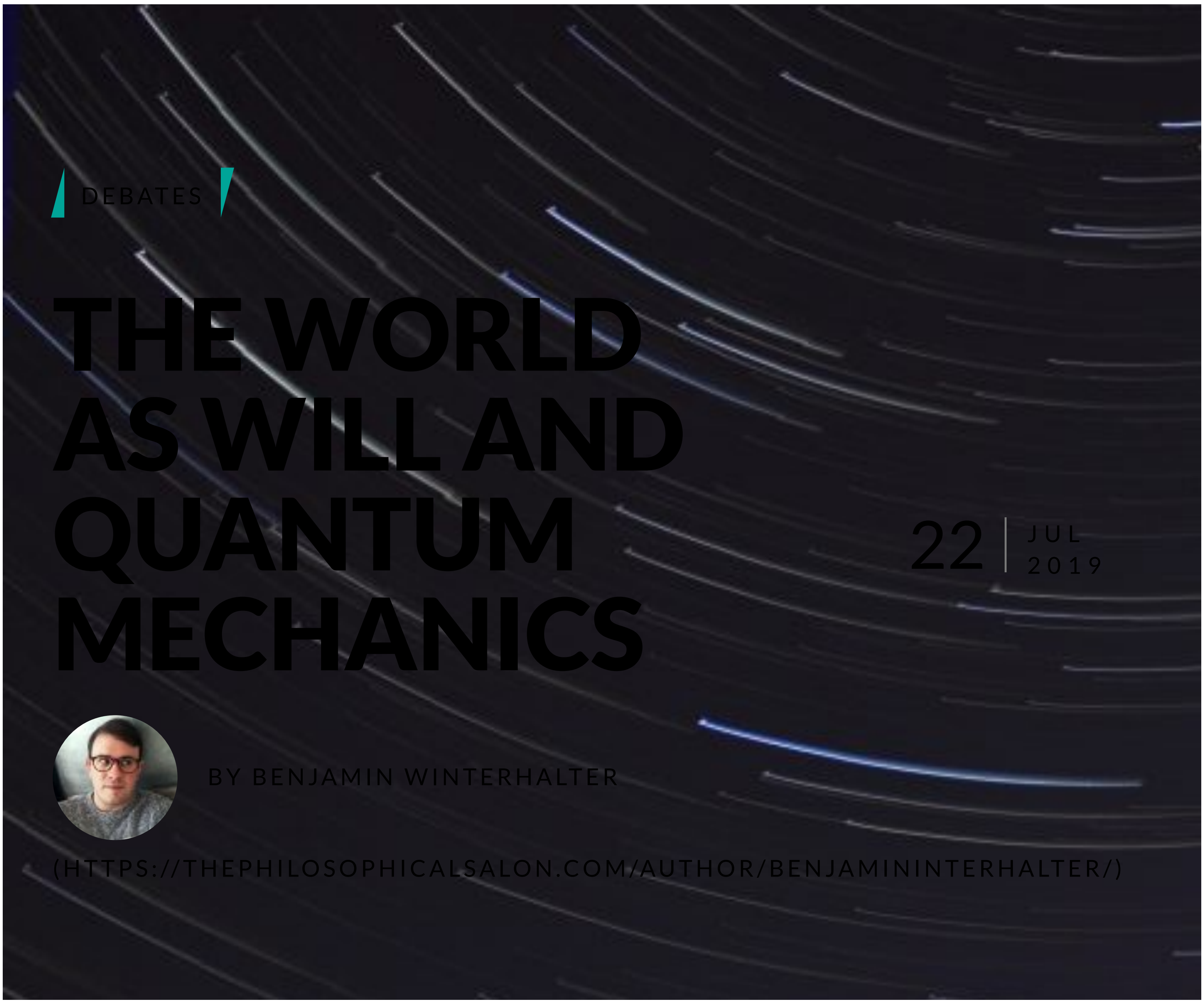

DEBATES

THE WORLD AS WILL AND QUANTUM MECHANICS

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There is, unfortunately, no such thing as fate. If we accept that quantum mechanics—for all the strangeness associated with it—gives an accurate description of the universe's basic ontology, we should also accept that the will is real. The evidence for quantum mechanics is extremely strong, and physicists, including Alan Guth, David Kaiser, and Andrew Friedman (https://www.quantamagazine.org/physicists-are-closing-the-bell-test-loophole-20170207/), have closed some of the few remaining loopholes around the reality of quantum entanglement, a phenomenon wherein the state of a particle cannot be described independently of the state of at least one other. (Albert Einstein called entanglement "spooky action at a distance.") But the existentially terrifying prospect of free will contains a shimmering surprise: In the conception of free will that's compatible with quantum mechanics, exercises of the will—intentions or desires that lead to bodily actions—are fundamentally limited, finite, and constrained. In a word, entangled.

According to the American philosopher John Searle's 2004 book *Freedom and Neurobiology*, the fact of quantum indeterminacy—the ineradicable uncertainty in our knowledge of physical systems, first formulated by the German physicist Werner Heisenberg—does not guarantee that free will exists. Indeterminacy is a necessary but not sufficient condition for the belief that there is no such thing as fate. As far it goes, Searle's position is right, but it doesn't go particularly far. Searle's unadventurous view prevents him from seeing a deeper compatibility between quantum mechanics and the idea of free will, a compatibility that the Australian philosopher Brian O'Shaughnessy had already intuited twenty-four years earlier, in 1980.

O'Shaughnessy's daunting two-volume book, *The Will: A Dual-Aspect Theory*, was originally published that year. And its basic framework is compatible with at least two of the major interpretations of quantum mechanics (including the one Einstein favored). Despite its imposing length, the intuition that guides O'Shaughnessy's book is simple enough: having free will means being able to put intentions and desires into action through the body. O'Shaughnessy reconciles this definition of the will with physical causation by arguing that there is only one reality, which has two equally fundamental *aspects*. Reality can be seen as at once fully physical and fully psychological, and so can our exercises of our motor capacities.

