

# THE FINAL CUT

The idea of an indivisible, ultimate atom is inconceivable by the lay mind. ... The only true atom, the only thing which we cannot subdivide and cut in half, is the universe. We cannot cut a bit off the universe and put it somewhere else.

Samuel Butler (1912)

at-om-ism *n* [fr. Gk atomos, indivisible, atom] : PHILOS. a theory that the universe is made up of tiny, simple, indivisible particles that cannot be destroyed

Webster's New World College Dictionary (1953)

Perhaps there [is] no such thing as an indivisible particle.

Werner Heisenberg (1972)

Democritus: Have you seen anything inside quarks?

Mercedes: (shaking her head, smiling) As far as we can tell, quarks and leptons are as good an approximation to points as you can get.

Democritus: (jumping up and down, clapping, laughing hysterically)

Atomos! Finally.

Leon Lederman (1993)

It has been demonstrated repeatedly that the differences between supposedly fundamental particles are, in fact, merely consequences of the composite structure of underlying reality. ... The difficulty is that, as such a process does not have an end, we can continue to suppose that below the currently understood structure is another set of *more* fundamental particles.

Jonathan Hackett (2008)

This morning I am staring at North Hollywood and thinking his Beginning shows that Butler has it right. The universe is a true atom; no bit can be cut from it and put somewhere else. When, at Move 1, the Manifold sets out to multiply, the fact there is no 'somewhere else' makes space. And who's to argue with a universe? Flecks multiply apace. How long does this go on? A femtosecond or a thousand years? Whatever. He insists it goes on to this day. It's why, he says, the universe is still expanding. No need for six idiosyncratic stages; it's all one.

It takes four hundred thousand years for the Beginning to give rise to atoms of the kind found everywhere in stars these days. In due course some of them breathe life into philosophers and physicists and movie stars. From stars to stars

this progress is well understood. This understanding started with philosophers. I went through this before with Other Frank. Before the atoms get their physicists together, Greek philosophers discuss what happens when they cut a bit of matter—maybe feta—into ever smaller chunks. They wonder whether this will end with Something that's uncuttable. It's an idea that they call *a-tomos*, meaning can't be cut. Their question stays in play for some two thousand years. Then in 1905 it is, I'm unsurprised to find, Einstein who shows that *a-toms* do exist. Chalk up one more for the Greeks.

When physicists get hold of atoms they set out to cut them up to find what makes them tick. And cut. And cut again until it seems that all that's left of this fine Greek idea is its name. So now I ask of his Beginning: Can it stop the cutting? Is the specter of unending cutting true?

The cuts get going in the latter 1800s. Physicists cut bits off atoms. They're called electrons. They are charged; convention calls them negative. Keep cutting and an atom runs out of electrons. What's left is called the nucleus. Its charge is positive, exactly equal to the total of its lost electrons. It's far smaller than an atom—a few quadrillionths of its volume—but it carries almost all the mass. The cutting builds a picture of the atom. At its center is the nucleus with the electrons weaving round it in an organized but quantum-fuzzy web. It's said that most of every atom's empty space but Frank would beg to differ. He'd say every atom's *full* of space.

The nucleus soon gets cut up. It's made of protons (positive) and neutrons (neutral). Physicists invent more energetic tools for atom smashing. It's a crude investigative strategy. It works: By the 1960s physicists are cutting protons into quarks. Neutrons will soon follow. One result of physicists' successful subdivision of the subdivided atom is that people start to gossip. For example, the *Sakata* school says matter *should* be made up of—as Swift's flea-bitten entomology suggests—an infinity of sub-sub-levels hidden under each new basement floor. One might wonder: Could it be the Greeks don't know their cheese? Maybe the atom's artfully constructed like an endless nested Matrioshka doll, a perpetual employment plan for physicists.

"It's not."

He wakes up with a self-assured opinion. This begins to be annoying but I think I must agree. Surely the Beginning brings an end to atom cutting. It shows nothing can be smaller than a Fleck. This leads me to a thought—an echo as it were of Butler. A Fleck is after all a copy of his Manifold. There is no way to subdivide it. Butler brings another way to say the cutting's at an end.

"But what about a particle that's *in* a Fleck?" he asks. A pause. And then: "What about *two* particles?"

Well, I've had a little time to think about his particles. They beg the question: What's a particle? Could it be that particles are *made* of Flecks? To tell the truth I never did much like his concept of Pooharticles that hang around in Flecks. It's not just that they're silly, which no doubt is his intention. Somehow the idea of a thing that gets inside a Fleck seems wrong. Surely it must violate the Primal Principle, the very principle that got us here. So, I don't know precisely what a particle may be but my bet says it won't go in a Fleck.

"Who says it's *in* it?"

Actually, I thought he did. I'm sure he did.

"Oh that," he says diffidently, "is only my manner of speaking. In, on or around. They all mean the same thing at that scale. Nothing whatsoever."

Does he mean to be provocative?

"Particularity must be a property of Flecks."

Now *that's* provocative. The idea; not the meaning he is giving to the word. But the issue, well, my issue, which he's trying to gloss over, is: Is it a property of *single* Flecks? Of course the only Fleck that *could* be single was the universe before Move 1. Every Fleck since then has company like party animals who won't go home. To my way of thinking it comes down to this: Is there mass in the Beginning? Can he cut it into Manifold and mass? I don't see how.

"Does *inside* have a meaning in the Manifold?"

He sounds bored though I suspect it is another affectation. But he has a point. We think we are *inside* the universe but surely inside needs an outside to have meaning. For the Manifold there is no out so what does 'in' mean? This sounds like a picky presidential question so I let it go. In the Beginning I'm not sure that mass has meaning either. Yet it seems to me there *is* a question here that I'm not able to pin down.

"Are particles a property of space or of its pieces?"

Okay, now that may be what I am after. Knee-jerk I'd say: Of space. And I remember someone—was it Smolin?—saying that it must be all about relationships. A relationship, it seems to me, takes two. Or more, which can get messy, but with Flecks it seems to be just one-on-one. Each Fleck has several Windows; I figure at least four. That's it: Each represents a one-on-one relationship that's Fleck-to-Fleck. But a particle? It can't sit in a Window. It must be a property of space. Which brings me to the question that keeps troubling me. What *is* a particle exactly?

"It can wait."

Oh yes, my lord and master. Hammerstein, I shift the thought before he catches it because he's right again, it *can* wait. We have what we want: No particles in Flecks and thus the *a-tomos* exists. Somewhere outside the Fleck must

lie the final cut. I'm filled with awe as his Beginning shows us things no one will ever *see*. Sufficient to the day these revelations. Wearily I head home early. Meaning only not so late.