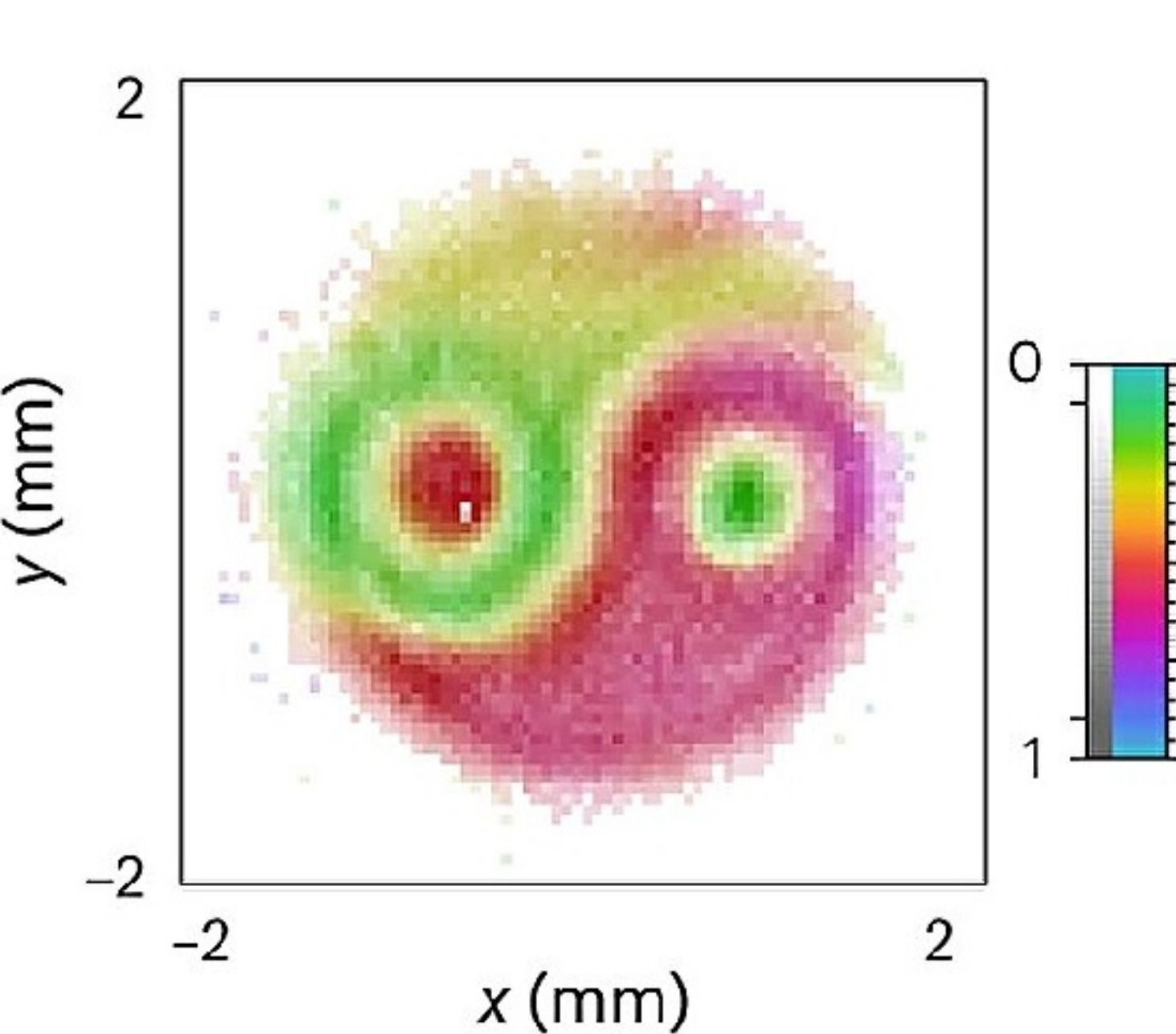


Sacred Geography: Entanglements



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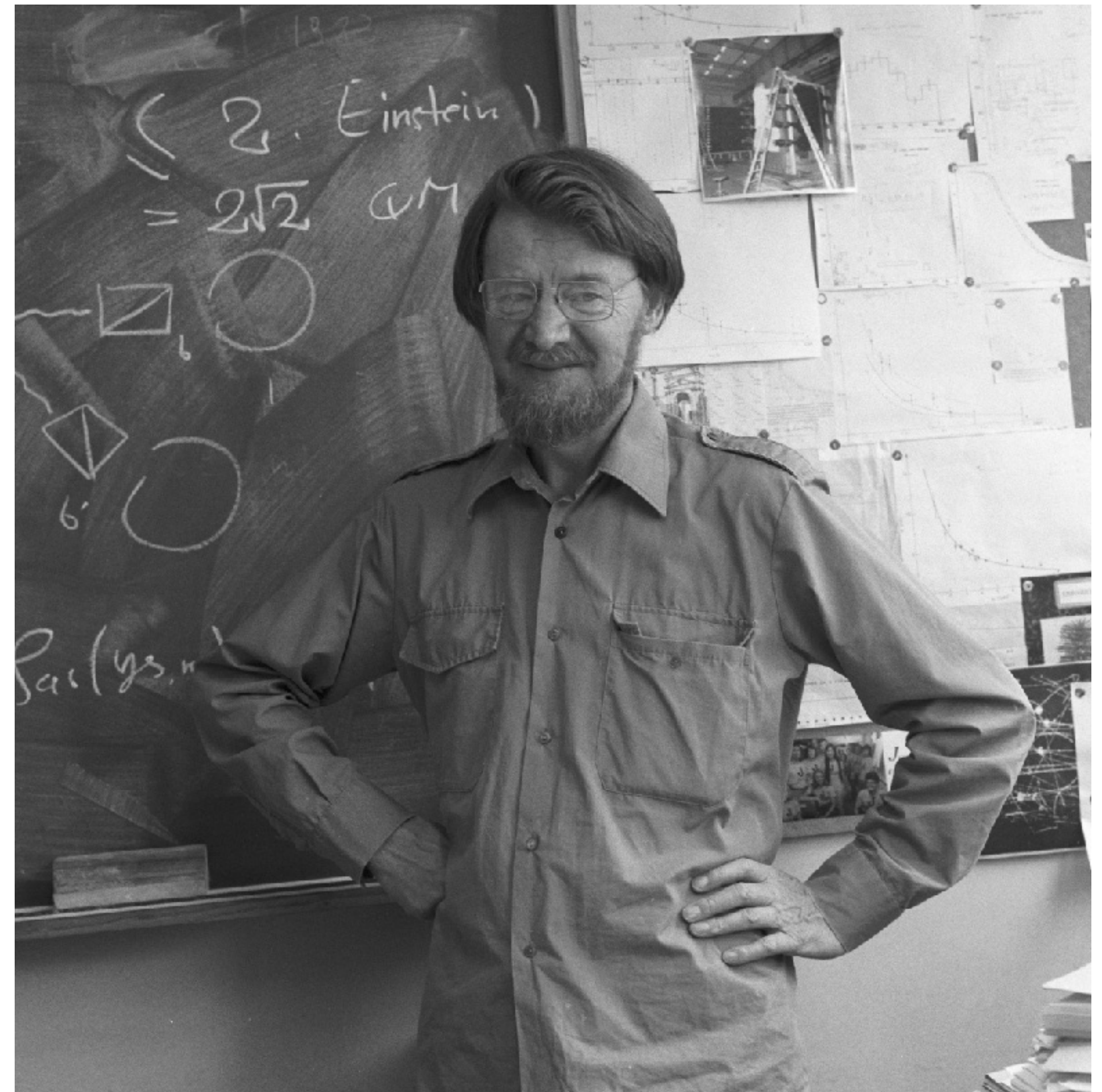
Etymology