O'Shaughnessy's view is a species of what philosophers call "dual-aspect monism," the thesis that there is exactly one reality, describable simultaneously under its mental and physical aspects (though perhaps not always equally well under both). Scientists are, in their turn, now grappling with the prospect of "quantum monism," as a 2019 article in *Scientific American* by the German physicist Heinrich Päs (https://blogs.scientificamerican.com/observations/quantum-monism-could-save-the-soul-of-physics/) shows. No doubt O'Shaughnessy's work was ahead of its time: his argument for a monist ontology avoids a key mistake that determinists are prone to making—and that quantum physicists challenge—namely, assuming that, to be genuinely free, the will needs some connection with randomness.

For followers of one interpretation of quantum mechanics, the von Neumann-Wigner interpretation, free actions can't be random given a quantum understanding of the universe. These thinkers argue that the evidence drawn from quantum mechanics reveals that the universe's fundamental ontology is *not* random. In fact, their version of quantum theory comes with the concept of free will baked right in. As one adherent of this interpretation, the American mathematical physicist Henry Stapp, wrote in a 2008 paper (https://arxiv.org/ftp/arxiv/papers/0805/0805.0116.pdf):

…the orthodox quantum successor to classical physics involves the necessary introduction, into the basic dynamics, of actions by agents; actions that are not specified by the micro-physical laws, but that, within the theory, arise from free choices of means to attain intended ends.

While it's true that quantum processes involve indeterminacy, Stapp notes, that's not the same as the universe being inherently random. One among *certain specific* possibilities occurs when an observer makes a measurement. And measurement-making is an intentional action undertaken by a conscious being. So, if the von Neumann-Wigner version of quantum mechanics is correct, there can be no escape from free will (so to speak).

But it's not even necessary to go that far to find an interpretation of quantum mechanics compatible with O'Shaughnessy's dual-aspect conception of the will. The ensemble interpretation, favored by Einstein because it banishes the notion of an object being in two states at once (an "unnatural assumption," Einstein said), offers a statistical framing of quantum theory. This interpretation takes away the sting of "mental causation," the implicit claim that consciousness somehow precedes the universe (which appears, after all, to *contain* consciousness) associated with the von Neumann-Wigner interpretation.

