TIME ONE

Which came first, the bird or the egg?

Lucius Plutarchus (ca. 100)

The whole matter of the world must have been present at the beginning, but the story it has to tell may be written step by step.

Georges Lemaître (1931)

A major extension of physics will be necessary to delve into the first 10^{-43} second and follow the history of the universe in those first quantum moments when it was entirely shrouded in mystery.

John Barrow (1983)

Give me some time, some space, and I'll give you your story.

Wesley Strick (1998)

When we look on a small enough scale, we see that space is made of things that we can count.

Lee Smolin (2001)

By God playing dice, Einstein meant that the deepest laws of nature have an unavoidable element of randomness that can never be overcome, even if every detail that can be known, is known.

Leonard Susskind (2008)

So here I am, we are, sitting alone together in the office. His Beginning, if I understand him, is no thing, it is a happening. A state of oneness turns into a state of twoness.

"Now they grow," he said abruptly. "Space and time together."

That was a half hour ago. He sounded exhausted. As am I.

From the sidelines I see that he has no problem going with the Rules when all he knows or thinks he knows is they must be some kind of quantum theory. A real detective would have trouble. But for him I think it's simple: He can't see another way. Like when Meyer (he's MacDonald's Watson figure) says, 'Fit the facts together in any other way and you get more nonsense instead of less.'

Something happens, is his starting point, so someone needs to set up what it was. He's fitting clues together like a jigsaw; they must make a picture. I think of Lemaître again. He sets out on the same trail. Unsurprisingly he loses it. He has hardly any clues. He conceives a quantum start but has no basis to imagine what it is. Worse, his thoughts on how to get his quantum going seem inane. Explosion! Fireworks! At the time, few note he also says his quantum must divide.

"It must tunnel . . . something of that kind."

He seems to be assuming that the Rules prescribe a quantum-tunnel process of some sort. My thought too; and, searching, I find Barrow saying:

> In more conventional quantum mechanical terms, we would say that the Universe is the result of a quantum mechanical tunnelling process, where it must be interpreted as having tunnelled from nothing at all.

Something similar, I think, but not precisely. My guy says: No, not from nothing! That he cannot prove it doesn't seem to faze him. In his genre, fingering the culprit is distinct from arguing the case. Step one is detective fiction. Step two is the prosecution. That's not just another book; it's on another shelf.

He need not worry where it tunneled *from*, like Barrow. His issue is where does it tunnel *to*?

"It didn't tunnel *into* San Fernando."

So he knows the silly story of Frank's car, sitting on the I-5 shoulder out of gas. Next, it simply *is* in San Fernando because QM says it *could* be there and when he looks it is. I can see his problem: San Fernando was there for it to be in. His Manifold has nowhere it can tunnel. There is no *there* for it to go, no place for it to be.

"What if it doesn't need one?"

Well, it needs at least a way to *be* in some way other than the way it is. If it gets to be a new way by a quantum tunnel process, does it need a place to *go*? Perhaps it only needs some probability of being that new way. There is no reason that I know of why a tunnel jump can't make a Manifold, a twin of the Beginning. Like he said, a state of One becomes a state of Two. Of course the Two are nowhere too; not even. They are all of what I can already see is going to be space but isn't yet. In my mind the Two are stuck together like two bubbles as if there was a place, some kind of space, for them to be stuck in. A simple image but I know it isn't true.

"It's the only way to go," he says, approvingly. He means the tunnel jump to Two.

"Maybe not the *only* way," he says a moment later. "But, to my mind, it's the only *simple* way for it to go."

I let the bit about *his* mind go by. He is setting up a new linguistic situation. Like a cell that divides into two cells, the Beginning he's envisioning makes two . . . two whats? Just as twins are not just children, these are not mere Manifolds. There is no name for them. I'm sure to need one as I'm sure to be the one who gets to write them up. I can envision the next steps already. The two whatsits will divide and then again etcetera, thus making many more. If the two of them were bubbles, many more could be a foam.