- Entanglement.
- tangle (v.)
- mid-14c., *tanglen*, “encumber, enmesh, knit together confusedly,” a shortening of *entangle* in some cases, in others probably a nasalized variant of *tagilen* “to involve in a difficult situation, entangle.”
- From a Scandinavian source (compare dialectal Swedish *taggla* “to disorder,” Old Norse *pongull* “seaweed”), from Proto-Germanic **thangul-* (source also of Frisian *tung*, Dutch *tang*, German *Tang* “seaweed”).



Quantum Entanglement

- Irish physicist John Bell (1928-1990).
- Bell's Theorem - "stipulated that quantum objects that had once interacted would retain some strange link or connection, even after they had moved arbitrarily apart from each other" (Kaiser, 2011, p. xxiv).
- Upended classical way of thinking, e.g. that objects, particles, etc., are independent of each other - separate things.
- Used terms such as "non locality" and "entanglement" to describe this effect.
- Albert Einstein referred to it as "spooky action at a distance" and suggested that it was not compatible with his special relativity.
- Einstein suggested that there must be some form of 'hidden variable' that explains it, whereas Bell suggested a non-local connection.



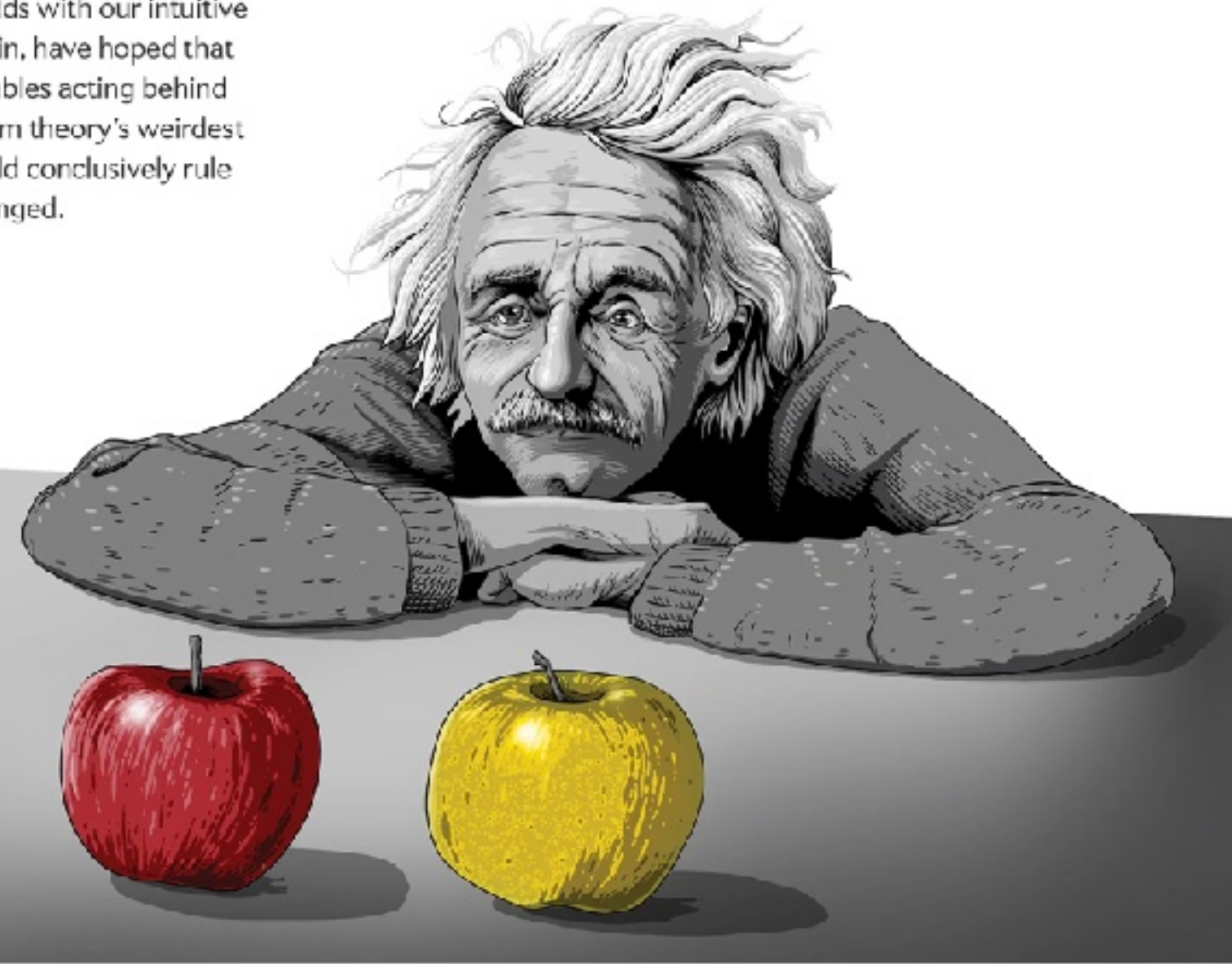
Closing All the Loopholes

Quantum mechanics proposes a universe at odds with our intuitive reality. Some scientists, including Albert Einstein, have hoped that alternative theories with so-called hidden variables acting behind the scenes might explain away some of quantum theory's weirdest implications. Until recently, no experiment could conclusively rule out local hidden variables, but in 2015 that changed.

