THE TROUBLES WITH TIMES

Absolute, true, and mathematical time, in and of itself and of its own nature, without reference to anything external, flows uniformly and by another name is called duration.

Isaac Newton (1687)

The tendency to negate the reality of time is one of the most persistent features of our philosophical and scientific traditions.

Leemon McHenry (1994)

It feels as though time flows inexorably on. But that is an illusion.

Paul Davies (2002)

At what speed does time flow? One hour per hour? Newton does not answer these questions.

Jay Kennedy (2003)

Capturing time through mathematics … is like trying to trap water with a net.

Palle Yourgrau (2005)

The meaning of time has become terribly problematic in contemporary physics.

Simon Saunders (2007)

More and more, I have the feeling that quantum theory and general relativity are both deeply wrong about the nature of time.

Lee Smolin (2007)

Now the rift between the time of physics and the time of experience is reaching its logical conclusion, for many in theoretical physics have come to believe that time fundamentally does not even exist.

Craig Callender (2010)

If Fuzzy Frank shows up today I plan to ask him for the time. Cheap trick. His response should be to ask me: Time? What time? Whose time? In my dreams. Abstract questions aren't his style. This leaves me, almost but not quite alone, sitting for a self-exam, a single question on the paper. It is what he ought to ask me: What is time?

If he shows and asks I will be ready for him anyway. Time is—I will say—just a four-letter word. Physics has a hundred different definitions for a dozen different types of time. No one can be sure that any one of them is real. The universe

owes us no duty to comply with our ideas.

Smolin says time's definitions tend to hit a glitch: They turn out to be circular. As in: Time is what is ticked by clocks; clocks are devices that have perfectly regular cycles; perfectly regular means equally spaced in time; time is what is ticked, etcetera. It's sometimes said that it is Einstein who kicks off the timely troubles. He claims, so it's said, that time is what is measured by a clock. My digging doesn't find he says it, though SR does throw a spot on clocks and on the times they measure. This may not be what kicks off the troubles. Healey says, 'Physical science has been chipping away at common sense aspects of time ever since its inception.'

But, no question, SR kicks the chipping into gear. Its big chip is a simple matter: Clocks, it says, go slow depending on how fast they move. Relative, that is, to an observer: one who checks clocks flying by, the float-in-space Einsteinian clock-watcher, a subclass of those persons who are waiting for the time to pass. Though by this time cracks are already there in its facade, this takes a wrecking bar to time. Physicists observe all kinds of clocks, anything at all that changes over time. Just as SR says, time changes. For example, particles decay more slowly zipping through the lab than resting on the bench.

SR shows that two observers traveling at different speeds may disagree about the sequence in which two events take place in different places. Another way to put it is that simultaneity has no meaning for events at different points in space. Einstein says '"now" loses for the extended world its objective meaning.' He uses the example of two lightning strikes that hit ends of a train. There's a woman in the middle on the train and a man who's in the middle by the track. If the man sees the two strikes as simultaneous, the woman sees the front flash happens first. Why? Well, while the light from the two flashes moved towards her, she moved with the train toward the light from the front flash. So its light doesn't have as far to go. Measurements confirm this is correct.

SR says an astronaut who travels to the nearest star and back arrives home younger than a stay-home twin. A round trip in ten years finds that the twin has aged by thirty. Atomic clocks with circumglobal tickets show a relatively smaller but precisely-as-predicted slowdown. It's a whole new kind of jet lag.

Thus SR charts a path that leads to time's destruction, a world in which times past and future simply *are*, just like all places. Satisfaction or regret attaching to the past, or hope or hesitation to the future, are signs of our unphysical confusion. Soon this is the established view. Weyl says:

> The objective world simply is, it does not happen. Only to the gaze of my consciousness, crawling upward along the life line of my body, does a section of this world come to life as a fleeting image in space which continuously changes

in time.

GR takes the time-warp further. It says clocks tick faster on a mountain top than in the valley; and they do. Satellites for GPS fly overhead; their clocks need two corrections. One, for SR, as they run slow on account of speeding and the other one, for GR, as they run fast on account of being high. After Einstein, time becomes a sometime thing, no longer moving futures uniformly into pasts.

Trying to make sense of this, one trouble is there are too many times. It's not only different definitions, though it is that too. The worst is: What we *mean* by time and what time *is* may be two different ideas. This hasn't changed a lot since Newton. I find a paper where Rovelli lists ten kinds of time. Flatfoot Frank may have some trouble with the fact there are so many. How many there may be is, as Rovelli shows, a matter of debate. I'll tell him, if I find a way to tell him, that this list of times might be a clue, maybe the best of clues. It lies close to the center of the quest. If time began in the Beginning, surely it was one time. *Which* time was it that began?

