

**The Official Newsletter of the New Mexico Faceters Guild**

NMFG

# Show and Tell



The picture on the left shows the 10.22-carat tanzanite cushion cut triangle before Nancy Attaway re-cut the gem's pavilion. The photo shows how the pavilion "windows", how light falls out the bottom.

The picture on the right shows the re-cut pavilion and its improved optics that resulted from Nancy Attaway recutting the gem's pavilion.



The picture on the left shows a side view of the tanzanite's irregular pavilion shape before Nancy Attaway re-cut it. Note the big ribs and boat-shape.

On the Cover: The AGATE Show 2003 post-card theme: amethysts, ametrines, and citrines, both loose and set in gold jewelry, from the Attaways and Paul Hlava.



The

**New Mexico Faceters Guild**

**Guild Officers 2002-2003**

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**Vice President/Programs:** Paul Hlava

**Secretary/Treasurer:** Ina Swantner

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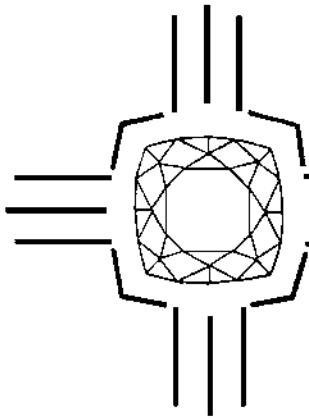
***Purpose of the Guild:** The purpose of the New Mexico Faceters Guild is to bring together persons who are interested in faceting or faceted stones. We promote the art and science of faceting and provide a means of education and improvement in faceting skills. Finally, we provide a means of communication between those persons involved in or interested in faceting as a hobby.*

***Guild Membership:** Dues are \$20.00 per calendar year (January through December) for newsletter issues sent by e-mail. Hard copies of newsletter issues sent by US mail are \$30. Please see the membership application / renewal form on the last page of the newsletter.*

***Meetings** are held the second Thursday of odd-numbered months at 7:00 p.m. at the New Mexico Museum of Natural History, 1801 Mountain Road N.W., Albuquerque, NM. Workshops are generally held in even-numbered months. Date, time, and place are given in newsletter. Also, any change in guild meeting times or dates will be listed in the newsletter.*

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**The next meeting of the New Mexico Faceters Guild will be September 11, 2003.**



# The New Mexico Faceter

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NMFG President Scott Wilson

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## The Prez Sez:

by Scott R. Wilson, Ph.D

Elections for Guild offices will take place this fall. I would like to encourage everyone to help the New Mexico Faceters Guild serve the membership and continue its legacy as a world famous educational resource for gemcutting and gemology. We have a great heritage here, and now is your chance to lead it.

I will be stepping down as Guild President after serving two terms to give others a chance to take the Guild in new directions. That said, I shall remain an active member of the Guild and will be happy to stay on as Guild Librarian, another position I currently hold. You will also see me at workshops. Steve and Nancy Attaway would like to step down as Editors of the Guild newsletter, the *New Mexico Faceter*; after six years of service. They wish to take a well-deserved breather and have more time to focus on their custom gemstone and jewelry business. They will remain active in the Guild and help instruct folks at workshops. Paul Hlava would like to take a break from being Vice-President/Programs, but he will remain as a great source for talks on gemology.

Any of the out-going Guild officers will be available as resources to ease the transition for a new leadership, scheduled to take place in December, 2003 during the Guild Christmas Party. I would like to personally thank all of the Guild officers for their service. We applaud their unwavering dedication to the New Mexico Faceters Guild and thank them for jobs well done.

A slate of officers will be decided upon at the September meeting, as stated by our bylaws. That slate of officers will be published in the newsletter, and the Guild membership will vote for the officers at the meeting in November. The responsibilities of the vacant offices are described in our bylaws. They are straightforward and just need someone to stay on top of them on a consistent basis.

Please consider yourself for these positions, and do feel free to nominate yourself for one of the officer positions at the September meeting. You will find that holding these positions is a rewarding experience that leads to great personal satisfaction, while serving your fellow Guild members and the international faceting community, as well. Sounds great. Now, go for it. See you in September.



## New Mexico Faceters Guild Official Website

We invite everyone to visit our website at: [www.attawaygems.com/NMFG](http://www.attawaygems.com/NMFG) for interesting and informative articles on gemstones and faceting techniques.



## Minutes of the NMFG Meeting

July 10, 2003

by Nancy L. Attaway

**President Scott Wilson** called the meeting to order at 7:10 p.m. and welcomed all members and guests.

### Old Business

**President Scott Wilson** and **Ernie Hawes** reported that the Guild workshop held at the home of Steve and Nancy Attaway on June 19 was a very good one. Ernie reported on the California symposium held in early June that he attended. He also showed and discussed two new faceting laps and two new books on faceting. Nancy Attaway discussed the merits of three designs: the Apollo cut triangle, the Flasher cut (twelve-sided) round, and the Square Barion cut. She instructed faceters on how to render the Apollo cut, a simple but elegant cushion cut triangle. Faceters who attended the workshop enjoyed their time cutting stones, and several faceted stones in the Apollo cut.

### New Business

**Scott Wilson** announced that the election of new Guild officers will appear on the September meeting agenda, where a slate of officers will be selected. The Guild membership will vote on the elections for officers during the November meeting.

### Show and Tell

The Show and Tell Case tonight held many lovely faceted stones and fine jewelry rendered by Guild members. **Moderator, Steve Attaway** used video and television equipment from Paul Hlava, Ernie Hawes, and the museum to better show the individual pieces.

**Dylan Houtman** displayed eleven stones that he faceted. He showed a small chrome tourmaline round, a small but lovely cushion cut/emerald cut pink sapphire, a small round chrysoberyl, and a small hot pink cushion cut oval sapphire with intense color. He showed a small cushion cut square pink topaz and a small round brownish-pink topaz cut with 154 facets. Dylan also showed a small round red spinel with pink/orange hues, two small red Nigerian zircons, a chrome tourmaline twelve-sided round, a small chrome diopside cut in an elongated marquise with truncated ends, and a bright orange, round Mexican opal with an apex table.

**Russ Spiering** displayed two large pendants that he handwrought. He showed a large pendant rendered in 22Kt. gold and sterling silver set with a long and thin pink tourmaline crystal on one side and a large quartz piece with short (long, thin black tourmaline) inclusions set on the other side, accented by a small round pink tourmaline at the bottom. He showed a bracelet woven in a 24Kt. gold micro-alloy, a Japanese technique that used an annealed metal heat-hardened with platinum. Russ made 24Kt. gold endings for the bracelet. He explained that the metal was heated to 450 degrees F for four to six hours and soldered to the 24Kt. gold loops with 18Kt. soft gold solder. Russ also showed a pendant rendered in 18Kt. gold and sterling silver set with a large druzy gem silica (chrysocolla), accented by several red and yellow round zircons bezel set at the top and bottom. He fused 18Kt. gold and 14Kt. gold balls on the pendant and used reticulated gold techniques on the finish. The pendant hung on an 18Kt. gold woven chain. Russ' wife, Kathryn Spiering weaves their gold chains and does beautiful work.

**Nancy Attaway** displayed four large stones that she faceted, two fine quality rose quartz from Madagascar, a Bolivian ametrine kite, and a Bolivian amethyst kite. She cut one rose quartz in a 16mm flasher cut (twelve-sided) round and cut the other one in a 17x17mm square barion. She faceted the two kites in tablets and left room in the pavilion table facet for Steve to render a reverse intaglio carving. The ametrine faceted kite tablet showed the dividing line of the yellow and purple zones at the center of the gem.

### Refreshments

**Steve and Linda Vayna** brought refreshments to the July meeting. Gourmet coffee was served. Thank you very much. **Nancy Attaway** volunteered to bring refreshments to the meeting in September.

### Future Programs

**Vice-President/Programs Paul Hlava** asked Ernie Hawes to bring the Smithsonian video "*Gemstones of North America*" to show during the September meeting. The video tours the mines, tells the stories surrounding the gems, and shows the gems. Steve and Nancy Attaway, along with Scott Wilson, visited the sapphire mining area near Gem Mountain during August. They will update us on the Gem Mountain area, with photos and maps accompanying their tales.

Paul Hlava will present a talk at the November meeting about the alloys used in precious metals.



## Program Speaker

by Nancy L. Attaway

Nancy Attaway presented Guild members many of her faceting tips that she acquired over the last seventeen years of cutting natural gemstones. She listed and explained each one.

