The New Mexico Facetor

Volume 17, No. 4, March-April, 1998

In This Issue

The Prez Sez:

By Moss Aubrey, Ph.D.

It's Your Guild

Spring always represents a time of rejuvenation, an opportunity for new projects and fresh ideas. I've been wondering what we as a Faceters Guild might consider doing for ourselves and for the promotion of our artistry. As your President, I am focusing my efforts on some technical changes that may show long term benefits for the New Mexico Faceters Guild. These include: 1) the possibility of incorporating the New Mexico Faceters Guild in order to limit our liability, 2) establishing formal non-profit status so that any donation made to the Guild are tax deductible, and 3) some other important matters which the Board of Directors can consider. I challenge each of you to find at least one new way where you can contribute to the growth and vitality of your Faceters Guild. Following are some ideas how each of us can be actively involved. However, don't limit yourself to these suggestions. If you have an idea, but are not sure whether it fits with the mission of the New Mexico Faceters Guild, please feel free to talk with me or with any member of the Board.

Tell us something new. Learn an interesting point of information regarding gems or lapidary arts or any related technical area and share that at a meeting. This does not have to be a full presentation as part of our educational forum. We share many ideas and technical points during the initial discussion portion of our meetings and also during show and tell. If you have come across an interesting tidbit, research it a bit further, and share what you have learned. This could include: new lapidary techniques now in development; the history of a notable gem; political events that can influence the gem industry; waxing or waning popularity of a particular gem material; or similar current events. You might share an interesting anecdote from your own experience, relating just enough history to put it into its proper context.

Offer to help one of the Guild committees. If you're interested in field trips, gather some information on a prospective site and share that with the committee. Let them know the location, whether permits are required, if there is a fee for collecting, and what types of materials have been collected there in the past. Also, let them know what time of year is best in terms of weather considerations and how strenuous an activity will this be.

Offer to assist the program chairman by helping to identify potential speakers. Provide the chairman with information regarding the nature of a potential talk, who the speaker would be and what are the qualifications to speak on that topic, how to contact them, and whether you already have broached this subject with them.

Offer to help at one of our technical workshops. If you have technical expertise that can be shared through a workshop, discuss this with the committee. If you would like to attend a workshop on a particular topic, voice an interest so that the committee knows how to best serve the members of the Guild. If you know someone from outside the Guild who possesses some technical expertise that may be of interest to our members, mention this at a meeting so we can discuss it.

Help with the social aspects of the Guild. I appreciate that so many of our members have been generous in bringing refreshments to the meetings. If you have not helped with refreshments in the past year, please offer to do so. Also, we have discussed having a social event separate from our regular meetings. Offer to help organize or host such a get-together. Think about ways where we can meet others and share our common interests.

Bring a newcomer. We're always meeting people with interests similar to our own. Some of these people have had unique experiences. Others have technical talents that can educate us. Many are simply people we like and with whom we enjoy spending time. Bring someone to a Guild meeting. Don't tell yourself, "Oh, they wouldn't be interested." Let them decide for themselves. We are a pretty fascinating group!

Surprise me. Think of something totally different from any of my suggestions. Be creative. Think of a way to facilitate the growth and enthusiasm of your Faceters Guild. After all, it is Spring.

Minutes of the NMFG Meeting

March 12, 1998

By Nancy L. Attaway

Treasurer **Bill Andrzejewski** presided over tonight's meeting. President Moss Aubrey was sick with the flu, and Vice-Presidents Susan Wilson and Louie Natonek were both out of town. Bill called the meeting to order at 7:15 p.m. and welcomed all members and visitors.

Treasurer's Report

Treasurer **Bill Andrzejewski** reported:

Heading	*Total*
Previous Balance	$1,118.30
Expenses	$196.24
Deposits	$328.00
Balance Forwarded	$1,250.06

Old Business

Bill Swantner mentioned that he is still the contact for ordering the official New Mexico Faceters Guild badges. The yellow and red badges show the Guild member's name above the NMFG name and logo.

New Business

Paul Hlava informed us that he is scheduled to participate as a dealer during the Spring Show in the Rockies to be held in Denver April 17th through 19th. He will report on that show at the Guild meeting in May.

Bill Andrzejewski stated that Rick Ford's Anglic Gemcutter will now be one of the newsletters exchanged with the New Mexico Faceters Guild newsletter.

Paul Hlava reported on the Gem, Jewelry, and Mineral Expo 1998, sponsored by the Albuquerque Gem and Mineral Club. Paul served as a co-chairman of this year's show. The show advertising committee ordered post card invitations and distributed them to club members and dealers as notices to customers. The post cards featured many different minerals from locales in New Mexico. As last year, several Guild members participated as demo-dealers this year, demonstrating the art of faceting, carving, and bead stringing.

Nancy Attaway announced that she withdrew the Guild faceted stone collection from the safety deposit box and displayed it as an exhibit during the show. The collection has since been returned to the bank vault. Guild members who wish to include one or more of their faceted stones to the NMFG stone collection should contact **Nancy Attaway.**

Paul Hlava thanked the Guild for displaying the faceted stone collection as one of the more interesting and educational exhibits at the show.

Steve Attaway mentioned that he met an older gentleman at the show who attended college in Socorro many years ago. This man showed Steve a few pieces of amethyst that he collected fifty years ago from Ladron Peak. Steve introduced him to Dr. Virgil Lueth, curator of the mineral museum in Socorro. Hopefully, some of this amethyst will be donated to the museum and several of the Guild members will be asked to facet a few for exhibit.

Edna Anthony and Herb and Maria Traulsen donated books to add to the Guild library. Guild Gemologist Edna Anthony donated several mineral and geology books, and Herb and Maria Traulsen donated several books on Australian opals. Thank you very much. **Susan Wilson** serves as the Guild librarian.

Show and Tell

The show and tell case was filled to capacity and brimmed over with lots of jewelry and gems.

Will Moats showed two stones that he faceted, a pink tourmaline from Afghanistan cut in a square and a hydrothermal emerald cut in a round. Will pointed out the pleochroic colors of the emerald, going from blue-green to yellow-green. He also cautioned buyers of hydrothermal emerald material to be aware of the wide range of qualities and to closely scrutinize every piece.

Waylon Tracey brought several large concha belts he rendered in sterling silver. One had turquoise fashioned in the conchas, and another was set with chrysocolla. A third one had large oval cabochon agates with a different type of agate set in each concha. Waylon said that he liked the look of an agate set in each concha, but that the agates added much to the weight of the belt. **Elaine Weissman** suggested that he have a stone set in every other concha, alternating stone and plain silver concha around the belt to lighten it. Waylon also faceted an emerald cut ametrine and a lab-grown pink corundum round.

Steve Attaway said that certain stones seemed to have a particular shape associated with them, and **Paul Hlava** elaborated upon that premise. People are accustomed to seeing certain gems cut in a certain way. They expect to see ametrines cut in rectangles, rubies as cushion- cut ovals, emerald-cut emeralds, oval opals, and diamonds cut in the standard round brilliant. These gem materials are pricey, and a gemcutter wants to minimize the waste and retain the most carat weight possible. Therefore, the original outlines of the gem crystal are cut in shapes that best follow the lines of the crystal. For example, long hexagonal emerald crystals are usually faceted in rectangles (emerald cuts), diamond tetrahedron shaped crystals are fashioned into rounds, and tourmalines are mostly seen in emerald-cut rectangular shapes that closely copy the shape of the original crystal. As gemcutters, it is fun to surprise people by faceting colored gemstones in creative ways not the least expected.

Ernie Hawes displayed an emerald-cut bi-colored Afghanistan tourmaline that showed raspberry red and green hues along the long axis. A golden color could be seen through the C axis of this tourmaline.

Herb Traulsen brought examples of opals from Coober Pedy, Lightning Ridge, and Andamooka, and displayed Keshi pearls, Paua shells, and mabe pearls on mother-of-pearl shells from Broome. He showed his official Australian Fossicker's License that allowed him to hunt for gems and minerals on state land in Queensland. Herb also showed examples of dark green and light green jade from New Zealand.

Steve Attaway rendered an oval opal and set it in a fabricated gold pendant. He fabricated a chardonnay leaf in gold (he downloaded the image from the net) attached it to a gold stem, and set many small Thai sapphire rounds to resemble a grape cluster for an interesting pin. He mentioned that since Nancy does not like to facet stones smaller than four millimeters, he buys melee rounds in different gem materials. When he was purchasing the Thai sapphire rounds at the last Tucson Show, the dealer thought that Steve should buy the darker material, thinking it more valuable. Steve explained that the cornflower blue sapphires were the most desirable. Since stones appear a shade darker when set, Steve opted for the lighter shades of blue sapphire melee.

Steve Attaway also mentioned that Thai goods had caught the Asian economic flu, and that prices had fallen. However, dealers from Thailand said that they were maintaining a tight control on their colored gemstones and were not going to dump stones onto the gem market.

Nancy Attaway faceted twelve gemstones, and eleven of the stones were faceted in the flasher cut twelve-sided round and ranged in sizes from 7mm. to 10mm.: six Tanzanian rhodolite garnets, a Pakistani peridot, a teal green tourmaline, two amethysts, and one aquamarine from Madagascar. The twelfth stone was a pear-shape aquamarine also from Madagascar. Nancy mentioned that the rhodolites and the amethysts vary in hue, making it sometimes difficult to obtain a pair of matched stones the same size and color.