Einstein's objections to quantum theory rested on two basic principles: *realism* and *locality*.

Realism is the notion that objects have determined properties—an apple, for instance, is red, or it is yellow.

Locality is the idea that objects can only be influenced by their surroundings; influences cannot travel faster than light.



Yet the theory of quantum mechanics suggests that reality is much weirder than that.



According to quantum mechanics, a particle can be in two states at the same time.

For example, a quantum apple ...



... may not be red or ...



... yellow but ...



... a superposition of both.

Particles can even be entangled with one another. That is, if you look at one apple and find it red, the other instantly becomes yellow.

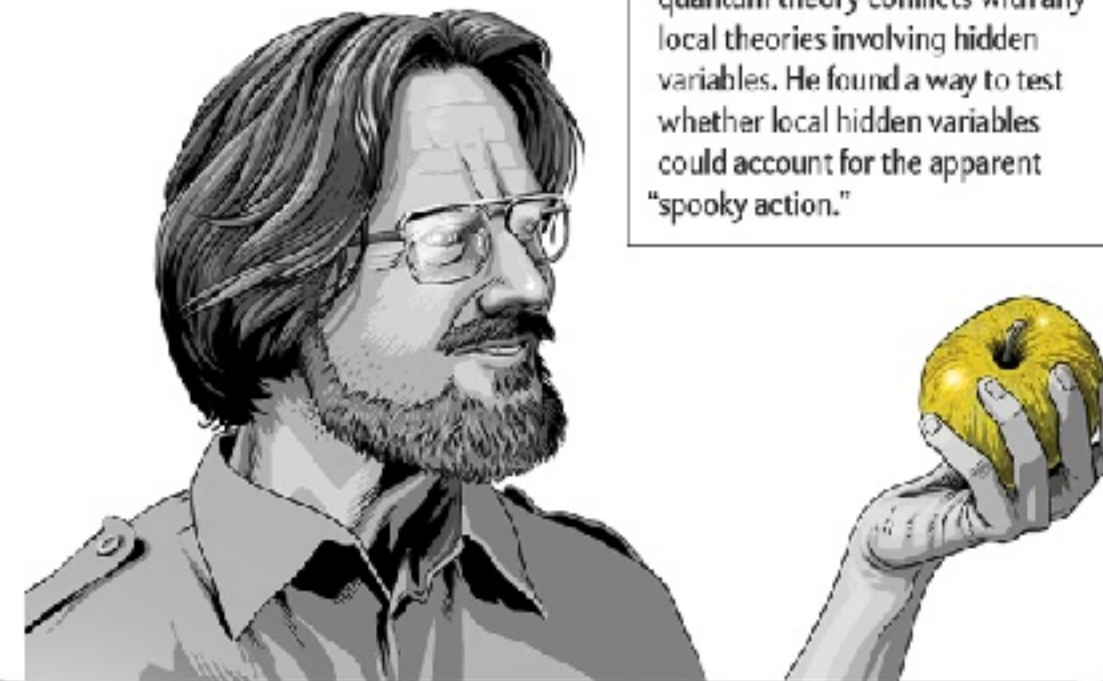
Entanglement exists no matter the distance between particles.

Einstein refused to accept this concept, calling it "spooky actions at a distance."

He claimed there must be local hidden variables, unknown to observers, that control this entanglement because otherwise influences must be traveling faster than light.



In 1964 John Bell discovered that quantum theory conflicts with any local theories involving hidden variables. He found a way to test whether local hidden variables could account for the apparent "spooky action."



The Bell test: Two observers would make separate measurements of two supposedly entangled particles. Bell calculated the maximum amount of correlation that could arise between the two observers' findings if local hidden variables limited by the speed of light were at work.



Experimenters soon got to work putting the test into action. But two loopholes left some leeway for hidden variables.



1. Locality loophole

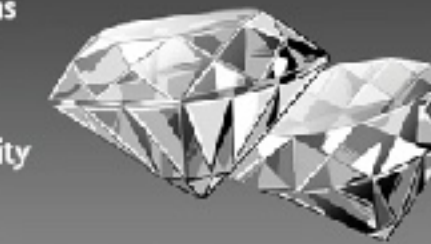
The measurement stations are close enough to allow communication with each other at sub-light speed during a test.

2. Detection loophole

The detectors are only able to measure some but not all the entangled particles.

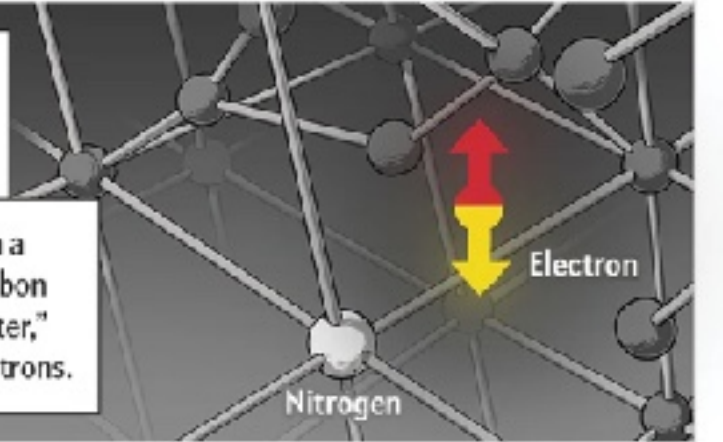
In 2015 several groups of scientists devised versions of the Bell test that close both loopholes.

One, at the Delft University of Technology, starts with two tiny diamonds.



In the nearly perfect carbon lattice of a diamond, there exists a flaw, the occasional nitrogen atom.

In some places, next to such a nitrogen atom there is a carbon atom missing, a "defect center," which acts as a trap for electrons.



Electrons have a spin ...



