Curves and Optics in Nontraditional Gemstone Cutting

By Arthur Lee Anderson

A series of cuts, designed by the author, exhibit extraordinary optical effects that result from a combination of curved surfaces and plane facets placed to take advantage of internal reflection. Examples are provided that illustrate the cutting techniques for two of these "open-table" cuts.

In recent years, a renaissance of sorts has been taking place in gem cutting. Increasingly, cutters (in particular, custom cutters and gemstone designers) have broken with the conventions of traditional faceted cuts and have incorporated new shapes and techniques in their approaches to stones. The results have been as varied as the cutters themselves.

Many of these newer cuts indicate a trend toward carving and sculpting, rather than flat faceting or cutting en cabochon (see, e.g., Koivula and Kammerling, 1988 a and b). While the results are often beautiful and unusual, at times they appear to sacrifice the use of internal optics in favor of a more unusual external shape. This article illustrates some ways in which the cutter can still use internal optics as the central characteristic of a cut while executing unconventional treatment of a stone wherein curved surfaces are produced freehand on a flat lap.

ABOUT THE AUTHOR

Mr. Anderson is a lapidary and gemologist whose business, Speira Gems (P.O. Box 849, Ashland, Oregon 97520), deals in a variety of gemstone-related activities, from custom cutting and stone design to gem identification and sales.

Acknowledgments: The author wishes to thank Mr. Robert Jaffe of Ashland, Oregon, who provided most of the excellent photographs that accompany this article. Additional thanks go to Ms. Ione Rodenick, who indirectly inspired the "halo" cut, and to Ms. Martha Wilhelm, who likewise inspired much of my work. Goldsmithing for the amethyst-and-opal pendant was provided by Mr. Ron Hansen of Gold & Gems Jewelry, Ashland, Oregon.

Gems & Gemology, Vol. 27, No. 4, pp. 234–239

DESCRIPTION OF SAMPLES

Two gems were selected to illustrate the principles proposed here. The first is a pyramid-shaped 8.98-ct golden beryl, finished in what I call a "halo cut" (figure 1). In this cut, the crown has been virtually eliminated and the table "spread" in order to emphasize the internal optical effects and draw the observer's eye past the surface shape of the gem and into the interior. The name of this cut is based on the circle, or halo, of light that moves around the interior of the stone as it is turned.

The second example is a 12.90-ct hexagon-shaped yellow labradorite with an "iris cut" (figure 2), so named because it exhibits a petal effect similar to that of the flower. As the stone is moved,

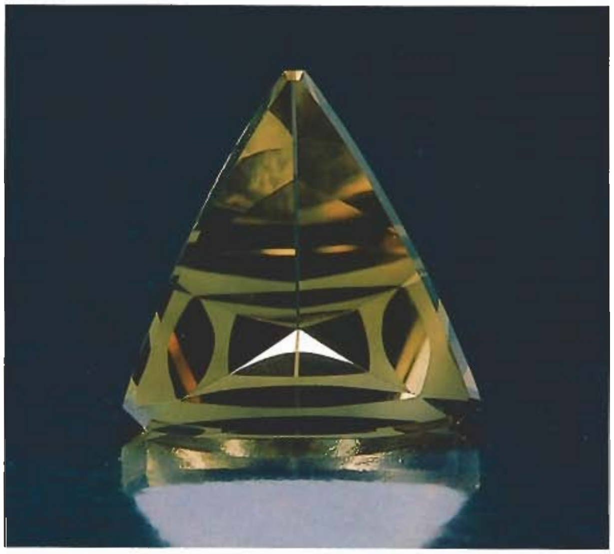

Figure 1. The halo cut of this 8.98-ct golden beryl eliminates the crown and "spreads" the table to draw the observer's eye into the interior of the stone. Photo © Robert Jaffe.

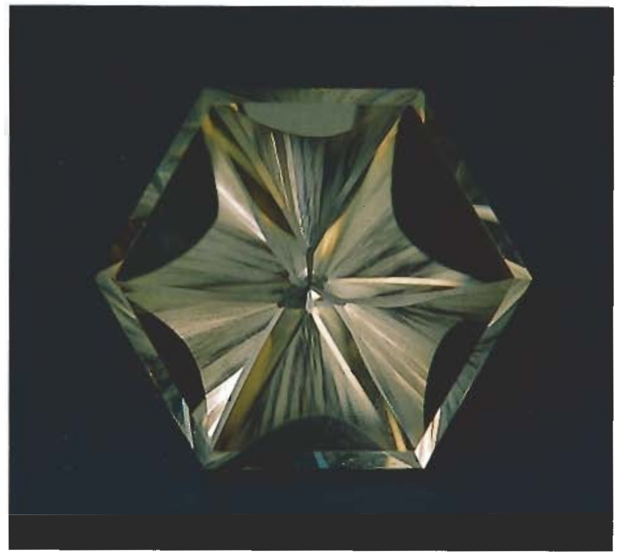

Figure 2. The "petals" of this iris cut appear to approach or recede from the table as the stone, here a 12.90-ct labradorite, is moved. Photo © Robert Jaffe.

