

THE OBSERVER PROBLEM

Experiments ... require one to conclude that God plays dice.

Filmer Northrup (1958)

Nobody knows how it can be like that.

Richard Feynman (1965)

Standardly, we are cautioned not to inquire further. Physics stops here.

Arthur Fine (1996)

Quantum theory has always invited rather extreme speculations about the nature of physical reality.

Martin Daumer (2006)

Classical systems are paradoxically necessary to describe the quantum systems of which they are made.

Louisa Gilder (2008)

I could go crazy thinking of this stuff. I mean, it's interesting but at times I worry. Sitting here all day I lose track of my reality, whatever that may be. It's kind of lonely. If she shows at all she breezes in, hullo, and breezes out again. He isn't much more company. He hangs around some days, looking to me for I'm not sure what. The pretense that I'm briefing him is in decline. Each in their way, they're tending to become more distant. Some days my nearest thing to real people contact is back-chatter with the bums who beg spare change.

Today we're back to QM. It starts out so simple. Like Democritus and atoms, it's the notion that stuff comes in tiny pieces. Call them quanta. There are books about them. Dozens, maybe hundreds, and they're full of math. I can't digest them. I'm a junior catfish sucking quantum plankton off the QM-gravel bottom. I regurgitate some of it half-digested for him. All he needs to know is: QM predicts average results of an experiment that's performed many times. Like flip a coin a million times and it will fall half heads, half tails.

There's a difference between coin tossing and QM. The tosser has the coin. He holds it. He sees how it works. QM just says the flipping numbers make their drunken way to half and half. Actually, it is worse: QM says that there *is* nothing more than numbers. It's as though you get coin-toss results but there's no coin. You're told, in fact, that there's no point in even speaking of a coin. QM's universe is made of little pieces. Each is made of numbers kept by an observer of experiments and *nothing else*. It's this, the 'nothing else', that upsets Einstein.

There's no room for causality, so he says QM's incomplete. For this, he's tarred and feathered and then ridden out of town.

The argument runs deep. It involves two different views about the nature of reality. I don't tell Frank—I wouldn't want to disappoint him—it's an argument that Einstein will eventually lose. He tells me only that this QM thing is hard to take. What he doesn't tell me is clear to me too. He thinks QM is BS. This has me worried. There is no future in a bet against QM. QM is *always* right. Well, there was that ghastly business of the vacuum. But that's the only failure I can find.

In coin tossing there's the coin and there's the tosser who must tally heads and tails. Along these lines QM splits the universe in two. There's the quantum part that's under study and there's all the rest. For example Bell says that QM 'necessarily divides the world into two parts, a part which is observed and a part which does the observing.' Fine elaborates: 'On Bohr's view we are required to divide each experimental situation into an observer part ... to which we do not apply the quantum formalism, and a quantum part, to which we do.' It seems kooky and for many years it furrows many brows. My reading tells me that this paradigm begins with Bohr. Philosophers and physicists strive to break out of it for more than eighty years. They fail.

I have my take on this. I wonder: If Lemaître's right, if it starts with a quantum, who is the observer? This is where the boss steps in. Theology is out of bounds, she said some time ago. Which leads to a conclusion and I write it down: A quantum theory that applies to the Beginning cannot be QM. I tape it to the wall next to my desk.

My fictional detective wouldn't get hung up on theory. And he wouldn't heed my boss. He'd be listening to Bell, who asks, 'When the "system" in question is the whole world where is the measurer to be found?' If he gets to the Beginning and if quantum theory has anything to say about it—only one of which seems likely—where's the measurer to sit? For Bell it's theoretical. For a detective it is practical. But my detective would be fictional. So he could think about this kind of question in a different way. Could *he*, god-like, sit outside? It's tantalizing but I don't see how.

Thus the Problem is confusion that arises trying to apply QM to the whole universe. Another name for this confusion is 'quantum cosmology'. As Smolin says succinctly, 'Quantum cosmology is a controversial subject.' He explains:

There are approaches to quantum cosmology that take the mathematical structure of the theory to be the same as that of ordinary quantum mechanics. ... All other approaches propose that the formal structure of quantum theory must be modified for the theory to be sensibly applied to cosmology.

It is not for me to say, but off the record I'd bet my buck on 'other approach-

es'. I can see that some of this could trouble Frank if he would take the trouble. The attraction of QM is it's so useful. But from his perspective, it looks useless. How can he modify it? Well, of course, he can't.

It seems to me the clue behind this Problem—if he were to ask me, which I don't suppose he will—lies in its insistence on a viewpoint. If he could get to the Beginning what would be *his* viewpoint? Where exactly can he stand?