For both mirror-image and radial symmetry, there is a measure of how many directions of symmetry exist. This is where the 8-fold and 6-fold come in. The "fold" value measures the number of symmetry lines around the gem for mirror symmetry, or the number of steps to a full rotation for radial symmetry. For example, a sixteen-sided standard round brilliant design would look the same if you placed the mirror across any of the eight pairs of equally spaced opposite vertices. You can try it yourself with Figure 10-16 on page 17. The SRB thus has "8-fold, mirror image symmetry."

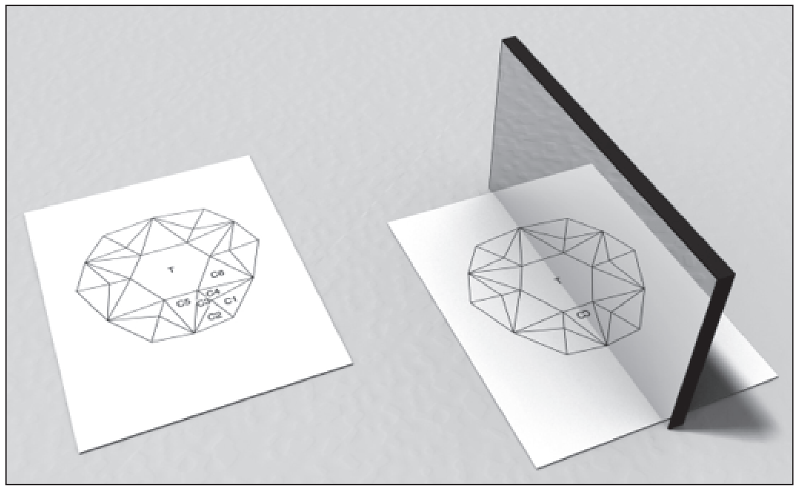

Figure 10-35 Mirror-image symmetry. This is the crown of the Briar Rose design (see Chapter 18).

A couple of notes for the sharp-eyed reader. First, the SRB has 8-fold symmetry, not 16-fold symmetry. This is because each placement of the mirror corresponds to a line connecting a *pair* of vertices, and there are only eight such pairs. Effectively, placing the mirror between vertex 1 and vertex 9, say, is the same as placing the mirror between vertex 9 and vertex 1. It is also equivalent to flipping the mirror around 180°.

I know. You're confused (heck – I'm confused). Here's another way to think about it. Imagine the mirror placed up-down, dividing the SRB design into left and right halves. Whether the shiny side of the mirror faces left (vertex 1 – vertex 9) or faces right (vertex 9 – vertex 1), the test answers the same question: does the left side look exactly like the right side flipped over? This measurement produces one symmetry axis, not two.

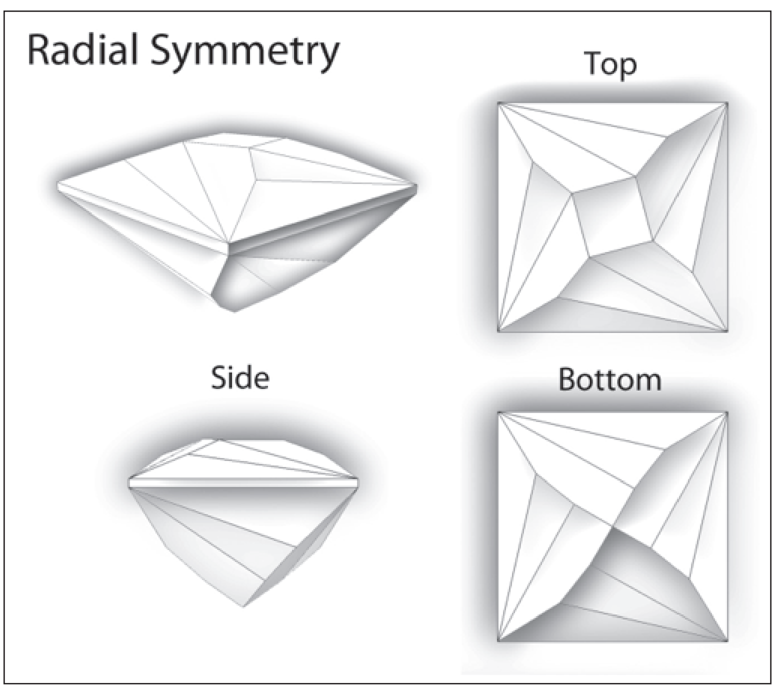

Figure 10-36 A gemstone has radial symmetry if rotating it by a fraction of a turn leaves the design unchanged.

