (late of 27 Portland St, Derby) has acquired the good will and immense stock of rocks, minerals, and fossils of James R. Gregory & Co., of 30 Church St, Chelsea, London, (late of 139 Fulham Rd, South Kensington, London)."

The name and address of the new firm is:

Douglas, Bottley & Co.,
Mineralogists and Geologists,
30 Church Street,
Chelsea, London, S. W. 3, England

Our greetings are extended to Mr. Bottley and to his new company and we hope and trust that Gregory, Bottley & Co., will continue to prosper and for many, many years.

A large brown jasper (boulder) weighing 5/7 pounds was found at Toddsville, near Peekskill, N. Y. last May, during the construction of the Westchester County Parkways, and presented to the Editor by Robert Krug, a young civil engineer employed by the Westchester County Park Commission. We are grateful to Mr. Krug in donating this interesting specimen to us.

Nears, Willis Croft, George Dietz and George Hayes, also young civil engineers employed by the Park Commission, Peekskill Residence, have made frequent contributions of interesting specimens found along the parkways. This remembrance of our special interest in the minerals of this locality is greatly appreciated.
Tourmaline Troop Redux
By Mitch Portnoy & Aaron Lemle

Do you remember all the kids that used to come to our meetings and other events? They had formed a unit within the Club called the “Tourmaline Troop.” Technically, this miniclub still exists and the kids, at least most of them, are still around and still have an interest in gems, minerals, geology, etc. The reason we no longer see them is that they grew older (like us) — and got swallowed up by the high school pre-college beast – characterized by mountains of homework and a myriad of hugely demanding extracurricular activities.

I kept in touch with all these kids over the years but mostly with Aaron Lemle (and his mother, Beth Mount) because they happen to live right around the corner from me he on the UWS, directly across the street from the Museum of Natural History.

As you might imagine, Aaron, now 17 and a Senior at the Fieldston School up in Riverdale, is in full gear into the college admission process, and Aaron applied early to Amherst, which is his first choice (then, after that, eight other applications!). I wrote a reference letter for him to add to his admission portfolio emphasizing his interest in geology, including many formative experiences with the NYMC.

Aaron, you might remember, along with several of his friends here, used to make meeting presentations, write for the bulletin, go on field trips, bid at the auctions, attend the banquet, and do exhibits at the New York Mineral Show. He participated in the club as much as anyone so I had plenty to say. (By the time you are reading this we may know his college admissions results.)

In the meantime Aaron has proposed to rebuild the Fieldston rock collection/display for his senior project. The current collection is hidden and in sad shape. Aaron hopes to bring it to life and to light via a reconstruction effort. He will want the help of the Club with this project, which probably does not kick in till 2009. His proposal has already been accepted by the head of the Geology Department at his High School. I have also asked Tony Nikischer (as president of the Hudson Institute of Mineralogy) for possible assistance to Aaron.

I thought you might be interested in how he answered some of the questions in the proposal:

1. **What question, problem or larger idea are you trying to answer or address by doing this project? How does this project further your education? What do you anticipate you will learn about your subject and about the process of learning itself?**

   When I was six years old I read about a group of kids who made their own museum. They used cardboard boxes as display tables and they displayed acorns, pine cones and rocks. I was very intrigued by their story and set up my own “museum” in my room, using three cardboard shoe boxes and tablecloths made out of napkins. Originally my museum was shells, corals, fossils and minerals, however, I became interested in just expanding the mineral part.

   My early rock museum marked the beginning of my interest in minerals. I became a member of the New York Mineralogical Club, I won multiple awards for articles I wrote about mineral collecting and I organized a children’s rock club (the Tourmaline Troop) for my friends. Studying rocks in elementary school certainly changed the way I looked at the world. It gave me a better understanding of the environment and of science. However, geology is a hard sell (no pun intended). Most people cannot see any value in studying rocks. The geology departments I’ve visited at colleges all struggle to keep their departments alive. One way they manage to maintain their geology departments, however, is to have really incredible geology displays that are able to entice some students. I still feel that geology is an immensely important science, capable bringing people closer in touch with our natural world.

   By making a Fieldston rock and mineral “museum,” I am trying to promote and encourage geology and awareness of the natural world.