Steve and Nancy Attaway purchased some heat-treated green-gold citrine at the 1997 Tucson Show, liked it, and purchased more at the 1998 Tucson Show. However, the most recent purchase of this citrine had saw marks on some of the crystal faces. No natural terminations were found. They asked **Paul Hlava** to closely examine the citrine.

Paul Hlava wondered about the saw marks when he saw them. He knew that quartz forms in flat hexagonal crystals. Why bother to ground off the crystal faces? He also knew that synthetic hydrothermal quartz exhibits characteristic surface features on the crystal faces. He microprobed the citrine, performed an electronic data scan analysis with a wavelength spectrometer, and went through the periodic table as he checked for rare earth elements. Besides silicate, he found high concentrations (500 p.p.m.) of cerium and some (150 p.p.m.) cobalt, but nothing else. The presence of cobalt with cerium, a rare earth element, made no sense, especially the presence of rare earth elements in quartz. Cobalt forms first, and the rare earth elements form last. Why would they be together in the same crystal by themselves? Then Paul remembered that cobalt wiring is used to lace things together during the hydrothermal growth process. The subsequent surface features were erased to hide evidence of their presence.

Future Programs

Guild Mineralogist **Paul Hlava** will present a lively and very informative discussion to explain the many types of gemstone phenomenon during the Guild meeting in May. Paul will continue with Part 2 of the mechanisms of color for gemstones. He plans to cover opals, asterism, and the schiller effect. Don't miss this talk!

Vice-President Susan Wilson will be arranging several interesting program speakers for the remaining meetings in 1998.

Refreshments

Herb Traulsen and **Nancy Attaway** baked refreshments for the March meeting. Thank you very much. Herb explained his concept of an opal cake. **Eva Tordson and Eileen Smith** volunteered to bring refreshments to the meeting in May.

Bill Andrzejewski performed the duty of running the meeting. Thank you for a job well done, Bill.

Program Speaker

Herb Traulsen led the Guild through a whirlwind trip Down-Under with his slide show. A full report, including photographs taken by Herb and Maria, appears in this issue of the *New Mexico Facetor*.

NWNM Science Fair

By Scott Wilson, Ph.D.

I received a letter this weekend from the NWNM Science Fair. They had apparently noted that I arrived late for the judging at UNM, and they had given our criteria to another judge to award on our behalf. The students selected for our awards were:

1st place: $100 bond and 1 year NMFG membership:

Travis Hatcher
8th grade, Junior Division, Physics
Project Title: Holography
School: Jefferson Middle School (Mike Richie, teacher)

2nd place: 1 year NMFG membership:

Elizabeth Fernandez
11th grade, Senior Division, Space Science
Project title: Spectroscopy: Unlocking the Secrets of the Universe
School: St. Piux X (Fr. Sam Falbo, teacher)

The Science Fair folk ask that we process the awards promptly. I will be contacting the students to see about getting them in for our next meeting in May.

In the News

New Gem Lab

Source: JCK March 1998 and National Jeweler April 1, 1998

The American Gem Trade Association (AGTA) plans to establish their own gem lab in New York. The new lab will identify natural and synthetic gemstones, country of origin, and any enhancements, placing their emphasis upon colored stones. Ken Scarratt, formerly of the Asian Institute of Gemological Sciences in Thailand, will head the new lab. He also served as director of the Gem Testing Laboratory in London.

New Russian Demantoids

Source: JCK March 1998

A new deposit of demantoid garnets found in Russia has yielded a significant quantity of high quality gemstones. These new stones are a fine as the original gems from the Ural Mountains during the 1850's.

Australia's New Black Opal

Source: JCK March 1998

A new deposit of black opal has generated a flurry of activity in the Wyoming area of Lightning Ridge, Australia. More than 1,800 people live in Lightning Ridge, and it swells to between 6,000 and 8,000 people.

Info on Diamond Laser Drilling

Source: JCK March 1998

FTC Guidelines state a non-disclosure ruling for laser drilling of diamonds. However, new continuous wave lasers are harder to detect because they produce a cleaner and much narrower drill hole.

More on Moissanite

Source: Modern Jeweler March 1998

The market for moissanite is poised for success, as over $45 million was raised in sales last November. Current examples have been marked as M color or better. Commercial production expects eye-clean stones between I and M color range.

Emerald Oiling Problems

Source: Modern Jeweler March 1998

Cedarwood oil has been used in the treatment of Columbian emeralds for over twenty-five years. The recent switch to palm oil has generated many problems. Palm oil is cheaper and hides the visibility of fractures in emeralds better than cedarwood. However, palm oil dries out within a few months, greatly diminishing the value of many gems.

Info on Pearl Processing

Source: Modern Jeweler March 1998

The vast majority of pearls undergo treatment and enhancement methods. To smooth the bumps, pearls are tumbled and polished. Bleaches, color rinses, and irradiation enhances the color of pearls. However, all these are not readily disclosed by dealers.

New Cultured Pearl Video

Source: National Jeweler March 1, 1998

The Cultured Pearl Information Center announced the release of a new educational video entitled, "Cultured Pearls: Legendary Gems". The thirty-seven minute video combines historic documentary with recent developments to explain the significance and evolution of pearls. To obtain a copy, call 1-212-688-5580.

GIA Examines Moissanite

Gems and Gemology Winter 1997

GIA featured an in-depth report of moissanite, including a scientific description and detection methods.

The "Titanic" Necklace

Source: CNN on The Net and National Jeweler April 1, 1998 and JCK April 1998

The Oscar-winning movie "Titanic" featured a heart-shaped blue diamond pendant on a diamond studded chain worn by the heroine. The stone was called "La Coeur de la Mer" and was composed of cubic zirconias. The Asprey London company reproduced the piece using platinum to set a 170 carat blue Sri Lankan sapphire and sixty-five white diamonds, each weighing 30 points. Valued at $3.5 million, the necklace sold at auction for $2.2 million. Two charities split the money, the Diana Princess of Wales Memorial Fund and Southern California's Aid for AIDS. The J. Peterman Company of Lexington, Kentucky offers a costume jewelry replica of "La Coeur de la Mer" (The Heart of the Ocean).

New Prase Deposit

Source: National Jeweler April 1, 1998

Blue Lagoon Australia of Adelaide announced the discoveries of two new deposits of prase in South Australia, one in 1996 and the other in 1997. Prase is a green chalcedony.

Simulated Tanzanite

Source: National Jeweler April 1, 1998

M.P. Gem Corp. of Los Angeles reported strong sales of tanavyte, their tanzanite simulant, at the 1998 Tucson Show. Sales for tanavyte is growing because the amount of quality tanzanite has not kept pace with the increased demand. Tanavyte resembles top grade tanzanite.

Resins Identified in Emeralds

Source; National Jeweler April 1, 1998

The Gematrat process by Arthur Groom features a secret signature tracer made to detect treatments in emeralds. Gematrat is a process that involves thoroughly cleaning an emerald to remove any residues from previous treatments and injects a special epoxy resin into the emerald. A small amount of tracer is included in the epoxy resin just before injection.

Apache Coup in San Carlos

Source: Albuquerque Journal April 8, 1998

After a long controversy over corruption allegations, an Apache Indian group, independent of the tribal government, assumed control of tribal headquarters at the San Carlos Apache Indian Reservation. Charles E. Vargas, CEO of Apache Gems said that the frustration level has neared the potential for violence.

New Tanzanite Perfume

Modern Jeweler April 1998

Inspired by sales from White Diamonds and Black Pearls perfumes, S.T.S. Gem Group markets a Tanzanite perfume. Sales are strong.

New Irradiation Detector

Source: Modern Jeweler April 1998

Serious shoppers began carrying a geiger counter with them at trade shows to help detect irradiated gemstones, like the cat's-eye chrysoberyl found to be "hot" from irradiation. GemAlert now sells a radiation measuring device that displays quantitative readings for alpha particles, beta particles, x-rays, and gamma rays as a digital readout on a computer monitor. The machine measures all radiation, calculates any exposure, and is 1,000 times more sensitive than a typical geiger counter. For more information, call 1-800-972-1162.

Flooding in Tanzania

Source: Faceter's Digest April 15, 1998

A post said that a geologist reported heavy rainfall in northern Tanzania, which has occurred continuously since last October. Last weekend, a flashflood in Arusha wiped out most of the native gemstone mines and left more than a hundred mineworkers buried.

The Chinese and Diamonds

Source: JCK April 1998

The New York Diamond Dealers Club and the World Federation of Diamond Bourses held discussions with a high-level delegation from the People's Republic of China regarding the diamond industry and China's possible participation.

Russia's Diamond Trade Slows

Source: JCK April 1998

Decreased supplies of rough diamonds and delays in deliveries slowed diamond shipments from Russian diamond factories to diamond companies in New York.