1) When first roughing out a stone on the coarser grit laps, such as a 220-grit lap or a 360-grit lap, work (cut) both the girdle facets and the pavilion main facets to establish the shape of the faceting diagram chosen. This step gets rid of most or sometimes all of the crystal roughness and reduces the need to grind away gem material unnecessarily. Using too coarse a grinding lap removes too much gem material. All crystal roughness will be eliminated with the next pass on a finer grit lap.

2) Do not worry or fret about cutting exact meets and those small sliver facets of a diagram when first roughing in a stone. Every facet cut on a coarse lap will be erased with the next pass on a finer grit lap. Cut the small sliver facets and correctly align the meetpoints on the finer grit laps, such as a 600-grit lap. Use a 1,200-grit lap or a 3,000-grit lap for the pre-polish stage.

3) When cutting expensive gem rough (like ruby, emerald, sapphire, imperial precious topaz, benitoite, fine aquamarine, high quality tourmaline, and tanzanite), use a new or nearly new 600-grit lap (because they are sharp) to carefully rough in the stone's shape.

4) Always be mindful of the damage layer produced by each grinding lap. Remember that each grinding lap generates a measurable damage layer left after its use. These layers must be totally removed by each finer grit lap before the pre-polish stage to obtain a complete polish. An 80-grit lap leaves a damage layer between 1.04mm and 2.60mm deep. A 180-grit lap leaves a damage layer between 0.34mm and 0.86mm. A 220-grit lap leaves a damage layer between 0.24mm and 0.60mm. A 325-grit lap leaves a damage layer between 0.12mm and 0.30mm. A 600-grit lap leaves a damage layer between 0.06mm and 0.16mm. 1,200-grit lap leaves a damage layer between 0.03mm and 0.07mm. A 3,000-grit lap leaves a damage layer between 0.01mm and 0.03mm. Keep those in mind.

5) Try not to be in such a hurry to finish cutting the stone. Many mistakes are made as a direct result of haste. Louie Natonek, my original faceting instructor, tacked on the wall above his Facetron the following

words: "Why is there never enough time to do it right but always enough time to do it over?"

6) Consider re-cutting poorly cut gemstones, especially those faceted in fine quality gem material. Re-cutting these gems gives them a new life with improved optics, attention to facet detail, and a great polish. Re-cutting broken stones of good gem material can salvage those gems and may even inspire new faceting designs. Just imagine how improved faceting techniques can greatly increase the value of a poorly cut gemstone of fine quality gem material. What a treasure of a gem you will have when you are finished recutting it.

7) Use conventional diagrams and add your own variations. This better accommodates the gem rough slated for cutting that is slightly irregular in its rough shape. "Fat's where it's at" in gem rough, however, not all gem rough is shaped like big round marbles. Do what the rough shape suggests to maintain carat weight, while paying attention to proper optics.

8) Consider rendering faceted tablets for those flat pieces of gem rough that are not deep enough for traditional pavilions with culets. Cut them with double-sided table facets and facet parallel step cuts both top and bottom. Add decorative facets or scissor facets to those step cuts, if possible. Keep the girdle facets for these wide to maintain carat weight and ease of setting.

9) New, unusual, and completely different shapes for gemstones are normally inspired by the original shapes of the gem rough slated for cutting. These help retain carat weight and allow the faceter to use most of the pieces in a parcel of rough. The modern look of these bold shaped stones in jewelry is appealing.

10) Look at the various styles in antique jewelry, gaze at the shapes of windows in churches and old homes, check the shapes of beveled glass mirrors, and browse through museums for inspiration in facet designs. Nature's flowers and leaves also provide new ideas in shapes for gemstones. Begin with the shape outline and go from there to build a faceting diagram.

11) Use the sets of facets that you find pleasing, the ones that you like to see in a faceting design that yield a pretty arrangement, and incorporate them into your new faceting diagram. These facets will give your new design sparkle and pizzazz. Be familiar enough with the angles to know how these facets come into the design, high or low, wide or narrow, as your choice dictates.

12) Problems can occur in faceting. If you over-cut a crown main facet when polishing, then the facet may be adjusted by polishing the corresponding girdle facet upwards to meet the girdle alignment. Those small, tiny

facets on the culet, as well as those long and thin sliver facets, may be polished in place on some gem material, as these can be easily over-cut during the pre-polish stage. Use the ceramic lap with diamond carefully for this task. Those star facets around the table of a round cut may be polished in place at a shallower angle with the ceramic lap on some gem material. Also, a shallower angle may be used on a crown facet that “crashes” during polish. A good pre-polish goes a long way toward yielding a good polish.

Sometimes, chips on the girdle may be smoothed with the ceramic lap. Damaged facets can even be corrected or replaced by cutting facets with the ceramic lap. Add facets where damage has occurred, if shallowing the angle on the designated facets of a diagram does not work to remove the chipping. The ceramic lap can also thicken a girdle facet that has accidentally been over-cut and made too thin, but that will widen the corresponding pavilion facet a bit.

13) Check the polish on a facet at different angles from different light sources. Louie Natonek advised me to take the dopped stone into the sunlight to check the polish. Using higher magnification loupes, like 15x or 16x, may be helpful, too. Some folks use binocular microscopes when faceting and polishing. Also, be mindful of the heat generated during polish, as this could potentially damage a heat-sensitive gem. If a polish does not come in well at the clockwise direction, stop the machine, and change to the counter-clockwise direction to polish. Likewise, the placement of a facet on the lap, where the stone addresses the lap, makes a difference as to how it is polished, whether it faces north, south, east, or west on the polish lap. That determines what part of the fact gets polished, as well as the direction the polishing compound takes to travel along the facet.

14) Try to get undisturbed flow time when faceting. Maintain a state of relaxed attention. Have the chair at the proper height for the table. Consider listening to different types of music when cutting gemstones. Take periodic breaks and stretch. Have fun faceting.

Nancy ended her discussion by relating a faceting story. She recently re-cut the pavilion of a large cushion cut triangular tanzanite. The 10.22-carat gem exhibited very good blue color, but most of the pavilion of the stone badly windowed and showed hardly any sparkle. Light simply fell through the culet area. The gem also was not cut to proper proportions. One side was left slightly larger than the other two sides. Steve helped her create a possible cutting solution by rendering an alternative cutting diagram with the use of GEM/CAD.

Armed with the new diagram, Nancy carefully began cutting pavilion facets into the tanzanite with a new 1,200-grit pre-polish dyna lap. The gem had been faceted into a rounded cushion cut triangle to retain carat weight. The crown facets had been cut in a balanced arrangement and finished with a good polish, so they were not touched. The table facet showed a large enough proportion and had a good polish, and this facet was not touched, either. It was not long, however, before she realized that Steve’s design would not work on the pavilion. The gem was just too rounded and fat to accommodate the proposed facet arrangement.

Nancy then decided to develop a new design slowly, step by step. She placed five pavilion main facets above the girdle at 47 degrees, not quite touching the girdle, and left then suspended there about 2 mm above the girdle line. No girdle facets were touched. When she saw that the facet spread arrangement covered the gem in the upper pavilion (just above the girdle line) from rib to rib for one side, she did the same to the two other sides. They all worked. Then, she cut four kite-shaped facets in the mid-to lower pavilion area at 42 degrees on one side, and that worked, too. She then did the same again for the other two sides.

Nancy cut one culet facet at 41 degrees and two culet facets off-set from it. That arrangement worked on two sides but would not work on the third side. The culet on that side had been rounded near the top, and the new facet did not cover the original faceting work. So, Nancy cut two small pennant-shaped facets, using a ceramic lap, on either side of the point of the new larger culet facet. That solved the problem. She did the same on the other two sides and polished the gem’s new pavilion facets on a corian lap with 60K diamond.

After the polish, Nancy noticed how sharp and prominent the ribs of the triangular gem actually were. If a jeweler were to cut the seat for such a gem, he or she would have trouble cutting a proper seat for the stone that would not chip it during setting, since the ribs stuck out so far. Nancy decided to cut a kite-shaped facet upon each rib, where the points of the facet (top and bottom) did not touch the culet or the girdle. That would allow the jeweler a definite flat spot to set the tanzanite in a mounting without chipping the gem. The re-cut tanzanite, still a cushion cut triangle, weighed 8.86 carats and sparkled like a million bucks! Nancy’s new design solved a real world faceting problem that may be applied to cut other gemstones slated to be faceted in a similar shape. Consider it as a possible design arrangement for gem rough slated for cushion cut triangular designs.



**KISS**

## Keep It Simple, Stupid!

by Ewing Evans

first published October, 2002; updated May, 2003

(Contact author for permission to reprint.)