   By making a rock and mineral “museum” I am hoping to explore two major topics. First, I hope to learn more about rocks and minerals, especially the ones in the collection Fieldston already has. I hope that I can also learn about collecting specimens Fieldston does not already own. Second, I hope to learn about thoughtful presentation techniques like what kind of display case to use, how to make identification tags, how to light the case properly, etc.

2. **Describe the project in detail. What does it consist of?**

   Fieldston already has a really nice small mineral collection on the second floor of the science building. Unfortunately, it is in a dark case in a rarely visited area of the school. I would have never found the collection had my locker not been next to it sophomore year. So, during the first part of the project, I would be studying the existing Fieldston collection. First I would clean and identify all the rocks in the collection.

   Next, I would determine what important mineral groups were missing from the collection. As far as I can tell now, the collection represents almost all mineral groups. Regardless of what minerals are missing, I would enhance Fieldston’s collection with specimens donated from my own mineral collection. I have at least two thousand rocks, minerals and fossils, which I cannot take to college with me. My collection is very high quality as well, so there would be no pebbles I found on the beach or interesting looking rocks I found in Central Park as a kid. So the first part of the project would be

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**Ethical Culture Fieldston School**

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**Epilogue:**

**The Future**
an analysis of Fieldston’s specimens, and assembling a collection of my specimens to fill in any major mineral group that is missing.

Diagram of Intended Fieldston Mineral Display

The next part of the project would be setting up the display. The display would consist of one or two all-glass display cases. Depending on how much money I can raise, I would like to be able to get two to four track lights to shine into the case. However, if that is unreasonable, then having lights inside the case would be fine as well. Once the case and lights are set up, I would need to organize and label the specimens. The specimens would be organized by type (metallic minerals, quartzes, beryls, etc.) and mounted on square glass mounts or black customized polymer clay mounts. The labels would include the name of the specimen, the general type of mineral and the location where it was found if possible (see figure above). The labels would then be mounted on cardstock or black foam core to make them look nicer. Besides the labels inside the case, I would make at least two larger posters that describe basic mineral identification and a few basic geological concepts to hang on the walls next to the cases. The final product will be a nicely designed, well-lit exhibit with fully labeled rocks and minerals.

3. How much time do you anticipate spending on this project? Be as detailed as possible.

Some parts of the project will take more time than other parts. For the first quarter, I’ll probably spend a few free periods a week going through the current collection to clean and identify all of the specimens. When done thoroughly, mineral identification is a tedious process. While I can identify most of the minerals by sight, there are most likely going to be a few minerals I will need to identify using crystal structure, hardness, luster and other identification techniques. By the second quarter, I will be mostly setting up the display area and display cases. Setting up the cases will not take much time, however, organizing the collection must be done thoughtfully. I will probably spend two full days setting up the collection either after the seniors are done with classes or on two Saturdays. Doing it all at once will help me stay organized and avoid security problems.

4. What books, materials, equipment and space will you be using?

I already have a plethora of mineral books. Out of my mineral book collection, rock guidebooks will most likely be the most helpful. The materials I will need for the actual presentation are one or two locking full-view glass display cases. I hope Fieldston will cover the cost of the cases (about $700 each) because it is a permanent collection. However, if Fieldston cannot, I will try to raise the money or use some of the old wooden cases the school already owns. The display cases I want to purchase do not have lights in them. Two wide beamed track lights would be ideal, however, I would also be fine finding cases with lights built into them. The space I want to put the collection in would be one of the nooks on the third floor of one of Fieldston’s buildings.

5. What will the final product be (as part of an exhibition of all projects)?

The final product, as described above, will be a nicely designed, well-lit permanent exhibit with fully labeled rocks and minerals, and geological explanations. The exhibit will be located on the third floor of the building in one of the nooks leading to the earth science classroom.

I think everyone will agree that this sounds like a great project and one that we as a club or you as an individual should support. It is nice to see that we as a Club can truly affect the youth of NYC and their interest in mineralogy.

Reference Letter for Aaron Mount Lemle
By Mitch Portnoy (Written November 3, 2008)

I have known Aaron since early 1999 when he appeared at a meeting of the New York Mineralogical Club at the Museum of Natural History here in New York City, dragging his parents with him. Aaron lives across from the museum and having looked at the Museum’s published list of activities open to the public, decided to give it a try. He was curious, even at an early age, about rocks and minerals and geology.

