

# RANDOM ORDER

Nature herself does not seem to know which way the electron is  
going to go.

Richard Feynman (1965)

But the universe would not turn backward.

Frank Herbert (1976)

Gradually, over the last twenty years, the vacuum has turned out to  
be more unusual, more fluid, less empty, and less intangible than  
ever Einstein could have imagined.

John Barrow (2000)

A mostly deterministic law, with just a touch of randomness, is  
possible.

Leonard Susskind (2008)

It would be more than miraculous ... if we were in any sense set apart  
from being as a whole.

Marilynne Robinson (2010)

“Think about it,” he says on the train last night.

It startles me a bit; he’s never spoken on the train before. He means random order and his interruption tells me that he doesn’t always know my thoughts. Random order is what I am thinking of and I don’t mean a scrambled list of numbers or ska-reggae band. It’s my name for how those tweedley twists in linky space cavort in tocky time. In short, it’s nothing more nor less than how things happen. It’s the order underneath the randomness that in its turn lies under what we see as ordinary order.

Thinking on this keeps me up all night. It’s chilly on the beach. The tide is low at first. I sit on cold sand in the shadows by the pier. My eyes stare sightless through the sparkly sky as if to find what lies behind it, my mind lost beyond the vastness of the view. Detached, I sit here delving in its smallest secrets. I think that I must be mad.

It all happens in a few Moves and they seem so simple. Yet each time I get the hang of it some question drags me down. I strain at one as B-T leaves me dangling between Tweedles: Why no tweedlenones? A tweedlenone—my own invention—is a Tweedle with no twist. The way B-T gets no twist is to use a dee to cancel out a dum. With two counter-half-twists in a ribbon the result is obvious: A slight tug and the half-twists disappear. B-T’s half-twists stay. Each, in this

configuration, cancels out the other one's electric charge. It seems a complicated way to get to zero. It seems overdone, a step away from Primal. But on second thought I see the overdone is an illusion. Two Tweedles, each the mirror image of the other, *are* Primal, simpler than an added tweedlenone. This is pleasing as it reconfirms my answer to the question B-T doesn't ask: What is he twisting? In my mental picture every ribbon running Fleck to Fleck has half a twist. Or does it? No sooner do I get it than it comes undone, leaving me still reaching up for *sūnyatā*, with everything-connected pure relationships that are both nothing and the all.

I go back to my room to try again to mock it up. It is soon obvious my Styrofoam and toothpicks kit can't do the job. It tracks the Flecks—the easy part. It leaves to me the hard part—tracking twists. I find a long wide rubber band. The idea is that it keeps track of twisted Links and leaves their Flecks to me. Suddenly Move 1 is easy as I bend the band; there are the two half-twists, one dum, one dee. The thought leaps into mind that at Time One the entire universe comprises Tweedledum and Tweedledee! Wouldn't Carroll be enchanted? What will B-T make of it? I don't suppose that this is what he had in mind. Another thought: She's out there somewhere doing something. I feel like I'm in a race to finish what I'm doing before she does.

Now, fumbling with the rubber band, I see—it's so much simpler than those toothpicks—that at Move 2 and so at every Move each doubled Fleck just makes more of the same—a Fleck necklace like a string of beads except the string's a ribbon and it half-twists left-right, left-right pairwise as it's threading through. The Flecks of course don't dangle on the string; the string must be imagined as if flung into a heap. The heap makes space. And as it becomes bigger the same ribbon threads throughout it, twisting left-right as it Links between the Flecks.

"It's not so simple."

Do I hear a hint of petulance? Of course there are four more dimensions but they don't thread through the two Flecks at Move 1. They won't fit through the Windows. I am sure a 2-D Window can't support more than one 2-D ribbon Link.

"What does the next Move do?"

Well, he is right, that complicates it. At Move 2 two new dimensions must match up through the new Windows and thread like a twisted ribbon through each of the four Flecks. It must take another path. It's as if each bead has two holes and two Threads. There's no way I can keep track of the twists or even of the tangle with two rubber bands. What I can see is that each must cross the other four times where the two bands go through the two holes in each bead. The 2-D universe contains eight Links. I'm fooling with the future of the cosmos. It's strange to think of something so *outré* and have it feel familiar. Suddenly—it star-

bles me—I see there must be *two* new Move-2 ribbons, each one formed from one of the two Move-1 Flecks, each just like Move 1 itself except that it has only four inside dimensions from which to choose its pair.