**Faceting is hard enough. Don't make the hobby any harder!**

1. **Selecting Rough**
2. **Orienting Rough**
3. **Doping**
4. **Rough Cutting**
5. **Fine Cutting**
6. **Pre-polish**
7. **Polish**
8. **Transferring**
9. **Removing cut stone from dop**
10. **Cleaning Finished Gemstone**
11. **Dog and Pony Show**

Disclaimer: I will mention various brand names in this article because they are the ones I currently use. I am not endorsing any of these products here. It is possible that these same products will not perform the same for you as they have for me.

Superstitions: There are many techniques advised by faceters for particular problems. Some are real breakthroughs in the faceting hobby, however, some are just old wives tales and repeated superstition. There is only one way to prove the case. You must test the technique by not using it on one facet and using it on the next. Then, you must repeat this procedure. If you can tell the difference, then you can proceed with confidence, using whichever works best for the stone on the dop. Be aware that the next stone may be different. Study the basic physics of the crystal structure of the stone you are faceting. Understanding how the various atoms interact will give you an understanding of why a certain problem exists and how to solve it. The best example is to think about the planar structure of graphite and the cubic structure of diamond. In your mind, compare the problems to be encountered when you try to facet either one of these crystals of carbon.

### **1. Selecting Rough:**

Selecting rough is the place for the faceter to start. If the rough material you are working with is flawed, then you cannot produce a perfectly cut gemstone. The primary knowledge you must have here is the nature of the crystal you are examining. A very brief description of a few types is all that there is space for here. Use light transmitted through the stone, and rotate to view from all directions. Many internal flaws can be seen by their shadows on frosted surfaces. Use Refractol to enable you to visualize the interior (or some other liquid that nearly matches the refractive index of the rough). Try to see the size and shape of the future gemstone in the piece of rough.

**Quartz:** The quartz species are fairly easy to view the internal flaws. There are veils, bubbles, cracks, and inclusions of other mineral species. Look for clarity in that part of the rough where the future gem is located. Be sure to note the location of color zoning. If you have to cut a section off the rough to avoid a flaw, then you might not have any color left for your faceted stone.

**Topaz:** Topaz can be viewed through the natural windows of the cleavage plane. It can contain cracks, which may be serious if they lie parallel to the cleavage plane. Minute bubbles and inclusions of other crystals are possible. Then, select for color.

**Sapphire:** Sapphire has problems with color zoning, where different colors are shown along different crystal axes. It has problems with hardness zoning, and it has problems with multiple inclusions. It is the hardest stone we work with.

**Tourmaline:** The vast majority of the tourmaline on this earth is too dark to be of any use. However, when the color is pale enough for you to tell what color it is, then tourmaline can produce beautiful faceted gems. The dark C axis must be avoided in most of the green varieties, but tourmaline in lighter colors, such as pink, may be faceted down the C axis for intense color.

**Beryl:** Goshenite, Golden Beryl, Heliodor, Aquamarine, Morganite, Blue Beryl, and Emerald. Beryl, when clean, is a relatively hard material that will not cause any problems for the faceter. When there are small flaws that reach the surface, polishing will be difficult. Emeralds are the only stones of such value that flaws on the surface and inclusions within the stone are tolerated. Study color zoning carefully.

### **2. Orienting Rough:**

Quartz is one of the many gemstones that do not require any particular crystal orientation. Orient quartz

for color zoning, for yield, and the shape of the cut intended. If acicular tourmaline or rutile crystals are included, then be sure to orient for the beautiful patterns they form.

Topaz has that perfect and weak cleavage plane. Try to orient the rough so that no facets are exactly parallel to this cleavage plane. When doping to the cleavage, the joint will be too weak to withstand the cutting and polishing forces. The cleavage plane will separate at the dop, and you will have to start over. Also orient the cleavage plane away from any large facet. Polishing a facet that is nearly parallel to this plane must be done with close attention to the lap direction and hand pressure. After you account for the cleavage plane, then you would proceed to orient for any color zones present. Finally, yield and the shape of the cut may be considered.

Some tourmaline has a totally dark C axis. This is usually true for the green varieties. If you cut a gemstone table perpendicular to that axis, then it will be seen as black. These stones must be oriented to be perpendicular to either/other axis of the crystal. You must look carefully with the light source above the rough to see the approximate color that you will see in the cut stone. Finally, when the C axis is dark, any facets perpendicular to this axis must be cut at very high angles, around 70 degrees or higher.

Sapphire has several properties that affect the orientation. It has two indices of refraction, it is usually color zoned, and there are always those hard spots. Lying near those hard spots are soft spots. Considering the cost of the rough, you should usually orient for yield first, color second, and just work around the variable and directional hardness.

### **3. Doping:**

For doping, I have usually used the adhesives cyanoacrylates (Superglue), and epoxies. These adhesives give a much more rigid attachment of the rough to the dop than the traditional doping waxes. They will not soften at any temperature where you can still hold the gemstone.

For the pavilion, I have always used the cyanoacrylates (superglues) to glue the stone to the dop. This requires that you have a flat about the same size as the end of the dop. Holding the rough by hand and using a lap with a lot of water creates that flat. A lot of water would be about 3 drops per second. The lap can be any grit, but 600-grit works about right for 15mm rough.

Now that you have a flat to glue to, it must be cleaned. Any trace of oil or grease (fingerprint) will act as a release agent, and your bond will fail. I wipe the flat with a piece of paper towel that is wet with denatured alcohol. The alcohol will remove any oil or grease on the flat. Wipe these surfaces dry quickly. Do not allow time for them to evaporate dry. As some alcohol evaporates, the rough is chilled. This causes a very small amount of water to condense on the flat. This very small amount of water helps catalyze the cyanoacrylates polymerization. Also, clean the flat on the dop the same way.

Next, place a small drop of glue on either the dop or the rough and firmly set the dop on the flat. The glue will set in a few seconds. If the location of the dop is critical, then the rough should be placed in the transfer block. Hold it in place with some plasticene clay. This allows you to move the rough until it is precisely positioned. Press the dop against the flat for a perfect fit. Separate slightly, add a drop of glue, and press together again. If you want to begin faceting immediately, then you should use an accelerator. The spray provided is not necessary. It uses way too much accelerator. Take the top off and wave the end of the plastic suction tube around the joint. The fumes are sufficient to cause polymerization of the superglue.

### **4. Rough Cutting:**

Use a trim saw or a blade on your faceting machine to cut off any larger pieces of rough. You will be able to start faceting sooner, and you will have the cut off pieces to cut smaller gemstones.

Rough cutting should begin with a lap not coarser than 360-grit. Keep in mind that a diamond point scratching across a gemstone surface will leave cracks that are much deeper than the scratch left by the removed material. These cracks are only visible through the use of special optical equipment. If you cut with the next finer lap, then you may not remove enough material to totally remove the cracks.

These cracks will cause a lot of difficulty when you come to the polishing stage. A breakout of a chip starting with one of these cracks is the most common cause of scratches occurring during the polishing stage. Leave enough material at this stage so that you can cut below these incipient cracks with a finer lap.

### **Finding the exact center for the culet:**

Sometimes, it is necessary to place the culet at the exact center. The following procedure will accomplish



this task. First, cut one of the facets that touch the culet to the approximate center of the rough. Then, change the index to the facet most nearly opposite and again cut to the same depth. At this step, you will have an edge, or nearly so. Look at the preform edge very carefully. Cut a little more if you do not have an edge. It is very important that you cut these two facets to the same depth. Cut each one a very small amount, go to the other facet and cut it. There should be about four repetitions to randomize any errors. Then turn the index to a facet that is about 90 degrees from these two and cut to almost the same depth. Now, change the index to the facet most nearly opposite and cut to nearly the same depth. Repeat the repetitious slow cutting until there is a nearly perfect meetpoint. This procedure will leave a four faceted preform, where the culet is very near the center. Note that I did not specify any particular index numbers. The odd number of main facets in some designs precludes using 0, 90, 180, and 270 degrees.

This whole sequence must be repeated at each of the finer stages of cutting and again while polishing. Be sure to use the same set of facets. After each stage, the culet point (or line) will be closer to the axis of the dop and average out any cutting errors, such as uneven hand pressure, differential hardness of the rough, etc.

## **5. Fine Cutting:**

Fine cutting should be done with a 600-grit lap or finer grit. At this stage, you should be placing the facets very close to the final position. If you have to do any adjusting of the stone orientation, then be sure to write down the values of the adjustments. This cutting stage must remove enough material so that you have gotten past any incipient cracks remaining from the rough cutting. This may require removing more than 0.1mm from each facet surface. Twice this amount would be better if you have enough room to cut that far.