I was president of the organization at the time; after the meeting, which featured a lecture about the minerals of Cornwall, England, Aaron came over to me and wondered if it was okay for kids to be in the club. I said certainly and gave him an idea about what we do, the kinds of presentations we encourage, the fact we have a bulletin and to be honest it is within our mission to foster scientific endeavors among the youth of New York City.

He was clearly engaged. Within two meetings (and we are talking about a boy of 10, at a meeting of 50 adults) Aaron did a presentation, with slides, about on an abandoned blast furnace in Clive Valley, NY. He showed some slides of the site, displayed examples of the slag pieces from the dump area and a diagram showing the workings of the blast furnace. Indeed, over the next few years, whenever Aaron went to a location of mineralogical or geological importance, he would report on it to the club. Talk about precocity!
But this was not all. He actually helped co-found a kid’s unit within the club (we’ve been operating since 1886 by the way) that they named the Tourmaline Troop. He helped organize and lead a weekend activity in which the young members of the Troop went on a field collecting trip to the northern part of Manhattan. They found tourmaline, quartz and garnet and later displayed these minerals with educational labels at the New York Mineral & Gem Show. Eventually, this “kid’s scientific club” was even written about in the New York Times!

Aaron demonstrated his creativity, writing skills and wanting to be part of the team by contributing articles to our club’s newsletter. Now understand, I have difficulty getting the “regular” members to write; he did this without asking, on a regular basis, on a variety of topics. He often included illustrations and graphs! In addition, on occasion he would try his hand at poetry. We submitted his writings as a junior member in our club to the national federation to which we belong. Aaron won a national trophy every year.

By the way – and I only know about this in hindsight as I grew closer to him and his family – Aaron had been diagnosed with mild dyslexia. I don’t know much about that but I understand writing does not come easily. It did not seem to stop him and he overcame it like a champion.

He was a really quick learner in another way. He listened and understood how to identify and evaluate minerals rapidly. Throughout the year he would save his birthday and holiday gifts of money so when our annual benefit auction occurred, he would actually bid against the older members for some of the most interesting and aesthetic specimens. (This really frustrated some of the old-timers who were only looking for bargains!)

Not to go over-the-top here too much but our oldest member, who died recently at the age of 105, said to me that “not quite,” he patiently replied. “They’re quartz crystals called ‘Herkimer Diamonds.’” A week later, my mother and I drove four hours to the small town of Herkimer, New York to find some of the diamonds for ourselves. I spent the day in a wide quarry breaking open small gray rocks. Every now and then, little quartz diamonds fell out of the broken rocks. I wondered how these little gems were formed. Little did I realize the question I had that day in Herkimer would transform the way I looked at the world.

I soon became a member of the New York Mineralogical Club, the youngest by at least thirty years. I also began to read countless books about rocks and minerals. My interest in rocks leapt beyond just Herkimer Diamonds and within a few years I had a collection of more than two thousand minerals and fossils. The specimens in my collection were mostly lustrous and colorful, yet they acted as my gateway to a broader understanding of geology. My early collection allowed me to discover the beauty in the cold grey Antarctic landscape.

Edward Hitchcock, an early professor and president of Amherst, saw the value in both collecting and understanding rocks, minerals, and fossils. His extensive collection of dinosaur footprints from the Connecticut River Valley had no monetary value in the mid-1800’s. However, like the landscape I saw in Antarctica, those footprints brought Mr. Hitchcock a little closer to understanding our Earth. He used geology as a way of broadening our knowledge of the universe, rather than as a way of exploiting the Earth’s resources. For me, nothing is more appealing than a geology department founded on Mr. Hitchcock’s principles, making the Amherst Geology Department an ideal next step to on my journey to understanding the Earth.

I stood on a windswept ridge overlooking a desolate, colorless, lunar-like wasteland. The other tourists trudged past, anxious to take more pictures of penguins and seals, but I stood frozen in awe. All the geological books I had read suddenly sprung to life in front of me. I could see temperature dependent crystallization, strata exposed by ice wedging, and upheaval caused by magma and pressure. The barren landscape was a picture of early earth and it was immensely beautiful. “Come on man, don’t let the boat leave without you,” said my guide, interrupting my journey back in time. “He must not understand the beauty here,” I thought.

