THE UNMISSED MOVE

What shall we do with the Ring, the least of rings?

J.R.R. Tolkien (1954)

Now, what exactly is meant by the 'origin' of the Universe? How did it come into being? Could it be avoided? And, more provocatively, *what is before the* Big Bang? These are the ultimate questions human beings are privileged enough to ask and to think.

Bei-Lok Hu (2007)

Some may think it doesn't matter. It's the least of things. But it's the most important object in the universe. It matters even though it all unfolds so long ago. And it may matter too that it does *not* unfold the way he says it does.

Hu's question leads my thinking back to: What *exactly* is the origin? I have a kind of mental movie. When he deigns to speak he hints he has another answer. Then away he goes. To where? Who knows? He leaves me with a nagging, loose-end feeling and last night it dawns on me and wrecks my restless sleep: The problem is Move 1. It *didn't* happen! Some Move happened but it didn't play the way he claims. The key is in the Window, the first Window.

It is hard to think it through without his help. Once more I close my eyes and conjure up the Manifold. Move 1 Moves one to two. I see their six dimensions. Like he says, two form a Link. It's Linking through the Window, the first-ever Window. When I hold the image, I see that it cannot be! The two dimensions have loose ends. I mean, can a *dimension* have an end? It makes no sense. Like even our out-in-the-open three dimensions loop back on themselves in far-flung finity, as Einstein shows.

Could one dimension Link across the Window and loop back again? I don't think that would work. The two are opposite. If they are in a Link, I think they'll cancel and so make no Link at all.

So the problem of Move 1, if I can call it that, is this: One Window has but two dimensions. Two Flecks have one Link. So neither Fleck can Link two of its six dimensions to two of the other's, as they'd each be left with two loose ends. But if the two dimensions don't Link up at Move 1 they'll need Rules to make them do it at Move 2. It can't be; it's not Primal. It's his thinking Links that led me into this dilemma. There must be another way. Last night while the AC ate money and I simulated sleep it came to me: The universe must skip Move 1. It tunnels through to four Flecks without ever having two. It just tunnels through a doubling it can't do. It can do that. It may see a bigger barrier so getting to Move 1

may take more non-existent time.

What results from my Move 1? It's a ring that's like the one that he imagined as Move 2. Four Flecks, four Windows. All is in accordance with the Rules: The Links are two dimensions; the dimensions don't have ends. Doing this stuff in my head is hardly easy. In the end I cut up chunks of *Styrofoam*. They make my Flecks, and toothpicks make my Links. Sticking to the Rules there's only one way I can do it: Linked-up two dimensions make a ring, a single ring, the least of rings as Sauron's emissary says. Four chunks for Flecks; four picks for Links; and so four Windows. No dangling dimension-ends. The ring runs through each Fleck exactly once. I imagine it to be a tetrahedron but it may be making only two dimensions. And each Fleck is Linked to two, not three.

Next Move needs more chunks, more toothpicks. Eight Flecks and they are still Linked into a single ring. Trying to be tetrahedral, it's quite kinky in 3-D. Move 3, sixteen Flecks, and still just one ring. It circles through each Fleck exactly once.

It's awkward trying to keep all the angles at exactly 60°. I have been assuming that more toothpicks would create a tetrahedral kind of honeycomb. A search shows that I'm wrong again. My pyramids *won't* fit together. Not even close. Haji-Akbari shows the best fit found so far. It fills about five sixths of a container. How to fit such shapes together with the least waste space is called the packing problem. Palffy-Muhoray explains that 'It is easy to understand how cubes can entirely fill space with no voids, but for the simple tetrahedron the packing problem is unsolved.'

And suddenly I see it's not a problem. I've been chasing my need to see Flecks in a familiar form. What's real is a relationship we may imagine but will never see. It's a matter of remembering that Links between the Flecks don't have a length. But the Flecks have a fixed volume and a search turns up the Kelvin Problem: What shapes do equal-volume bubbles of least area take on? It's 1887, and it's Thompson—now Sir William, soon to be Lord Kelvin—once again . . .

"Aren't we forgetting something?"

Merde. I love the rush and instantly I lose the lonelies. Michelle Deann Rice sings in my mind. He sounds sarcastic but I think about his question: What did I forget? Oh yes, the Flecks are not in space. They are not bubbles, they are . . .

