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What Do Nanquan and Schrödinger Have Against Cats?

IT IS WITH A CERTAIN trepidation that I broach the topic of Buddhism and quantum physics. There is, of course, already a large literature on the subject, propelled in part by two popular books that appeared in the 1970s: Fritjof Capra's *The Tao of Physics: An Exploration of the Parallels Between Modern Physics and Eastern Mysticism* and Gary Zukav's *The Dancing Wu Li Masters: An Overview of the New Physics.*[1] But there were many more in the decades that followed, including Amit Goswami's *The Self-Aware Universe: How Consciousness Creates the Material World*, Evan Harris Walker's *The Physics of Consciousness: The Quantum Mind and the Meaning of Life*, as well as new offerings by Capra and Zukav.[2] Despite, or perhaps owing to, the appeal and commercial success of these books (*The Tao of Physics* has appeared in forty-three editions and twenty-three languages), this area of scholarship has acquired a rather tawdry reputation among scholars. The critical concern with these books is not, however, what one might suspect. It is not that the authors lack an adequate understanding of quantum physics. Rather, the problem is their naïve and facile grasp of Asian philosophy.

At the time they wrote their books, Capra, Goswami, and Walker were all bona fide physicists with PhDs and records of research and publication. Zukav, while not a scientist, was an informal member of the Fundamental Fysiks Group at Berkeley in the 1970s, and he rubbed shoulders with some of the leading physicists in America at the time.[3] These authors were all transfixed by the conceptual and philosophical puzzles posed by quantum mechanics. At the same time, they were products of the counterculture and new age movements of the 1960s and 1970s, so it is not surprising that they should turn to the "mystical East" for inspiration and guidance. As it would turn out, their guides to things Asian were the likes of D. T. Suzuki (1870–1966), Alan Watts (1915–1973), and Jiddu Krishnamurti (1895–1986),

REPRESENTATIONS 144. Fall 2018 © The Regents of the University of California. ISSN 0734-6018, electronic ISSN 1533-855X, pages 154–65. All rights reserved. Direct requests for permission to photocopy or reproduce article content to the University of California Press at http://www.ucpress.edu/journals.php?p=reprints. DOI: https://doi.org/10.1525/rep.2018.144.6.154.

and accordingly they regarded Hinduism, Buddhism, Daoism, and Zen as different expressions of a common, somewhat superficial, Advaita Vedantic monism.[4] But while their familiarity with Asian thought may have been limited, they were correct about the challenges to scientific naturalism posed by quantum physics. In this regard they were simply following in the footsteps of the early pioneers of this new science, including Albert Einstein (1879–1955), Max Born (1882–1970), Niels Bohr (1885–1962), Erwin Schrödinger (1887–1961), Louis de Broglie (1892–1987), Wolfgang Pauli (1900–1958), Werner Heisenberg (1901–1976), David Bohm (1917–1992), and so on. Virtually all of these founding fathers reflected upon and wrote about the philosophical conundrums engendered by quantum weirdness.

The weirdness can be summarized under the following four headings: (1) wave-particle duality, also known as "complementarity," which refers to the fact that quantum phenomena appear to behave like waves in some situations and particles in others; (2) the Heisenberg uncertainty principle, which holds that two conjugate variables of a single particle (such as position and momentum, or spin along different axes) cannot be known at the same time; (3) quantum entanglement and nonlocality, which means that correlated particles separated from one another in space appear to affect one another instantaneously (superluminally); and (4) the measurement problem, which concerns the way in which the measurement or observation of quantum phenomena affects the behavior of the phenomena under investigation. These four puzzles all have one thing in common: each, in their own way, foregrounds the relationship between the world that we observe and the process of observation itself—between the mind-independent universe and our knowledge of it. Note that these enigmas did not emerge from armchair philosophical speculation but rather from scientific experiment and formal mathematical modeling.

Recently I have been working on the structural relationship between the quantum measurement problem and the Buddhist problem of *vikalpa* or "discriminative construction." In brief, early Buddhist teachings hold that the phenomenal world in which we find ourselves is brought into being by our discriminative engagement with that very world. Medieval Buddhist scholiasts, like modern quantum theorists, then had to struggle to make sense of the seemingly paradoxical relationship between the mind-independent world and our consciousness of it. In the midst of my work on this project, I was invited to present a paper at a conference on the place of animals in Buddhism, a topic on which I am largely ignorant. But it occurred to me that I could use the conference as an opportunity to contemplate the deaths of two unfortunate cats, both executed to make a philosophical point. We will start with Schrödinger's, but this will require a bit of background for those unfamiliar with the basics of quantum theory.

According to what came to be known, somewhat contentiously, as the "Copenhagen interpretation" of quantum mechanics, our measurement or observation or engagement with a quantum particle does not merely alter the nature of the particle, but brings it into existence.[5] Prior to observation there is no particle per se, but only a "wave function" (also known as a "psi function" or "state vector") that can be thought of as a superposition of multiple quantum states, known as "eigenstates." Various mathematical models such as the Schrödinger equation or Heisenberg's matrix mechanics describe, with great precision, the linear evolution of the wave function through time, but these models can only predict the *probabilities* of what will appear when we actually interact with the wave. There is, then, an ineliminable element of chance or randomness in what appears when we take a measurement. Scientists sometimes speak of the act of measurement or observation as bringing about the "collapse" of the wave function, resulting in the appearance of one eigenstate out of the many that constituted the superposition. This leads to a number of thorny questions bearing on the ontological status of the wave function prior to collapse, what precisely incites collapse, and whether collapse is indeed the right way of understanding things.