Then Move 3 makes another set of ribbons—four of them, each formed from one of the four Move-2 Flecks, each left no choice so it must use the two dimensions that remain unpaired in its originating Fleck. And now space is 3-D. Move 3 reveals a reason why it stays this way: Three 2-D ribbons use up all six of the Manifold’s dimensions. There’s no way to make more ribbons.

Move 3 makes eight Flecks. Even with three ribbons running through each one of them, each with eight half-twists in the first ribbon, it should still be simple. So it seems until I try to mock it up. Eight half-twists? What happens to them as these other Links come into being? And what happens to *their* twists?

“How does ribbon number two hook up between the Flecks?”

Well, I did that already. And suddenly I realize what he is saying. Back to the drawing board. Forget the rubber bands. Move 2 makes a 2-D universe; it should work on paper. Two penciled circles for two Flecks, one above the other. I find felt pens in five colors. First in yellow I draw two lines through the circles; then I dot them back beside to close the ring. Yellow for the One Ring made of gold. Close the ring with dots because this is a Pac-Man world with no edge in its 1-D space. Both lines are the same color because they will stay together for the lifetime of the cosmos. No reaction. Does this mean that he agrees?

So next, at Move 2 each Fleck Fizzions. Pencil circles side by side, two more below. I color in the yellow One Ring first, dashed down into the top left Fleck, then top right, down, and to the right a dashed connection. Then dashed from the left into the bottom left, then dash it down and out. Now it’s just a matter of gold dots to close the ring, top to bottom, left to right. The One Ring runs through all four Flecks and it will run through all the Flecks forever.

Now his question if I understand it is: What happens to the two new rings? Do both choose the same dimensions? I don’t know. If it’s random then the odds are only one in six. I play the odds that they are different, using two pens, blue and green.

“It’s messier than that.”

Oops. He’s right. I focus back on one of the two Move-1 Flecks. When it Fizzions, its new Links make a new two-Fleck ring. It’s like a copy of the One Ring but it runs through only half the universe. Likewise for the other Move-1 Fleck. So the two new rings may have a mix of same or different dimensions. Such as blue and green for one, and blue and purple for the other. It’s messy. This convinces me there is no way I’ll figure out Move 3.

“What if the dimensions are already tangled?”

Okay, I get it. It would be a mess.

“You don’t get it.”

Sometimes he won’t let it go. So what if there *are* tangles?

“Have you coiled a hose?”

Not for years, I’m thinking. ‘Not’ morphs into ‘knot’; a penny drops. Beach house in Hawaii. Watering the potted plants, a favor for a friend. A hundred feet of tight-coiled hose. Uncoiling, it is soon a tangle. Putting it away is worse until I learn the trick: Retwist it; loop one, twist one. Now a thought comes back from B-T’s paper: Twists turn into braids and vice versa.

I get it now—the Fizzions, twists and tangles. They’re not neat; in a few Moves there is a writhing torment of uncoiling ribbons. It’s like all the duplicating DNA the world has ever seen—meiosing, reproducing, separating, pairing up again; it’s messier than sex in six dimensions. All that I can keep intact is: Every Fleck’s connected by those two gold lines.

“And . . . ?”

There is more?

“What is the matter?”

Somehow I know he’s not asking what is wrong. He means the universe’s matter. All along I’ve been assuming that the matter must be packed into the Manifold. Hoping or pretending that this isn’t inconsistent; but it is. If matter’s made of twists in the Beginning then it messes up my simple picture badly. My attempt to picture just how badly boggles my imagination. It seems wrong.

“It’s wrong.”

*What* is wrong? He’s not exactly being helpful.

“Did you think that this would be so tidy?”

There he goes again. It’s not my fault if something’s wrong. This Beginning is all *his* idea. ‘You’ jumps out at me—a change of voice. It’s not more friendly but it’s more familiar. If we could communicate in French or German, would he now *tutoie* me?