"Where's the edge?"

He's more than just sarcastic; he sounds hostile. What's he on about? *What* edge?

Silence says he's not about to help.

It takes me a few minutes. He means Einstein's paper on cosmology where Einstein reasons that there is no edge to space. My toothpick model has a prob-

lem; it is *in* space. It has edges all around it where it ends and all else carries on. It's wrong. Like Hannah Montana I have to start all over. Maybe too I ought to wonder if this brainwave is a rogue.

But with more thought it becomes clear. It was a natural mistake. He's right. There is no missing Move. Move 1 must happen as he says and it must make two Flecks. What I missed is that each Fleck makes *two* Links! The Move-1 universe has one dimension and it has no edge. So each Fleck Links the other on *both* ends, if 'ends' has meaning, which it doesn't. Two inside dimensions Link right through both Windows of the Flecks. Nothing is left loose or dangly. It was all a false alarm. Imprisoned in our 3-D space, the best that I can do is string two chunks of Styrofoam on an imagined rubber band. And now it truly dawns on me. *This* is the ring. The least of rings! Literally. It is the One Ring. Literally too. In that fleeting instant it's the ring of all the power of the universe. Literally.

So the least of rings reveals exactly how the universe is able to begin. Right from the Beginning there's no edge. It is impossible for me to form a proper mental picture. But I don't doubt that it was real.

Trying to recover gracefully from my mistake, I juggle my new ring, the least of rings, the *oldest* ring. I turn its 3-D model in my 3-D hands and try to hold a 1-D image in my head, admiring it in a proprietary way. This works even worse when I try picturing the Flecks with Windows in between. So I string them on a mental ribbon made of two imagined stray dimensions. Slowly, almost grudgingly, my mental picture shows me that the Flecks are strung on the same two dimensions all the way. I wonder about consequences as the Moves move on.

Move 2 is even harder to envision. Each time I try to make four Flecks, keeping front and center that there is no edge, my mental picture falls apart. Then, when I'm almost reaching for the toothpicks, suddenly it works. And now I know! The *same* ribbon of the *same* two dimensions forms a ring that runs through all four Flecks. The reason that the ribbon's made of those dimensions is the same as it was for Move 1. It happens in the selfsame way.

So Move 1 goes from 0-D to 1-D and Move 2 goes to 2-D so its Flecks lie flat. Well, no, I'm thinking of them *in* 3-D. Unlike me they exist *in* only two. And yet, I think, they have the property of volume? Every time it gets confusing I think 2-D and it sorts itself back out.

I see the power of his point about no edge. Of course it isn't his, it's Einstein's. And I see a further implication. It means that at Move 3, which *is* 3-D, the ribbon-ring must run through the new Flecks. The Flecks are all connected. The marvel of it is this ring needs no assumptions. In fact it avoids the new assumptions that he *would* need if there were to be an edge.

My mock-up's clumsy as I turn it in my hands. With its help though I can

close my eyes and form and hold a growing vista as the universe begins. And as my mental image does its perfect dance I see much further, far beyond Move 3! I see that every Move forever has each Fleck Linked this same way by this same ribbon, these same two dimensions. The Link-ring says about our world: A ribbon runs through it. Maclean might have liked the pun. This is no ordinary ribbon. It's two miniscule dimensions bleeding through the Windows between pairs of Flecks. By this Fleck-wise bleeding they are strung through space. No matter where I care to start—in which Fleck, that is—this 2-D ribbon-ring runs zigzag through each other Fleck exactly once and links up right back in that selfsame Fleck where I begin. It's mind-boggling. But now I have the freeze-frame hang of it, it's inescapable.

I wonder. Is this what 'entangled' means? Well, no—I know it's all just speculation. I turn back to admire my eight-Fleck ring with eight gold Links through eight Windows when he fires off his second salvo.

"What about the other Windows?"

He does know how to bring me to a grinding halt. Is it to deflect him that I choose to check the time? Almost one. Ten minutes too late to catch the last train. It won't be the first time that I work right through but I will need to eat.

A brisk walk buys me time to think. His question lingers. I know what he means. The Manifold has *six* dimensions. But what *can* I say about the other Windows? Are there, foam-like, lots of Windows? Or must each Fleck stop at six?