It is the faceter's choice as to the type of lap to use. Solid steel gives a faster and flatter cut, discs with steel facing and composite backing are lighter and usually cheaper, and dyna discs do well, also. It is a general rule that the less expensive laps will not cut as many gemstones.

## **6. Pre-Polish:**

The pre-polish stage should leave a facet in its exact position and perfectly flat. My approach to this, for stones harder than quartz, is to use a ceramic lap

with 14,000-grit diamond. There should be a small amount of oil to hold the diamond and lubricate the surfaces. This combination will cut relatively quickly. It will leave a surface that looks polished to the naked eye. It can be easily adjusted to make perfect meet points. The surface of the facet will show only very fine parallel scratches. You must adjust the angle of the inspection light and the loupe carefully to see these scratches. Again, I will say, write down the adjustment values of each facet. These numbers will save you a lot of time when you are polishing.

For quartz and softer stones, I use a Dyna disc, 1200-grit or a 3000-grit. The edge-rounding can be corrected in the polishing steps that follow.

### **Hand Pressure:**

Pay attention to your hand pressure! This should be the same during the pre-polish of the whole tier of facets. There are two effects that are at work here. The first is the torque on the stone. This torque may cause the dop, quill, and yoke to twist. If you use variable hand pressure, then the twist imparted to the stone will be variable, and the facets will not be at exactly the same index. Then, you have to use to index divider a lot.

The second effect is flexing the whole system from the support plate, mast, bearings, quill, dop, and adhesive. To be absolutely inflexible, the mast would need to be around 2 inches in diameter, and the other components equally increased in size. Variable hand pressure here will cause the facet being pre-polished to be a curved plane from top to bottom. To adjust for this, you will have to adjust the mast height and index divider. When you finally get to the polish stage, you will need to polish a longer time to bring in the meets on the top and bottom.

Both of these effects are markedly affected by the relative lap direction. If the lap direction is at right angles to the dop axis, then you will see maximum torque applied for any given pressure. There will not be much flexing of the mast or the rest of the system, however. If the lap direction is parallel to the dop axis, then there will be maximum flex of the mast and very little torque applied to the stone.

Sometimes, you have to add lubricant and/or diamond while polishing. (N.B.) This will affect the drag between the lap and the stone, and that will alter the effective angle that the facet is contacting the lap. Look a lot, and you can correct for this small change.

## 7. Polish:

There are an infinite number of combinations of lap materials, polish compounds, and gems to be polished. I think that I have tried a few hundred of them. Since 50,000- to 200,000-diamond boart will polish almost everything, I have quit starting with any of the other polishes. Should I encounter a stone that will not polish with diamond, I will certainly try some of the other polishes available. For instance, if diamond did not yield satisfactory results, then I would try cerium oxide next for a quartz gem.

### Lap Materials:

There are many materials that will produce a satisfactory lap. If you are into polishing calcite, then use one of the softer materials, such as Lucite (a CD is a good source of plastic, as it's a polycarbonate). However, for the gem minerals that will produce a wearable gem, you will usually have to go to harder laps. There is a strong correlation between the hardness of the lap and the degree of edge-rounding produced. This effect may not be of much concern until the stone is submitted to a competition, where the judges will certainly recognize it as a fault.

The hardest material generally available is the ceramic lap. It will produce very flat facets and almost no edge-rounding. However, it is nearly impossible to avoid the cat hair scratching on any material except sapphire with the ceramic lap. With sapphire, it is only difficult to avoid the cat hairs. The composite laps, (Fast Lap and Last Lap), are excellent, but there is a definite rounding of the facets. The composite laps need a lot of lubricant and can hold a lot of diamond.

My overall choice for a lap is tin. The best variety I have found so far is the Batt Lap. The Batt Lap is hard enough to give reasonably flat facets with little edge-rounding. The Batt Lap also allows a fairly heavy diamond loading.

### Lap Lubrication:

Your lap must be lubricated with something, and some kind of oil is the best choice. It will not evaporate like water, so you have some control over the surface without constantly having to adjust the amount of water. Typically, I use the diamond sprays. Since the manufacturer supplies these spray bottles with way too much diamond, I dilute with alcohol at least 5:1. Also, I add a few drops of oil to the bottle. This is usually enough oil to keep the lap lubricated.

### Lap Surface Conditions:

Lap conditions are the limiting factors in your polishing. First, you should clean your lap before you start using it. Spraying it with alcohol and wiping with a piece of paper towel as the lap is turning will remove oil, gem swarf from the previous stone, and diamond from the lap. Spray one or two squirts of the diamond onto the cleaned lap while it is turning and then use a flat to spread the mixture evenly. This flat can be any mineral with a large enough facet that it will not roll when hand held. Postage stamp size works fine. Agate, quartz, corundum, or jade will work fine, too.

### Lap Speeds:

Generally, the speed at which you polish should be in the slow end of the range. Faster speeds will produce a polish faster, but the tendency of the stone to bounce over the higher spots becomes more pronounced. This is one source of rounded facets and some cat hair scratching. Also, at higher speeds, the stone will cause uneven wear on the lap. When the lap surface is uneven, you cannot make flat facets. Faster speeds become very risky for the more fragile stones.

### Read The Grease:

There is much useful information that the lubricant, diamond, and swarf layer on the facet will reveal. When you first are aligning a facet with the lap, place the facet gently on the stationary lap. Then, inspect it carefully. There will be a tiny bit of grease on a corner of the facet. Now, you can make the small adjustments to the angle and index that will bring the facet into exact alignment. This is the time to make those judgments on how and where the meet points of this facet will come together with the adjacent facets.

Next, start the lap turning and test the alignment. Set the facet down on the lap gently for a couple of turns. Inspect the facet without wiping. You should see a series of minute streaks in the direction the lap was turning. Study these carefully. Look for streak size, direction, coverage, and a diffraction pattern. If the streaking is all uniform in size, and if the diffraction pattern is uniform and the streaks cover the entire facet, then the alignment is perfect. If the alignment is not perfect, then there will be bare areas where the lap is too far from the facet. Remember, the lap itself should never contact the gemstone facet. The facet must ride suspended over the lap on a very thin layer composed of diamond, lubricant, and swarf.

Look at the swarf buildup along the leading and trailing edges of the facet. Assume for the first case that the facet edges are perpendicular to the lap direction.

The leading edge should be smaller particles, uniform across the edge of the facet. The trailing edge will have a larger amount of buildup, coarser grained than the leading edge. The buildup should look slightly oily. When it gets dusty looking, you do not have enough lubricant or diamond on the lap. If the buildup is greater on one end of the facet edge, then you should consider why there is more action along that side of the facet. The possibilities are that the edge is not perpendicular to the lap direction. This is no problem. If there is not "enough" buildup, however, then you can be pretty sure that the adjacent area of the facet is not being polished. A "ghost facet" will be forming there. You will also be able to see that the streak pattern and the diffraction pattern are slightly different in the area where the ghost facet is residing.

If the facet leading edges are not at an angle perpendicular to the direction of the lap, then the buildup will be a long, slender triangle. Since the amount of buildup is proportional to the amount of polishing action, you can use some judgment as to the adjustments needed to complete the polish and bring in the meets to the required alignment.

**Diffraction pattern:** The diffraction pattern is the tiny rainbow effect caused by the streak size being an increment of the wavelength of that color you are seeing. If one side of the facet is closer to the lap, then the pattern can be a rainbow across the whole area. The blue areas are closer to the lap. The red areas are further from the lap. I have seen bull's eyes and rainbows arching across a facet. The best to see is a multitude of tiny color bits distributed at random over the whole facet.

#### **Observation of the Facet Polish:**

It is in the observation of the facet being polished that most mistakes are made, and it is the only place where you can get the information to correct the fault. First, you must clean the facet perfectly. Wipe with a piece of paper towel, then wipe with a clean washcloth. This two-step series leaves a clean surface with maybe a few specks of cellulose from the washcloth. These specks are useful to aid you in focusing with your loupe, but they do look like pits. Pits can be distinguished from specks on the surface, because they seem to change color and reflectivity as the light angle changes.

In order to see a facet's polish, you must have an excellent light source and a good loupe. A 10x loupe is the most powerful magnification that is useful for observing the polish quality. A 50-watt narrow spot tungsten/halide light source is ideal. With these two

tools and your eye, you can detect scratches that may be no wider than the wavelength of light. I believe you should spend much more time looking than you do contacting the lap. Patience, patience, and more patience. The light rays should be very nearly parallel to the facet. You must move the stone slightly from side to side and up and down, and the light should pass over the facet in all four directions. You should see the reflected light go off the facet. Then, just as it does, you can best see if there are any scratches.