the "petals" appear to approach or recede from the table, sometimes seeming as much as a half-inch from the table surface, although the stone is only 10 mm deep. Again, the crown is essentially eliminated, leaving an open table, to place the focus on internal optics.

GENERAL CUTTING CONSIDERATIONS

Rough. These cuts require that rough material be internally flawless, since the open tables expose virtually all of the interior of the finished stone. Moreover, the use of optical reflection to create the internal effects will "multiply" any small inclusion.

A variety of materials have proved to be suitable for these cuts, including quartz, topaz, spinel, and corundum, as well as the beryl and labradorite illustrated. However, the crisp definition provided by singly refractive materials such as spinels seems to be particularly effective (figure 3).

Medium to light colors produce the best results. Larger sizes also seem to be optimum, although I have successfully produced the pyramidal halo cut in stones as small as 6 × 5 mm that were still interesting and effective.

Figure 3. These cuts are particularly effective on singly refractive gem materials such as spinel. This 9.75-ct halo-cut synthetic spinel demonstrates the "holographic" quality whereby the interior design appears to move beyond the periphery of the girdle. Photo © Robert Jaffe.

Figure 4. Although standard equipment is used for these cuts, considerable "play" is needed in the faceting head to allow for small adjustments in facet placement. Here, the author is actually touching the lap with his fingertips to maintain maximum control while cutting a freehand curve. Photo by Martha Wilhelm.

Equipment. No special equipment is necessary to fashion the convex curved facets on which these cuts depend. Although there are now special machines on the market that are designed to execute curved surfaces (Homer, 1990), all of the work illustrated here was executed on an old, early-model, flat-lap unit with a generic faceting head. However, there is excessive "play" in the faceting head, which permits small adjustments to be made in facet placement with the exertion of slight finger pressure (figure 4). My equipment also includes a heavy steel base for stability, with a 0 to 3000 rpm motor and rheostat, and a variety of laps (metal bonded, glass, copper rechargeables) and grits (100 to 3000). Polishing is performed with Lucite laps and cerium oxide, tin-lead, and Linde A, or a Crystolite "Last Lap" for 50,000-grit diamond.

Preforming. For the cuts described in this article, no special consideration need be taken in preforming except to leave a slight bulge wherever you plan to produce a curved surface later. The amount of bulge left is comparable to that allowed in cutting the pavilion of a step cut, where the finished facets bow out (Sinkankas, 1962).

Dopping. Typical cold dopping is recommended for all materials except corundum. Cyano-acrylic glue is used to hold the stone in the wax mold; the stone can be removed after cutting by soaking in acetone (except where oiling is suspected) or by gently scraping the glue with a razor blade. (For more on cold dopping, see Wycoff, 1985.)

HALO CUT

Anyone who has successfully rounded a girdle freehand has the skill necessary to cut a curved facet. Generally, the table is cut first, beginning with a 45° adapter and a 260-grit lap, followed by 600- and 1200-grit laps. The table is finished with whatever lap and polishing compounds are suitable to achieve an optimally reflective finish on the gem material being cut.

After the table has been cut and polished, the girdle is cut. Indexing will depend on what type of gear is used, but it should be set slightly off from an equilateral triangle to achieve the pyramid shape shown here.

Then, while the stone is still dopped from the pavilion, a set of small girdle step facets (generally 0.5 to 1 mm or more, depending on the final dimensions of the stone) are cut on the crown. For larger stones, sometimes two sets are cut. The purpose of these facets is mainly to provide a surface for a bezel or prongs to grip when the stone is set in jewelry.

At this point, I generally crop the corners of the triangle to protect against chipping during setting, but they may be left sharp. Both the crown girdle facets and the corner facets are usually cut straight with a 1200-grit lap. Then, once the crown is completed, the stone is transferred to a dop centered on the triangular table.

