

THE RULES

The whole story of the world need not have been written down in
the first quantum like a song on the disc of a phonograph.

Georges Lemaitre (1931)

The fact that there are rules at all ... is a kind of a miracle; that it is
possible to find a rule, like the inverse square law of gravitation, is
some sort of miracle.

Richard Feynman (1963)

We can try to imagine the pre-Big Bang universe: timeless, featureless,
but in some unimaginable way beholden to the laws of physics.

Leon Lederman (1993)

The only way to have a scientific theory is if the laws of physics hold
everywhere, including at the beginning of the universe.

Stephen Hawking (1994)

While some cosmologists are speculating that the laws of physics
might explain the origin of the universe, the origin of the laws
themselves is a problem so unfathomable that it is rarely discussed.

John Brockman (1997)

When attempting to solve a problem, changing your physical vantage
point or mental framework can loft you past perceived limits.

Mariette DiChristina (2010)

Two cups of coffee later it's still sinking in. What he's done I mean and where he's gone. At this moment he's outside the universe! He's become the one observer who can see it all. Is there any way that he could see it from inside? QM seems to say it can't be done. His move leaves me feeling queasy. What he feels is not for me to say.

I think back to the first days after she hired me. The toughest task was finding the Beginning. Well, now I see it wasn't. For one thing, Lemaitre was on its trail. A tougher task, I hope he understands, is figuring the Rules. The Rules have to explain all that we see. Their success becomes the acid test for the Beginning.

This is why where he is now is vital. In Baggott's book—I have it here—there is a diagram. It shows the relationships among the basic physics rules. They all revolve around the role of the observer. He concludes: "The considerable difficulties encountered in forging a full account of gravitational effects in a quantum theory—creating a theory of quantum gravity—may be resolved only when the

conflicting demands of the status of the observer are resolved.'

That's why, inside his head—or, rather, mine—he's out there, so to speak. He *has* resolved the demands on his status. He has slipped the bonds of measurement, having neither need nor means to measure anything. He is free to do what all observers do, which is observe. And the reason he can do it is he isn't real. Might we pay dearly for his far-flung reaching for the Rules? If he succeeds does this not say that ultimate reality is all in his imagination?

While I wait I wonder: What is it that he seeks? What kind of Rules can govern how it works? Of course any model must have rules that say how it moves on from its IC. The Beginning can be no exception. Without rules it is an ending; it can't change. So he knows: In the Beginning, there are Rules. How can he find them? Well, he has some leads to help him figure some things out. The first is simply this: Given that it doesn't stay the same, how *can* it change? The Primal Principle points to the simplest change, which is for it to divide. One makes two. Simple, and so also beautiful. But how can it? It's stuck in itself. As the universe, it has no other place to go.

This is where he might remember that out-of-gas disaster on I-5. There *is* a way for something to get someplace when there seems to be no way that it can go. The nature of the question should suggest this sort of answer to his mind. If he asks me, the Rules should include the tunnel jump. He needs a kind of quantum rule that says there is a chance that the Beginning will begin.

The more I think of this the clearer it becomes. There are two choices. Either it divides or it does something complicated. And getting the Beginning out of hock is the first quantum step in what surely must be quantum Rules. This is no surprise. By 1994 Gell-Mann could say, 'It has become increasingly clear that quantum mechanics must apply to the whole universe.' Except for the observer our Beginning meets the definition of a quantum system. Every other quantum system will be more complex. This doesn't mean that QM works with the Beginning. It won't and the reason's easy: QM needs both space and time. QM works today because it results from the Rules that are built into the Beginning. But physics needs a brand-new quantum theory to describe what happens in the squintosecond before the Big Bang.

Perhaps he's taking on a hopeless task. It's possible the Rules include details of how space must unfold and of all the particles and forces in it. But this would make the physicists unhappy. They think there are few fundamental laws and all the others spill out from the few as everything unfolds. So far, physics shows a trend: With more study laws get simpler.

The coffee pot is empty once again. Pre-dawn light is in the sky. And still no word.

What he *won't* be thinking of I'm sure is a new quantum theory. That will be a challenge for the physicists. He needs to get ahold of the Beginning. He needs to grasp exactly its first move. It seems to me it has to tunnel but this cannot be the kind of tunneling that QM does. It must tunnel where there is nowhere to tunnel to. But the crux of his problem is: Once it's tunneled it must have all of its Rules. It's like he's trying to design a working acorn after checking out an oak tree. Any Rule he builds into his acorn will be with the tree and all its progeny forever. Any Rule that he omits, oak trees will never have.

Come to think of it, an acorn would be relatively easy. An acorn may have more than 10^{20} working parts. All it has to lead to is an oak tree that makes acorns. His Beginning has one part. It must lead to the whole universe. Doubt consumes me as I think of this. It can't be done. For a moment my imagination runs amok: Is he lost?

I tell myself he's fine. He's likely wondering what more there may be to the Rules. He knows—I hope he knows—that he will need more rules. He'll need a rule that leads to water flowing downhill. If he goes that far he may go further: For example, he could have a rule that says he gets to be a fictional detective. I hope he knows that this approach is hopeless. The problem isn't only that he'll need too many rules. It's that he will no longer be explaining; he'll be writing a prescription. Plugging in such rules would ruin the one thing that the Beginning might have going for it. Its explanatory power would be zero and its beauty would turn ugly.

So he can't add all the rules the world will need. What can he add? Well, what he needs is a few simple rules that lead to all the other rules as water waters many wonders where it flows. Like Jane he must be thinking: I don't make the Rules. How many can he add? He must be asking the same question. Fewer will be better I would say. Every rule he adds in his Beginning makes it less attractive, less *explanatory*. If he brings back a sack of them the dream is dead.

It takes me a while to realize that quantum theory has some kind of answer. There's no room in the Beginning for another Rule. Once he says a quantum theory is a Rule, he cannot add another. A quantum theory of his Beginning should say how it changes. Any other Rule will clash with that or else add nothing. So he can't add another Rule. Now I see he doesn't need one: The first Rule will arrange things so that water flows downhill.