The second note is more semantic than conceptual. The standard round brilliant actually has radial symmetry as well. Rotating the gem by an eighth of a revolution leaves you with an identical gem. Why is it assigned mirror-image symmetry? The unsatisfying answer is that it just is. At some level, you can consider the symmetries as a hierarchy, with mirror-image above radial. A gemstone exhibiting both types is labeled with the highest order of symmetry, in other words, mirror-image. Incidentally, not all gemstones with mirror-image symmetry have radial symmetry. The heart cut is a straightforward example.

Purists could argue that a heart, does, in fact, have one-fold radial symmetry. If you split a full rotation into N equal steps for N-fold radial symmetry, then one-fold corresponds to a complete rotation of 360°, bringing you back exactly to where you started. Of course, by this definition, every gemstone (and indeed every object in the Universe) has one-fold radial symmetry.

What's My Symmetry?

Here's a fun exercise. Reproduced below are the top views of several gem designs from Chapter 19. Try to figure out each type of symmetry. You can find the answers in the cutting diagrams starting on page 334.

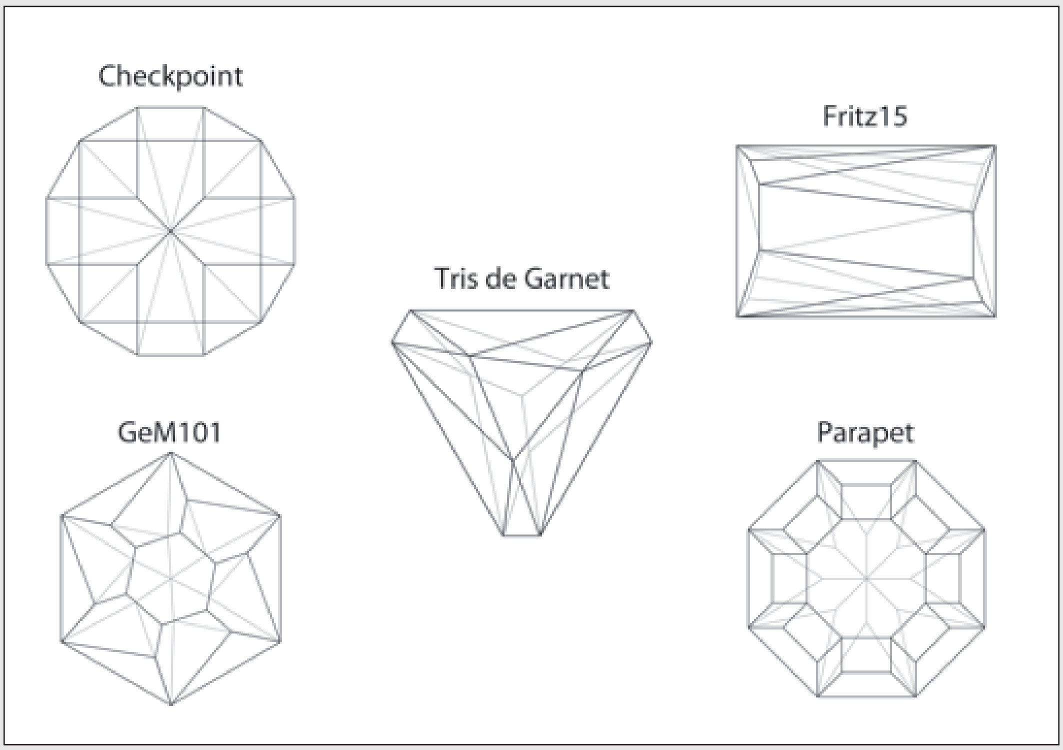

Figure 10-37 Try to determine the type of symmetry for each gem. These are top views, with the crown outlined in black and the pavilion in gray. Refer to Chapter 19 for the correct answers.

All this talk of symmetry has some serious real-world consequences. The reason is that the symmetry of your gem design may be different from the symmetry of your index wheel.

For example, a gemstone design with five-fold radial symmetry will have facet tiers distributed every 72° around the gem, since 360 / 5 = 72. More than likely, your faceting machine has a 96-tooth index wheel, and thus you can measure angles in units of 360 / 96 = 3.75°. How do you make steps of 72° out of units of 3.75°? Do the math. You cannot. You would need 19.2 gear teeth on your machine to produce a rotation of 72°.

Oops.