ON LOCATION

It may be that we have to admit that causal influences *do* go faster than light. … An 'aether' would be the cheapest solution. But the unobservability of this aether would be disturbing.

John Bell (1981)

It would appear that, on a sufficiently small scale, points cannot be identified either by their metric relationship to neighboring points or by local physical characteristics.

Peter Bergmann (1992)

[There] seems to be a 'conspiracy' between relativity and quantum theory, whereby uncertainty noise prevents one from using subquantum nonlocality for practical signalling. Why should the nonlocality be *hidden* in this way? A physics whose coherence rests on such a peculiar conspiracy can hardly be regarded as fundamental.

Antony Valentini (1996)

And then there is Bell. For forty years the battle over QM rages, with Einstein and Bohr as principal protagonists. Which side one picks is purely personal; there is no way to disprove either side, or so it seems. But then, in 1964, John Bell, who works at CERN, shows that there *is* a way.

The issue's this: Einstein says reality exists everywhere and always, measure it or not. Bohr (and it seems QM supports him) says not so; it's measurement that makes reality—at, and only for, the instant it is made. Bell's Theorem, as it soon is known, sets out an experiment to show which view is true.

At this point my fictional detective would be on high alert. He'd think this no ordinary place. He'd think this the universe's crack house, the place where its action is. And what does good old Frank think? He's on power-save. Can I get him to tune in? Sometimes my mind works better when I tune him out.

Bell's work has roots that reach back all the way to Newton. *His* biggest worry is how Earth's mass is known to the Moon. Instant action at a distance is unnerving for philosophers and physicists alike. Bell thinks of a way it could be found.

He's offended by the way that the establishment treats Bohm. Though it's not related to his work, he takes an interest in Bohm's approach. He thinks it might match QM's success with no need for a boundary between the quantum system and the classical observer. He goes on to prove that, if some probabilities

predicted by QM are accurate, Einstein is wrong. Experiments soon show that they are accurate. It means that Bohr, not Einstein, has it right.

This ends the old argument. But the implications turn out to be more profound. They reveal a stunning aspect of the nature of reality.

The experiment Bell thinks about is simple in concept. Take two particles. Photons or electrons are the particles of choice. Mash them up so that they share a quantum property. Send them off in opposite directions. Measure the property of one, forcing it to take a value. No matter how far off, the other *instantly* conforms. Bell's experiment reveals this long-range link. 'Measurements Are the Only Reality, Say Quantum Tests' says the headline in the leading science journal *Science*. Check it out, I want to tell him, but I don't.

Momentarily I wonder at the words. She says them almost every time we meet. Checking takes up half my working day. Did I pick it up from her; did she from me? I used it long before she came along but these days it hovers in my head, a mantra of a kind. The further I pursue the quest the more I need to check reality. If, that is, reality's what Google gives the world.

In physics' world it takes some time to penetrate. The message is both clear and shocking: What is done in one place can instantly affect what happens far away. There is *no way* for this to actually happen. But that it does says that *the universe must be non-local.* It's a message that seems made for Frank. What can it mean?