Two broad mirror facets are cut on the pavilion, at an angle of 50° to the girdle plane (figure 5). These two surfaces will determine the sharpness of the reflected design, so they must be cut and polished as cleanly as possible. The 50° angle is sufficiently larger than the critical angle of most gem materials that the internal design does not wash

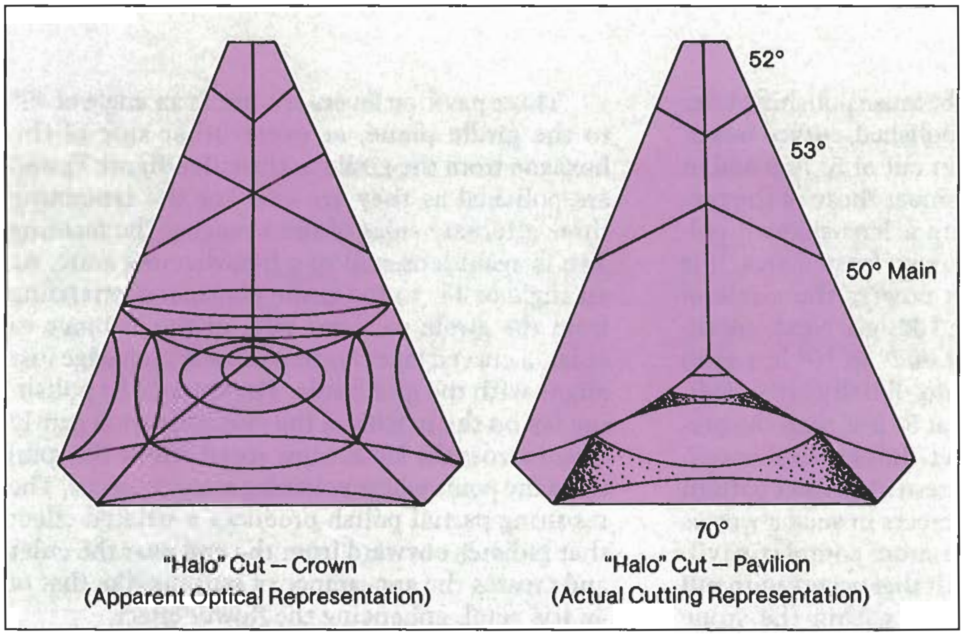

Figure 5. The appearance of a halo-cut gemstone as seen through its crown (left) is quite different from what might be expected from the pattern of faceting on its pavilion (right)—a result of placing the pavilion facets to take advantage of internal reflection.

out as the angle of observation changes. Two additional sets of facets are then cut, at 53° and 52°, toward the apex of the pyramid (again, see figure 5). These facets only provide aesthetic activity towards the top of the stone and are not integral to the optical phenomenon of the design, as are the 50° main facets. The deep pavilion that results from these steep pavilion angles does require some creativity in designing settings. On the other hand, these cuts are particularly striking in closed-back mountings (figure 6).

It takes some practice to form the combination of alternating flat and curved facets that results in the desired design and optical pattern. Beginning at the base index spot and working from the girdle toward the culet, a flat facet is first cut and polished at approximately 70° to the girdle plane (again, see figure 5). At approximately 5° less, the next facet is cut as an arc. This is done by locking the faceting arm in a freewheeling position so that it rotates freely. Using a worn 600- or a new 1200-grit lap, gently sweep the stone across the lap in tight, economical movements, constantly checking the evolution of the curve until a graceful arc is achieved. The arc is left unpolished to provide sharp definition and contrast with the adjacent flat facets. The frosted surface also acts as a "light sponge" that cuts down internal brilliance and optimizes the desired optical activity.

The next facet, like the first, is flat and is cut at an angle of 3°-5° less than that of the previous surface. Again, it is polished; all flat facets should

Figure 6. The optical effects of these cuts are particularly good when stones are placed in a closed-back setting, as can be seen in the 13.50-ct halo-cut amethyst in this 14k gold pendant, also set with opal. Photo © Robert Jaffe.

be polished as they are cut, because polishing later might alter the adjacent, unpolished, curved facets. Next, a curved facet is again cut at 5° less and in such a way that its corners meet those of the previous curved facet, forming a lens-shaped, polished flat facet between the two frosted arcs. It is this lens-shaped facet that creates the circle of light, or halo, in the finished design. Next, another flat, polished facet is cut at 7° to 10° less than the previous, unpolished arc. Finally, two additional polished arcs are cut at 5° less than the previous cut to form the culet. Internal reflection transfers the image of the alternating facet pattern to the two large, flat, main facets in such a way as to form the appearance of a more complex pavilion faceting. Unlike the result that occurs with full faceting, however, the image within the stone moves around the pavilion as the viewing angle changes.

