Moreover, in such a reasonable world, objects are separable. That is, they affect each other only by physical forces, which cannot travel faster than the speed of light (not by "spooky actions" traveling infinitely fast). The Newtonian world described by classical physics is, in this sense, a reasonable one. The world described by quantum physics is *not*. Bell's theorem allows a test to see whether perhaps it's just quantum theory's *description* of our world that's unreasonable, and that our actual world is in fact a reasonable one.

We won't go for suspense. When the experiments were done, Bell's inequality was violated. Assumptions of reality and separability yielded a *wrong* prediction in our actual world. Bell's straw man was knocked down, as Bell expected it would be. Our world therefore does *not* have both reality and separability. It's in this sense, an "unreasonable" world.

We immediately admit not understanding what the world lacking "reality" might mean. Even what "reality" itself might mean. In fact, whether or not reality is indeed required as a premise in Bell's theorem is in dispute. However, we need not deal with that right now. For *our* derivation of a Bell inequality, we assume a straightforward real world. Later, when we discuss the consequences of the violation of Bell's inequality in our actual world, we'll define a "reality" implicitly accepted by most physicists. It will leave us with a strangely connected world.

Derivation of a Bell Inequality

We offer a derivation of a Bell inequality with objects something *like* twin-state photons. We will call our objects "fotons." Each of our twin-state fotons has a physically real polarization angle, just called its "polarization." Moreover, the twin fotons can be separated so that what happens to one cannot instantaneously affect the other. Our fotons are clearly *not* the photons of quantum theory, which *denies* such reality and separability.

Do the photons that make Geiger counters click in our actual world have the quantum-theory-denied reality and separability of our fotons? That's something experiments with actual photons must decide.

To be concrete, we present a specific mechanical picture. However, the logic we use *in no way depends on any aspect of this mechanical model* except the reality of each foton's polarization and its separability from its twin.

Bell's mathematical treatment was completely general. It did not even specify photons.

If you only skim our pictorial derivation of a Bell inequality and just accept the result, you will not be *much* hampered in understanding the rest of the book. For a fast, first reading, you might even skim all the way down to "An intentionally ridiculous story" and Figure 13.6.

An Explicit Model

In figures 13.2, 3, 4, and 5, we present a specific mechanical picture. To display each foton's assumed polarization as graphically real, we show a foton as a stick, and the angle of the stick is its polarization. Picturing fotons as sticks necessarily displays properties beyond their polarization. These properties, a stick's length or width, for example, are irrelevant to our derivation. Only the foton's physically real polarization is relevant. This is our reality assumption. Its polarization determines which path a foton takes upon encountering a "polarizer."

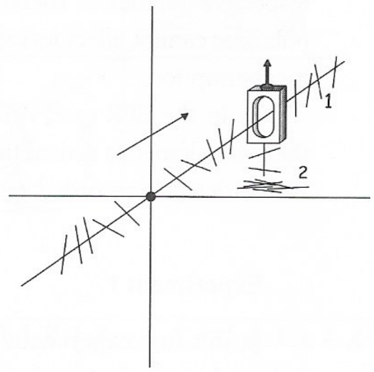

Figure 13.2 Model of stick photons and oval polarizer

A "polarizer" in this mechanical model is a plate with an oval opening whose long dimension is the "polarizer axis." A foton whose polarization is close to the polarizer axis will pass through the polarizer to go on Path 1. One whose polarization is not close will hit the polarizer to go on Path 2.

This mechanical model could in principle, but need not, account properly for all the behavior of actual polarized light. Our logic depends on nothing about these fotons except their reality and separability.

We will describe four Alice-and-Bob thought experiments. They are much like the EPR experiment described in chapter 12. (In fact, Bell's theorem experiments are sometimes loosely referred to as EPR experiments.) But there's a big difference: In the EPR case, Einstein's "hidden variables" and Bohr's "influences" led to the *same* predicted experimental outcome. The disagreement between Bohr and Einstein was only a difference of *interpretation*. In our model, and in the actual Bell's theorem experiments,