Was he watching me attempting to indoctrinate the flic? Does he know that quantum foam, or quondam phone as Crichton calls it, is a well-known concept? Should I say his universe is made of specks of foam? No, *Fleck's* the word I want. His Beginning makes two Flecks. A fleeting image of a move in chess, the classic opening, pawn to King four, flits through my mind and leads me to a new conception. Well, new to me; no doubt he sees it. This is the universe's opening Move and, with it, time begins. Time, now I too see it, is a process. Until the process starts there is no time. He sees, I'm sure he sees, more Moves unfolding. Does he see what he has done? The perfect symmetry of timelessness is lost in his Beginning.

I want to get a grip on what he sees, or he suspects, about the first two Flecks before he moves on. Like his Beginning, they must be Calabi-Yaus, each with six loopy small dimensions. Each with its share of pseudo-mass. Each must obey the quantum-theory Rules.

"It costs energy to make the extra Fleck."

For a moment my mind asks him: Why? Then once again there is that sense that maybe I can see where he is going. Before he's even got space up and running is he thinking how the run will end? If there is a cost then we can figure out how much. Without so much as jotting on an envelope I can already see that it must be absurdly small. Is he thinking of the Problem of Small Numbers? And that tiny number no one can explain, the Cosmological Constant? Is he saying that it is the energy—which is to say the mass—of space? Is it Dark Energy? Can he nail down three Problems, maybe more, with this idea?

True, it is a number pulled out of a hat. More precisely it's a number that must fit facts rather than explain them. In other words it's a parameter. But it's more than that. It's real! It's the smallest quantum, the mass of a Fleck of space. And it's one of just three numbers that he needs so far to explain the universe. All three of them are integral to the Beginning: the 6 dimensions, the initial mass, the mass of a space quantum. In other words all three are in the Rules.

The two Flecks make a kind of 1-D proto-space. And is there proto-time? Well, one would have to say that Two come *after* One. The proto-space is *after* the Beginning. This is sequence language and it seems a little like the way we talk of time. Move 1 has moved. Move 2, I think, is coming. How long did Move 1 take? It's another question with no meaning. I recall that tunneling may take no time. But that's a QM calculation. Now I see it isn't so. The Beginning says the time it takes to tunnel is exactly one. One time quantum, one might say. From this point of view I see it can't be zero. The time it takes to tunnel *is what time is.* If the time to tunnel were exactly zero, looking forward I see time would all be over before it begins.

Then too there's dimension. He seems to say the Manifold itself has no outside dimensions. But the Flecks, by being Two, must have a pseudo-dimension between them. I can see where this is heading. In my mind's eye I can see how the next Move may make it 2-D.

"It's not so simple!"

His voice sounds harsh. It shocks me like a bare-skin plunge in freezing water. Where am I wrong? It takes more than a minute's thought to realize I'm picturing the universe as if it could unfold *in* space although I know there isn't any space for it to unfold in. So *when* will space exist? Does it need more Moves?

Another question has been troubling me a while: Which came first, space or time? Well, now the answer's clear: It's time. Though I find Nabokov—who's more than a novelist—does not agree. Then there's that ancient Greek conundrum: Chicken first or egg? As we watch in our mind's eye, he and I, the cosmic egg is hatching. The Greeks now have their answer. First the egg. His voice keeps nudging at the edges of my thinking as I jot my notes. Maybe he's right. Straightforward as it seems at first, the hatching isn't simple. I want to see the cosmic chick. But first he must find time.

Just to think about what we think of as physics we need time. Not time to think about it; time to think about. And then we need a clock. Yet it will be a quarter million years before there is a single atom. But wait: His Moves seem certain to continue. For now, what better clock than an inexorable Move, Move, Move?

It seems to me that the Beginning brings, well, maybe doesn't *bring* so much as it *becomes*, a *Cosmic Clock*.