“If you want a picture why not use a real one?”

He sounds like he’s trying to be rude. There *are* no pictures. I found mock-ups of Calabi-Yaus—cross-sections of their 6-D shapes—on various Web pages. I liked the two on Andrew Hanson’s page. Google turns up other images. They look tidy in a twisty kind of way.

“Do you think a tangle tends to make more twist?”

Four you’s in a row. Is this a message? I wrench my thoughts to his question. Yes; it’s true. Of course. And once again the rush of seeing where this goes: Fizzion making tangles, tangles twists. B-T shows twists are braids in waiting, speculating braids may be the basic building blocks of mass and radiation. *He’s*

saying matter's made of knots in Nature's knitting. That 4.5%, the quarks and atoms, frogs and physicists, all made of knots caught in the cosmic gotch? Then the answer to the Antimatter Problem's easy. Right from the Beginning there's asymmetry in Nature's knitting. Check.

Back on the beach it is still cold. The tide is rising but the sea is quiet. Wavelets snuffle at the sand. Bay City lies behind me; it's where Chandler set his Marlowe stories. Night fog's masking Malibu. Above the Channel Islands looms black western sky. Each winking pinpoint is more mass than my mind can imagine. For each one I see there are a trillion more. A chill runs down my spine. Could all this mass be made from nothing?

"It isn't."

Dangling on a brink I think it through as he has somehow taught me. Matter's made of twisty bits of space. Tangles make the twists. Fleck Fizzions make the tangles. And why do they Fizzion?

"Just because they can."

Clinton? Can it be so simple? Why do they stay Fizzioned? I remember: Odds are overwhelmingly against them going back. Maybe a few glue together for a Tock or even two. Who knows? Who cares? If this is truth it has no consequences. It's a happening that no one can detect.

So there it is. It *is* so simple! The unfolding of the universe is driven by the perfect order of the Beginning. It stacks the odds in one direction: order going down. The gas that's in the universe's tank in the Beginning is not pressure of hot matter, it is perfect order and cool calculating chance. There is no universe of matter crammed into the Manifold! Its matter is emergent and it's made of space. Move 1 starts it down the slope. For nearly 14 billion years it slides inexorably, order driving all—space, energy and matter—willy-nilly on their way to messy. It's an entropy machine.

The strange thing is that this should come as no surprise. It's called the Second Law. Seeming for so long to stand outside the bounds of physics—a law that is no law, more like a summary of observations—it now takes its rightful place: Not second; it is *first!* And most fantastic is the way with B-T's twists the Fleck's the *only* entity from which the universe is built. It's all space-knitting. So Frank says, though now he's saying nothing.

He may be right. It's not that I am unconvinced. I'm just mind-weary. It seems that every time I get the drift of what he says he changes it again. Might he have a slight sadistic streak? He is original for sure but right now I might trade him for a hot topologist.

No sooner is this thought thought than I think that it is not a good one. If a thought can be a shot this is a cheap one. He says nothing. I take cover in my own

confusion. Three pairs of two dimensions run into each Fleck and out again; three Threads. One pair runs right through the entire tangle. Each of two pairs runs through half the Flecks. Each of four pairs must run through a quarter of them but each time I try to think of this I lose it. So I hang onto the three Threads, a fantastic mash of half-twists that, if he is right, amount to all the matter that was *not* there in the Manifold. Who'd have thought that anything so simple could so quickly get to be so big a mess?

This then seems to me to be the massive mystery: Exactly what knot *is* it that, spilling from the Manifold, can make not only space but all the matter in the universe? Is this knot the final grail, not of cosmology alone, but of all physics? Will it come to be known as God's knot?

Writing notes on this would be a useful way to end the day but as I stand and stretch he speaks.

"What of superposition?"

Could God's knot be all knots at once? It strains the brain. It is too much. I will not think it. Walking up the beach I try to find some other thought. What comes to mind is: Can new rules emerge that are not in the Rules? The question finds an instant answer: Of course they can. The state of the universe after any Move can't be predicted, even given perfect knowledge of its state. Enough random-order steps can create anything. Even a self-conscious critter of its own. Like me. Like him.

Is this free will? He will be happy. All along I've felt that this is what he wants.