# BOOKS & ARTS

## The father of parallel universes

**Robert P. Crease** is fascinated by a biography of quantum physicist Hugh Everett III, the difficult man behind one of the most logical and bizarre ideas in the history of human thought.

**The Many Worlds of Hugh Everett III: Multiple Universes, Mutual Assured Destruction, and the Meltdown of a Nuclear Family**
by Peter Byrne
Oxford University Press: 2010.
348 pp. $45, £25


COURTESY OF M. EVERETT

Hugh Everett III: his 'many worlds' theory was ignored for years after it was published.

The 'many worlds' theory of quantum mechanics is one of the most logical, bizarre and ridiculed ideas in the history of human thought. In *The Many Worlds of Hugh Everett III*, investigative journalist Peter Byrne details the short, fragmented life of the physicist who created the theory. A compulsive model-builder, Hugh Everett III "burned to reduce the complexity of the universe to rational formulae". Yet while he tried to grasp everything through physics, he kept losing track of his own life.

Everett entered Princeton University in 1953 to study mathematics, attracted to the new field of game theory. A year later he switched to physics, intrigued by quantum mechanics and its measurement problem. Quantum mechanics uses a wave equation to encapsulate the protean qualities of the microscopic world, which it represents as a superposition of many possible states. Whenever such a quantum system is measured, or interacts in any way with the classical world, it abruptly adopts one of these states, corresponding to a particular observation.

In the prevailing explanation for this strange quantum behaviour — the Copenhagen interpretation, promulgated in the 1920s by Niels Bohr and Werner Heisenberg — the wave is not a physical entity but describes the probabilities for each possible measurement. The superposed states collapse when a reading is taken and an outcome is realized. The Universe is cast in this interpretation as a cosmic apartheid, split into a determinate real domain and an indeterminate quantum domain. The measurement switch between them is abrupt, magically eliminating all possibilities bar one.

In his 1957 doctoral dissertation, written under the supervision of John Wheeler, Everett found a simple yet outlandish way to avoid this bizarre collapse of the wave function. When a quantum system is measured, he proposed, the alternative possibilities don't vanish — the system splits into a series of parallel, almost-identical worlds. Each of these worlds itself keeps branching as more measurements unfold, the junctures being at every place where the quantum domain contacts the classical world. "Schizophrenia with a vengeance," wrote one of Everett's sympathizers.

Everett's idea wasn't taken seriously, even though it worked. Fellow graduate student Charles Misner recalls that "no one could fault his logic, even if they couldn't stomach his conclusions", adding that: "The most common reaction to this dilemma was just to ignore Hugh's work." Everett left the field and never published on quantum mechanics again.

Fortunately, the cold war created a market for game-theorists and modellers, who worked in military research to chart the possible outcomes of nuclear war. Here Everett found respect, having invented an 'Everett algorithm' to improve on the traditional Lagrange multiplier method for calculating consequences in logistics problems. Starting in 1956, he worked for the Pentagon's top-secret Weapons Systems Evaluation Group, devising nuclear strategies and estimating the lethal effects of fallout, and from 1964 worked for the Lambda Corporation, another military think tank.

Years after its publication, Everett's take on quantum mechanics was the subject of a 1970 article in *Physics Today* by theoretical physicist Bryce DeWitt, who named it the 'many worlds' interpretation. The catchy phrase helped attract attention to the idea and made it acceptable to discuss. Science-fiction authors also took note. Before Everett's dissertation, alternative worlds had featured in the fiction of H. G. Wells and Jorge Luis Borges, among others. Renewed scientific interest boosted the theory's popularity in science fiction, where it features still. Neal Stephenson's novel *Anathem* (William Morrow, 2008) is a recent example that uses it as a plot device. Invariably, however, these portrayals cheat the physics by intersecting the branched worlds.

Everett's personal life was as erratic as his career. Byrne describes him as a stubborn, overweight, chain-smoking alcoholic who ignored his children and mistreated his wife. "His objective function didn't include emotional values," says one friend. According to another, "He looked at life as a game, and his object was to maximize *fun*. He thought physics was fun. He thought nuclear war was fun." Or modelling it, anyway.

At the end of his life, the near-bankrupt Everett was writing code for a software program to calculate mortgage payments in various scenarios. He died of a heart attack while drunk. As paramedics carried the corpse away, his son realized that he did not remember ever having touched his father in life. Following

Everett's wishes, his widow threw out his cremated remains in the rubbish. His daughter, who had schizophrenia and married an addict, became addicted to alcohol and drugs herself and later committed suicide.