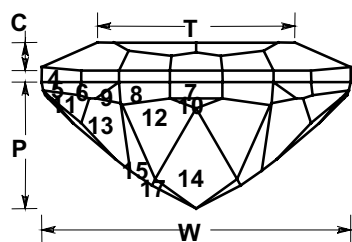
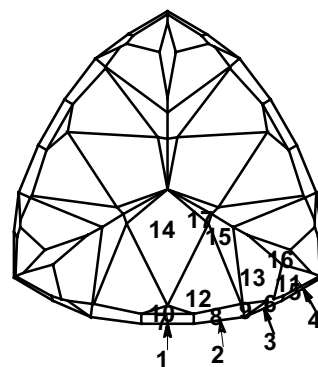
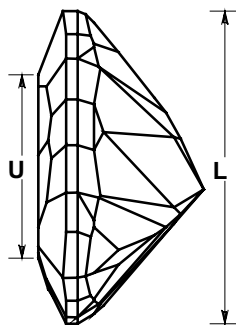
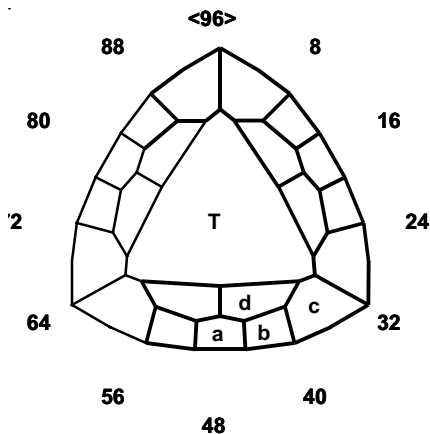
#### **Cat Hairs:**

Cat hairs deserve a whole lot of discussion. Cat hairs are those almost invisible scratches that can only be seen when the light is strong enough and at exactly the right angle. It is very easy to miss seeing them, but the Judges always will! Why do they happen? My personal theory comes from observing the swirling of the polish compound under a facet as the lap goes by. Then, I noticed that cat hairs are most frequently found just after you have made a small adjustment. It was obvious that most cat hairs are on the area of the facet that was just lifted up from the lap by the adjustment, nearly always on the down-stream side of the facet. My conclusion is that these scratches are caused by a swirl of the polish compound rising upward from the lap into the space left by the adjustment. Imagine breakers in the California surf. This correlates fairly well with my observation that cat hairs can be caused by too much polish compound and too high of a lap speed.

These facts can be helpful in keeping your facet scratch free and totally flat. Polishing longer will eventually flatten the facet out, and the cat hairs will be cleaned up. Or, if there is too much polish, wipe some off the lap and then reduce the lap speed. If you cannot reduce the motor RPM, then remember that the feet per minute speed of the lap is much slower as you get closer to the center.

#### **Observation of the Facet Meetpoints:**

You should use the same techniques to see if the meetpoints are correct that you use to see the polish. The differences are that you usually have many facets at different angles and indexes. Use the light to focus on the point of each facet at a meetpoint. The best light I have found for this application is a 75-watt narrow spot tungsten/halide. Magnification up to 30x is useful for meetpoint observation. You should look for incomplete meeting, curvature, and tailing. At this stage, it is necessary to see if there are any ghost faceting problems. Avoid these by polishing sufficiently long after



## Tanzanite Recut By Nancy Attaway

Angles for R.I. = 1.7

88 + 21 girdles = 109 facets

3-fold, mirror-image symmetry

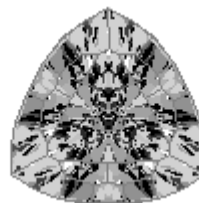
96 index

L/W = 1.012 T/W = 0.639 U/W = 0.594

P/W = 0.410 C/W = 0.090

Vol./W<sup>3</sup> = 0.196

Average Brightness: COS = 58.0 % ISO = 73.4 %

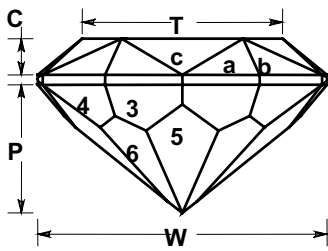
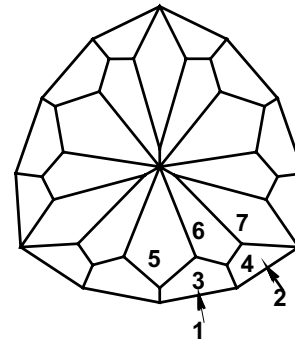
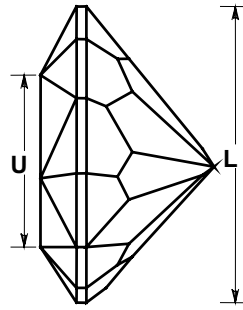
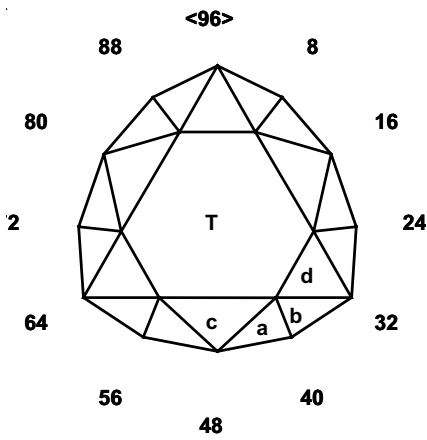


### PAVILION

1	90.00°	16-48-80
2	90.00°	14-18-46-50-78-82
3	90.00°	10-22-42-54-74-86
4	90.00°	08-24-40-56-72-88
5	72.00°	08-24-40-56-72-88
6	70.00°	10-22-42-54-74-86
7	60.00°	16-48-80
8	60.00°	14-18-46-50-78-82
9	60.00°	12-20-44-52-76-84
10	47.00°	16-48-80
11	47.00°	07-25-39-57-71-89
12	42.00°	15-17-47-49-79-81
13	42.00°	10-22-42-54-74-86
14	41.00°	16-48-80
15	41.00°	13-19-45-51-77-83
16	39.43°	96-32-64
17	39.00°	15-17-47-49-79-81

### CROWN

a	26.00°	16-48-80
b	26.00°	14-18-46-50-78-82
c	26.00°	10-22-42-54-74-86
d	20.00°	15-17-47-49-79-81
T	00.00°	Table



## Cushion Triangle for Liddicoatite By Nancy Attaway

Angles for R.I. = 1.620

43 + 12 girdles = 55 facets

3-fold, mirror-image symmetry

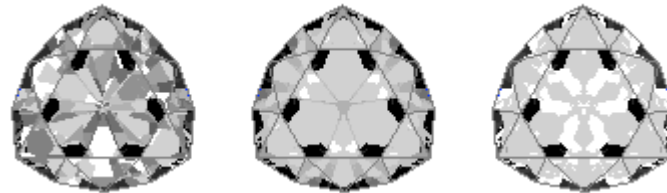
96 index

$L/W = 1.033$   $T/W = 0.691$   $U/W = 0.598$

$P/W = 0.443$   $C/W = 0.128$

$Vol./W^3 = 0.222$

Average Brightness: COS = 69.9 % ISO = 80.3 %



### PAVILION

1	90.00°	13-19-45-51-77-83	cut equal length sides
2	90.00°	07-25-39-57-71-89	
3	50.00°	13-19-45-51-77-83	
4	50.00°	07-25-39-57-71-89	
5	42.00°	16-48-80	
6	40.00°	10-22-42-54-74-86	
7	39.00°	96-32-64	

### CROWN

a	40.00°	13-19-45-51-77-83
b	40.00°	07-25-39-57-71-89
c	33.00°	16-48-80
T	00.00°	Table
d	28.37°	96-32-64 This angle may need to be adjusted

each adjustment. Make very small adjustments to bring your meets to perfection. Polish a lot between each adjustment in order to bring the whole facet into one plane, instead of two or more planes. If there are cat hair scratches, then they will be on the ghost facet that is not being polished. Repeat, repeat, and repeat.

### **8. Transferring:**

For the transfer to cut the crown, I use epoxy. Usually, the kind with a 5 minute setting time is used. I have heard many complain about failure of this adhesive. There are several likely causes. The first is a film of oil/grease/fingerprint that will act as a release agent. The second is an incorrect ratio of epoxy to hardener. It is well worth the time to actually weigh the components onto a piece of aluminum foil on a carat scale. Weigh out the same weight of each component. Then, you can get the 1:1 weight ratio nearly exact.