Botswana's Diamonds

Source: The Economist April 4, 1998

Botswana had the world's fastest growing economy between 1975 and 1990 because of the diamonds found under the Kalahari sands. Botswana is the world's largest diamond producer and expects to double production by the year 2000. The wealth generated from diamonds eludes most people in Botswana, as half of the population lives in poverty.

Angola's Diamonds

Source: The Economist April 11, 1998

Reports estimate Angolan diamond exports at one billion dollars a year. That plus successful off-shore oil operations should make Angola's population wealthy, but seventy percent of the people live in poverty.

Possible Blanket Disclosure

Source: National Jeweler April 16, 1998

Many retailers of colored gemstones are considering using a blanket disclosure for colored gems regarding industry-accepted gem treatments to cover themselves from fraud. Some retailers fear that such a blanket disclosure may hurt sales.

New Red Diamond

Source: National Jeweler May 1, 1998

The William Goldberg Corp. cut a 5.11 carat heart-shaped red diamond from a 13.90 Brazilian rough.

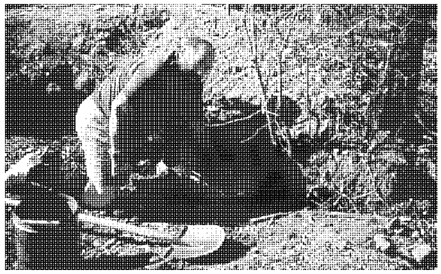
Herb and Maria Trek Down-Under

By Herb and Maria Traulsen, with Text by Nancy L. Attaway

Herb and Maria and first landed in Cairns, in northeast Queensland. They toured the Great Barrier Reef on semi-submersible boats. They rode the scenic rail train into the highlands to see waterfalls and Lake Bareen, situated in a volcanic crater.

Herb showed pictures of the curtain fig tree, which has roots that extend fifty feet into the earth. Herb showed the crops grown in Australia with his slides of sugar cane fields, sugar refineries, banana plantations, and wheat fields. Brahma cattle and sheep graze upon the land. Kangaroo ran everywhere. When driving, look out for the roos and water buffaloes.

A very important feature of Australia, shown in a recent issue of National Geographic, was the road train, and Herb showed a slide of one. A road train is a heavy-duty semi-tractor trailer truck that has sixty-two wheels. It hauls produce and supplies across the continent and can pull two or three trailers full of goods. When you see one of these coming your way, pull over to the side of the road far enough to avoid the debris generated from these trucks. They travel fast, and many windshields have been damaged from the gravel slung by these big trucks.



Herb on the scent of a big sapphire.

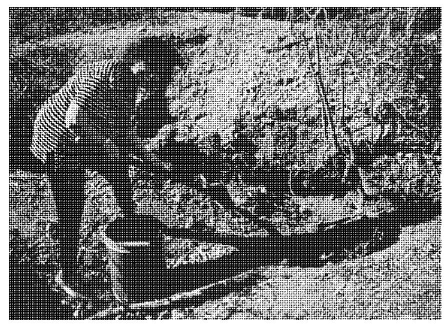
In Rubyville, near the Tropic of Capricorn, Herb and Maria dug for sapphires. They visited Charleville and Quilpie, home of boulder opal. They toured the wool co-op at Toompine and saw the mineworks at Yowah. Herb explained the self-tipping bucket wheel used at the mine. It does the job of several men by hauling up ore. Boulder opal is natural precious opal in ironstone matrix. The rare Yowah nuts are ironstone nodules with cores of precious opal.

As they toured the wineries and the date farms, Herb and Maria remarked how very thinly populated parts of Australia really are. Some parts even resembled New Mexico.

At Lightning Ridge, Herb and Maria visited the opal cave, a jewelry store with dirt floors that sells opals and gold jewelry. Opal miners look for wild orange trees, as their growth indicates the presence of water and geologic fault lines that may contain opal. The Lightning Ridge opal knobbies are cut by miners in the opal fields to determine their value.

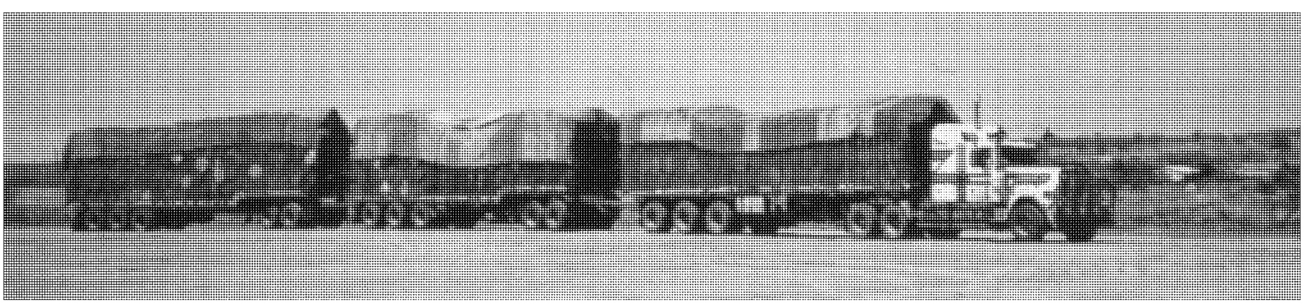
Herb mentioned that many opal miners make just enough money from their operations to continue their lifestyle as opal miners. Opal mining is a tough life of working in hot climates with little water. Only a few opal miners have hit it rich.

Leaving thinly populated areas for a large metropolitan city, Herb and Maria visited Sidney and toured the famous opera house and harbor bridge. Herb explained that Sidney and Melbourne both wanted to house the nation's capital, but could not come to an agreement. It was then decided to establish a city half way between the two, and Canberra became Australia's capital city.



Maria digs sapphires!

Herb showed slides of the Blue Mountains west of Sidney where the eucalyptus trees grow. They toured Tasmania, saw the Tasman Sea, and walked the ruins of the penal colonies that were established in the early 1800's by the British. They traveled to Hobart in the southern part of Tasmania and saw both the Indian Ocean and the Southern Ocean.



Mabe pearl market day in Broome.

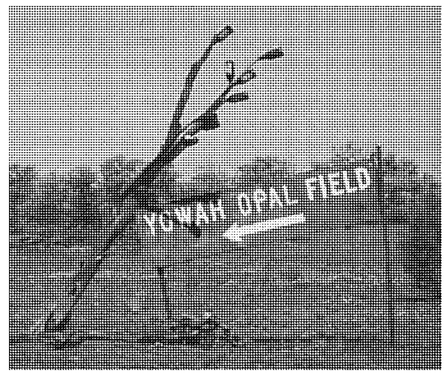
In Broome, Herb and Maria watched mabe and keshi pearl dealers conduct business. Mabe pearls, also known as blister pearls, are mother-of-pearl domes cultured on the inside surface of pearl shells. Domes are implanted (seeded) with either fresh water pearl material or plastic and attached with glue to the surface of the shell. Much of the seed material used in the cultured pearl industry comes from Tennessee fresh-water mussel shells. With time, the oyster coats the seeded domes with nacre. When harvested, the mabes are core-drilled and separated from the seeded domes. The mabe hollow half spheres are filled with epoxy and then backed with mother-of pearl. Incidentally, mother-of-pearl has been used as buttons for centuries.

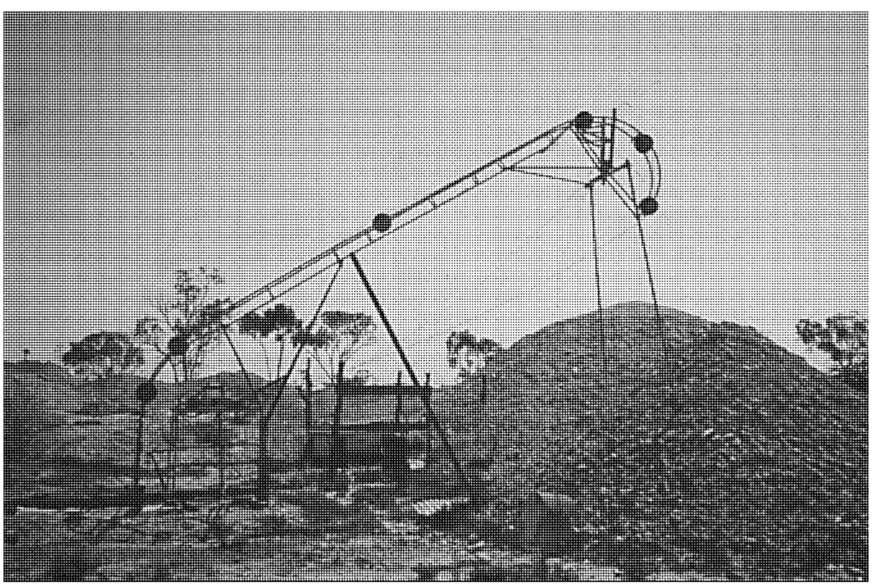
Keshi pearls are all-nacre pearls, non-nucleated from both salt-water oysters and fresh-water mussels. Considered natural, they are harvested from mussels that were cultivated, but they grew spontaneously without being seeded. Keshi pearls are highly lustrous, come in a wide range of colors, and are usually in baroque forms and fancy shapes.