People think of time in terms of clocks. But, after Newton, some think of a time that needs no clock. As the graffito has it: 'Time is God's way of preventing everything from happening at once.' To which physicists may say, in a literal—not metaphoric—way: Sorry but we don't have time! In this, Gödel is their main man. Desmond Child; rare Cher! Gödel is clear, or thinks he is, on what he means by time. He means, he says, two different things. One, he calls formal time. Yourgrau calls it time as it is studied in physics, or just *t*. The other, Gödel calls intuitive time. It is, says Yourgrau, 'time as we experience it in everyday life.' Seems to me they both have lost track of the time that he and I are after—the time that Newton says is true. But already by Gödel's time, around 1950, true time's falling into disrepute.

In his analysis of time, or of his two times, Gödel first shows that intuitive time can't survive SR. But SR starts out by assuming that time passes; to prove it doesn't, Gödel needs Minkowski's reconstruction of SR. Then he turns to GR and assumes the universe rotates. This might seem a fair assumption. After all, most everything that's in it does. He then shows that one can travel keeping track of formal time and finish up back where and *when* one started. This, says Gödel, proves that formal time does not exist. Thus neither of his times is real. Yourgrau castigates those physicists who don't embrace this as a fact. Of course it isn't clear the universe rotates but, says Yourgrau, that it *could* should be enough. Me, myself, I wonder: If the universe is all there is, what's the meaning of supposing it rotates?

This is where my head is at when Frank walks in. I ask him, just to get him going: Does he think that time exists? It doesn't get to him at all. He just looks

blank.

"Why waste *time* on him?"

It's so loud and clear it is amazing that Frank doesn't hear it. It's the voice I think of as the other Frank. He keeps asking the same question. This time I can tell he doesn't mean me wasting *my* time. He means don't waste the topic; don't hand him the clue. What can I say? How can I say it? What to do?

It's true that Frank can't understand why time is central to the search for the Beginning. He doesn't even grasp that this may be when time begins. But, in detective-story-speak, he must have a *hunch* that he is looking for a Something that is timeless. If time *never* did exist it could make his search simpler. However, it seems clear to me that something time-like *does* exist. Surely he must see that he's engaging in a search for time itself. After all, doesn't the idea of beginning invoke time?

I can see how he will get confused. I'll have to tell him physicists say time does not exist, not in an objective way. They say time is an illusion, some kind of subjective trick we play upon ourselves. If so this blows away the way we see ourselves relating to the world. Is it not surpassing strange to think we're tasking a detective to avert the death of time? My thoughts are jumping from one notion to another, not because I do not know the voice has posed a telling question but because I know it has.

Frank still stands, stopped by *my* question. He's not exactly dumbstruck but he's looking at me like he thinks I should say more, and what comes to mind is: One time or another every physicist has shown time as a line. As in a graph—I sketch one on a handy sheet of paper—of, say, temperature versus time. Or salt concentration; particle velocity; elevation above sea level; or whatever—versus time. Each whatever has a zero on its axis. Contrast with time—it has no zero. Or, if it has a zero, it is any arbitrary time the physicist may choose. Unless it shows the lifetime of the cosmos.

He's sitting now; he's watching me so I go on.

These arbitrary time lines all ignore the central attribute of time as everyone perceives it: They show no *now*. The physicist could pick a point and call it now but it will not behave like now. It will not move. The time that's shown on physics graphs has lost its past, its present and its future. It pretends there is no difference. This is no accident. Physics has no room for there to *be* a difference. Physicists may pass this off as *our* problem: We are not equipped to grasp the true reality of time, they say. We are 3-D seers in a 4-D world, etcetera. When I tell him this he gets it right away. He says: That's *their* problem. It's not often he and I agree.

About time, physics doesn't get it. This is a BIG problem. After all, it is what

physics is about: How things change with time. Pick an equation in a physics text; likely it involves the symbol t. It almost always stands for time. There is a fancy shorthand too. Like, for example: $\partial/\partial t$ in front of Something means the rate that Something changes over time. It's no squiggle; it's the bedrock for the edifice of physics. Yet physicists are picking at it, looking for a soft spot that could take it down. Some believe that their equations may work better without time. For example, Folger says: 'The possibility that time may not exist is known among physicists as the "problem of time." It may be the biggest, but it is far from the only temporal conundrum.'

This problem is especially vexing. Time seems fundamental. But as Barrow points out in '07 (if '07 has a meaning): 'The existence of time is a mystery. There is no use for it.'

Yet my Frank may find use for it: That its existence is a mystery should be a clue.