After fixing the two dops in the transfer jig, I wipe dop and gemstone surfaces with a piece of paper towel soaked in alcohol. Wipe these surfaces dry quickly. Do not allow time for them to evaporate dry. Then, mix the epoxy for several minutes and apply. Rotate the transfer jig in your hands until the initial set has occurred. This takes about two minutes.

Next, I set the jig in the cold kitchen oven, set the thermostat for 225 degrees F, and let it bake for ten minutes after the oven has reached 225 degrees F. Heating completes the epoxy curing much quicker and harder. The epoxies can tolerate a temperature just over 300 degrees F. The cyanoacrylates will weaken just over 220 degrees F. Allow the oven to cool.

### **9. Removing Gemstone from Dop:**

**Superglue Joint:** When you remove the dops from the jig, a slight rap with a table knife on the dop on the superglue side will cause that dop to release its hold. Heating in the oven weakens the cyanoacrylates enough that there is little risk to the stone. If you have one of the very expensive and/or heat sensitive stones, such as emerald, then I prefer to use the trim saw and just cut the dop off near the gemstone.

**Epoxy Joint:** To remove the gemstone from the dop, I soak it in methylene chloride. Methylene chloride is the active ingredient in Attack. It takes hours to completely soften the epoxy, but there is no risk to the gemstone. (N.B.) Methylene chloride will remove any

dye added to the gemstone. If you have a "color enhanced" emerald and soak it in methylene chloride, then the result will be a very pale emerald. Finally, as a safety warning, keep the methylene chloride container closed. The vapors are hazardous. A ¾-inch layer of water prevents evaporation of the methylene chloride.

Methylene chloride cannot reach the epoxy at the bottom of a cone dop. One trick I have learned to accelerate the removal of epoxy is to drill small holes into a cone dop near where the culet will be. You can drill several of these holes, since the brass is usually strong enough. For a "V" dop, I saw another "V" groove at tight angles to the main groove. This makes a four-prong dop. Keep in mind that epoxy is relatively strong and not nearly as flexible as waxes are.

### **Trouble Shooting:**

Here is a list of frequently encountered problems and some "what to do" statements.

- 1 *There are many parallel cat hair scratches over the whole facet.* There is too much diamond for the lap speed. Reduce lap speed, even down to hand lapping. Or, wipe some diamond off the lap.
- 2 *There are parallel grooves in the facet.* The lap surface grooving causes these. Oscillating the stone faster and reducing the lap speed can eliminate them.
- 3 *Single scratches appear starting from middle of a facet.* A small chip detaching from the gem usually causes these. This is caused by the incipient cracks from one of the coarser grinding stages. The solution is to cut a little more at the last pre-polish stage. However, that is not practical at this juncture. First effort should be to try to polish it out.
- 4 *Single scratches beginning at the leading edge of a facet.* The chip that broke out as described in the previous section usually causes these. Polish it out.

### **10. Cleaning Finished Gemstones:**

It is necessary to present an absolutely clean stone to the competition judges. The following steps should help obtain a clean gemstone. After the gemstone has separated from the dop in the methylene chloride, there is a three-step cleaning process. I wipe and dry it with a piece of paper towel. Do this quickly before the solvent has evaporated. Then, I wipe the gemstone with a piece of paper towel soaked with alcohol. Then, finally wipe dry with another piece of paper towel. Use this piece of paper towel to hold the gemstone until you can set it in a safe place.

Always wipe dry before the solvents have evaporated. This keeps any solids dissolved in the solvents from precipitating on the gemstone surface. These solids are always present in trace amounts, and the result is like painting the gemstone. Very bad for appearance!

### **11. Dog and Pony Show:**

This story is included to illustrate that challenging the system is always a good learning experience. When you do these in real life, you must understand the extent of all possible consequences. Only then go ahead and try it!

I was very new to the faceting game. I had been the proud owner of a Facetron for several months, and everything I knew about faceting was from Soukup's little pamphlet that is included with a Facetron, along with some cutting experience that I had at the time. I decided that I would take a class on faceting from a man who is now one of my heroes in faceting, Charles Covill, a genuine faceting guru. One evening, Charles was not in the classroom, and another student asked about orienting a facet slated for polishing to the lap. I smarted off and said watch!

I was polishing the pavilion mains of a round double brilliant in quartz. This stone was 22.8mm and weighed 41 carats. These mains were just over 15mm long. I used the old standby magic marker to totally cover the facet I was polishing. Then, I changed every setting on the machine. I removed the dop from the quill, lowered the mast, dialed a new angle, reset the index, changed the index divider (cheater), moved the mast back, and took the lap off the machine.

Now, the challenge: put everything back and test the orientation. I put the dopped stone back in the quill, put the lap back, adjusted the mast location, dialed in the original angle, set the index, set the index divider to the old setting, adjusted the mast height using the indicator needle, started the lap turning slowly, and touched the facet to the lap. It was just a very light touch, less than one quarter of a turn. When we inspected the facet, it was completely clean, and the adjacent facets were all still blackened. This degree of repeatability is one of the criteria one should use in selecting a faceting machine. If you are going to be cutting competition stones, then you really need that repeatability.

{Editor: Thank you, Wing. Ewing Evans won the top honors at the international single stone competition for the last three years, a truly awesome achievement!}



## **In the News**

### **Indepth Look at Beryllium Diffusion**

*Source: Gems & Gemology Summer, 2003*

GIA studied the heat-treatment of ruby and sapphire that involves lattice diffusion of beryllium at temperatures over 1,800 degrees C, changing sapphire to orange and orangy-pink (padparadscha). This method also produces corundum in yellow, blue, and red hues. Examination of hundreds of rough and faceted Be-diffusion sapphires revealed that standard gemological testing identifies many of these gems, but some require chemical analysis by mass spectrometry. GIA reports its research findings in this definitive article and is seeking new methods to better determine this process.

### **Color-Change Garnets from Madagascar**

*Source: Gems & Gemology Summer, 2003*

Miners near Bekily, Madagascar unearthed several perfectly terminated, transparent color-change garnets, 4-5mm in diameter. The distinct crystal faces show dominant trapezohedra and subordinate dodecahedra. They are blue-green or yellowish-green in daylight and purple to purplish-pink to pink in incandescent light. Rough pyrope-spessartine garnets are normally found as irregularly shaped fragments without crystal faces.

### **Cultured Pearl Market Update**

*Source: Professional Jeweler August, 2003*

The increased supply of cultured South Sea, Tahitian black, and Chinese freshwater pearls have caused a decrease in pearl prices. Production increased in all categories except Japanese akoyas, still plagued by high mollusk mortality rates and competition from finer Chinese freshwater pearls. Top Japanese akoyas still command high prices, but overall pearl prices dropped 30% in 2002, while Chinese freshwater pearls fell 60%.

### **US Bans Products from Myanmar**

*Source: Professional Jeweler September, 2003*

President Bush signed into law a bill that bans the import of any product from Myanmar (Burma) for one year, unless Myanmar's government enacts democratic reforms, such as free elections. This law will greatly affect the gem trade and will impact gem dealers.



## Facet Designer's Workshop

By Ernie Hawes



Nancy Attaway creates some very interesting designs, sometimes by just sitting down and starting to cut an idea that eventually emerges into a design, and sometimes out of the need to deal with a particular piece of gem rough. In the case of the two designs presented in this issue of *The New Mexico Facetor*, Nancy had two different situations that many faceters face from time to time. In one case, it was how to deal with a particular shape of rough that looked best cut down the C axis. In the second case, it was how to deal with a recut of an existing faceted gem to improve the appearance and the optics of the stone, while maintaining the stone's original outline shape and size. Neither of Nancy's designs are for beginners. The first design, as Nancy comments, is not a meetpoint design, and I would suggest it as a project for more experienced cutters. I see the recut design as an opportunity for everyone to learn methods for approaching different real world faceting situations. The rest of the column will be Nancy's comments regarding her designs.

"In our last issue, Ernie Hawes created a new design for a cushion cut triangle. He specifically rendered the diagram for a pink tourmaline from the Pala mine in California. While he was at the faceters symposium in Los Angeles held in early June, I purchased three pieces of dark pink Nigerian tourmalines (Liddicoatites) at a show. I noticed that one of the crystals would best accommodate a cushion cut triangle, orientated down the C axis. The other two would be faceted in Flasher cut twelve-sided rounds (and these two finished gems measured 9.5mm), also orientated down the C axis. Ernie's cushion cut triangular design inspired me then to think of a design for this other triangular tourmaline crystal."

