

INSIDE THE BOX

by Edward M. Lerner

Edward Lerner's novels include *Probe*, *Moonstruck*, and (in collaboration with Larry Niven) *Fleet of Worlds*. His short fiction has appeared in *Analog*, *Artemis*, and **Jim Baen's Universe** magazines, on **Amazon Shorts**, in the anthologies *Year's Best SF 7* and *Future Washington*, and in his 2006 collection *Creative Destruction*. He tells us that in the pipeline are the novels *Fools' Experiments*, *Small Miracles*, and (with Larry Niven) *Juggler of Worlds*. In his first story for *Asimov's*, the author looks at the complicated and strange goings-on...

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The lecture hall was pleasantly warm. Behind Thaddeus Fitch, busily writing on the chalkboard, pencils scratched earnestly in spiral notebooks, fluorescent lights hummed, and feet shuffled. A Beach Boys tune wafted in through open windows from the quad.

Or so, in any case, the professor imagined the lecture hall. Chattering, muttering students squirming in their seats this morning drowned out the customary sounds. Or what he thought he remembered to be the customary sounds...

Chalk squeaked as Thaddeus, with more energy than artistry, began sketching a stick-figure quadruped. "I'll explain this cat momentarily, class." Shrodinger's thought-experiment cat. Today's Introduction to Physics lecture introduced the counterintuitive topic of quantum mechanics. "Recall from your reading that the behavior of atoms and their constituent parts cannot be fully described by such conventional characteristics as position and momentum. More precisely, how we think about those descriptive terms must change." He continued drawing as he spoke, the cube in which he was attempting to enclose the cat somewhat out of perspective. He winced as the chalk snapped, its tip caught by the hole that should not be there. Should it?

"In classical physics, we can, with sufficient care and expense, measure to arbitrary precision the position and momentum of any particle. At sufficiently tiny scales, however, nature does not behave as we expect. Instead, in those infinitesimal domains, we discover that certain parameters exhibit heretofore imperceptible granularity or lumpiness—what physicists call quantization. Further, we cannot measure at quantum scales without influencing whatever is being measured. The math is inappropriate

for”—beyond—”this class, but a consequence of quantization is that we cannot have absolute knowledge of subatomic particles.”

His crude diagram complete, Thaddeus pivoted to face the packed auditorium. “If we know an electron’s position quite exactly, we can know little about its momentum. If we know its momentum, we can tell little about where it is. We are reduced to probabilistic descriptions of where the particle may be, and where it may be going.” Doggedly, he ignored the arm waving from the second tier of seats. “But can this uncertainty manifest itself in the macroscopic world we experience? That is what Erwin Shrodinger set out to consider....”

“Professor.” Young Mr. McDowell’s tone, although respectful, was quite insistent. The sophomore stood to emphasize his seriousness. “We—the class, that is—we feel we should discuss yesterday’s events.”

A flood of ... memories? ... displaced whatever the student said next. A near-miss handgun attack. A flung knife by chance impaling a pigeon inopportunately availing itself of the open window. A hurtling hand grenade vanished in mid-arc.

Thaddeus shook himself by the mental lapels. *Nonsense*. Pointing at the board, he continued. “Returning to today’s subject, Dr. Shrodinger devised a thought experiment to illustrate quantum uncertainty. My cartoon reveals the inside of the box, but imagine that its walls are quite opaque, quite impenetrable.” Beside the stick-figure cat, he drew a tiny square. “This mechanism contains a bit of radioactive material. Detection of a single radioactive decay,” and he tapped the board once with his chalk stump, “releases poisonous gas.”

He was explaining a decay event as a particle’s spontaneous emission from an atomic nucleus—a manifestation of positional uncertainty—when murmurs of protestation stopped him. Hairs rose on the nape of his neck. In the otherwise jammed hall, one cluster of seats remained unoccupied. It was where *something* had happened.

Only it couldn’t have.

Mr. McDowell was still, or once again, on his feet. He followed Thaddeus’ gaze to the empty few chairs. “We don’t understand abouthimeither, sir. The ... intruder.”

Heads nodded. Voices rang out in agreement. A hundred pairs of eyes beseeched Thaddeus. He relented. “My unborn grandson, you mean.

It's impossible, you know."

"But professor..."

With outstretched arm and firm voice, Thaddeus interrupted. "You know what you saw, you were going to insist. What you, and your colleagues in later sections of the class, all saw. Or what, rather, you've now *convinced* yourselves you saw, after repeated retellings of the tale." He lowered his arm and voice. "Surely there is a simpler explanation than the impossible.

"A time-travel lecture, illustrated with the grandfather paradox, in a hot, stuffy classroom. A passing car backfires. A guest audits the lecture, someone with red hair like mine. Thrill-seeking students attend later sections of the lecture, and their rumor-fed expectations stoke our own fevered imaginations."

Thaddeus took a deep breath. "What I, too, admit to remembering did not happen. It *cannot* have happened. This can only have been an instance of mass hysteria."

"Like UFO sightings," someone called out.

"Or the Salem witch trials," Thaddeus agreed. Better a moment of soft-headed gullibility than to deny causality. Not that he cared for either of his options...