Herb and Maria enjoyed visiting Alice Springs and made the trip to Ayers Rock. They remarked how similar the Aboriginal rock art is compared to the southwestern American Indian petroglyphs. Aborigine tribes have lived in Australia for many thousands of years.

Herb showed slides of the places noted for mining opal, such as Coober Pedy, Mintabe, and Andamooka. Mine operations included two-man bucket and shovel workings to underground diggings and usage of heavy machinery. Water is hauled by trucks and is rationed. Miners are required to work the mines at least twenty hours a week. Opal mining activity varies from season to season, and the population of the mine areas increases and decreases as a result.

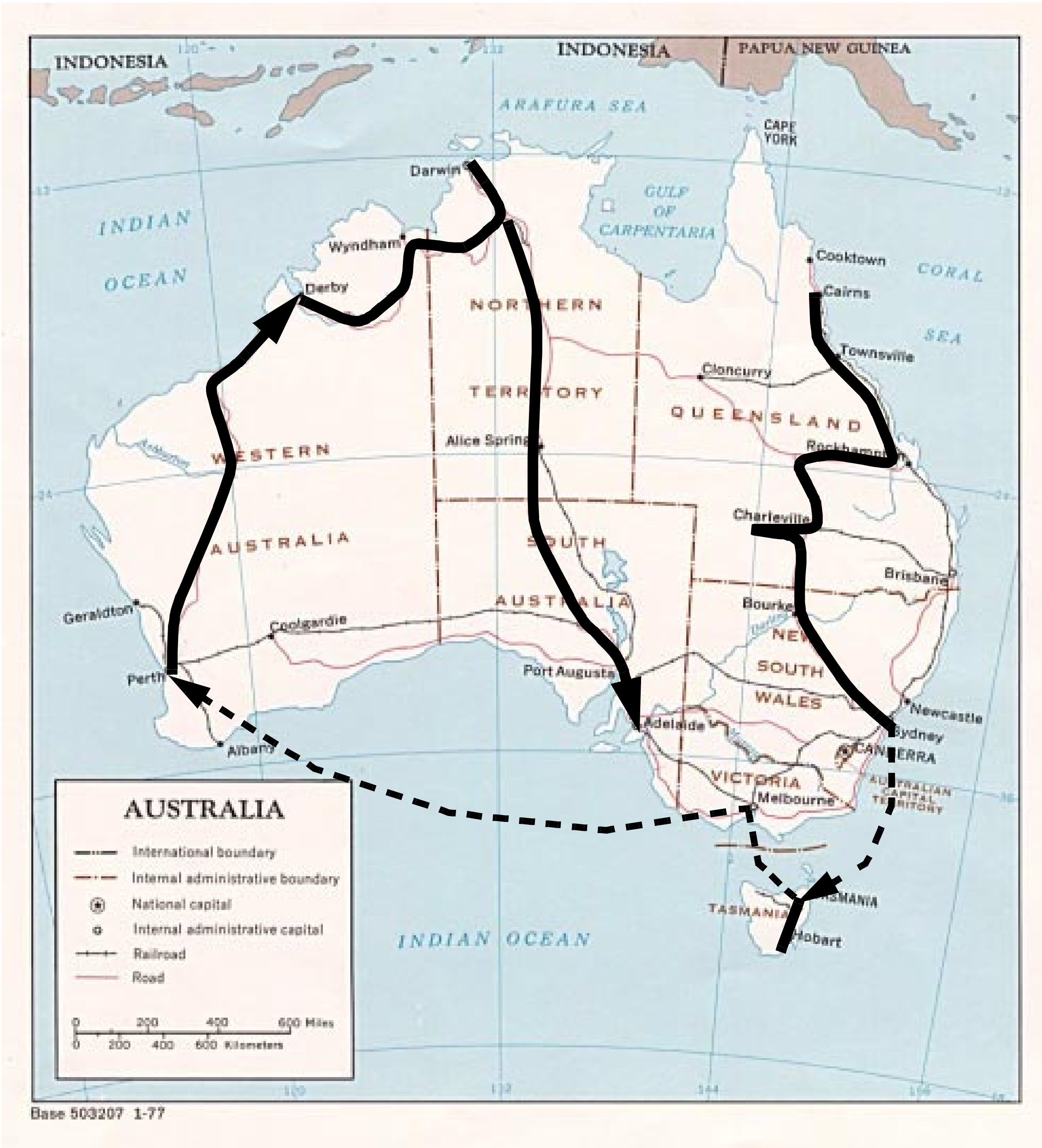
Thank you Herb and Maria!





Opal mine with self tipping bucket wheel.

Route Taken by Herb and Maria



Hot Rocks

New Scientist, February 28, 1998 number 2123

(reprinted with permission from New Scientist)

{There's a secret to cooking up the perfect fake diamond or emerald. Whatever your brand of alchemy, throw in a few flaws, says Amy Adams, or the gem police will get you.}

It was formed when the Earth's first continent was still unbroken, and it is probably older than anything you see around you. It has survived the demise of dinosaurs and the rise and fall of empires. It adorns royalty and movie stars. And it is, apparently, still a girl's best friend.

Few things are as magical or mysterious as a glittering diamond. "Each gem is a piece of history," says George Harlow, curator of the diamond exhibition at the American Museum of Natural History in New York. Something that may have survived for three billion years has got to be special.

But what if the sparkling diamond on your finger wasn't formed in the intense pressures and ferocious heat that prevails miles beneath the Earth? Supposing it came instead from a vat of chemicals in an industrial estate on the outskirts of San Francisco? Could such a fake ever feel as special?

Advances in chemistry have not only made the creation of synthetic gems a reality, but these little fakes are now so good that it is almost impossible to tell the real thing from a crafty copy. That's fine when synthetic gems are clearly labelled, but who do you turn to if you think an unscrupulous dealer has sold you a dud? Enter the Gemological Institute of America (GIA), based in California. Although it has no regulatory role, the GIA helps to monitor the industry and keeps jewelers and gemologists up to date about counterfeiters' latest tricks and techniques. James Shigley, director of research at the GIA, says that most jewelers can usually spot a synthetic gem. When they are unsure, jewelers often send their hard-to-identify gems his way. But as the gem makers get more skilful, it has become ever harder to be sure what you're looking at. "It is a challenge to recognize some of these things," admits Shigley.

Faking gems has a long history. The first attempts were pretty clumsy, but this changed with the arrival of two revolutionary techniques for cooking up gems. The first was devised at the turn of the century by the French chemist Auguste Victor Louis Verneuil, who created impressive synthetic rubies using a method now called Verneuil flamefusion (read "The Fake in the Crown", New Scientist, December 21, 1991, page 25).

Verneuil knew that genuine rubies and sapphires were crystals of aluminum oxide, Al2O3, and that they gained their color from contaminants: chromium ions in rubies, and iron and titanium ions in sapphires. His idea was to trickle aluminum oxide powder and the right color-giving contaminant through a torch-heated chute kept at more than 2000 degrees C. When the resulting molten liquid hits a pedestal at the bottom, it crystallizes. As the crystal builds up, the pedestal is slowly lowered so that the mound, called a boule, is never directly in the flame. When the crystal is several centimeters high, it can be cut into individual stones.

Warts and All

Verneuil gems are easy to identify, because they contain bubbles and curved growth lines that are visible under a low power microscope. The lines result from layers of melted aluminum oxide dripping onto the growing boule and trickling down the sides before crystallizing. Each drop adds an additional curved cap to the boule.

There are two problems with this technique. First, while the Verneuil process could turn out sapphires or rubies, emeralds proved impossible to grow. Secondly, Verneuil gems have none of the tiny imperfections of natural gems. Natural gems have irregularities in the crystal structure that can form unique feather-like patterns or contain particles of the rock in which the gem formed.

However, improvements in technology have made it possible to produce gems, warts and all. Not only do these synthetic gems have the same chemical composition and crystal structure as natural gems, but, most importantly, they mimic the flaws in a natural stone.

The pioneer who made these fakes look almost real was Carroll Chatham. In 1926, the teenaged Chatham decided to grow some diamonds. He dissolved graphite in molten iron and dropped the fiery solution into a vat of liquid nitrogen that he'd placed outside his parents' basement window. He expected that, as the red-hot solution cooled rapidly, the dissolved carbon would crystallize into pure diamond. Instead, the resulting explosion blew out the windows around his San Francisco home.

Urged by his father to find another hobby, Chatham turned his attention to emeralds. When he was 21, Chatham had his first success, and by 1938, he had introduced the first lab-grown emeralds to the market.

The key to his process was a special solvent called a flux, a combination of chemicals, such as lithium oxide, molybdenum oxide, and vanadium oxide, that remain liquid at high temperatures. Emeralds are crystals of beryl, Be3Al2Si6O, with some chromium mixed in for color. Verneuil's technique did not work for emeralds, because there is no way to melt all the components together. Some of them evaporate before others have even melted. But Chatham's unique and highly secret flux recipe got around this problem. He suspended tiny seed crystals in the hot flux to give new crystals something to grow from, much like providing the first row of a complicated brick pattern to help place the subsequent rows. After a long wait, as it can take over a year to grow marketable stones, out came emeralds.

Chatham's son, Tom has carried on his father's business, distributing lab-grown rubies, sapphires, and emeralds from his San Francisco office.