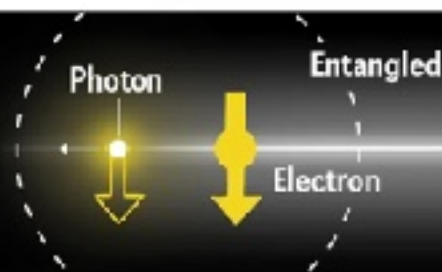
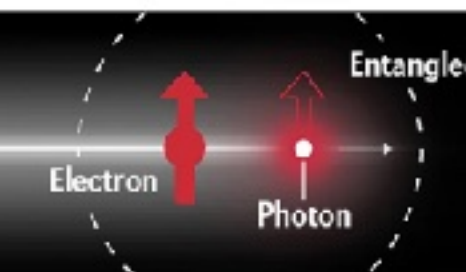
Or in a superposition, both up and down.

Using two electrons, in two diamonds separated by 1,280 meters, scientists can be sure there is no time for communication even at light speed during the time it takes to determine the measurement setting and detect the electron spin.

Locality loophole closed

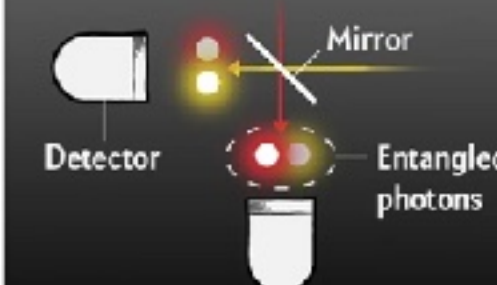


Scientists use lasers to excite the electrons, which then emit photons that are entangled with the spin of the electrons.



Those photons travel across campus until they meet each other at detectors.

When the photons meet, they become entangled. By extension, their distant respective electrons—which are easier to detect and measure than photons—also become entangled.



Detection loophole closed

For the first time, a loophole-free Bell test

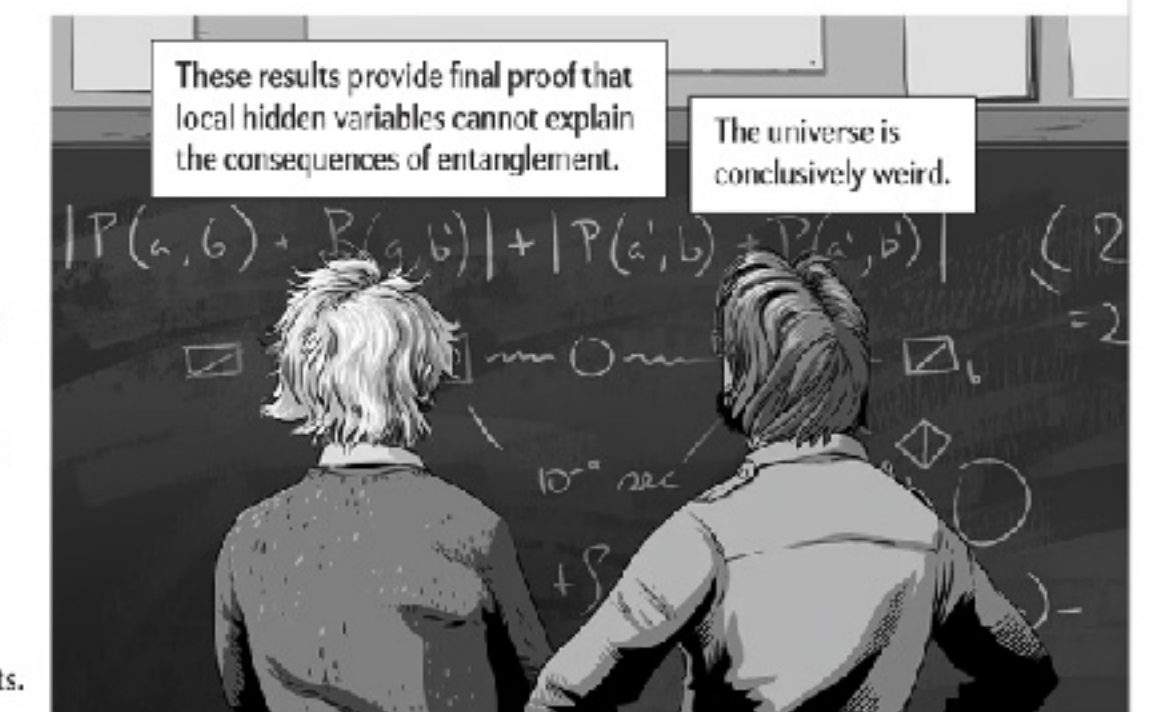


At Delft, scientists ran 245 trials in which a pair of electrons 1,280 meters apart were entangled. They measured the particles in every case and found 80 percent were correlated—significantly more than would be possible with local hidden variables.

Experiments in the U.S., Austria and Germany found similar results.

These results provide final proof that local hidden variables cannot explain the consequences of entanglement.

The universe is conclusively weird.



