CHAPTER 17

Odd Radius Parry Arcs

No odd radius Parry arcs have ever been reported. But from studying halo displays like the one in Figures 6.7 and 6.8 we know that prismatic crystals can sometimes take on Parry orientations as they fall. If those same crystals had small pyramidal faces in addition to their prism and basal faces, wouldn't they still take on Parry orientations? If so, then odd radius Parry arcs should be possible, and eventually someone will see one. We touch on odd radius Parry arcs here mainly as an inducement to watch for them. But seeing one is much more of a long shot than seeing a good display of odd radius column arcs. People with the best chances of seeing an odd radius Parry arc are those lucky few who are able to spend extended periods in the Antarctic interior, where ordinary Parry arcs are common. But even for those folks it will take extraordinary perseverance, or luck.

The simulation in Figure 17.1 shows odd radius Parry arcs for a sun elevation of 20°. The crystal orientations were barely allowed to deviate from ideal Parry orientations, so the simulation shows more than one could normally hope for. Probably the arcs most likely ever to be seen are the four strong arcs closest to the sun at the left and right. They are the 9° Parry arcs with ray paths 8 25, 28 5, 4 27, and 24 7. Their locations in the sky are consistent with their poles (Figure 17.2). That is, since Parry arcs are non-contact arcs, the direction of each arc from the sun is about the same as the direction of its pole from $\mathbf{D}_u$.

According to the pole diagram, there are two more 9° Parry arcs, namely the upper and lower symmetric arcs 3 26 and 23 6. But the lower symmetric arc has its pole far too close to $\mathbf{D}_u$ to be visible at the relatively low sun of this simulation. And although the upper symmetric arc is visible in the simulation—it is the suncave arc above and nearest the sun—its pole is also fairly close to $\mathbf{D}_u$, so that

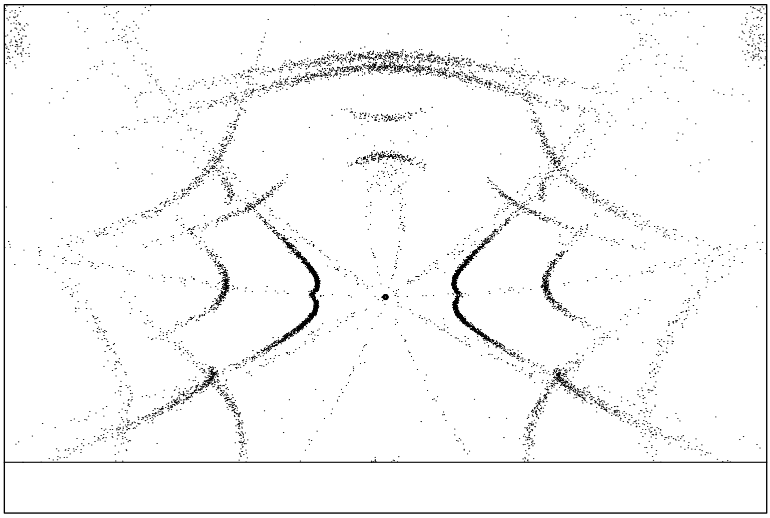

FIGURE 17.1 Odd radius Parry arcs. The simulation was made using Parry-oriented pyramidal crystals shaped like the one in Figure 17.2. $\Sigma = 20°$.

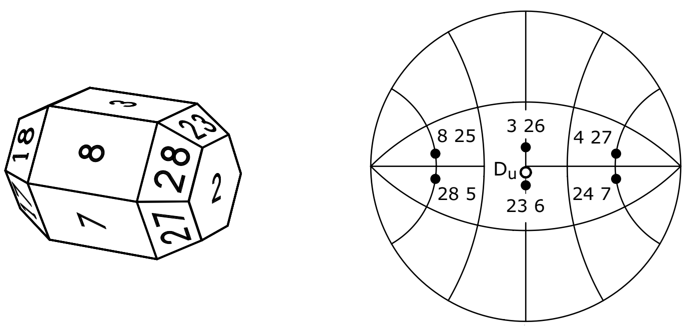

FIGURE 17.2 (*Left*) Parry-oriented pyramidal crystal. Faces 3 and 6 are horizontal. (*Right*) Poles of the six 9° Parry arcs.

at this sun elevation the arc is substantially more than 9° from the sun and would be weak and diffuse, were not the tilts of the crystals so small.

Many odd radius Parry arcs are theoretically possible. The pole diagram of Figure 17.2 shows the possibilities only for $\Delta_{\min} = 9°$. There is an analogous pole diagram for each of $\Delta_{\min} = 9°, 18°, 20°, \ldots$

Sometimes I (Tape) think that contemplating odd radius Parry arcs is pure fantasy, and that nobody will ever see one. Then I am reminded of a halo simulation that

I made after my first season at the South Pole. It was a simulation of halos from Parry-oriented prismatic crystals. (It had nothing to do with odd radius halos.) That first season I had seen some pretty good 22° Parry arcs, so—mostly for amusement—I turned the crystal tilts in the simulation way down and I turned the numbers of crystals way up. The resulting simulation was exquisite, but it seemed farfetched; I had never seen anything like it. Yet it was not many weeks into the second season at Pole that a display appeared that was nearly the equal of the simulation. (It was not quite as good as the display in Figures 6.7 and 6.8.) So the point is that it is sometimes hard to predict what is possible. We have spent a lot of time watching for odd radius Parry arcs, and we have seen nothing. But maybe one of you will do better.