I never would have found the beauty hidden in the gray Antarctic landscape had I not had an intense interest in geology growing up. My interest began one day when I was seven, standing on my toes and pressing my face against a display case in a mineral store. “Mom, look! They’re so beautiful,” I squealed. Huge clear diamonds sparkled inside the case. “Are those real diamonds?” I asked the shop owner.

“Not quite,” he patiently replied. “They’re quartz crystals called ‘Herkimer Diamonds.’” A week later, my mother and I drove four hours to the small town of Herkimer, New York to find some of the diamonds for ourselves. I spent the day in a wide quarry breaking open small gray rocks. Every now and then, little quartz diamonds fell out of the broken rocks. I wondered how these little gems were formed. Little did I realize the question I had that day in Herkimer would transform the way I looked at the world.

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Respond to the following quotation – “The world as revealed by science is far more beautiful, and far more interesting, than we had any right to expect. Science is valuable because of the view of the universe that it gives.”

College Bound
By Mitch Portnoy
Club member Aaron Mount Lemle was given the following assignment to demonstrate his writing skills on his college application for Amherst College in Massachusetts:

Aaron was accepted for admission to Amherst College on December 13, 2008 for the class of 2013.
By Diana Jarrett

Gemstones have been harvested for thousands of years around the globe. Huge conglomerates and individual prospectors have all fought for their parcel of the earth in search of precious stones. For the most part, this occupation has occurred in corners of the world rife with political and social turmoil. Many gem deposits are also located in underdeveloped regions of desperate poverty or remote mountains so high and treacherous that few would risk their life to recover them.

Still gems are found in mines as old as recorded history, and they also pop up in unexpected places where the thrill of the hunt remains a strong drive. One industry insider spoke candidly about this process. “It’s a single harvest you know.” It certainly is. It took millions of years for the earth to produce these marvelous wonders, and when they are once extracted—well, that’s it.

Fortunately humankind is developing a greater appreciation for this one earth that we all share, and for the precious natural resources found in it. One must not overlook the fact that the inhabitants of the regions where gemstones are recovered are likewise a precious natural resource to uphold and respect.

The green push of the 21st century seeks to educate and empower the global community to actively search out ways to sustain our planet now and for future generations. Fortunately this mindset is penetrating the gemstone trade.

Mining methods of minimal impact to the environment or in some cases methods that improve the environment are being implemented today. Initiatives that enhance the lives of miners have proved both successful and mutually beneficial. When workers have dignity and receive a fair wage for their work, productivity is favorably impacted. Diamond and gemstone mining companies are now actively looking for ways to benefit the local communities surrounding their mine sites—schools, clinics, and orphanages for HIV positive children are supported by a portion of the proceeds made from mining in these regions. These and other practical support systems such as improving roads and drinking water offer hope for long-term beneficiation to all society.

Greening Up the Gem Trade

By Diana Jarrett

Ask a hundred people what the green movement means—get a hundred answers. Still, most people have a basic idea of the intent of green initiatives pervading global consciousness today. Since the 1970s, the awareness that we ought to take better care of this earth and each other has steadily gained momentum within big industries including the gem trade.

And who is in a better position to assess these pressing needs and devise ways to affect a change than mining-related businesses? After all, the industry owes its very existence to the earth. Gems are harvested around the globe from remote regions that are often hot beds of political and social unrest, or that suffer from third-world status. This makes the gem trade an ideal industry to employ green initiatives in regions near the mines and to assume leadership in delivering humanitarian aid to its citizens.

Several gem entities are doing just that—exercising ecological wisdom dedicated to global responsibility and sustainability. Providing humanitarian aid and social justice to these regions’ inhabitants also has a far reaching impact. From behemoth mining conglomerates exercising massive efforts to artisanal miners with a single grass roots project, people are making a tangible difference. Here’s a snapshot of just a few who are doing their part.

Turkey

Nestled in the Anatolian mountains of southeastern Turkey is a unique deposit of rare gem quality color change diaspore, trade named Zultanite. Turkish owner-miner Murat Akgun has a deep fondness for the rolling bucolic terrain surrounding his mine sites. His mining is conducted in the very hard bauxite tunnels below the earth. But they use no chemicals in their process, Akgun confirms, so mining does not disturb this rural area which legendary for its ancient olive groves.