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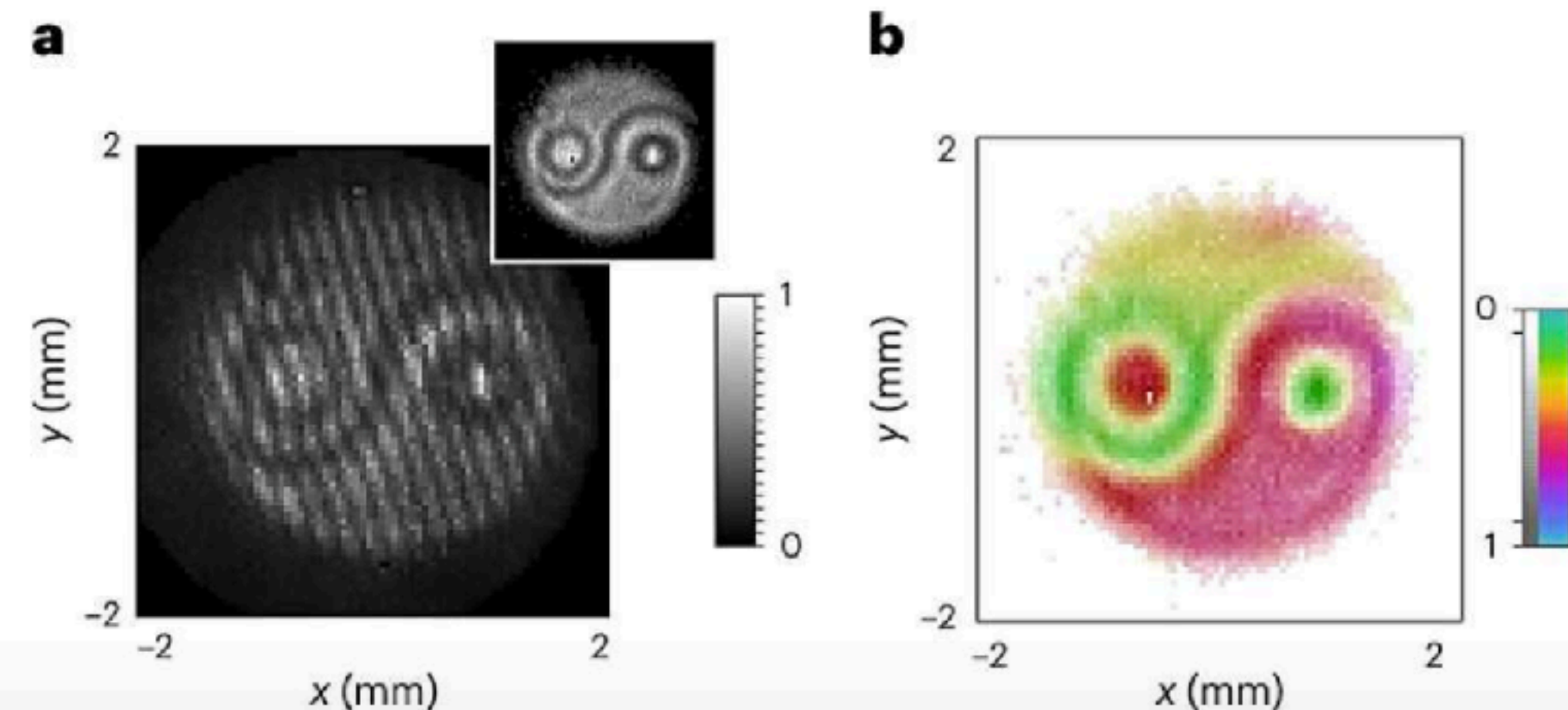
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Scientists achieve world-leading quantum entanglement of molecules

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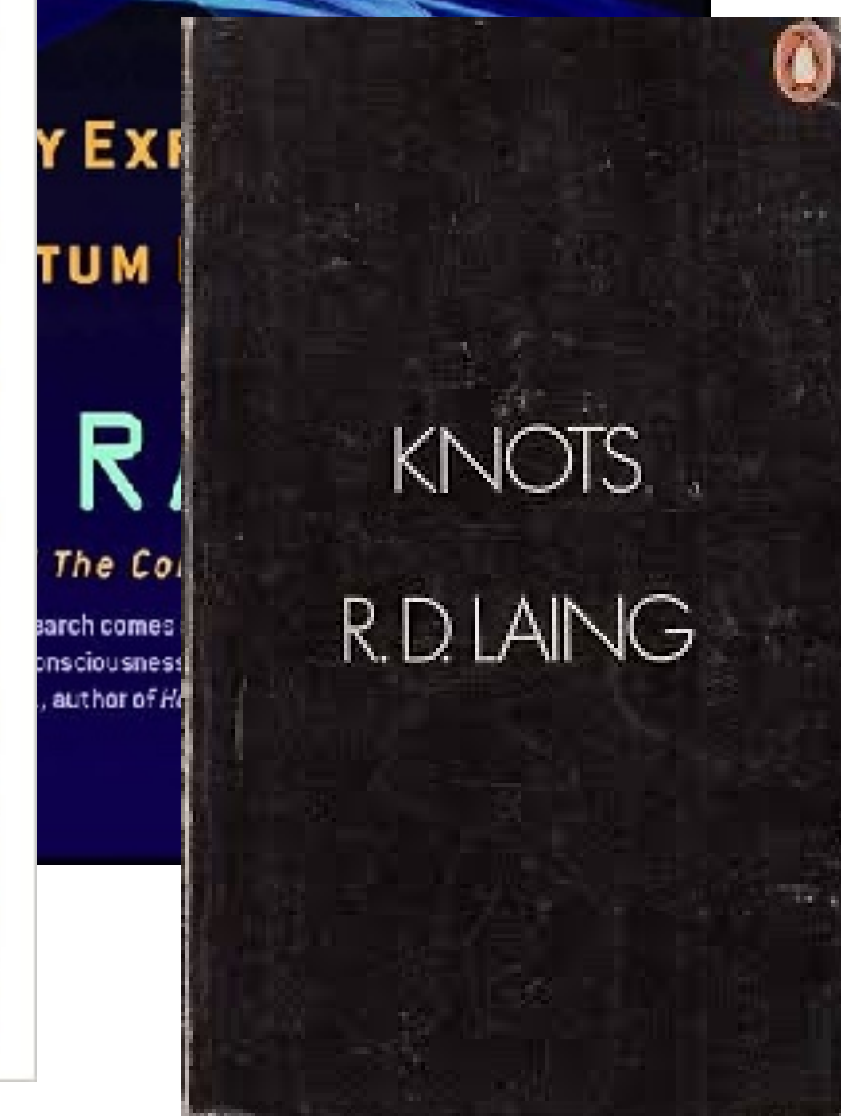
Scientists from our top-rated Physics department have set a global milestone by achieving quantum entanglement of individual molecules using cutting-edge magic-wavelength optical tweezers.

Entangled Minds

- Taking the model of quantum entanglement.
- “Minds are entangled with the universe, so in principle minds can non locally influence anything, including a collection of other minds or physical systems. Individual neurones in the brain combine into networks of neurones, giving rise to complex brain circuits and consciousness awareness (or correlates of awareness). By analogy, individual minds may combine in networks of entangled minds, giving rise to more complex “mind circuits,” forms of awareness, and collective psi effects beyond our conception” (Radin, 2006, p. 270).
- Roots of these lines of thinking go back to the 1960s counterculture, and also to John Bell:

“When pressed to give an opinion on possible connections between parapsychology and his own work on quantum entanglement, John Bell refused to dismiss the matter out of hand” (Kaiser, 2011, p. 167).
- Yale physicist Henry Margenau:

“[...] highlighted quantum entanglement as a likely means of reconciling ESP with action at a distance [...] He wrote with parapsychologist Lawrence LeShan:] “ESP is not stranger than some of the discussions” that had recently emerged in Quantum theory [...] they found no contradictions between well-tested laws and ESP. “We *can* find contradictions between ESP and out culturally accepted view of reality, but not - as many of us have believed - between ESP and the scientific laws that have been so laboriously developed.”” (In Kaiser, 2011, p. 168).
- Minds are also entangled in other ways, e.g. emotionally - R.D. Laing *Knots* - tangles in our thinking, tangles in relationships.



