

THE PROBLEM OF THE INITIAL CONDITION

Nothing from nothingness was ever born.

Titus Carus (50 BCE)

The universe is what it is because it was what it was.

Stephen Hawking (1987)

This problem of the initial state of the cosmos presents outstanding difficulties in conventional quantum mechanics.

David Peat (1997)

We don't know what the initial conditions of the universe were, or even the ideas, concepts, and language that should be used to describe them.

Brian Greene (1999)

The traditional view that initial conditions are for the theologians and evolution equations for the physicists seems to have been overthrown—at least temporarily.

John Barrow (2007)

It's happenstance. It's 4 a.m. I'm in a cab. I never take a cab but it's a mercy mission for a friend. The address is kitty-corner to a morgue. In the back seat I am thinking that the neon never stops on Sunset Boulevard. Getting out, I'm minded of the film and Swanson saying it's the pictures that got small. It has a writer in it too. He writes the movie in the movie. Two tens; I tell her, keep the change. The side door of the mortuary catches my eye as it opens in slow motion. Frank's face looks both ways. He comes out. Right after comes another face I know. Some kind of news—his name escapes me. A third guy joins them. No recognition this time but like theirs there's something furtive in his stance. The name comes back. It's Larry Pratt. Posse Comitatus is the link that leaps to mind. The militia movement? What's Frank got to do with that? He doesn't look at me or so I hope. They walk away down Sunset on the other side.

At the office three hours later I'm still reaching for a grip on this. What do I know about him? That he's lazy. That I'm pretty sure he used to be a cop. His LAPD story seems legit but doesn't lead to him in company with Pratt. Not in any mortuary; not at 4 a.m. Not on Sunset where one can find anything at any time. It is, I think, his second hokey hook-up; she's the first. That phony hiring business!

How they play at being strangers. How he horses round, pretending he's Columbo like he wants to do a number on my head. And then there is that he took on this pretense of a job. But so did I. Now I'm the one who is invested. I keep surfing, reading, writing; all these clues have been a lot of work. Now I'm in the stretch and her detective story's gone to pot. The rationale for briefing him is shot.

Then there's the book. What's the story on the book? I can never bring myself to ask. As usual I turn back to the task at hand, the clue. This one is not an option. This one *is* our problem. It is, in other words, a fancy name for how the universe began. Some say it's on the other side of what I call the Old Divide. Hawking says:

Most scientists ... separate the problem into two parts. First, there are the laws that tell us how the universe changes with time. ... Second, there is the question of the initial state of the universe. Some people feel that science should be concerned with only the first part; they regard the question of the initial situation as a matter for metaphysics or religion.

It's curious that even Hawking puts it backwards. The initial state should be the *first* part of the problem. But this is just a purist quibble. Hawking differs with 'some people'. He says, 'Cosmology cannot predict anything about the universe unless it makes some assumption about the initial conditions.'

Other comments I find are confusing. Lloyd says that the Big Bang is 'the mother of all initial conditions.' For some purposes this may be apt. But, for the purposes of seeking the Beginning, the problem with the Big Bang as *IC* is: It's not initial. Which takes me to another problem: I don't know what my Frank knows. Lloyd could mess him up. If, that is, he didn't see me briefing Other Frank. So, in case he reads my notes, I write: This is the first Problem. We have come full circle. Lloyd has got it wrong. The Big Bang's the expansion that comes *after* the Beginning.

Next I delve back into Barrow's book *New Theories of Everything*. Its longest chapter is 'Initial Conditions'. It tells me that the quest makes sense, that it's important. Indeed it isn't just important. As that saying goes: It's not the main thing, it's the only thing. All else comes from it.

An IC is the way Something begins. Its proper context, I find, is a model, which is a way to mimic something real. It's a forecasting tool. It applies the laws of physics—rules—to a system like a nuclear reactor, or Atlanta's weather, or the movements of the planets, or growth of a galaxy. It says what the system does as time goes by. The model's based on knowledge of two things about the system: how it starts and how it works.

The universe is such a system and the Big Bang is a model. It starts with today. Its time runs backwards. This works because the laws of physics work both

ways in time and so ensure that the results agree with what we know. It predicts—if that's the word—the way the universe *begins*.