With his back to a well-lit case of colorful synthetic gems, Chatham says, without a hint of irony, "Luckily, our product is not perfect."

Spot the Fake

Although the imperfections he's referring to lower the quality of the stones, they make the jewels more realistic, and, therefore, more expensive than Verneuil gems. They also make flux-grown gems hard to spot by visual inspection alone. It takes a trained eye and a lot of equipment to tell if an eye-catching gem is what it pretends to be. Chatham says that even trained jewelers or gemologists occasionally get it wrong. Crooked dealers can buy synthetic gems and try to sell them overseas as the real thing.

This is where the GIA comes in. Suspect gems might have been labelled correctly when they were first sold, but such information gets lost as gems change hands, says Shigley. "By and large, people who sell treated and synthetic gems attempt to disclose the information." Jewelers are keen to sell honestly, because if they make one mistake, their reputation is gone forever. It is partly this fear that makes them send stones to the GIA for analysis.

No single technique can determine a gem's origins. When a suspicious jewel turns up, Shigley first examines its color, which depends on the light absorbed by tiny amounts of metal ions trapped inside the stone. The differences can be subtle, impossible to distinguish by eye alone. A red stone could be a ruby, synthetic or otherwise, or a similar-looking gem called red spinel. Checking more closely under a microscope, Shigley looks for the curved lines of Verneuil gems or for the dark-colored platinum inclusions of flux grown jewels. These tell-tale impurities come from the platinum growth chamber where they are grown.

If Shigley is still unsure, he turns to fluorescence for clues. When electrons in a crystal are excited, they fluoresce with a characteristic color. Although synthetic gems may have the same crystal structure as natural ones, subtle differences in the atomic arrangements create differences in the energy levels that the electrons can occupy. This causes them to fluoresce at slightly different wavelengths. For example, red spinel and ruby fluoresce at different wavelengths when ultraviolet light is shone on them, and a natural emerald gives off a reddish light slightly different from that of its synthetic equivalent.

If such tests are inconclusive, he can also look at the strain patterns in the crystal's structure. Putting a transparent material, such as Perspex, between a pair of polarizing filters reveals the patterns of strain inside the material. In the same way, natural gems show unique strain patterns that are characteristic of the way they grow.

Shigley can also replace the ultraviolet light with high energy X-rays and examine the fluorescence again, this time inside an X-ray spectrometer. Or, he can use X-ray crystallography to reveal a gem's exact crystal structure.

Taken together, this battery of tests will usually reveal the synthetic, says Shigley. But sometimes things aren't so tidy, and the occasional mystery still pops up.

One such puzzle was a star ruby that had stumped other jewelers. Natural star rubies are highly valued. They contain thin filaments of titanium oxide that reflect light in a beautiful, star-like pattern. But the top of the mystery gem had the gas bubbles and curved lines typical of a Verneuil gem, while its middle layer was slightly opaque and seemed to be where the star originated. It turned out that the gem was built from several bits. The synthetic top and unidentifiable bottom gem were fused together, and at the join, someone had scored fine lines in three directions, reflecting light in a too-perfect star.

Facet Lift

According to Shigley, this sort of assemblage appears regularly at the GIA. Manufacturers often glue an expensive gem on top of a less expensive one. When done honestly, it reduces the cost of a natural looking gem. However, Shigley has seen a few less than honest versions. Although it's relatively easy to spot a synthetic stone, once it's been fused to a real stone and the whole conglomeration treated in some way, things become far more complicated. One purplish-red stone was being sold as natural spinal. When Shigley examined it, however, he found that the bottom half of the stone was synthetic spinal. Since the synthetic was similar in color to a natural stone, it is possible that the manufacturers made an honest mistake. Then again, maybe they didn't.

The most difficult fakes to spot are natural gems that have undergone the mineralogical equivalent of a face-lift. These gems look real, but are doctored to make them more expensive. Many gems on the market today fall somewhere between natural and synthetic. They may have originated underground, but it took a little laboratory magic to put them in a jeweler's display case. For instance, emeralds, which are prone to cracking, often have a plastic or oil filler to disguise faults. Diamonds can have dark inclusions removed with a laser knife or can be irradiated to improve color.

Heat-treatment often works wonders. Cook a ruby in the presence of chromium ions, and the color of the gem will improve, at least in the outer few millimeters. Many sapphires are also heated to enhance their natural blue. Such treatment dissolves titanium oxide contaminants, which can make the gem cloudy, and removes an electron from the color-giving iron contaminant. Iron without the extra electron will steal an electron from a neighboring titanium ion, changing t

he stone's color in the process. This trickery can turn a valueless, murky-gray sapphire into a highly prized deep-blue gem. It can also make its distributors some extra money.

What of the most prized gems, diamonds? General Electric and De Beers have been growing diamonds for industrial use since 1955, but these tend to be yellow/brown or blue in color. Officially sold only for industrial use, gemologists have seen a few synthetic diamonds masquerading as real gems. Brown-yellow diamonds have been spotted in Antwerp and London. "Despite the limited numbers of synthetic diamonds seen, the fear that they will enter the marketplace and will not be readily identifiable continues to haunt the trade," says Shigley.

Gems with Attraction

Such fears came a step nearer reality when Chatham turned his attention to the diamonds that gave his father such explosive problems. It began when he got a call from some Russian scientists claiming that they could grow "white" diamonds. "I told them that if they could grow them, I could sell them," Chatham recalls. And so he has become the first gem manufacturer to grow white diamonds for jewelry.

The new gems are dismissed by Cheryl Pellegrino of the Diamond Information Center, the marketing arm of diamond giant De Beers. "Diamonds are a gift of love," she says. "We don't think synthetics will ever compete." But not everyone shares her lack of concern. "Someone very high up in the GIA came to me and said, 'You just can't do this. It isn't right'," says Chatham.

Though Chatham's white diamonds look like the real thing and are being marketed as jewelry, the GIA says it is easy to spot them. Synthetic white diamonds fluoresce a yellow-green color under ultraviolet light, while natural diamonds emit either blue or a weak yellow light. The synthetics also contain iron impurities from the growth chamber. The clue is a dark reflective inclusion, which hints at the presence of iron.

There's a simple test to confirm it, says Shigley. You just dangle the diamond on a string and hold a magnet next to it. If it moves, you've been had.

(Amy Adams is a free-lance science writer based in California.)

Designer's Workshop for Faceters

By Ernie Hawes

In our last issue, I included a preform for Merrill O. Murphy's "Tri-Polar" cut that was originally published in the February 1998 issue of ***ANGLES***, the newsletter of the Southern California Faceters Guild. I wasn't sure at the time who created the preform, although I had a good idea of a suspect in mind. Recently, I received an e-mail from Jerry Carroll, the Editor of ***ANGLES***, confirming my suspicion. Jerry frequently designs preforms to accompany the patterns that he creates. Sometimes, he will develop a preform for a popular design created by someone else. Jerry wrote that he did a little "reverse engineering", taking the design from DataVue2, reducing it down to the girdle outline, and then experimented with it until he arrived at the preform angles.

So, our thanks goes to Jerry Carroll for providing us with the "Tri-Polar Preform".

Editor, Nancy Attaway, has come up with a new pavilion design to go with an emerald cut design that uses a step cut crown. It's a very attractive pattern that has some interesting characteristics. Nancy talked about her new design by e-mail much better than I could, so here are her comments.

"Emerald cuts do not readily return the sparkle usually seen in triangles, rounds, or even some squares. Although the 'Barion Emerald Cut' is my favorite pattern for emerald cuts, the 'Barion Emerald Cut' is a very complicated and time intensive diagram. Like the 'Square Barion' and the 'Barion Triangle', the 'Barion Emerald Cut' utilizes a precise arrangement of sliver facets in the culet area."

"However, most emerald cuts have a long keel where these sliver facets are placed. I wanted to design an emerald cut pavilion to have a specific culet point that acts as the common meetpoint for several corresponding sets of facets. I also wanted to have a series of secondary facets that can float near the common meetpoint culet area. The 'Barion Emerald Cut' is a most beautiful design, but it never seems to become easier for me the more I cut it. It requires a lot of time in cutting the many sliver facets and a lot of time fine tuning the associated meetpoints during the polish stage. I wanted to have an emerald cut pavilion with facets that fit well together, take less time in rendering the diagram, and return a lot of sparkle."

"My interpretation of a radiant type of emerald pavilion is relatively simple. It certainly yields a sparkling stone, but it does require some depth in the rough. I do not profess to be a seasoned gemstone diagram designer, but I have faceted a lot of stones in many types of natural gem materials over the last eleven years. I do not like to spend days faceting a stone, like I did when I first began learning to facet. I want speed, but I also do not want to compromise my accuracy, nor diminish the stone's potential optics. I think that I will call this new emerald cut pavilion design, 'Emerald Glitter'."