Young McDowell persisted. "Professor, the blackboard has a *bullet hole*. And how do you explain that the attacks stopped? They ended—you ended them—when you announced you would never have children."

Thaddeus braced himself against his lectern. "A hole was surely in the board all along, unnoticed until the suggestive backfire. And our visitor likely vanished by no more mysterious a means than," and he gestured to the rear of the auditorium, "that rear exit door." Still, his memory insisted his doppelganger had disappeared—to the future?—from beneath a pile-up of angry students. "Would *you* choose to re-experience our welcome?"

That drew nervous giggles.

"Ladies and gentlemen, yesterday we spoke about cause and effect. Now you claim that my grandson traveled through time to kill me, and that I defeated his attack by my declaration I would have no children.

“If so, no grandson ever traveled back to cause my decision. Will I still make that decision? Might I now *have* children?” Doubts blossomed on their faces, and he hammered the figurative nail into the metaphorical coffin. “How, if I halted the attacks by deciding never to have children, can *you* remember my grandson?”

Whispering stopped as Thaddeus rapped the oaken lectern. “Back to Shrodinger’s cat. Has an electron, its exact position uncertain, chanced to manifest itself outside an atomic nucleus? That is, has a radioactive decay occurred to cause release of the poisonous gas? Remember, we cannot see inside the box. Class?”

Confusion returned, but of a more academic nature than the controversy just concluded. (Concluded, mocked some corner of Thaddeus’ thoughts, or simply set aside?)

“A show of hands, please. Who thinks the cat is alive?” A few hands rose tentatively. “And who thinks the cat is dead?” More hands. “Not everyone expressed an opinion. Do the rest of you imagine it’s a vampire cat—the undead?”

The chuckle was overlong and overloud. He wasn’t the only one still on edge. “In the closed system of the sealed box, we cannot know the cat’s status. Neither living nor dead *is* the correct answer—at least by the formalism of quantum mechanics. There is only probability until the box is opened and an outcome observed. Until then, all possible outcomes are said by physicists to be in superposition.”

A familiar arm waggled. Thaddeus managed not to sigh. “Yes, Mr. McDowell.”

“But what does it *mean*?”

“The math of quantum mechanics is crisp, beautiful, and wonderfully predictive. What is not clear,” what not even Albert Einstein could discern, “is the physical meaning of that mathematical formalism. Some argue that to ask the question is impermissible. Some assert that the realm of quantum mechanics is so removed from our senses we’re unequipped to judge.” That, of course, was why Shrodinger devised the cat in the box. A cat is not a subatomic particle....

Why did his mind keep wandering?

“There are several interpretations, all unprovable, of the mathematical formalism. Living or dead: To have but one outcome when the box is opened is unaesthetically asymmetric. Hence, one theory has it that both outcomes occur—which implies the spawning of another universe. More generally, whenever an uncertainty at the quantum level must resolve itself into a particular result, *the* universe itself must split into *many*, one to instantiate each possible outcome. If we, the occupants of one universe, unseal the box to let loose a live cat, in another universe, the occupants must encounter a dead feline.”

More murmuring. This time Thaddeus let bewilderment run its course. As young minds grappled with countless myriads of branching universes newborn each moment, into Thaddeus’ own churning mind popped the vision of two commingled universes. Of two possible professors in superposition. From what source might free will arise, except for quantum uncertainty?

Children or not? Memories or hallucination? A bullet hole or just a hole?

Clanging yanked his attention back to the lecture hall. An unseasonably warm autumn day and an alarm: almost surely a fire drill. “Attention, everyone! Leave in an orderly fashion. Assemble on the quad.” Thaddeus watched the students stand, form lines, file efficiently from the room, his eyes sweeping from exit to exit to exit. His thoughts remained in turmoil.

“Mr. McDowell!” The lad was at the blackboard. Had he likewise concluded this must be a fire drill? “Cease your foolishness and go now.” Thaddeus’ eyes resumed their sweep. When his gaze next touched the front of the auditorium, the area was empty. A hastily scrawled phrase had appeared below Shrodinger’s cat. He squinted to read it.

Now what had he been thinking about?

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The students filtered back from the sunny quad into the hall. A few glanced unsubtly at the wall clock. The hour was almost up. He could have dismissed them straight from the quad, instead of squeezing in a final few minutes of lecture.

“A pleasant day for a fire drill.” Thaddeus picked up a piece of chalk.

“Where were we?”

Tittering erupted as he looked to the flawless blackboard. His face, thankfully hidden from the class, reddened. “Quite clever.” He briskly erased the scribbled graffiti that had appeared beneath his crudely drawn sketch of Shrodinger’s cat. The chuckling grew. “Very clever, indeed.”

He wished he *had* dismissed them from the quad. A minute later the bell rang, ending the session. Grinning students in twos and threes bustled from the hall.

His humble drawing followed the student witticism into oblivion. Not that it mattered; the caption had been memorable enough. Straightening a sheaf of lecture notes, Thaddeus wondered whether even Einstein would have agreed.

“The *cat* knows.”