Most often there are no exact solutions to equations for the laws of physics. Such solutions need computers. Weather forecasts are a case in point. They are made with models and computers. The models use equations of thermodynamics—the physics of how heat does work—to calculate what weather will do over time.

Here's how it happens: The forecaster inputs two kinds of information. The second is equations that describe the rules. A model of the weather may need an equation for what happens to the Sun's heat over land. It might say that cloudy sky reflects all of the heat back into space and clear sky reflects none. It might also say half of the absorbed heat warms air and the rest warms the ground. Of course the real model must be more precise than that.

But the *first* thing that the model needs is start-up values for the things the model is to track. For example, over each part of the land how cloudy is the sky right now? It could be 30% cloud over Atlanta. Whatever. The model needs a number to begin. After that it takes control. Its cloud cover at each place will change over time. But if the start-up numbers are not right the forecast will be wrong.

Of course ICs include more than clouds. A real weather model will need temperature, wind, humidity and atmospheric pressure in many places and at many heights. These are called variables; each one changes over time. The model will need data for the start-up value of each variable that the model tracks. A good forecast uses recent information about many places, some nearby and many far away. The computer calculates how all these numbers change. A good model with good data gives a forecast that is good for several days. The data—all of them—are its IC.

In modeling a system like the weather, GIGO is the rule. Small errors in the IC give rise to rapidly increasing errors as the forecast looks ahead. This is why the long-range forecast's unreliable. Some errors may be due to limitations in the calculations. But most are due to inability to pin down *today's* data in detail. In other words, the problem with a ten-day forecast is not knowing its IC.

To understand the universe one needs its IC. Even the ultimate attempt to avoid one—Hoyle's steady-state model of a universe that always existed and always will (proven wrong by Hubble)—requires a start-up state. Its assumption makes a start-up time irrelevant. Any time will do—they're all the same. This is ugly. Actually it's the ugliest IC possible: Assume the entire universe in order to predict that selfsame universe.

There are many ways to say there's no IC. They all turn into contradictions.

Sifting through them, in the end I get the message: The elephant that's in this room is called religion. Ever since Lemaître, the universe's IC is off limits for most physicists. To me, avoiding an IC enmeshes physics in the very thing it's seeking to avoid—religious speculation. Worse, it lets religion limit physics.

Thirty years back Hawking said that ICs are fair game for physics. Does *The Grand Design* reveal a change of mind? With Mlodinow in tow he says that *M-theory* kicks off the cosmos. It begins with nothing. God's not needed, they say, in a strikingly unphysical aside. Well, M-theory is little more than five string theories strung together so that one can choose the one one likes. This eliminates the need for an IC? Well, no, this hides it. Even Hawking's nothing's an IC.

Next question is: If Frank finds what he thinks is the right IC, how can he predict what his new universe will do? He'll need the *Rules*. How can he find them?

“They will be there.”

The sensation's stunning. Moments pass before his meaning hits me. He'll already have them! If not there in the Beginning, where else could they be? And when? They *must* be there. The Beginning doesn't come before the Rules, it *is* the Rules. Without them it will never get begun.

So what Hawking says most scientists separate in two parts is all one. They see two parts because they look back through time. Is Frank watching while I write this? Does he know I get his message? If Hawking's right about most scientists, most scientists are wrong.

So her question is the final Problem, though it now seems clearer: What could be this one thing that is all things, both IC and Rules? As I review the clues, some words that Chandler put in Marlowe's mouth—though here he's calling him John Dalmas—as he reviewed *his* clues, are ringing in my ears: ‘None of it made any sense.’

I'm happy. He is here and here we are and all the clues are screwy. The list is open-ended—but one needs a sense of when to do the deed. Carroll writes as if he has in mind this moment:

“The time has come,” the Walrus said,
“To talk of many things:
Of shoes--and ships--and sealing-wax--
Of cabbages--and kings--
And why the sea is boiling hot--
And whether pigs have wings.”

The time has come for the detective to deliver. Carroll picks on boiling seas and flying pigs; the eccentricities of our clues leave his outré items in the shade.

The problem now is method. How can he combine these clues?