Swarm Intelligence

- Superorganism:

“The basic elements of the super organism are not cells and tissues but closely cooperating animals [...]” (Holldobler & Wilson, 2009, p. 4).

- Swarm Intelligence:

“Swarm Intelligence [...] is a collective behavior that emerges from interaction between individuals in a group. Typical SI includes fish schooling, ant foraging, bird migration, and so on” (Wang *et al.*, 2025).

- “The behaviour of bees, bacteria, glow-worms, fireflies, slime moulds, cockroaches, mosquitoes and other organisms have inspired swarm intelligence researchers to devise new optimisation algorithms” (Parpinelli & Lopes, 2011).

- Human being are also highly social animals:

“An odd parity exists between social insects and humanity. About 6.6 billion individuals compose *Homo sapiens*, the most social and ecologically successful species in vertebrate history [...]” (Holldobler & Wilson, 2009, p. 5).

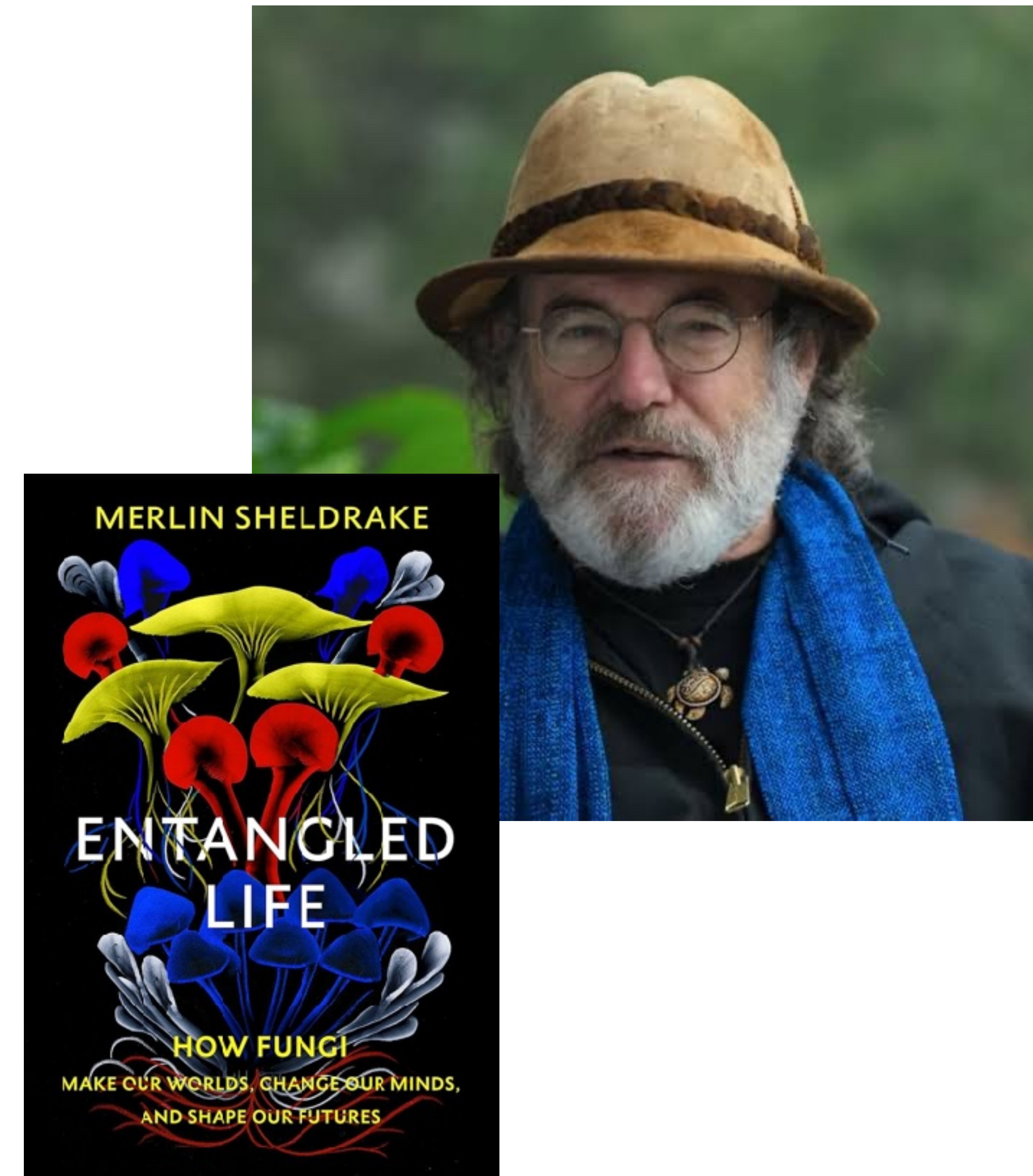
- Can a place have a ‘swarm intelligence’? The collective intelligence of place?

- Entangled minds...



Mycelial Entanglement

- Mycologist Paul Stamets:
- “I see mycelium as the living network that manifests the natural intelligence imagined by Gaia theorists. The mycelium is an exposed sentient membrane, aware and responsive to changes in its environment. As hikers, deer, or insects walk across these sensitive filamentous nets, they leave impressions, and mycelia sense and respond to these movements. A complex and resourceful structure for sharing information, mycelium can adapt and evolve through the ever-changing forces of nature (Stamets, 2005, p. 4-6).
- Merlin Sheldrake:
“Fungi throw our concepts of individuality and even intelligence into question. They can change our minds, heal our bodies, and even help us remediate environmental disaster.”



