THE WAR FOR INDEPENDENCE

The human requires a background grid through which to see his universe.

Frank Herbert (1965)

The problem of how to make a theory of a whole universe is thus the problem of how to construct a theory without making any reference to anything that exists … outside of the system we are describing.

Lee Smolin (1997)

Many of the important concepts that lie at the foundations of contemporary science were first created by philosophers.

Jay Kennedy (2003)

Everybody says they want background independence, and then when they see it they are scared to death by how strange it is. … Background independence is a big conceptual jump.

Carlo Rovelli (2003)

I've been putting off the background question. It seems simple. Until I start to think about it. Then it bends my brain. The more I think the less I comprehend it. I can procrastinate no longer. I need to sort it out and write his brief. What *is* background independence? Two things are clear. One is it is important. The other is it baffles better minds than mine.

He will want to understand it. He may give lip service to her grand objective but he wants to not feel foolish. Like, if someone should say 'background independence' at a party he'd want something clever top of mind. Not that he attends that kind of party. And who knows if he'll bother coming in today.

So I try to pick up tips in case they may be useful. They mostly come from Smolin. It's tough stuff. I try to follow what he says. He says a lot. Among other things he says *the* theory *must* be background independent. He ties this to the notion that the universe is all there is. By definition. So it can't be *in* anything, even in a basic thing like space. Space must be in the universe; not vice versa.

But this is not the same as saying that the universe must start with nothing. It just can't start with all the stuff I *want* to start with when I try to think of this. Minutes after I start thinking, my mind's warring with itself. It makes me crazy! I need to slow it down.

When defining anything—a universe, an apple, or an atom—there's a tendency to end up doing it in terms of something else. The apple is a fruit that grows on a tree; the tree grows from a seed; the seed comes from an apple; or an

atom's made of protons, neutrons and electrons; protons . . . Well, he'll get my drift. For most purposes this kind of definition works. But for the purpose of conceiving how the universe begins it's worthless. It seems to me that its beginning must just *be*. If we define the universe in terms of something else like space or even time, my guy *should* say: That's *not* the way the universe began. Why? Because, if it's *in* space or time or anything, it's not the universe. Smolin says that 'it seems reasonable to require that a quantum theory of gravity [must] make sense as a theory of a whole universe, as a closed system.' But then he seems to say GR is background independent. Not in my book! Elsewhere he acknowledges other inputs (dimension and topology) are needed to construct a GR universe.

So what *is* background independence? It seems nobody really knows. A few years back Rickles tries to answer. He uses lots of words. He tries to make it simple but it's not. Rereading for the third time what he writes gives me a sudden insight: Background independence gets its meaning from the beginning of the universe. So this is how I've come to see what background is: Stuff like space and time when it begins.

The mainstream theory of the universe is the current version of the Big Bang. In '77 Weinberg writes a book about it. He describes it in these terms:

> In the beginning there was an explosion. Not an explosion like those familiar on earth, starting from a definite center and spreading out to engulf more and more of the circumambient air, but an explosion which occurred simultaneously everywhere, filling all space from the beginning, with every particle of matter rushing apart from every other particle.

He goes on to explain (if this is explanation):

> "All space" in this context may mean either all of an infinite universe, or all of a finite universe which curves back on itself like the surface of a sphere. Neither possibility is easy to comprehend, but this will not get in our way; it matters hardly at all in the early universe whether space is finite or infinite.

I've scratched around enough to recognize this as GR by another name. Does it describe a background-independent universe? Not if it has 'all space' where this explosion can explode.

Weinberg begins his pitch with 'In the beginning …' but he doesn't really mean it. He admits there is 'an embarrassing vagueness about the very beginning, the first hundredth of a second or so.' He talks about how everything comes after a certain something. To me, to Frank, that certain something's the whole point. Even Child's lone ranger Reacher seems to understand it: 'Scientists measure time all the way down to the picosecond. A trillionth of a regular second. They figure all kinds of things can happen in that small interval. Universes can be born.'

Frank should know by now the fancy name for the beginning Weinberg is as-

suming vaguely. It is: Initial Condition. For this purpose any old condition may not do. Vagueness *is* a problem; this condition should be clear. And even if it were clear it's no good: It's not initial. Weinberg is another look-back guy. But he admits a hundredth of a second after the beginning is 'the earliest time about which we can speak with any confidence.' This is good. I've been wanting someone to tell me when confidence begins. So the breakdown is: One-hundredth of a second of uncertainty; thirteen billion seven hundred million years of confidence. It is impressive. But the war for background independence must be won or lost in the first instant of that hundredth of a second.

Frank—the real one—is still AWOL but then so's his boss. Once more I'm talking to myself. We're looking for a way to start that's *not* background-dependent. So, what is it that it *is*? This may look like a pleonasm—though the French would not agree—but it is the very question. Once again, I look to Smolin. His campaign for background independence is almost the only show in town. So I google smolin+background+independence. It finds an old hit and a new word. Theories that are background independent Smolin calls '*Relational*.' He posits three criteria for a Relational theory:

> It has no background.
> Its only properties are relationships between its elementary entities.
> These relationships aren't fixed, and time is simply the ordering of
> changes in these relationships.

At first glance this looks promising. It goes further than 'no background'; it says what this kind of theory *can* include. But as I read and then reread it, it seems futile. If he were here he wouldn't read it; if he did, he wouldn't have a clue. And after four rereadings, nor do I. It may look less messy from the beach.

The elevator groans to Ground. Smolin and Relational keep spinning in my mind. They impinge on our approach. Physics proceeds step by step. Smolin says the strategy should be: 'Seek to make progress by identifying the background structure in our theories and removing it, replacing it with relations which evolve subject to dynamical law.' That is, he would start with theories that are partly Relational. In this way he aims to get to totally Relational. But a detective brings a different perspective: Partly Relational is like partly pregnant. If Smolin's right, the Beginning has no background. None. As in, either it has some or it does not. To which I add: If it has any then it can't be the Beginning.

So we need to go straight to a relational Beginning. All Frank has to do is work out what that is. All? Do not pass Go, I'm thinking for some foolish reason. Do not collect $200. The worry is that with no space and time he'll have no way to work out anything.

Trudging from the bus stop to the shore, one more thought bothers me. Re-

lational needs things that are related. Elementary entities, as Smolin says. What are they? Whence could *they* come?