ON THE HOLE

We have already had the example of the big-bang singularity in the remote past, which seems not to be avoidable. The "disaster" to physics occurred right at the beginning.

Roger Penrose (1973)

At present … the question of what happens inside of a black hole when quantum effects are taken into account remains unresolved.

Lee Smolin (1997)

The Spacetime singularities lying at cores of black holes are among the known (or presumed) objects in the universe about which the most profound mysteries remain—and which our present-day theories are powerless to describe.

Roger Penrose (2004)

Of more immediate interest—and concern—is the possibility that we might be able to fabricate our own black holes.

David Darling (2006)

It is unlikely that anyone will ever detect a black hole shrinking.

Leonard Susskind (2008)

The energy's so dense, it could trigger all kinds of things. It could trigger mini-black holes … but let's not worry too much about that.

James Pinfold (2010)

It's not that I ignore his latest question. Come the morning, I still don't know what to think. I forge ahead to tackle the next topic on my list, her favorite, black holes.

To start with I should say that Susskind may have overplayed his hand. In fairness, his eye is on *big* black holes, the kind that he calls astronomical, and big black holes are cold. They are the coldest objects anywhere. Their cold makes their surrounding space look like a blaze. Cue Hawking, who shows how black holes are radiating frozen photons. They're so frozen each must have a wavelength longer than the Solar System. So the influx of the far-more-energetic cosmic background radiation will keep even starving black holes growing for ten trillion years. And big black holes don't starve, they swallow stars. Thus so far Susskind seems to be on solid ground. But he puts me in mind of something else I read: The LHC may make black holes.

If so, they will be very small. This makes them hot. Maybe hotter than the world has ever seen. It's likely—CERN says certain—they will quickly fizzle. Question is: What sort of sizzle will the fizzle give? Though there are theories, no one can be sure. If the sizzle's made of photons they'll be very energetic—the hardest of hard radiation. Dr. Seuss would surely have a field day with this story: Some sizzle will be sited in the middle of the biggest sizzle sensors in the world. They in turn are sited in the tunnel-circle of the LHC. If a sizzle hits a sensor Dr. Susskind may wish he had been more careful with his words.

But the dawn of the Beginning brings a brand-new black-hole question: If not zero, what's its size? Is it Fleck-size? Is it bigger? Could the sizzle give an answer? Could the LHC say something about this?

"What can we say about the size?"

He asks this in the evening as I leave the office. I can think of nothing else the whole way home. I know I don't know near enough to find the answer. But this doesn't stop me working all night long.

What he's asking me is more or less my question: What happens to a black hole's mass if it's not squished to zero? If it isn't packed in no space, what space *does* it occupy? I assume that this is what he means by size.

I think again it can't be smaller than a Fleck. My next thought is it should be not much bigger. If the pull of packed-in mass is strong enough to scrunch it down to zero size—if space would let this happen—it should scrunch it to a tiny size if space will not. I brace for some sarcastic question. Nothing happens. Hawking gives me comfort, saying GR 'may require modifications on the Planck scale, but I don't think that will affect many of the predictions that can be obtained from it.'

What keeps me up all night is that this may be wrong. It needs a proper calculation. I can't find where anyone has done it. Does it matter? Maybe not. I could just say that this is not our Problem, but he wants to keep on digging.

The two tentative conclusions—it's not smaller than a Fleck and not a whole lot larger—have me thinking of black holes as a few Flecks with lots of matter in them. A quintessential quantum system. Black holes need new description. Meantime, is there any more to say?

"Is the black hole a quantum system?"

I just said so. Physics says so. Anything can be a quantum system, even a black hole. Big systems are more complex and less interesting so few care to waste their time. Then suddenly I realize he isn't asking about *a* black hole. *The* black hole is what he said, I'm sure.

He isn't thinking of the matter, he is thinking the event horizon, he is thinking Flecky thoughts. He means if a real black hole has an event horizon, then at any Move each Fleck is either in or out. He means even more than that—my mind is racing—he means what defines a black hole *isn't* the mass in it. It's its Fleck number—that's what he's thinking—the number of space quanta it's secluding from our space. Can he prove it? I don't think so. Does it matter? I can't prove this either but I bet it does.

The onshore wind is late this evening and my thoughts are running far across the choppy Channel when another insight leaps to mind. The claim that Mach makes GR necessary is a cover story. Einstein has no reason for invoking Mach. *What* does it cover? GR was his Big Leap.