Akgun insists on employing local hire at his mines because these men can earn much more with him than at any other jobs nearby. Zultanite has created free housing onsite for those miners needing it, and for others who live in nearby villages, the company provides transportation to and from the mines. The entire mining team is fed three meals a day by an onsite cook paid for by the company. When the miners need supplies, food or machinery to rent, Akgun patronizes nearby sources. Zultanite Ltd., also improved the roads in this region which serve the mining interests, but also allows the villagers to transport their olives miles away where they can be processed into oil. When a local mosque needed bricks to finish closing their roof, Zultanite was there. When the villagers had too few means to buy meat for a religious holiday, Akgun’s company supplied them with that too. Zultanite has more plans in the works for benefitting this region and its citizens.

Colombia

Vancouver, BC-based Emerald Stone-Rio Verde Group is an emerald mining and research and development company operating in Colombia. Director Andy Rendle is as much at home in Colombia as he is in Canada, since he lived there while his parent served as missionaries to that region. Rendle pursues both ecologically sound mining methods and humanitarian aid for the Macuna tribal Indians near his mine sites.

Expert in emerald mining, Rendle’s R & D group has devised proprietary machines that extract crystals in a manner less invasive while protecting them from the extreme concussive fractures they are prone to under traditional drill and blast, or D & B methods. Less destruction to the earth ensues and their process reintroduces the sterile material back
into the earth to fill up the excavation. So the effect on the mountainous area is negligible.

Emerald Stone has spearheaded a series of field trips for the jungles’ young inhabitants by taking them to Bogotá’s science fair and other educational outings. This exposure to the bigger world around them has fueled their quest for knowledge. Because water transportation is often the first and fastest choice in the region, the company is building boat launches there which facilitate urgent travel such as transporting patients to nearby towns in medical emergencies. They are stimulating the local economy too. “Bees are of course all over the area. We contacted one of South America’s prominent bee experts and flew him out to the site,” Rendle explained. This encourages local businesses to add honey production into their inventory which they can sell as a local produce while creating jobs for the tribal Indians to sustain themselves well into the future.

Namibia

Diamond sightholder and manufacturer Almod Diamonds Ltd., operates mines and a polishing factory in Namibia. Company president Albert Gad has developed an important initiative which trains local Namibian residents in diamond cutting—a more skilled line of work than other vocations there. Northern Namibia native and plumber George Keiseb ventured to Windhoek where Almod Diamonds is headquartered, looking for work. “I came to the big city with big dreams and I ended up at Almod Diamonds Namibia doing something completely different. I was trained as a diamond cutter specializing in sawing, automats and later the laser machine.” This program provides many Namibians with a highly skilled trade and supports the local economy by eliminating the need for outside cutters to be contracted for this work.

Baby Heaven, a regional orphanage ministering loving care to Namibia’s tiniest HIV positive children is at the core of Almod Diamond’s social concern. Agnes Tom, the agency’s national director recently expressed gratitude for Almod’s ongoing involvement. “The generous support Almod Diamonds has given to us through the years and their contributions have been great. We are looking forward to working together for years to come.” Recently questioned about the inspiration behind his volunteer initiatives, Almod’s president Gad replied, “After achieving success in life and gaining wealth, I think it’s natural to give back. And who needs it more than the children? They are after all the future of this planet.”

Kashmir

American sapphire trader Ed Cleveland knew nothing about gemstones or the Kashmir and Jammu region of northern India when he first set foot in this secluded region a decade back. But his budding respect for the exotic landscape and its people had him looking for both a means to stay and a way to serve the isolated tribal folk. After learning all about the legendary sapphires found high in the Himalayas where he now lives he became a gem dealer. A portion of his income from this niche market is re-invested back into the province in the form of practical aid to these remote inhabitants. Aside from building a much needed school in Lake Dal, Cleveland organizes several medical missions each year delivering vital medicine so the villagers can survive another grueling winter. The small orphanage he founded is a safe and happy place where abandoned youngsters thrive and are well educated.

Afghanistan - Pakistan

The Rupani Foundation founded in 2006 focuses on the mountain regions of the world to integrate underprivileged areas and people into the evolving global socioeconomic society during the coming decades says their mission statement. The foundation has set its sights on Afghanistan, Pakistan and Tajikistan; all regions where the geology is rich with gemstone deposits for centuries. Rupani is developing several Gem Cutting and Polishing Training Centers in Hunza which give local residents a chance to be involved in not only the mining of gemstones, but also producing a finished product which has a higher resale value.