Our second design for this issue is a truly unusual pattern that should appeal to contemporary jewelers who like to use unusual shaped stones in their creations. This diagram will appeal to those who are sometimes more concerned about the shape and surface appearance of a gem than they are of the stone's optical properties. The name describes this pattern well. It is called simply **"S" Curve Without a Table**. It was originally published by Norm Steele in the April 1975 issue of ***Seattle Facet Design.***

Please note the refractive index, 2.42, given for this design. You will need to convert your angles for lower refractive index materials. (Actually, I suspect, Norm Steele didn't recommend using lower refractive index materials, but it can be done.) Even using highly refractive index rough, this design is not exceptionally brilliant. However, I feel certain that shape was the primary consideration when Norm designed this cut, rather than brilliance. A large, somewhat dark amethyst should be stunning in this pattern, but be sure to adjust the angles.

Lets Talk Gemstones

By Edna B. Anthony, Gemologist

BERYL

A CYCLOSILICATE

The varieties of beryl found worldwide include one of the most prized and one of the lesser valued of gemstones. The now exhausted mines south of Koseir in Egypt provided Cleopatra with precious emeralds, including, reportedly, one engraved with her portrait. Goshen, Massachusetts is a source of the little known and relatively inexpensive namesake, the colorless "white" or "lucid" beryl called goshenite. Aquamarine, heliodor, morganite, and the color designated varieties of beryl, that include yellow, golden, yellow-green, green, and red beryl (bixbite) compose the other members of this group.

As in all the cyclosilicates, the one to three ratio of silicon to oxygen is present in the linked SiO_4 tetrahedra. Beryl is composed of stacked rings of Si_6O_{18} connected horizontally and vertically by beryllium and aluminum ions. The channels of the stacked rings can contain various ions, atoms, or molecules, including sodium, potassium, cesium, rubidium, helium, iron, hydroxyl, and water. Beryllium, first separated from beryl in 1798 by the French chemist, N.L.Vauquelin, can represent up to fourteen percent of the chemical composition of pure beryl. Thus, beryl is the prime source of this light-weight metal often used in the production of alloys. Beryl greatly increases the hardness, tensile strength, and fatigue resistance of copper.

Beryl crystals commonly develop as elongated hexagonal prisms or columns in granitic rocks and pegmatites. Thick tabular crystals are found less frequently, and pyramidal forms are rare. Crystal size varies dramatically. Finds of large nodules in alluvial debris of weathered parent rock attest to the extraordinary chemical resistance, hardness, and poor cleavage of material developed in pegmatites and the surrounding rock outcrops.

Crystals found in pegmatites can attain enormous proportions. According to the *Manual of Mineralogy* by Cornelis Klein and Cornelius S. Hurlbut, Jr. after J.D. Dana, a twenty-five ton, twenty-seven foot long tapered crystal of common. beryl was found in Albany, Maine. In his book, *How to Know the Minerals and Rocks*, Richard M. Pearl mentions another eighteen-ton find there and a forty-ton giant unearthed in Madagascar. "Well formed crystals of huge size (up to 200 tons) are common," is a direct quote from *A Guide to Field Identification of Rocks and Minerals* by Charles A. Sorrell, published by Golden Press.

In rock outcrops that surround the pegmatites, beryl is produced by metasomatic processes. The minerals present are replaced during the pneumatolytic phase of mineralization when the forcibly-introduced gaseous fluid solutions react chemically with the existing rock to form new minerals. Although gem quality crystals of green beryl and aquamarine that weigh as much as two hundred forty three pounds have occurred in Brazil, most gemmy crystals are much smaller.

Deposits in mica schists and calcite veins, which develop by hydrothermal processes, differ in some properties and are limited in size. The fragile-famed emeralds from Columbia grew in this manner inside calcite veins within dark bituminous limestone formations precipitating from solutions formed at lower temperatures.

Gem beryl can be confused with a number of other materials because beryl contains many colors. Beryl also exhibits the rare, but known, characteristics of chatoyancy and asterism. In 1950, a unique deposit of pale green aquamarine was discovered in the Governador Valadares region of Minas Gerais, Brazil. Crystals from this source are so intergrown with ilminite inclusions oriented parallel to the base that they exhibit a bronze luster and show a weak golden asterism. Enough variance exists in the optical and physical properties of the beryl varieties that positive identification of some specimens requires very careful gemological examination. Scratch tests to determine hardness of gemstones are seldom used. For the gemologist who lacks a more precise method than the usual heavy liquids to determine specific gravity, the location of the interference figures to differentiate the uniaxial beryl from the biaxial amblygonite can be of the utmost importance. Meanwhile, the uniaxial scapolite can pose an even greater challenge. (More on this will be discussed in a later article.)

The abundance of beryl has limited the commercial production of synthetics and imitations to the more valuable emerald, aquamarine, and red beryl varieties. The plethora of information about beryl warrants presenting it in separate articles limited to data pertinent to specific or a small number of the varieties. The first of these articles will feature the rare and unique red beryl.

RED BERYL

A CYCLOSILICATE

The discovery of red beryl crystals (bixbite) in volcanic rhyolite in the Wah Wah Mountains of Utah created a stir in mineralogical circles during the late 1970s. These white effusive igneous formations, found there and in the Thomas Mountains of Utah, and also in the tin districts of Catron and Sierra Counties within New Mexico, are still the only known source of bixbite. The same formations contain opaque bixbyite, an unrelated manganese-iron oxide, which causes confusion between the two minerals. It is noteworthy that Walter Schumann states in *Gemstones of the World* that scientists do not accept bixbite as a separate variety of beryl. However, no explanation for this conclusion is presented. Dr. Joel Arem states that the name bixbite honors Maynard Bixby of Utah.

The small bixbite crystals, none over two inches in length, seldom yield material suitable for cutting gems larger than one carat, although some two or three carat stones may exist. Nearly all the crystals contain numerous internal cracks, partially healed fractures, tiny bixbyite and quartz crystals, two-phase inclusions, and growth banding. Damage can be inflicted easily because of its brittle nature. In *Gemstones (an Eyewitness Handbook)*, Cally Hall indicates that the refractive indices for bixbite, like morganite and goshenite, are relatively high for beryl. Also, red beryl, heliodor, goshenite, and morganite all show greater specific gravity characteristics than those commonly exhibited by either emerald or aquamarine.

The best color for bixbite is a clear, rich red with some blue tones. John Sinkankas attributes the red color to the oxides of manganese and cesium. According to Dr. Joel Arem in his *Color Encyclopedia of Gemstones*, the chemical make-up of bixbite also includes boron, lithium, lead, niobium, rubidium, tin, titanium, zinc, zirconium, "and traces of other elements".

Early efforts to capitalize upon the uniqueness and rarity of red beryl led to the practice of labeling it in the commercial gem market as "red emerald". Even today, bixbite is marketed as such. These misnomers, including "pink emerald" for morganite, only serve to misinform and further confuse the buying public. Such tactics are the bane of reputable members of the gem and jewelry industry who strive to serve the public and their clients.

The fragility, small size, and extreme rarity of bixbite precludes its use in items of jewelry except by avid collectors. Crystal specimens of any size are prized items in anyone's collection. *(Editor: Although I have seen a very fine faceted red beryl set into an 18 Kt. gold ring, a pin or a pendant would have presented less risk of damage.)*

SYNTHETIC RED BERYL

Previous **Let's Talk Gemstones** articles have focused upon properties and data pertaining to natural gemstones. Red beryl is the newest and, probably, the least known gem to be offered. Perhaps, the rapid creation and marketing of synthetic red beryl will increase the importance of presenting information regarding man-made counterparts and simulants together with information about the natural gems.

A simulant or imitation is any natural or man-made substance used to represent the gemstone which it resembles. Paste (glass) is an excellent simulant for many gems. Unlike a simulant, a synthetic gem possesses, within narrow limits, the same chemical composition, physical, and optical properties of its natural counterpart.

Recently, I was made aware of a particular source of synthetic red beryl available in both rough and faceted gemstones. WINTRA Created Emeralds, Inc. of Rockville, Maryland imports the material from Russia. I phoned the president of WINTRA, Dr. Anatoly G. Klimenko, and was able to obtain two faceted specimens. He was also kind enough to send with the specimens the gemological data that appears at the end of this article.

During our very interesting discussion, he imparted the information that synthetic bixbite is created by the hydrothermal process. This method uses water combined with an acidic mineralizer in a vessel capable of withstanding extreme heat and pressures for long periods of time. Aluminum and beryllium hydroxides used as nutrients are placed at the bottom of the container. Seed crystals of beryl are suspended in the center of the autoclave with nutrient-crushed quartz crystals positioned above them. The temperature and pressure are raised to cause the dissolution of the nutrients. Convection causes the diffused regents to form beryl in solution at the center of the container. Crystals of beryl then grow on the seed crystals. If the concentration of the solution becomes excessive, undesirable phenacite crystals, instead of beryl, develop. A highly acidic solution is necessary in the manufacture of emerald to prevent the precipitation of the added chrome, the colorant, from the solution.

Dr. Klimenko also told me that he has available the synthetic red beryl crystals grown on slices of natural goshenite, which form very unusual red and colorless layered multi-colored specimens. These could be similar to the Lechleitner product marketed about 1960, where a thin layer of synthetic emerald was grown by the hydrothermal process upon faceted examples of natural beryl gemstones.

