## The Nonexistent Paradoxes of Time Travel

Apparently the first story to hint at the paradoxes of time travel was Edward Page Mitchell's "The Clock that Went Backward," which appeared in a New York newspaper, *The Sun*, in 1881. Most of the action takes place in Leyden, the Netherlands, where a 300-year-old clock made by one Jan Lipperdam sends the narrator, his cousin Harry, and their professor, Von Stott, back in time to the historic siege of 1574. Events suggest, although with much uncertainty, that Von Stott *is* Lipperdam, and that Harry is his own greatgrandfather.



This clock has seen a lot of time go by. (Photo by Cami)

These are foreshadowings of paradoxes that have

long since become traditional: the grandfather paradox and the causal loop (or bootstrap paradox, named after Robert Heinlein's 1941 short story "By His Bootstraps").

The grandfather paradox raises the possibility that a man could return to the past and kill his own grandfather, an act that should have pre-erased him. The causal loop is often illustrated with the tale of an inventor of a time machine who uses it to return to his past, where he teaches his younger self how to build it. How, except from his future self, did he get the information?

Some kinds of time travel are both real and commonplace. If a scientist brings an atomic clock aboard a jet plane and flies around the world, velocity makes her clock run slower than an identical clock on the ground tended by her twin sister; she thus returns to Earth in her sister's future.

This is the so-called twin paradox, which is not a paradox at all but a straightforward result of Special Relativity. The clocks aren't necessary; they're just there to prove that people in the speeding airplane, or space shuttle, or some future rocket to Andromeda, really do travel into the future of those they leave behind, whether by nanoseconds or centuries. Many experiments have proven the reality of such outcomes.

Travel to the past is another matter. Even if not impossible, it would require tremendous energy and expense—not to mention unlikely circumstances, such as wormholes that don't annihilate everything that falls into them.

So far, visits to the past have happened only in fiction. If the protagonist gets whacked on the head (Twain) or runs into a chronosynclastic infundibulum (Vonnegut), it's probably a work of satire. If the author hand-waves about time machines, black holes, spacetime continua, or genetic disorders, it's a science fiction story. However much real science there may be elsewhere in the story, there's little or none in the mechanism for traveling back in time.

Philosophers love it anyway. In 1976 David Lewis published an essay titled "The Paradoxes of Time Travel." With typical bluntness, he begins, "Time travel, I maintain, is possible. The paradoxes of time travel are oddities, not impossibilities." He's not talking about practical difficulties but logical ones. "I shall be concerned here with the sort of time travel that is recounted in science fiction."

Lewis is beloved of fiction writers (at least this one) because of his argument—stated in his 1978 essay, "Truth in Fiction"—that "worlds where the fiction is told, but as known fact rather than fiction," are not only possible worlds but real ones.

Unlike the twin (non)paradox, however, the paradoxes of travel to the past are widely thought to render these fictional worlds impossible. Lewis deals with this objection by distinguishing two kinds of time, external and personal. External time deals with the real world, personal time with the time traveler's experience. "We can say without contradiction, as the time traveler prepares to set out, 'Soon he will be in the past."

With this simple distinction, Lewis demolishes the grandfather paradox. In neither the linear passage of external time nor the loops and leaps of the time traveler's personal time is continuity ever interrupted. Lewis posits a time traveler named Tim, who is motivated and able to kill his grandfather. But "Tim cannot kill Grandfather. Grandfather lived, so to kill him would be to change the past. But the events of a past moment ... cannot change."

There's no such simple solution to the causal loop, since it too respects the demands of both external and personal time. Causal loops are possible, says Lewis, but they don't matter. Where did the information come from in the first place? There is simply no answer.

The parts of the loop are explicable, the whole of it is not. Strange! But not impossible, and not too different from inexplicabilities we are already inured to. Almost everyone concedes that God, or the Big Bang, or the timely decay of a tritium atom are uncaused and inexplicable, yet possible. Why not also the inexplicable causal loops that might arise in travel to the past?

In this blithe paragraph, Lewis puts his finger on one of the central tenets of real science, namely, that there is a profound difference between the inexplicable and the impossible.

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