How does the ensemble interpretation work? The Austrian physicist Erwin Schrödinger's well-known equation represents the quantum world using a *wavefunction*, denoted by the Greek letter ψ (psi). His equation is a formal description of an apparent duality wherein a subatomic entity seems to behave as if it were both a wave and a particle. The various interpretations of quantum mechanics are all, in significant part, about how to make sense of the wavefunction. The ensemble interpretation states that the wavefunction isn't physically real; it's an abstraction that is only useful in referring to an *ensemble* of similarly prepared systems. For anyone who buys the ensemble view, the Schrödinger wave equation cannot be understood as a description of an individual system.

There's strong support for the ensemble interpretation among physicists. For instance, a 2017 paper by the Israeli physicist Yakir Aharanov and colleagues (https://www.pnas.org/content/114/25/6480) makes the case that the ensemble interpretation is the only serious option for making sense of the double-slit experiment—one of the best known results in quantum mechanics. They write that the wavefunction:

…is best viewed as a property of the entire thermodynamic system. On the single-particle level, it manifests itself as probabilities for the particle to be found in certain states. However, the intrinsic properties of the individual particle are those that can be verified directly, namely position and momentum, and only they constitute its real properties.

Hence, the authors claim that, in a double-slit experiment, we observe "a localized particle with nonlocal interactions with the other slit." Their paper offers "a Heisenberg-based interpretation for quantum mechanics" in which "individual particles possess deterministic, yet nonlocal properties that have no classical analog, whereas the Schrödinger wave can only describe an ensemble." In short, only particles are real, but each particle has *nonlocal* properties, including a "modular momentum," which, per Heisenberg's principle, is maximally uncertain when we observe the particle's position or momentum.

The point is that, if we accept *either* of these interpretations of quantum mechanics (and there are good reasons why we might), we cannot acknowledge the idea of multiple realities—often rendered in today's discourse as a reference to divergent or branching "timelines." We're left, instead, with a monist ontology. And that ontology, as O'Shaughnessy's work illustrates, is compatible with the idea that the will is real. If O'Shaughnessy's definition of the will (intention or desire put into action through the body) is right, our "free" will is intrinsically limited by the body's physical structures.

Does this mean that consciousness itself is, in some sense, quantum? To date, the degree of empirical support for quantum consciousness, advocated, for example, by the mathematician Roger Penrose (http://nautil.us/issue/47/consciousness/roger-penrose-on-why-consciousness-does-not-compute), is uncertain. However, it's safe to say, based on the available evidence for quantum physics, that consciousness isn't computational. The brain isn't a computer. Nor is it even much like a computer, except perhaps when we engage it to do calculations. We should ditch the "brain = chipset" metaphor for a prettier picture. As the psychiatrist and philosopher Gordon Globus writes in a 1992 article for the *Journal of Cognitive Neuroscience*, a non-computational account of consciousness predicts the existence of *fractal* properties, amounting to self-similarity, in the brain. He argues that:

It is easy to forget that information in the brain, even in a molecular perspective, is a theory… An alternative theory is that the readings on the neuroscientist's measurement devices have to do with influencing and being influenced, i.e., with participation in a nonlinear dynamical system that is self-organizing, self-tuning, and autodynamic.

With consciousness understood in this way, we don't need to shy away from the word *spirit* in O'Shaughnessy's old slogan, "Willing is spirit in motion," since *spirit* is just a psychological metaphor for the fractal component of the brain's organization.

O'Shaughnessy may not, of course, have had quantum physics or a fractal brain in mind. But if either one of two interpretations of quantum mechanics is correct, we should expect fractality in the structure of consciousness, meaning free will. And that *is* unfortunate, since it means we are tasked with the responsibility of deciding what to do with our freedom. In making those decisions, let's be conscious of the bodily limitations within which our wills operate. Let's make sure, in other words, that our reach is within our grasp.

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