*The Many Worlds of Hugh Everett III* is short on critical analysis and slightly long on sordid details. There is much championing of Everett and his theories. Byrne's opinions can be heavy-handed, and he casts Bohr and Wheeler as villains. He strains hard to find meaning, proposing that the story of Everett's flamboyant mother Katherine, a pulp-fiction writer with manic depression, "captures the difficulty of being a self-reliant woman in mid 20th century America", and that Everett's life "reflects America's collective personality during the Cold War and beyond".

Byrne does not clearly explain why most scientists find Everett's interpretation to be over the top. "It's an extravagant violation of Occam's Razor," as one of my physicist colleagues puts it. Why postulate uncountable infinities of unknowable, branching universes to address a problem for which there are solutions that prune the branches? Everett's idea is merely an interpretation; it fails to make predictions and cannot be falsified.

The many worlds theory is still garish after all these years. Nevertheless, it is fascinating to read the story of its creator, himself too obsessed with models to intersect effectively with the real world. ■

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# Soft-matter miracles

**Matière sensible: Mousses, gels, cristaux liquides et autres miracles (Sensitive Matter: Foams, Gels, Liquid Crystals and Other Miracles)**
by Michel Mitov
Seuil: 2010. 179 pp (in French). €18

Soft-matter research investigates ambiguous states of matter, the paradoxical properties of which rely on the art of mixture. An emulsion formed simply of oil and water plus a few molecules of detergent gains the stability of a cream. Similarly, foam produced from air bubbles in soapy water transforms those two fluids into an almost-solid state. In *Matière sensible*, liquid-crystal researcher Michel Mitov marvels at the surprising behaviour of these materials.

Rather than naming the book after his discipline, Mitov uses the title 'sensitive matter'. The expression 'soft matter' was coined as a joke in the 1970s by physicist Madeleine Veyssié — indeed, the French term *matière molle* sounds sleazy. However, it acquired a majesty when physicist Pierre-Gilles de Gennes chose it as the title of his Nobel lecture in 1991. From then on, the scientific community was converted.

Mitov's book, in French, begins with a description of emulsions, foams, polymer solutions, gels and colloids. He introduces their first sensitive quality — that tiny quantities of additives can dramatically alter the properties of a liquid. Bubbles and foams are created by adding less than one-tenth of a gram of soap to a litre of water. This blocks the gravitational drainage that would otherwise make these constructions collapse in a fraction of a second. Firemen know that a similar concentration of long polymer chains in water makes jets of the fluid twice as powerful by reducing turbulence in the hose. Remarkably, both of these examples remain partly unexplained: in this field, art often precedes understanding by decades.

The book reveals another form of sensitivity — that many of these critical architectures are easily disrupted. Small causes can generate big effects. Mitov explains how foam can be destroyed by hydrophobic particles; shampooing hair for a second time, for example, gives more lather than the first because the dirt particles have been removed. He also explains how tiny changes in pH or temperature can destroy the lipid capsules that surround many drugs. It is this controlled disintegration that allows drug delivery to specific places in the body.

The control of soft matter is even more fascinating than its architecture. Mitov describes the miracle of San Gennaro, a ritual that has taken place three times a year since 1389 in Naples cathedral, Italy. In the ceremony, a sealed glass ampoule is displayed to the faithful. It contains a brown solid that is said to be the blood of San Gennaro. At the end of the ceremony, the substance often liquefies into a soft gel that looks like wet blood. Mitov describes witnessing the ritual and puzzles at how the miracle works.

The phenomenon is seasonal, the blood being more fluid in warmer weather, implying that the brown material might be temperature-sensitive. Alternatively, the gel's fluidity may be driven by manipulation of the ampoule, as is the case for some Bingham fluids that flow above a given stress, or for thixotropic liquids whose viscosity can decrease as stress increases. Mitov suggests centuries-old recipes for materials that give such behaviour, including spermaceti — a waxy lipid extracted from whales' heads — or clay solutions. But he ultimately allows uncertainty to persist, suggesting only that the sacred 'blood' might contain a blend of both elements.

This emblematic example shows how subtle and smart a complex fluid can be, and illustrates the challenge of understanding these diverse materials. Mitov doesn't say much about the future of soft-matter research. But his book ably reflects a goal of the field — to extract beautiful intellectual challenges from 'dirty' industrial or everyday questions. *Matière sensible* is an excellent guide to the labyrinthine world of soft matter. ■

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S. LAPORTA/AP

**San Gennaro's 'blood' may owe its liquefaction to the quirks of soft matter.**