The Ecological Self

- Freya Matthews:

“Holistic nesting of a self in a wider self- system means a relative identification with that system. Because the self stands in relations of ecological interdependence (direct or indirect) with the elements of that wider self, those elements (or its relations to them) are logically involved in its identity...”
- “Individuality in this framework is thus...a relative matter - it is a function of involvement in a wider system, the identity of which is implicated in the identities of each of its participant subsystems. The individual is thus in a very real sense a microcosm of the wider self in which it occurs” (Matthews, 1991, p. 144).
- We are woven into the world, and the world is woven into us.

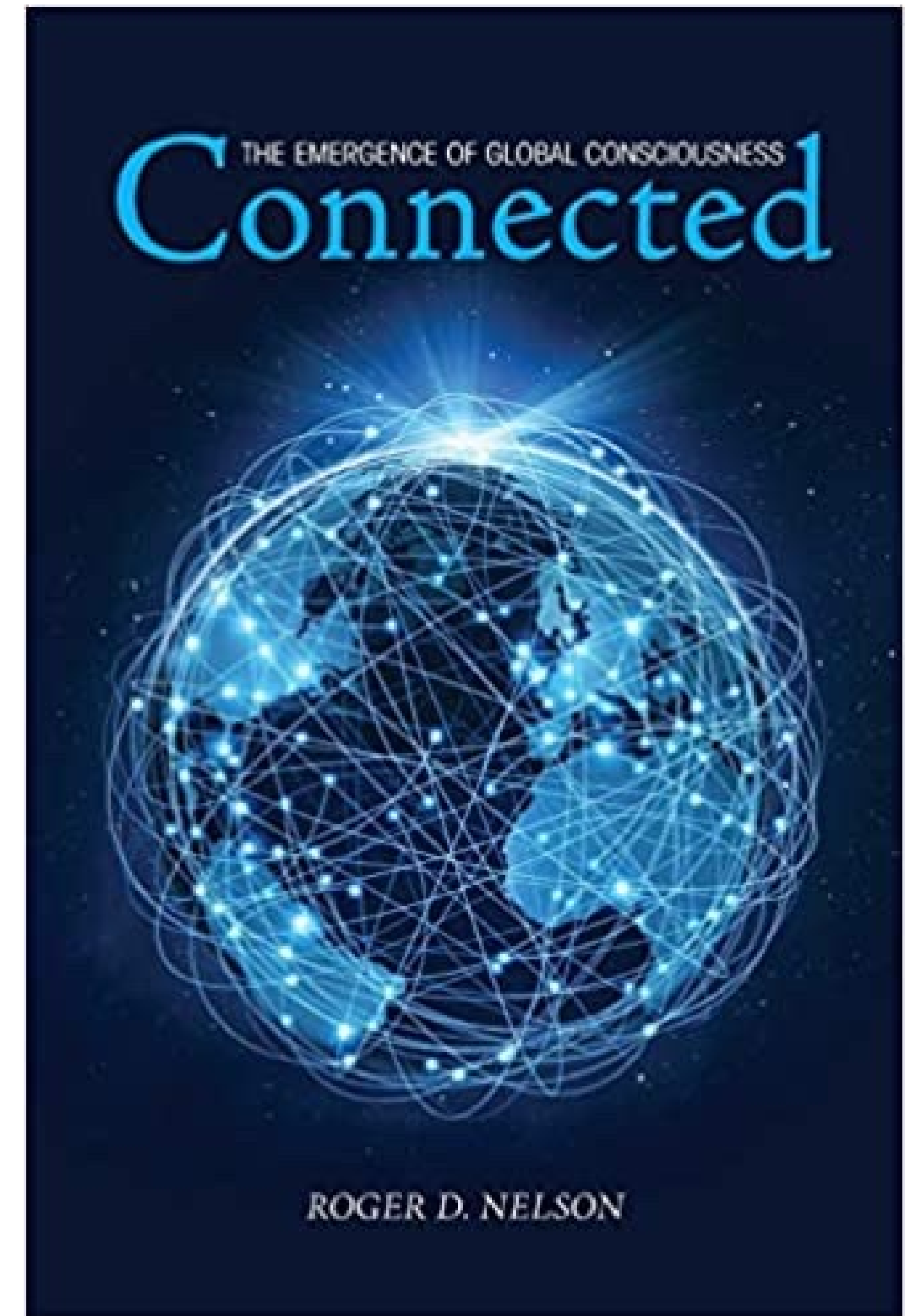


Global Consciousness

- “When human consciousness becomes coherent, the behavior of random systems may change. Random number generators (RNGs) based on quantum tunneling produce completely unpredictable sequences of zeroes and ones. But when a great event synchronizes the feelings of millions of people, our network of RNGs becomes subtly structured. We calculate one in a trillion odds that the effect is due to chance. The evidence suggests an emerging noosphere or the unifying field of consciousness described by sages in all cultures”

(<https://noosphere.princeton.edu>).

- Not just the world - communities - not just human communities, but non-human communities as well...



Assemblages

- Jane Bennett in *Vibrant Matter*:

“Assemblages are ad hoc groupings of diverse elements, of vibrant materials of all sorts. Assemblages are living, throbbing confederations that are able to function despite the persistent presence of energies that confound them from within...”

