THE TROUBLES WITH STRINGS

Three Quarks for Muster Mark
Sure he hasn't got much of a bark

James Joyce (1939)

Now the primary objection to knotted strings is that the superstring is necessarily living in a space of 10 dimensions.

Louis Kauffman (1991)

In string theory, at the most basic level, an elementary particle is treated as a vibrating string, rather than a point particle.

Edward Witten (2002)

One reason string theory is popular is that there is some evidence that it points to a quantum theory of gravity.

Lee Smolin (2006)

What string theories have in common is a stringy-thing conception. Not much more. The strings are only an idea. The idea is that some things physics treats as 0-D points might work better in 1-D. To make this happen takes an extra D on top of plain-3-D-plus-time. One extra D seems to work wonders, so soon more extra Ds are springing up all over town.

I went through some of this for Fearless Frank. I wonder what my Frank might know. He's saying nothing. Is he thinking? Might he need something to think about?

I hope that right away he'll see this is about dimensions. A string-theory string is tiny, far too tiny to observe with any feasible device. It vibrates. The vibration is its physical effect. Like a guitar string vibrates to make a sound. It's obvious that this needs a dimension: A guitar *point* vibrating? It's harder to imagine than the sound of one hand clapping. But here again I have this problem: How do I know what he knows about guitars?

Today's string theories seek to marry QM to GR. But the first string theory isn't about gravity at all. It's about quarks. Quarks are the building blocks of particles that make the nucleus of every atom of the matter we can see. Three quarks—two up, one down—make a proton. Three quarks—two down, one up—make a neutron. Joyce never knows this but, by 1970, that quarks are strings looks like the coming thing.

Turns out this has a problem: It doesn't work. However the *idea* behind strings is all about dimensions. It lives on. The next decade sees a bold attempt to build a theory of all the forces using strings. Again it doesn't work. But once again the *concept* of string theory survives. It proliferates into a thicket of string theories that don't work out. Then Schwarz and Green show that string theories can contain the forces and the particles and solve some conflicts with QM. Overnight, strings are re-energized. String theorists spring up all over. The string-theory thicket soon looks like a field. But again its promise dies aborning. It delivers little more than getting rid of zeroes. And yet it survives.

Do strings sing a siren song that casts the mariners of physics on the rocks? Brilliant people gamble their careers on strings. Could their lack of progress mean no more than that its math is new? New math can take time. But how long is long enough? It's been more than forty years. Commentators are divided: Smolin says it's over but Greene says push on.

I check out one branch of string theory that leads the pack in publications, media exposure, hyped excitement and the like. It works if Spacetime comes in ten dimensions. That's the four Spacetime dimensions we experience plus six more space-like ones we don't! Where are the extra six? Well, says Klein, who's propping up Kaluza who is working with just one, they collapsed (that ugly concept with that ugly name: Compactified). Why? That's anybody's guess. Each one curled back on itself into a circle that shrank to a tiny size (like a billion-trillion-trillionth of an inch). They curl into a Calabi-Yau Manifold. I can't describe it so I show him pictures on the Web.

So there are *nine* space-like dimensions, of which six cannot be seen, leaving three, the which we see, and time, the which we think must be because it seems to happen and we seem to go along. As if this be not enough bewhichment, it gets worse: There are vastly many ways in which these six dimensions can collapse; and each which way they can can make for different physics. So theorists can choose which one to use until things match what they observe. I see it said that they may need a hundred years to sort it out. Some say it's time to spend scarce research money someplace else. Of course, if the LHC turns up with a stringy particle next week, all bets are off. Indeed, the LHC may be strings' last best chance.

Why would anyone with money spend on strings? Well, they are seductive. And, too, there is a sense that something big is just around the particle-accelerator corner. Even Smolin says, 'No one disputes that a lot of good mathematics has come out of string theory.'

And a string theory, if it makes a prediction that checks out, could change the shape of physics. Yet, though meant to leave behind the blind alley of the Two Theories, strings seem stuck in a blind alley of their own. What I wonder is: Is this the same blind alley? Strings are situated in the same-old background space and time!

So, it seems to me, aside from strings, string theories have these two things in common: Their math is beautiful; and they don't work. This last fact fuels calls to give up strings. Woit writes, 'The theory has been spectacularly successful on one front, that of public relations.' In effect he says it is pop science with a twist: It's so popular it needs no science. He's not the only critic to suggest that it is wasting brains as well as bucks. But my money says strings will stay strong. This is why he needs to know they are, for him at least, a snare and a delusion. I would like to bind him like Odysseus to the mast till he's beyond the Sirens' stringy song. But, like Odysseus, he needs must hear it. It may hold a clue. Could it be that all that math—string-Siren lyrics as it were—contains a message? Lovely now; how lovely when the world began?

Meanwhile strings have troubles: They need at least six extra dimensions; when they get them they do little more than sing.