"I dopped the stone the way I like to dop stones for triangles, with the 96 girdle facet opposite the flat key on the dop. I am more familiar with cutting triangles starting with girdle facets on 96, 32, and 64, with small cut corners at 16, 48, and 80. This dopping manner allowed me to off-set the girdle facets from 96, 32, and 64 to be at 93 & 3, 29 & 35, and 61 & 67 to make the cushions. I added a very small girdle facet at 16, 48, and 80 to better protect the gem from any possible chipping at its corners. These small corner girdle facets are purely optional and may not even be necessary. However, these three corner facets can better protect the gem from chipping at the corners. The pavilion mains mimic the girdle facets. I derived the culet area with some shallow angles in mind, as it would better promote the sparkle of the Liddicoatite gem material. I also placed a pavilion facet at 16, 48, and 80 to allow the jeweler a flat spot upon which the gem would set in a mounting to prevent chipping during setting. Those prominent ribs resulting from cushion cut triangles can make a gem vulnerable to damage. The crown mains mimic the girdle facets. The arrangement of the star facets on the crown are very different from my usual step-cut crowns. I hope that you like the design. It is not a meetpoint design. The girdle facets and the pavilion main facets all need to be carefully cut as you go around the curves of the tourmaline crystal, so work both before continuing any further into the diagram. The design worked very well for my 10.5mm cushion cut triangular Liddicoatite."



**The photo above shows the 10.5mm Nigerian Liddicoatite tourmaline cushion cut triangle faceted by Nancy Attaway that weighs 4.01 carats.**

"I enjoy faceting tanzanite. It a real pleasure. However, the price for quality gem rough in tanzanite has exceeded the price per carat of the faceted gem. So, I became excited when I was asked to improve the optics on a 10.22-carat tanzanite cushion cut triangle. The crown and table facets appeared to have been rendered pretty well, and I noticed that all crown facets, along



with the large table facet, showed a good polish. These I decided to leave as they were. Since I did not want to make the gem smaller than its original girdle dimensions, I left the girdle facets alone, too. The gem showed a rich blue hue. However, light simply fell through the culet area and much of the pavilion, greatly diminishing the gem's sparkle.

Ignoring the original pavilion mains, I followed the curve of the original rounded cushion cut design and placed a row of new pavilion mains that hovered above the original girdle line. Next, I decided to see if I could place an off-set facet arrangement of facets at 93 & 3, 29 & 35, 61 & 67, on the second row at a shallow angle. (I used shallow angles for this gem design, since the color was so deeply saturated.) That idea seemed to work. Then, I needed to cut some culet facets near the tip at shallow angles, too. My idea worked on two sides but not on the third side, as the culet facets on that side had been "rounded in" at the very tip of the culet. This triangular stone was not a symmetric triangular shape. One side was originally cut larger and broader than the other two sides. I was not able to erase all of the original culet arrangement with my facet design idea, so I added two small pennant-shaped facets on either side of the culet tip. That solved the problem at hand, and then I did the same for the other two sides. I also added three pavilion facets at 16, 48, and 80 on the ribs of the stone. This will allow the jeweler a flat spot for the gem to be set in a mounting without chipping it, since the ribs of the original stone design were so prominent. The finished re-cut gem weighed 8.86 carats."

"Please note that Steve included a crown design he made up that mimics the original girdle facets, but it does not correspond and mimic the new pavilion. This was done to show faceters how the stone originally appeared and what the girdle arrangement originally was. It also was done to show how well the new modified pavilion arrangement shows through the crown. I would really like to change this crown facet arrangement to better correspond with the new pavilion. I hope to have a new crown design prepared for the next issue of the *New Mexico Faceter*. As I stated earlier, I did not re-cut the girdle facets or the crown and table facets, because I wanted to maintain as much carat weight as possible for such a valuable gem. The crown and table facets were fine as they were, but I think that the faceting design for the new pavilion could benefit from a new facet arrangement if applied to a different stone."



## Jemez Obsidian Inclusions Identified by John Koivula

by Nancy L. Attaway

John Koivula, Chief Research Gemologist for GIA's Gem Laboratory, identified the inclusions in the gem obsidian from the Jemez Mountains in northern New Mexico as hematite and ilmenite. I gave GIA a faceted example and a tumbled example of the material last year to study. John examined the table of the large twelve-sided round gemstone at 80x magnification using shadowed Nomarski differential interference contrast and shadowed transmitted light microscopy. A few inclusions exposed at or very near the surface were located in this manner. These were marked for analysis using a micromanipulation device that placed a spot of India ink next to the inclusion so that it could be easily located during the next phase of the identification process. Then, laser Raman microspectrometry was used to obtain Raman spectra for the inclusions.

The spectra obtained were matched by computer to standards in the Raman spectral computer database library at GIA. In this manner, the red to orange-red inclusions were identified as hematite, and the brown to grayish brown ones were identified as ilmenite. Many are hexagonal but not all of them. That is typical with any crystals, in that only a few show perfect morphology. John has a nearly perfect 80x photomicrograph that shows a red-orange hexagon of hematite right next to a dull gray-brown hexagon of ilmenite. In the background is a crystal that shows the six-spoked formation that some of the crystals also show. It is slightly out of focus because it was not in the focal plane of the other two mentioned above. The Raleigh light scattering from the tiny sub-metallic hematite and ilmenite inclusions gives them a false bluish color.

John Koivula's research article will appear in the Fall, 2003 issue of *Gems & Gemology* in the Gem News International section.



**The photo on the left shows the exquisite emerald cut pink sapphire faceted by Dylan Houtman with the long and short sides flared outward.**



## LET'S TALK GEMSTONES



Edna B. Anthony, Gemologist

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## INOSILICATES

### The Pyroxenoids

Confusion exists concerning the classification of what Cornelis Klein and Cornelius Hurlbut, Jr. (after Dana) in the twentieth edition of the *Manual of Mineralogy* refer to as the pyroxenoid group of minerals. Neither the Mineralogical Record Incorporated publication and the 1995 edition of the *Glossary of Mineral Species* lists a pyroxenoid group, nor lists pectolite, rhodolite, nor wollastonite as members of the pyroxene group. It states, also, that pectolite and wollastonite can develop in the monoclinic, as well as the triclinic crystal system. Polymorphs of both minerals exist but are not relevant to gem production. Pyroxmangite is not recognized. The *Manual of Mineralogy* states that wollastonite is an end member but the series is not identified. Other references make no mention of this.

It was noted earlier that the twisted chain structure of the pyroxenes exhibits a distance of 5.2 angstroms involving 3 SiO<sub>3</sub> tetrahedra in each repeat of the twist. In the pyroxenoids, the distance and the number of tet-

rahedra involved in each repeat varies with the specie. This difference causes a splintery cleavage and the fibrous habit typical of these triclinic minerals. Crystals of the pyroxenoids are usually small, brittle, and very difficult to cut, so faceted gems are rare. Cabochons of compact massive material are more common.

### Pectolite Ca<sub>2</sub>NaH(SiO<sub>3</sub>)<sub>3</sub>

Pectolite forms a series with serandite. The structure consists of units of 3 tetrahedra that measures a distance of 7.3 angstroms between the twists. Calcium-rich metamorphic rocks and vugs in basalts containing the crystals in association with zeolites are usual sources. Most mineral collectors' cabinets contain a specimen of the typically radiating acicular crystals that exhibit a fibrous appearance. The Sterling Hill, Franklin and Paterson, New Jersey areas produce excellent specimens of this type. Pectolite is usually colorless, white or gray, but, in environments containing manganese, a delicate pink color develops when calcium is replaced by manganese. Such manganiferous environments are located in Greenland and Magnet Cove, Arkansas.

Lovely blue and white cabochons are fashioned from the compact material, colored by copper, that occurs in the Dominican Republic. The finest is a translucent dark blue that takes an exceptionally high polish. Larimar is the name chosen for the blue variety. The interwoven crystals of the pale blue-green Alaskan pectolite create a tough substance that resembles jade. The dense, compact material, recovered in Lake County, California, is excellent for cabochons. Other sources include deposits in South Africa, Morocco, Scotland, Sweden, Italy, Czechoslovakia, the Kola Peninsula, and Japan. The German mineralogist, F. Kobell, first described pectolite after examining specimens from deposits in Italy.