My excitement about receiving the specimens grew as I began the examination. One stone is a well-cut 1.66 carat 8.0 x 8.0 x 5.1 mm. faceted bluish-red heart shape. The second is a 1.69 carat 8.0 x 6.0 x 5.0 mm. emerald-cut faceted gem of very similar color. The girdles of both stones have been polished. Their physical and optical properties conform to the data shown below. Microscopic examination revealed interiors with a definite orientation of a syrupy "scotch and water" effect, similar to that exhibited by hessonite garnets. In some views, the heart-shaped stone exhibited bright, sharp parallel projections at about sixty degrees, which marked the planes between distinct layers. The interior of the emerald-cut stone exhibited a slightly more "roiled" appearance with softened edges of the projections, presenting a picture of sleek tiny fish swimming in formation in a ruby sea. A plane of "frost" floated from side to side just beneath the table across one end. A transparent and highly reflective irregular rectangle with a torn upturned side gleamed from a corner at the opposite end. Dr. Klimenko doubts that it is part of a seed plate. Perhaps, further information regarding this unusual inclusion may be available from the manufacturer at a future date.

The following gemological data has been obtained from Dr. Anatoly G. Klimenko, President of WINTRA Created Emeralds, Inc. Dr. Klimenko may be reached by telephone at 1-301-340-9258 and by fax at 1-301-340-8222. The address for WINTRA Created Emeralds, Inc. is: 1783 Redgate Farms Court; Rockville, Maryland 20850.

* *No information specifics were available concerning the spectral norms, nor for reactions to the Chelsea and Aqua Filters. Thermal traits for the synthetic red beryl material were presumed to be similar, if not identical, to natural red beryl. The inclusions discussed in the article were specific to the two specimens of synthetic red beryl that I had available for examination.*

TABLE 1. Gemstone Properties

SPECIE	*WINTRA Created Red Beryl*
Chemical Composition	$Al_2[Be_3(Si_6O_{18})]$ $(R,H_2O)<1.5$
Crystal System	hexagonal
Habit	prismatic
Specific Gravity	2.69 to 2.70
Hardness	7.5 to 8.0
Toughness	fair
Cleavage	very difficult and very brittle
Fracture	not specified; natural red beryl exhibits conchoidal fractures
Fracture Lustre	vitreous to resinous
Diaphaneity	transparent to translucent
Lustre	vitreous
Refractive Index	0 = 1.5685 and e = 1.579
Birefringence	0.006
Optic Character	uniaxial and negative
Pleochroism	purplish red and orange red
Dispersion	0.014
Ultraviolet Fluorescence	inert
X-ray Fluorescence	not given
Transparent to X-rays	opaque
Acid Resistance	resistance to all except hydrofluoric

TABLE 2. Gemstone Properties

SPECIE	*Bixbite*
Composition:	beryllium aluminum silicate $Al_2Be_3(Si_6O_{18})$ + Mn, Cs, Ti, Pb, Li, B, Sn, Rb, Nb, Zn, Zr
Class:	cyclosilicate
Group	beryl
Species:	red beryl or bixbite

TABLE 2. Gemstone Properties

SPECIE	*Bixbite*
Crystal System:	hexagonal
Varieties:	bixbite
Colors:	red and violet red
Phenomena:	none known
Streak:	white
Diaphaneity:	transparent and translucent
Habit:	small elongated prisms
Cleavage:	indistinct
Fracture:	conchoidal
Fracture Lustre:	vitreous to resinous
Lustre:	vitreous
Specific Gravity	per Joel Arem: 2.66 to 2.70 per Cally Hall: 2.80
Hardness	7.5 to 8
Toughness:	fragile; the numerous inclusions can influence fracture
Refractive Index	per Joel Arem: 0 = 1.568 to 1.572 and e = 1.567 to 1.568 per Cally Hall: 0 = 1.59 and e = 1.58
Birefringence:	per Joel Arem: 0.004 to 0.008 per Cally Hall: 0.008
Optic Character	uniaxial negative
Dispersion:	0.014
Pleochroism	the specimens in my personal collection show weak shades of red
Ultraviolet Fluorescence	the specimens in my personal collection show none
Spectra	none discernible in the specimens from my personal collection
Color Filter	
Aqua Filter	the crystals in my personal collection almost fluoresce; the faceted specimen shows no change
Chelsea Filter	no reaction in the specimens from my personal collection
Solubility	HF in concentrate can etch other beryl; no specifics for red beryl
Thermal Traits	avoid thermal shock; beryl fuses into bubbly glass
Treatments	none known
Inclusions	partially healed internal fractures with quartz and bixbyite

TABLE 2. Gemstone Properties

A Gem Cutter's Enigma

(reprinted from Eclectic Lapidary, February 1998)

Colloidal silica and diamond powder are the two most nearly universal gem polishing agents. Colloidal silica will polish most gemstones in the Mohs hardness range between 5 and 9. Diamond will polish most gemstones in the hardness range between 6 and 10, and will polish many of the soft stones in the hardness range from 2 to 4. Notice the modifiers "most" and "many".

Disclaimer: I cannot, of my own resources, prove the theory of polishing that I present here. I can only do two things: 1) present my ideas and 2) give my reasons for believing this theory is true. It will be up to those more learned than I to determine whether I have the correct interpretation of the facts or have just, like G. T. Beilby, distorted the facts to fit the theory.

History

Gems have been polished for ages. The Egyptians, Chinese, Persians and other ancient peoples polished gemstones by the simple process of rubbing them on sandstone, starting with coarse grained sandstone and ending with the finest grain obtainable. The degree of polish attained was, of course, limited by the largest silica grains present in the finest-grained sandstone. The results were no better than one would expect from such a crude process and was limited to gemstones no harder than quartz. Centuries later, the process was refined to use silica sand on wood for a final polish. The sand-covered wooden surface was wetted with water, and the gemstone was rubbed against it. In this case, the degree of polish was limited by the lapidary's ability to sort out the larger grains of silica.

Eventually, cutters found another polishing agent called emery. Emery is an impure granular mixture of corundum, magnetite, hematite, and spinel. Corundum, consisting of the gem minerals sapphire and ruby, is very hard and will cut or polish most minerals below it on the hardness scale. Spinel is ranked just below corundum in hardness, while magnetite and hematite are much softer. With simple methods of particle size grading, emery replaced sand as a cutting/polishing agent in many areas of the world.

Later still, diamond was found in India and became the polishing agent of choice when working with the harder gemstones. Diamond particles could even be used to cut and polish the surfaces of gem-size diamonds.

The procedures for grading grit sizes improved slowly over the ages, but all information having to do with gem cutting and polishing was secretly held by lapidary groups called guilds. This was the situation when Sir Isaac Newton, a 17th to 18th century scientist (working with Hooke and Hershel), looked into the matter. Polishing, Newton and company insisted, was an abrasive process. In polishing, they said, the gemstone was rubbed against particles of polishing agents and scratches resulted. As the polishing particle size was reduced, the scratches became smaller. Reducing particle size still more and more resulted, eventually, in scratches too small to see. At this point, Sir Isaac said, a stone is truly polished. To this day, his findings still have some merit. There are, however, other factors to be considered. For example, certain cutter's guilds were aware, even then, that finely graded silica particles (Mohs hardness 7) could polish sapphire (Mohs hardness 9). I am surprised that a scientist as sharp as Newton did not unearth this fact.

The author has an acquaintance who works at the University of New Mexico. At one time, his job required him to polish large, flat synthetic sapphire slices. Since these slabs were for use in experimental optics, they were required to be both extremely flat and polished much better than jewelry use would have required. He succeeded by polishing without a lap. He simply suspended the sapphire blanks in a tank, then pumped a mixture of colloidal silica in water at high velocity across the sapphire surfaces. Remember these facts as we continue.

Beilby

In the period just before and after 1900, an Englishman named G. T. Beilby published what has become known as the Beilby Flow Theory of Polishing. His first paper was titled "The Minute Structure of Minerals". In 1903, he published a second paper, "Surface Flow in Crystalline Solids Under Mechanical Disturbance". His third paper, titled "Aggregation and Flow of Solids", was published in 1921. As late as 1937, scientists F. P. Bowden and T. P. Hughes accepted Beilby's theory, and these ideas became known as the "Beilby-Bowden Theory of Polishing". Other scientists were divided in their acceptance or rejection of the theory, mainly because there was no laboratory equipment yet available capable of proving or disproving the famous (infamous) theory.

Beilby's Theory

Beilby's famous theory, reduced to its essentials, claimed that (1) friction is involved in polishing, (2) friction generates heat at the surface being polished, (3) the heat generated is seen only by the surface molecules, (4) the heated surface molecules become molten, (5) the molten molecules are "pushed or flowed" from high spots and dumped into low spots, (6) the moved or flowed molecules remain in the low places, filling them and leveling the surface, (7) the flowed molecules, almost instantaneously, solidify in the low places, and (8) a smoothly polished surface is achieved. Unfortunately, Beilby forgot that the water, necessary to polishing, is one of the most perfect heat absorbers known to man.

Gemcutters, both amateur and professional, generally accepted the Beilby theory because there was no alternative theory to explain the process. Even today, there are many amateur cutters who will argue vehemently in favor of the idea of molecular surface heating and flow a-la-Beilby. Still, by the late 1940's, vastly improved instruments and techniques of examination led to less belief in Beilby-Bowden on the part of the scientific community. Scientists repeated all the original Beilby experiments over the following years and found little to support the old theory.