Their Mine-to-Market program for precious gemstones, nurtures the skill-sets necessary for the regions’ inhabitants in mountain communities to become professionals at mining, processing and value addition, along with other related gem trade abilities. Local organizations in those regions such as Aga Khan Rural Support Programme (AKRSP) and Karakoram Area Development Organization (KADO) also partner with Rupani in this ongoing endeavor. The six training centers in Pakistan have graduated over 500 in the three countries

The direct impact that these centers are making can be exemplified by Rupani foundation Chairman Nasruddin Rupani’s visit last year to Gilgit, northern Pakistan. Walking into a local gift shop next to his hotel, he was surprised when the store owner greeted him by name. That owner it turns out was one of the first graduates of their training program who wound up earning enough money in his new career over a 2 year period to purchase the gift shop. Mr. Rupani reflected, “For those of us who are blessed to have a comfortable life, the ethics of our faith, irrespective of which faith one belongs to, teaches us to provide support to those most in need who are struggling to survive.”
Northern Territories - Canada

Diavik Diamond Mines, a subsidiary of Rio Tinto operates an open pit mining venture in a remote area 300 km northeast of Yellowknife with plans to segue to complete underground mining after 2012. Diavik has numerous customized monitoring and management programs which protect vegetation, wildlife, and water at and around the mine site. Diavik’s location places them at the epicenter of some of the world’s most undisturbed natural wildlife.

Mr. Kim Truter, President and CEO of Rio Tinto explains, “At Rio Tinto we are in the business of creating value by finding and developing new, world class deposits and operating and eventually closing them safely, responsibly and efficiently. To do this we must take a disciplined approach to the economic, social and environmental aspects of all our activities.”

Truter says that Diavik Diamond Mine is a model for protecting the environment and providing local community benefits. Prior to construction, the mine underwent one of the most stringent assessments in Canadian mining history, including Diavik’s environmental agreement with local Aboriginal groups, territorial and federal governments. Diavik set ambitious local training, employment and business benefits standards. 2/3 of Diavik’s 800 employees are in fact northern, and the other 1/3 is Aboriginal.

Diavik works closely with local communities and regulators for environmental protection. For example, in order to protect the caribou migrating near the Diavik Diamond Mine, all haul roads have caribou advisory signs posted to ensure caribou and other wildlife have the right of way. Annually, Diavik monitors caribou within the region with the assistance of Aboriginal elders from local communities.

The preservation of water quality in the lakes and drainage systems is as important to the Dene and Inuit communities, as it is to Diavik. To protect the local water quality, water used at the mines is pumped to a treatment plant which removes suspended solids before being released into Lac de Gras. Diavik has also put in place the Aquatic Effects Monitoring Program whereby lake water is sampled and analysed regularly at set locations over the complete range of depth, both at times of thick ice cover and during open water.

More on John Mawe (1766-1829)

John Mawe, prominent British mineral dealer and author, was born in Queen Street, Derby, England in 1726, the son of Elizabeth and Samuel Mawe, a baker and flour merchant. He was orphaned at a young age and joined the merchant marine around 1777, eventually rising to become a ship’s officer, but when war broke out with France in 1783 he returned home and joined the Brown & Son lapidary company in Derby. He married Sarah Brown (daughter of mineralogist Richard Brown) in 1794, and together they later had one son and one daughter.

In 1794 Mawe became manager and partner of Brown, Son & Mawe’s new shop and “Petrification Warehouse” at 5 Tavistock Street, Covent Garden, selling mineral specimens and various manufactured lapidary items. The 1797 Brown & Company catalog of “Mineral Substances” ran to 16 pages, offering minerals, mineral analyses, and boxed collections, including “elegant crystallizations … in the greatest variety.” Minerals were acquired from local suppliers and also on collecting trips to mining districts. Mawe’s extensive tour of Scotland in 1800 yielded many specimens and led to his first book: Mineralogy of Derbyshire: with a description of the most interesting mines in the North of England, in Scotland, and in Wales (1802). By that time he was boasting of a sales stock of over 20,000 mineral specimens, “the most extensive variety on sale in the Kingdom.”