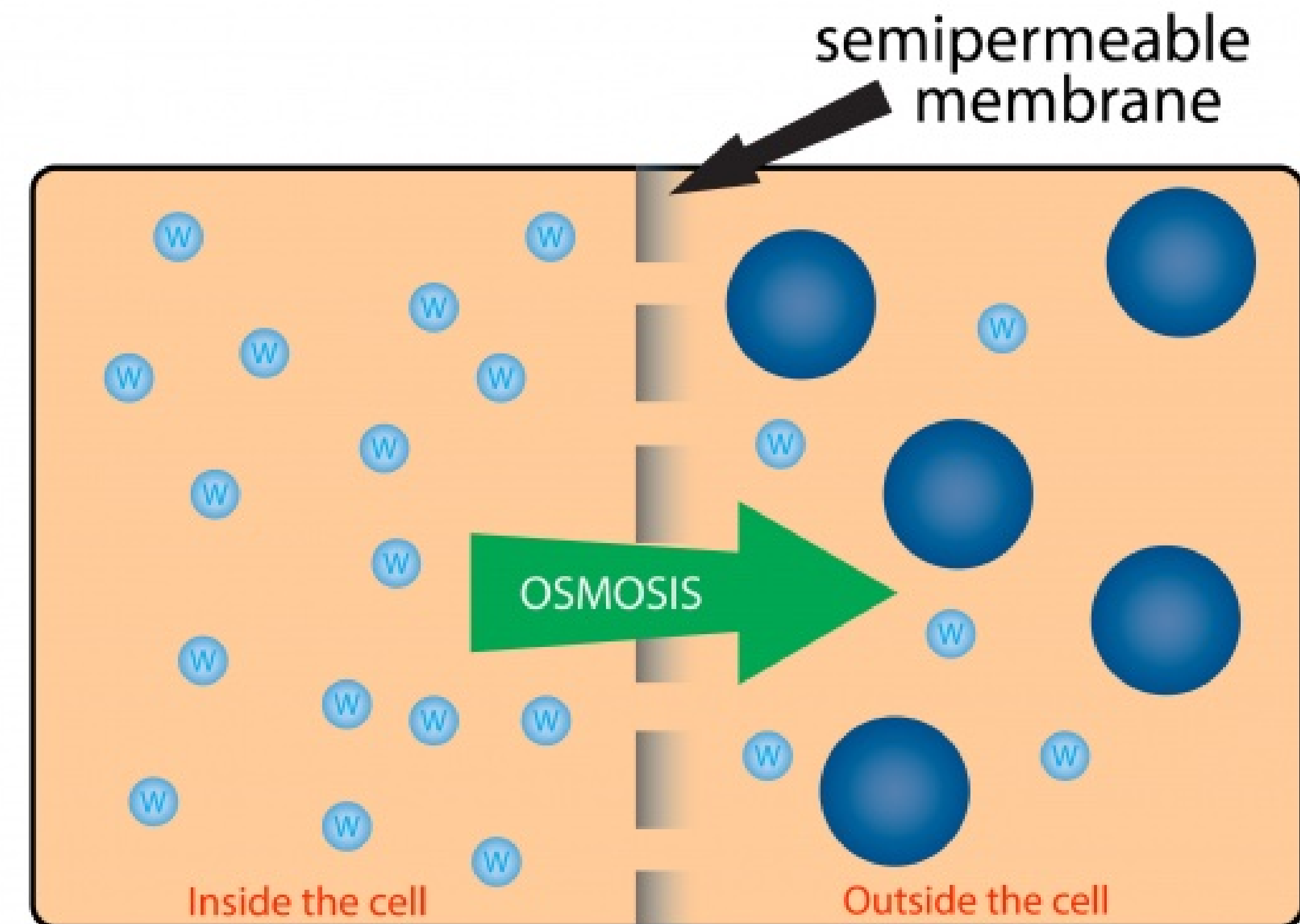
- “The effects generated by an assemblage are [...] emergent properties, emergent in that their ability to make something happen [...] is distinct from the sum of the vital force of each materiality considered alone. Each member and proto-member of the assemblage has a certain vital force, but there is also an effectivity proper to the grouping as such: an agency of the assemblage” (Bennett, 2010, p. 24).
- “[...] to highlight some of the limitations of human-centred theories of action and to investigate [...] a theory of action and responsibility that crosses the human-nonhuman divide” (ibid.).



Entangled Worlds

- The notion of “ontological pluralism” has been taken to imply the “pluriverse”—the idea that we live in “a world of many worlds” (de la Cadena & Blaser, 2018, p. 4).
- This is in contrast to the “One-world world” (Law, 2011) emphasized by the mainstream scientific worldview.
- Not a ‘universe’ but a ‘pluriverse.’
- “The pluriverse refers to a vision of the world that echoes the autopoietic dynamics and creativity of the Earth and the indubitable fact that no living being exists independently of the Earth [...] In this sense, we are all within the pluriverse, understood as the ever changing entanglements of humans and non-humans that result from the Earth’s ceaseless movement of vital forces and processes” (Escobar, 2015, p. 11).
- Ontological osmosis.

Osmosis



Chthulucene

- Donna Harraway:

“...we need a name for the dynamic ongoing sym-chthonic forces and powers of which people are a part, within which ongoingness is at stake...
- ...Maybe, but only maybe, and only with intense commitment and collaborative work and play with other terrans, flourishing for rich multispecies assemblages that include people will be possible. I am calling all this the Chthulucene—past, present, and to come” (Harraway, 2015, p. 160).
- “These real and possible timespaces are not named after SF writer H.P. Lovecraft’s misogynist racial-nightmare monster Cthulhu (note spelling difference), but rather after the diverse earth-wide tentacular powers and forces and collected things with names like Naga, Gaia, Tangaroa (burst from water-full Papa), Terra, Haniyasuhime, Spider Woman, Pachamama, Oya, Gorgo, Raven, A'akuluujjusi, and many many more...”
- “My” Chthulucene, even burdened with its problematic Greek-ish tendrils, entangles myriad temporalities and spatialities and myriad intra-active entities-in-assemblages—including the more-than-human, other-than-human, inhuman, and human-as-humus” (Harraway, 2015, p. 160).



Tangles

- Tangles of particles.
- Tangles of objects.
- Tangles of bodies.
- Tangles of minds.
- Tangles of worlds.

References

- Bennett, J. (2010). *Vibrant Matter: A political ecology of things*. Durham: Duke University Press.
- de la Cadena, M., & Blaser, M. (2018). *A world of many worlds*. Durham: Duke University Press.
- Escobar, A. (2015). 'Transiciones: A space for research and design for transitions to the pluriverse.' *Design Philosophy Papers*, Vol. 13, No. 1, pp. 13–23.
- Harraway, D. (2015). 'Anthropocene, Capitalocene, Plantationocene, Chthulhucene: Making Kin.' *Environmental Humanities*, Vol. 6, pp. 159-165.
- Kaiser, D. (2011). *How the Hippies Saved Physics: Science, Counterculture and the Quantum Revival*. New York: W.W. Norton & Company.
- Law, J. (2015). "What's wrong with a one-world world?" *Distinktion: Journal of Social Theory*, Vol. 16, No. 1, pp. 126–139.
- Matthews, F. (1991). *The Ecological Self*. London: Routledge.
- Radin, D. (2006). *Entangled Minds: Extrasensory Experiences in a Quantum Reality*. New York: Paraview Pocket Books.
- Stamets, P. (2005). *Mycelium Running: How Mushrooms Can Help Save the World*. Berkeley: Ten Speed Press.