The Knockout Punch

The final blow came in July 1981 with the publishing of "DEMISE OF THE BEILBY-BOWDEN THEORY OF POLISHING," by Peter J. Crowcroft, Ph.D., in The Journal of Gemology, Volume 17 (7), July 1981, pages 459 - 465. Peter J. Crowcroft is an internationally known and respected gemologist. His article was published with 22 references. It thoroughly demolished the Beilby-Bowden theory and was reprinted in the Lapidary Journal in a revised article. Unfortunately, Crowcroft was unable to provide a new theory to replace the discredited one.

Somewhere in the same time period, the Lawrence Livermore National Laboratory became involved in polishing phenomena. One of their experiments involved the measurement of heat generated in polishing. A transparent lap charged with a polishing agent in water was employed. By looking through the lap from beneath, instruments could monitor the contact surface of a synthetic sapphire blank while the lap was in operation. The maximum surface temperature rise noted was in the neighborhood of six degrees C. With adequate water on the lap, normal lap speed and hand pressure applied, there is, essentially, no gem surface heating.

Glass Research

The next and most important break-through came from Sandia National Laboratories in Albuquerque, New Mexico where Terry A. Michalske and Bruce C. Bunker were doing glass research. Their article, "The Fracturing of Glass," appeared in the December 1987 issue of Scientific American magazine. In their article, Michalske and Bunker described glass as one of the strongest of building materials and able to withstand tremendous stress - IF THERE IS NO WATER PRESENT in the surrounding atmosphere.

Glass, Michalske and Bunker said, has microscopic, shallow surface fractures. These fractures cause little trouble if there is no water present. In the presence of stress and water (or water vapor), things change. Because of surface tension, water cannot enter the microscopic surface cracks - if there is no stress present. Under stress, water is forced in and moves to the very tips of the cracks. There, atoms of oxygen and hydrogen (water) bond with the silicon atoms of the glass. A one-molecule-thick layer of new material forms chemically. The new layer, called a hydroxyl, blocks further contact with water and prevents formation of thicker layers. Hydroxyls are both softer and weaker than the glass. Stress, concentrated at the crack tips, causes the hydroxyl layer to fracture, exposing the glass, again, to chemical change. A new hydroxyl layer forms, and the process repeats in a process called propagation. Propagation may be exceedingly slow or very fast, depending on the amount of stress. Without stress, a hydroxyl layer forms very slowly.

Hydroxyls and Gem Polishing

Now, I'm not going to tell you that gem polishing is done by crack propagation, nor am I going to go through all the chemistry involved. (If you wish to follow the chemistry, crack the old chemistry book or "Mineralogy for Amateurs" by John Sinkankas, chapter 2. My copy of Sinkankas is the 1964 edition and is very good. I hope later issues still have the "Atoms and Minerals," chapter 2.) What I intend here is to show readers that a similar chemical/abrasive process is taking place as you polish a gemstone. And, yes, I did take my conclusions to Terry Michalske. He said my ideas sounded correct. That does not mean he sanctions everything I have said. To do that, he would need to run a large number of experiments. He has neither the time nor a pressing need to know. It just means that it seems in line with data received from stressed glass experiments Bruce Bunker and he have run.

Gemstones Versus Glass

Gemstones are chemically related to glass in that most of them are either oxides, silicates, or carbonates. All these minerals appear to be subject to hydroxyl formation in the same manner as glass. In the case of glass, stress forces water into the tiny fractures, then causes the hydroxyls to fracture. In gemstone polishing, water is present - even in oils, if you are using them as coolant/lubricant in place of water. Pressure speeds the formation of hydroxyls on a facet face just as it does within the tiny cracks in glass. (And, the greater the hand pressure, the greater the lap speed, the greater the tendency for hydroxyls to form.) Therefore, it seems logical to think that very thin hydroxyl layers form on facet surfaces even as you cut them. If I am right, the polishing agent simply abrades away the soft hydroxyl layers. And, of course, a new layer forms even as the older layer is abraded off. When enough material has been "polished" off, no more pits and tiny scratches remain. You have a polish.

Other Factors

Several associated items remain to be explained. There is that old problem of agglomeration. There is the hydroxyl formation on the polishing agent particles and the reasons why different gemstones require different polishing agents. Lastly, there is the question of how diamond particles polish gemstones.

Agglomeration

What is that old bugaboo called agglomeration? (Some people call it conglomeration, which it is not. Conglomeration is a rock building process wherein existing stones, usually stream-smoothed stones, are included in a later geological formation.) Agglomeration is the process seen in polishing, wherein a polishing agent and lap debris form relatively large particles beneath the stone being polished. When such a particle forms between gem and lap, all the polishing pressure is suddenly concentrated on the single particle. The pounds per square inch pressure remains the same, but the point pressure skyrockets. You get an ugly, ragged scratch.

Why does agglomeration occur? It probably results as particles tumble under the stone. Particles in contact become stuck together, or glued, by thin hydroxyl layers and compacted by polishing pressure. The agglomerated particle(s) may become much larger than a single grain of polishing agent. With the exception of diamond particles, all gem polishing agents are oxides and usually (but not always) harder than the gemstones they will polish. As we have noted earlier, metal oxides are susceptible to formation of hydroxyls when water is present. Then, we would expect hydroxyl formation that would include bits of lap debris and adjacent other bits of polishing agent - agglomeration! Excess hand pressure on the stone and/or excess polishing speed compacts and strengthens the agglomerate particles.

What does one do to prevent agglomeration? Slower lap speeds and lighter hand pressure have been suggested. Also, it is obvious that reducing friction will reduce the tendency of particles to tumble on the lap. Two ways to reduce friction have been suggested. One way is to lightly grease the lap surface with a Teflon-based lubricant before applying a small amount of diamond powder or oxide type polishing agent. A drop of extender fluid may be added if the lap becomes too dry. Australian faceters extol this idea. I like better the use of a very thin layer of hard wax smoothed on the lap surface. Polishing or prepolishing, then, proceeds as described by the advocates of Teflon grease. I use a commercial hardwood floor wax trade-named TREWAX. TREWAX is a paste wax sold at hardware stores. In either case, friction is vastly decreased and polishing particles slightly embed in the very thin wax layer, which further inhibits tumbling. Any polishing lap is suitable for these procedures.

An Anomaly

Why do oxide polishing agents, also, develop molecule-thick hydroxyl films that may cement many small particles into agglomerates which cause scratching? The answer is simple. These polishing agents are chemically much like the gemstones we cut. In the presence of water and stress, they develop hydroxyl films over their surfaces just as readily as Michalske and Bunker found they do in the cracks in glass. Lap pressure bonds the coated surfaces together. I can only guess at why different gemstones may require different polishing agents. My best guess is that the hydroxyl films form more readily if the gemstone and polishing agent are in similar crystal systems or are chemically similar. Perhaps you have a better guess.

Diamond

How about polishing with diamond particles? Isn't that a totally abrasive process? I doubt it. Diamond is a crystalline form of carbon. In the presence of water and stress, hydroxyl carbonates probably form. In polishing with diamond, abrasion of the gem surface (exclusive of the thin hydroxyl layers) probably becomes more prominent. Do note the uses of the word "probably".

It's a Wrap

Or, that is about all I have to say about that. I hope I have made some sense to each of you. If you totally disagree with me, that is okay. Perhaps, you have information that I have not. Get on the Internet and tell me about it.

Don't forget: next meeting is on May 14, 1998 at 7:00 pm. Dues of $20 are due.

Party time in Adelaide! Helen Huebler (widow of Al Huebler) on the left and Maria Traulsen seated on the right.

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TABLE 3. Shows of Special Interest

Name	*Location*	*Date*
Lubbock Gem and Mineral Society's Annual Spring Show	Lubbock, Texas	May 2 & 3
Santa Fe Symposium on Jewelry Manufacturing Tech.	Albuquerque, New Mexico	May 17 - 20
The Northwest International Faceters Conference hosted by the North Puget Sound Faceting Guild	Mount Vernon, Washington	May 23 & 24
White Mountain Gem and Mineral Club's Annual Gem, Mineral, and Fossil Show	Show Low, Arizona	May 23 - 25
Golden Spread Gem and Mineral Society's Gem, Mineral, and Jewelry Show	Amarillo, Texas	May 30 - 31
JCK International Jewelry Show	Las Vegas, Nevada	June 3 - 9
Flagstaff Gem and Mineral Society's 12th Annual American Gem and Mineral Show	Flagstaff, Arizona	June 11 - 13
International Gem and Jewelry Show	Denver, Colorado	June 19 - 21
Grant County Rolling Stones Gem & Mineral Society	Silver City, New Mexico	Sept. 5 - 7
Gem and Lapidary Wholesalers	Tucson, Arizona	Sept. 10 - 13
Colorado Mineral and Fossil Show	Denver, Colorado	Sept. 16 - 20
Denver Expo 98	Denver, Colorado	Sept. 16 - 20
31st Annual Denver Gem and Mineral Show	Denver, Colorado	Sept. 18 - 20