



Figure 1: "Waytwace" function in GEMCAD.

Diagram in Figure 1 is based on the "Waytwace" command function in the Gem Cad program. This function traces single light rays from cursor position into the stone, and back out of the stone. But it can be repeated as many times as desired. For example, in Figure 1 three separate raytraces are shown in Design 16.009 Asterisk Illusion. In the crown plan view (left side) the numbers 1,2,3 label the three rays and in the side view (right side) these same rays are labeled Ray 1 start/end, Ray 2 start/end, and Ray 3 start/end. On a color monitor screen (we have used EGA and VGA) the input , transit, and output phases are shown in contrasting colors and are much easier to distinguish than in the black and white of Figure 1, but the continuous ray trace path is the identical. "Waytwace" shows the path, but not the intensity of the each ray. It can be used to determine whether a particular light ray exits thru the crown or the pavilion and is a convenient tool for identifying reasons for some visual effects of facet designs. For example in Figure 1 (in Design 16.009) - -All three rays enter the crown, but after a triple bounce Ray 1 exits back thru the crown whereas both Ray 2 and 3 exit thru the pavilion. Rays that exit thru the pavilion create dark areas because they cannot contribute to brightness unless they bounce off of something outside the stone on the pavilion side. (some displayers put their stones on mirrors or in light colored styrofoam boxes to counteract this tendency to leak light thru the pavilion, however this trick is not available when a stone is mounted in jewelry so we do not take it into account when we evaluate a design). BRIGHTNESS PATTERNS such as the one for Design 16.009 on page 3 of this SFD issue, are computed with the L & S Raytrace programs which record the intensity (or attenuation) of the rays that return thru the crown and as well as the path of individual rays. Although the ray paths are shown on the computer screen when the program is run, we seldom show these in Seattle Facetor Design. On the computer screen intensity levels are shown in different colors (and length), but our printer (and publication printing system) is not capable of color so intensity levels are shown as various shades of gray formed by dots set off by white space and the size limitation restricts the number of gray scale values we can show (at small scale the dots get closer together and tend to increase contrast). Except for the absence of color the black and white Brightness Pattern is an approximation to the appearance the actual stone has. In the case of Design 16.009 the dark "asterisk" is clearly visible under most lighting conditions as it is in the diagram on page 3. The rays in Figure 1 were chosen to explain the shadow pattern using the "Waytwace" function of GemCad. Ray 1 returns thru the crown so it is perceived as a relatively light area (high intensity). Ray 2 impacts one of the mains and is reflected to an opposite side pavilion

facet, where most of it exits thru the pavilion thus forming a continuation of the arm of the "asterisk". Ray 3 is a ray that directly exits thru a low angle edge facet and is part of the primary dark area of the "asterisk".

We are in the process of converting our database of facet designs into an equivalent set using GemCad. Up to now to make our drawings we have used the L&S calculation programs which calculates each facet separately. We still need the L&S format to calculate the Brightness Patterns and make the final drawings we use for publication, but GemCad has some very nice features to utilize for the data base. Not the least of which is that it seems to be on its way to be a "standard" so that more people will be positioned to create and use the results. GemCad calculates designs more quickly by taking advantage of symmetry properties tiers of facets (related by symmetry) and having the computer do the calculation for updating four standard views simultaneously as well as keeping the graphics plotting sequence current. Because of size limitations of the computer monitor (screen) there is a slight loss of precision compared to the six digit precision we had been using, but it is well within the precision faceting machines that we know about. Another very good feature (of GemCad) is built in ability to do Tangent Ratio translation of crown and pavilion separately while they are still combined as a complete design. This makes it possible to do "what if" experiments on the computer quickly and easily. In our previous software we had to separate the crown and pavilion, make the Tangent Ratio conversion, then put them back together before we would run a Brightness or Reflection pattern. We still have to make the final conversion to L&S format before running the Brightness program, but the "EXPORT" feature in GemCad makes this a simple procedure. Fortunately the "IMPORT" feature of GemCad permits us to work the other way changing a previously stored L&S format design into GemCad format. (that allows us to salvage much of the work that has already been done). There is one other GemCad feature we have not used as much, but which is useful as a teaching tool. That is the "Playback Single Step" which gives a sort of time-lapse version of cutting a stone on screen. This is similar to the sequential drawings we used in our book "Introduction to Meetpoint Faceting". By showing the student how the design appearance on screen changes as new facets are cut, it can simplify his (or her) education. The American Society of Gemcutters has endorsed use of GemCad for their members (American Gemcutter, September 1990), so we may be entering a new era where more facetors will be getting into computer verification of their designs before they waste too much valuable rough material. Hopefully, when that time comes we will be ready with our database up to date with both GemCad and our L&S format data as well. However, even as beneficial as GemCad is to speeding up the process it will be some time yet before we have all known designs verified.

*GemCad is a Computer Aided Design Program for Faceted Gemstones by Robert W Strickland. It runs on IBM equipment CGA, EGA, or VGA and is 100% compatible with the Long and Steele design programs by means of a built in IMPORT/EXPORT feature that is capable of converting a GemCad format to an equivalent L&S format. Anyone interested in obtaining a copy of the GemCad program should contact the author directly:*

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