IRIS CUT

This hexagonal cut is somewhat easier to execute than the halo cut, although it employs similar principles of curves and reflection. It uses the same basic indexing as for other hexagonal cuts. The table is again left "open" and is cut and polished first, followed by the hexagonal girdle and minor crown girdle facets. The stone is then re-dopped to cut the pavilion sequence.

Three pavilion facets are cut, at an angle of 45° to the girdle plane, at every other side of the hexagon from the girdle to the culet (figure 7), and are polished as they are cut. For the remaining three alternate sides of the hexagon, the faceting arm is again loosened to a freewheeling state. At an angle of 44° to the girdle plane, and extending from the girdle to about 90% of the distance to culet, a curved facet is cut so that its top edge just aligns with the girdle side. Then, with the polishing lap on the machine, the curved facet is gently rolled across the lap at a low speed (about 100 rpm) up to the point where polishing starts to occur. The resulting partial polish produces a striated effect that radiates outward from the end near the culet and creates the appearance of striping like that of an iris petal, enhancing the flower effect.

This cutting sequence establishes a striated, curved surface opposite each flat, planar pavilion facet. Reflection of the curved surfaces by the plane surfaces causes the reflected image, as viewed from the crown, to appear to recede from the viewer. This receding effect is juxtaposed on the positive, nonreflecting, striated surface, the contrast adding to the apparent depth in the stone.

CONCLUSION

No specific mathematical approach was adopted to determine the angles used in the cuts described

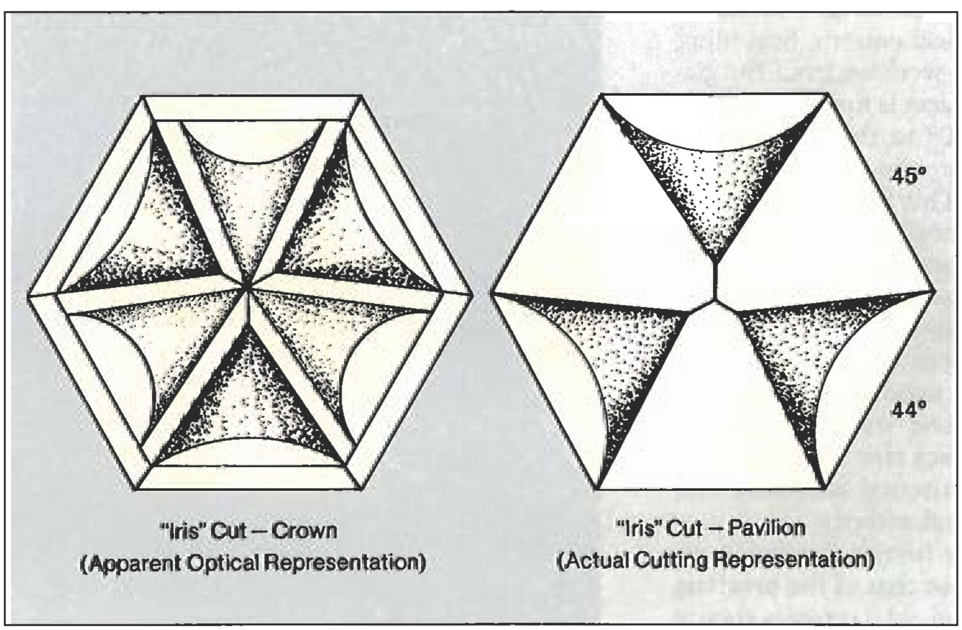

Figure 7. The crown view of an iris-cut stone (left) results from internal reflection of the pavilion facets (right), three of which are left partially polished to achieve the striation that contributes the iris-petal appearance.

above. The final designs are accomplished generally by making adjustments as the stone evolves. By cutting and polishing the table first, "en route" checking can be done, enabling the cutter to make minor angle adjustments by eye, as needed. Another example of some of the possibilities of "en route" designing is exhibited by the 17.5-ct "leaf-cut" citrine shown in figure 8. The natural skin of the rough citrine crystal was retained in the design of the stone, and is accentuated by select reflective planes on the pavilion. Although optical reflection is not intrinsic to this design, this open-table cut demonstrates again the concept of drawing the observer's attention past the surface and into the stone.