Mawe visited Paris in 1802, exchanging specimens with the various mineral collectors and mineralogists there and attending the lectures of Rene Just Haüy. He was listed in fashionable London directories as a “collector of minerals,” and was regarded as one of the best and most successful mineral dealers in London. In 1804 he embarked on a six-year tour of South America, especially Brazil (he complained of being unable to find even one doubly-terminated topaz crystal among “at least a cart load” at Ouro Preto), and later wrote his Travels in Brazil (1812) to recount his experiences and collecting discoveries.

He returned to England in 1810, and in 1811 his Covent Garden shop was transferred to 149 Strand, London’s busiest shopping thoroughfare, and remained there for the next 70 years. He developed an extensive network of connections in Brazil, Europe, North America and even Ceylon which provided a regular flow of specimens. His shop on the Strand soon became extremely successful, and he also opened shops in Matlock Bath and Cheltenham in Gloucestershire. Mawe and his wife were important collectors and suppliers of shells as well as minerals. Sarah built her own collection of minerals, some of which she loaned to James Sowerby for illustration in his British Mineralogy (1804-1817) and Exotic Mineralogy (1811-1820).

John Mawe wrote several highly successful works on mineralogy and conchology, including A Treatise on Diamonds and Precious Stones (1813), Catalogue of Minerals (six editions under various titles from 1816-1827), and Familiar Lessons in Mineralogy and Geology (12 editions from 1812 to 1830). He died on October 26, 1829, leaving his wife Sarah in charge of his chain of shops. She became a highly successful and respected mineral dealer in her own right, and was named “Mineralogist to her Majesty” Queen Victoria in 1837. Her employee James Tennant purchased the Strand business in 1840, and continued operating it until his death in 1881. Sarah Mawe died in 1846. Tennant kept her collection intact for many years, finally advertising it for sale in 1876 as:

“A collection of recent shells, minerals, rocks and fossils, in a large and well made cabinet of 108 drawers, with Glass Bookcase on the top. The Cabinet was the property of the late Mrs. Mawe, and contains her Private Collection of Recent Shells and Minerals. Among the latter are some crystals of gold, figured in Mawe’s Travels in Brazil, and supposed to be unique.” Its final disposition is unknown.

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Plate 6: Iridium, Nishni Tagil, Russia  
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Plate 7: Faceted Tourmalines (Misc. Locs.)  
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Plate 7: Sulfates on Mars (See page 59)

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**Figure 7**
Sulfates on Mars

**Figure 8**
Other Mars Minerals
Mars Express OMEGA. Shows distributions of very fine-grained ferric oxide, Ca-rich pyroxene, and hydrated minerals (the latter not showing too well on this scale).
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Source: Mindy Harris
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Plate 2: Burmese ruby crystal with a sapphire core
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Plate 3: Antique shell cameo and gold bracelet
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Plate 7: Variety of free-form rutilated quartz cabochons. Source: Prentice (See page 69)

Plate 8: Black diamond and yellow gold snake pendant hanging from a black diamond bead necklace
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Color Insert #5

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Plate 8: Tyuamunite  
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DESCRIPTION AND EXPLANATION
OF THE
COLOURED PLATE OF MINERALS.

A. Rounded mass of Native Gold.
   a. Granular Gold.
      a. Platina in grains.
   B. Native Silver, in curls.
   C. Native Silver, arborescent, and crystallized.

   No.  
   1. Native Copper, in branches, with Crystals of Ruby Copper.
   2. Yellow Copper Ore, blistered Copper.
   3. Malachite, striped, showing a zoned fracture.
   5. White, or Carbonate of Lead, accicular.
   8. Brown, or Liver Pyrites.
   9. Hematite, Iron Ore, showing a diverging fracture.
  10. Blende, an Ore of Zinc, in aggregate Crystals.

   No.  
  11. Calamine, coating a Crystal of Cale Spar.
  12. Violet coloured Fluor crystallized in cubes.
  15. Common Crystal of Cale Spar.
  16. Rock Crystal or Quartz, hexagonal.
  17. Garnets, dodecahedron.
  18. Ribbon or striped Jasper.
  19. Chalcedony, stalactitic and mammillated.
  20. Obsidian, Volcanic Glass, showing a conchoidal fracture.
  22. Common Red Granite, Quartz, Mica, and flesh-coloured Felspar.
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