Tests reveal a white streak, easy fusion at 2.5-3 to a glass with the flame colored yellow by the sodium content. Simon and Schuster's *Guide to Rocks and Minerals* states that dissolution in hydrochloric acid yields a silica gel, but the *Manual of Mineralogy* comments that the separation of silica occurs without the formation of a jelly. It also reports two directions of perfect cleavage and cautions that the needle-like fragments easily penetrate the skin. The specific gravity can vary from 2.74 to 2.88. The spectrum is not diagnostic. Exposure to LW ultra-violet light creates orange-pink luminescence in Bergen Hill, New Jersey material and a cream fluo-

rescence of specimens from Lendalfoot, Scotland. In SW, material from Scotland fluoresces greenish-yellow, while the substance from Magnet Cove, Arkansas exhibits a yellow or orange mottled by green. A faint yellow followed by phosphorescence takes place after Lake County, California material is subjected to SW light. Pectolite is biaxial (+), with refractive indices readings of:  $a = 1.595-1.610$   $b = 1.605-1.615$   $y = 1.632-1.645$ , with a birefringence of 0.036; 1.60 is the typical spot reading.

The two Greek words *pektos* and *lithos* are the source of pectolite's name. Arem tells us the word *pektos* means congealed. Translucent pectolite can appear jelly-like. The mineral has a vitreous or silky luster, and fibrous material can exhibit chatoyancy. Larimar is the variety of pectolite most frequently used in the jewelry trade. Pectolite's perfect cleavage and a hardness of 4.5 to 5 make it a delicate gem. According to Arem, the only known faceted gems of pectolite were cut from material found at Asbestos, Quebec, Canada. The largest of these weighs about 3 carats.

### **Pyroxmangite (Mn,Fe)SiO<sub>3</sub>**

In the twisted chains of SiO<sub>3</sub> tetrahedra creating the structure of pyroxmangite, a distance of 17.4 angstroms is occupied by seven tetrahedra in each unit of the chain. It forms a series with pyroxferroite, and alteration causes the darker colors of this triclinic mineral. It usually occurs in granular, cleavable massive form. Crystals are tabular. The American Geological Institute's *Glossary of Geology* states that it is a variety of rhodonite containing appreciable amounts of iron. Manganese-bearing metamorphic rock formations are the chief source. Deposits lie in Iva, South Carolina; Boise, Idaho, and Kern County, California in the United States. Excellent crystals associated with rhodonite are found at Broken Hill, New South Wales, Australia. Honshu, Japan produces gem quality crystals, and deposits in Sweden and Scotland yield red-brown material. The pyroxmangite of Finland is brown. Rose, pale pink, and purplish pink are the most sought-after colors.

Pyroxmangite exhibits two directions of perfect cleavage, an uneven fracture, and a vitreous or pearl-like luster. The hardness varies from 5.5 to 6, with a density range of 3.61-3.80. Refractive indices of  $a = 1.726-1.748$   $b = 1.728-1.750$   $y = 1.744-1.76$  yield a birefringence range of 0.016 - 0.020 and the biaxial (+) character. The spectrum is not diagnostic. Weak pleo-

chromism may be detected in red and pink material. It can be differentiated from bustamite and rhodonite, which it resembles, by its birefringence and the optic sign. Bustamite exhibits distinctly lower refractive indices. Faceting gems of pyroxmangite can be extremely difficult. Gemmy crystals are very rare, tiny, and seldom clean enough to cut. The rich color makes them especially lovely and highly desirable. Such gems should be worn with great care.

### **Rhodonite [(Mn,Fe,Mg)SiO<sub>3</sub>]**

The *Manual of Mineralogy* by Cornelis Klein and Cornelius Hurlbut after J. D. Dana shows units measuring 12.5 angstroms consisting of 5 SiO<sub>3</sub> tetrahedra compose rhodonite's twisted chain structure. It is triclinic, with an easily developed plane of perfect prismatic cleavage. Some calcium is always present in its chemical composition. Manganese can represent as much as 42% of its composition, so it is a valuable source of the metal. As the manganese oxidizes, it may form a black crust covering the mass. Fusion takes place at 3 to a red or almost black glass, and it is insoluble in hydrochloric acid. The specific gravity range of 3.57 - 3.776, a hardness of 5.5 to 6.5, and a conchoidal fracture are other physical properties. Translucent and transparent material exhibit a vitreous luster. Cleavage surfaces can appear pearly. Massive material is dull.

According to Arem, the dichroscope reveals weak pleochroism colors of pale yellowish-red/ pinkish red/ yellowish-red. A refractive index spot reading of 1.73 is the norm for massive material. Refractive indices vary for materials from different sources. They fall within the range of  $a = 1.711-1.738$   $b = 1.716-1.741$   $y = 1.723-1.752$ . The birefringence can vary from 0.011 to 0.014. A wide band at 5840, a distinct line at 5030, and a diffuse band at 4550 appears in the spectrum. Lines at 4120 and 4080 may be observed. Upon exposure to SW ultraviolet light, material from Hungary fluoresces a moderate dull red. Langban, Sweden material exhibits a deep dull red under LW light.

Rhodonite and the zinc-bearing variety, fowlerite, occur as compact and granular masses with black veining of magnesium oxides in formations of iron ores in Langban Sweden. Large masses are located in the Ural Mountains near Sverdlovsk and at Broken Hill, New South Wales in Australia. Blocks of quality deep-red material that weigh as much as 50 kilograms each are recovered from deposits in Cummington, Massachusetts. The crystalline marbles at Franklin, New Jersey

yield excellent fowlerite crystals. Other rhodonite deposits in North America are located in Butte, Montana, Colorado, California, Mexico, and Bella Koola, British Columbia. Fine pink and rose colored crystals, as well as the massive material, are found near Sverdlovsk in the Ural Mountains. Daghazeta, Tanzania is an African source. Gemmy crystals occur in Honshu, Japan and Vermland, Sweden. Cabochons and beads are fashioned from massive, translucent, and transparent rhodochrosite. Large carvings and ornaments of fine massive material are very attractive. Rhodonite is considered one of the most difficult minerals to facet, and gems cut from the fine transparent red and pink crystals recovered at Broken Hill are highly prized. They are the most delicate of gems.

### **Wollastonite (CaSiO<sub>3</sub>)**

The difference in chemical compositions distinguishes triclinic wollastonite (CaSiO<sub>3</sub>) and pectolite [Ca<sub>2</sub>NaH(SiO<sub>3</sub>)<sub>3</sub>]. Their atomic structures are quite similar [the twisted chains of each mineral consist of units of 3 tetrahedra measuring a distance of 7.3 angstroms between the twists]. Some iron and manganese and smaller amounts of magnesium may replace calcium in the composition of wollastonite. It forms at geologic temperatures below 1,125 degrees Centigrade in contact metamorphic crystalline limestone formations. [The Golden 1973 edition of Charles L Sorrell's *A Guide to Field Identification of Rocks and Minerals* states "wollastonite crystallizes in the monoclinic system as tabular or short prismatic crystals or as granular masses."]

Volcanic explosions of Mount Vesuvius in Italy expelled large blocks containing cavities lined with crystals. In the western hemisphere, major deposits lie in Alaska, Quebec, and Ontario, Canada, also California, New Mexico, Texas, Mexico, Pennsylvania, Franklin, New Jersey, and New York. Isle Royale in Michigan produces compact material suitable for cutting fine red cabochons. Other sources include Italy, Germany, Rumania, Norway, and Finland. It is not a rare mineral. Its usually fibrous nature was exploited in the industrial manufacture of "rock wool" insulation material and tile. The name honors the English chemist and mineralogist W. H. Wollaston.

Arem tells us that wollastonite so closely resembles other white fibrous minerals that the use of x-ray techniques may be needed to accomplish identification. He lists its forms as "crystals tabular; massive, cleav-

able, fibrous, granular." The deposition of silica occurs with dissolution in hydrochloric acid. A scratch test reveals a white streak. Fusion takes place at 4, with the formation of a white almost vitreous globule. Two planes of perfect cleavages exist. It is brittle with a splintery fracture and exhibits a hardness of 4.5-5.5, with a density range of 2.8 to 3.09. Fibrous material may have a silky appearance. A pearly luster appears on the cleavage surfaces of the transparent to translucent crystals. Colorless, white, gray, yellow, brown, and pale green are the most common colors. The presence of manganese may produce a pale pink or red hue. Refractive indices of  $a = 1.616-1.640$   $b = 1.628-1.650$   $\gamma = 1.631-1.653$  establish a birefringence of 0.015. The spectrum is not diagnostic, but its luminescence may aid in the identification. Material from Alaska, California, and Pennsylvania fluoresces a bluish-green and phosphoresces yellow in SW and LW when exposed to ultraviolet light. Material from Asbestos, Quebec, Canada is inert.



**The photo above shows the 14Kt. gold/sterling silver pendant rendered by Russ Spiering set with a pink tourmaline crystal, a carved quartz that contains black tourmaline crystals, accented by a faceted pink tourmaline and black and white diamonds. It hangs on a handwoven 24 Kt. chain by Kathryn Spiering.**



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