In this type of cutting, flexibility is central to creation and design. Experience and practice are also critical. In addition, it is important to record every step in the process to ensure that you can reproduce or make corrections to the design later.

As with all lapidary work, the hand and the eye are the paramount tools, but recent developments have also revealed the importance of the cutter's imagination. Experimentation will lead to the creation of even more variety and, as the "kinks" are worked out, the future should see a diversity of cutting styles and techniques that incorporate a balance of form and optics that both pique the interest and satisfy the aesthetics of the beholder.

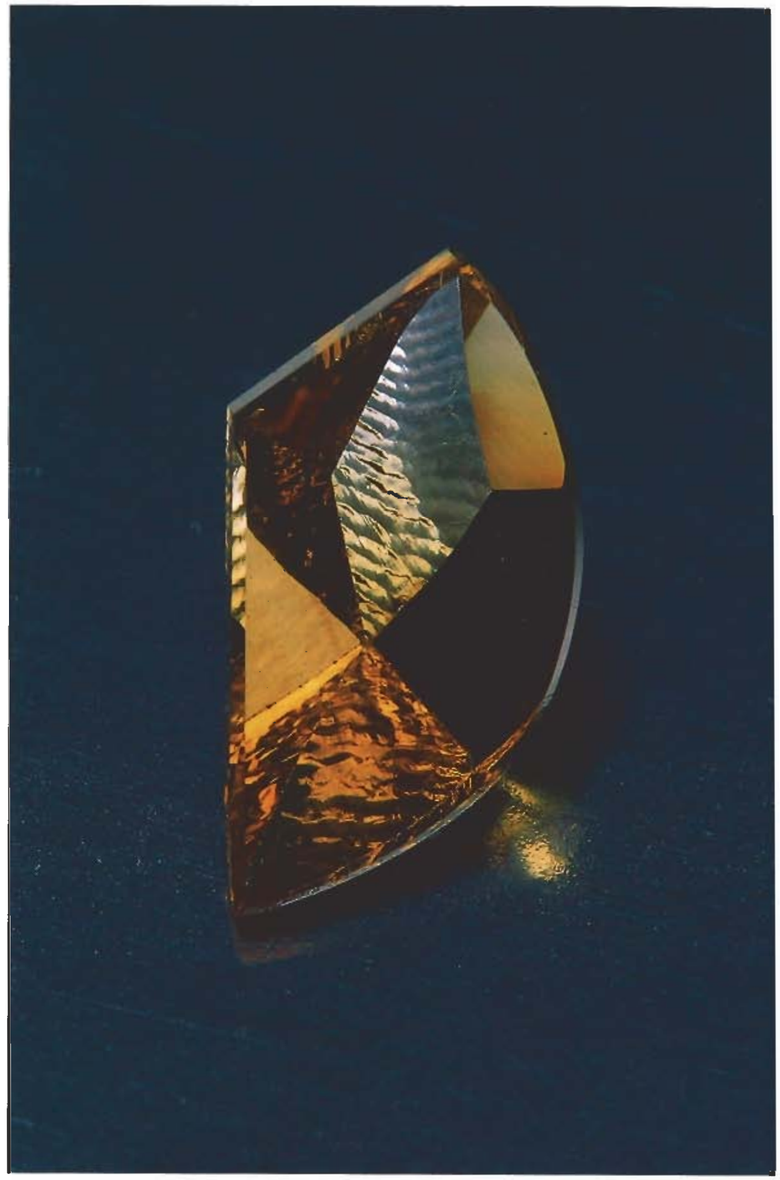

Figure 8. This 17.5-ct "leaf-cut" citrine demonstrates another example of how to optimize the interior of a stone by means of the open-table concept. Photo © Robert Jaffe.

REFERENCES

Homer R.P. (1990) The OMF Facetor. *Lapidary Journal*, Vol. 44, No. 3, pp. 26-41.

Koivula J.I., Kammerling R.C. (1988a) Gem news. *Gems & Gemology*, Vol. 24, No. 1, p. 56.

Koivula J.I., Kammerling R.C. (1988b) Gem news. *Gems & Gemology*, Vol. 24, No. 3, p. 181.

Sinkankas J. (1962) *A Lapidary's Manual*. Van Nostrand Reinhold, New York.

Wycoff G.L. (1985) *The Techniques of Master Faceting*. Adamas Publishers, Washington, DC.