Bohr and Heisenberg are the two figures most closely associated with the Copenhagen position. In their view, the wave function does not represent an actual state of affairs in the mind-independent universe, but is rather a conceptual model or mathematical formula for predicting what we see when we go looking. There is, in the end, no determinative domain beyond the contingent world that we observe. In Heisenberg's words, "The laws of nature which we formulate mathematically in quantum theory deal no longer with the particles themselves but with our knowledge of the elementary particles." And again: "The conception of objective reality…evaporated into the…mathematics that represents no longer the behavior of elementary particles but rather our knowledge of this behavior."[6] Accordingly, the "classical" Copenhagen interpretation and other related antirealist theories hold that it is impossible to understand the natural world without taking into consideration the act of measurement, observation, and perhaps even consciousness itself.[7]

But not all scientists agreed. Einstein and Schrödinger were among the most famous opponents of the Copenhagen view. They both felt that science necessitates belief in a determinative objective reality that is prior to and distinct from mind. They argued that if quantum science doesn't give us purchase on this objective world—if it seems to bottom out in chance—then it must be incomplete. In short, they reasoned that the randomness observed at the quantum level attests to the presence of some "elements of reality" not yet understood—later called "hidden variables"—that determine the eigenstates that appear.[8]

It is important to understand what is at stake in these debates. Nobody is disputing the formal mathematical models of quantum mechanics; these models quickly proved to be both accurate in their predictions and scientifically productive. The disagreement concerns the existence of, and scientific access to, some "objective" or mind-independent reality. Bohr and Heisenberg believed that it makes no sense to talk about the existence of a moon when nobody is looking at it—there is no determinative reality or noumenal world lying beyond what appears to us. Einstein and Schrödinger thought this position absurd.

In May 1935 Einstein and two young assistants, Boris Podolsky and Nathan Rosen, published a paper that they believed would deal a decisive blow to the antirealist position. The paper, "Can Quantum-Mechanical Description of Physical Reality be Considered Complete?," shows that if quantum mechanics were indeed complete as it stood, it would undermine "local realism"—the principle that things can have causal effects only on things proximate to them.[9] (That is, there can be no "spooky actions at a distance," to use Einstein's later way of putting it.)[10] To make their point, the authors engage in a thought experiment involving two entangled particles separated in space. According to the predictions of quantum theory, if you take a measurement of one particle in an entangled pair, it should instantly cause the conjugate properties of the second particle to become undetermined, and this would entail faster-than-light communication. As such superluminal transfer of information between entangled particles is ruled out by relativity theory, the authors reasoned that there must be something that we still don't understand that determines, nonprobabilistically, how the particles behave when measured. Ergo, quantum mechanics is incomplete.

Upon reading the Einstein-Podolsky-Rosen paper (now known simply as "EPR"), Schrödinger wrote to Einstein concurring with his analysis, and the correspondence that ensued led directly to Schrödinger's famous cat.[11] The impetus for the thought experiment actually came from Einstein; in a letter to Schrödinger dated June 19, 1935, Einstein imagines two boxes, one with a ball hidden inside. Prior to opening the boxes, common sense tells us that the ball is in either one box or the other. But according to the Copenhagen interpretation, the boxes are filled only with a wave function, and the wave does not collapse and the ball does not appear unless and until someone opens the boxes to peer inside. The point of Einstein's *reductio ad absurdum* argument is clear: scientists seem willing to accept implausible claims pertaining to the microscopic quantum level, such as the superposition of two contrary states, that they would never accept at the macroscopic level. He is, in effect, accusing the Copenhagen antirealists of sloppy thinking, if not bad faith.

In a subsequent letter to Schrödinger dated August 8 of the same year, Einstein came up with a different version of the same idea. This time he imagines a keg of gunpowder that might explode some time over the course of a year. It is patently absurd, he declares, to imagine the keg in a superposition of both exploded and unexploded states over this time period.[12] It was this letter that prompted Schrödinger to concoct his cat scenario. His famous feline is first mentioned in a letter to Einstein dated August 19, and a slightly revised version appeared shortly thereafter in a three-part article, "The Present Situation in Quantum Mechanics."

> One can even set up quite ridiculous cases. A cat is penned up in a steel chamber, along with the following device (which must be secured against direct interference by the cat): in a Geiger counter, there is a tiny bit of radioactive substance, so small, that perhaps in the course of the hour one of the atoms decays, but also, with equal probability, perhaps none; if it happens, the counter tube discharges and through a relay releases a hammer that shatters a small flask of hydrocyanic acid. If one has left this entire system to itself for an hour, one would say that the cat still lives if meanwhile no atom has decayed. The first atomic decay would have poisoned it. The psi-function of the entire system would express this by having in it the living and dead cat (pardon the expression) mixed or smeared out in equal parts.
>
> It is typical of these cases that an indeterminacy originally restricted to the atomic domain becomes transformed into macroscopic indeterminacy, which can then be resolved by direct observation. That prevents us from so naively accepting as valid a "blurred model" for representing reality. In itself, it would not embody anything unclear or contradictory. There is a difference between a shaky or out-of-focus photograph and a snapshot of clouds and fog banks.[13]

Schrödinger's cat-in-a-box thought experiment is an elegant reworking of Einstein's previous offerings, as it explicitly ties a supposedly indeterminate event at the quantum level (the decay of a radioactive particle) to an event at the macro level (the death of a cat). To accept the notion of superposition (a "blurring" of two contradictory states) at the quantum level now demands that one accept the consequences at the macro level—the cat must be both dead and alive until it is observed.

Note that this is intended as a *reductio* argument. Schrödinger is not suggesting that the superposition is true. On the contrary, Schrödinger regards the notion that the cat could simultaneously be alive and dead as so patently ridiculous that it will compel folks like Bohr and Heisenberg to abandon their antirealist stance. Moreover, putting a sentient creature, rather than an insentient ball, inside the box forces one to consider the cat's perspective on the matter: *surely, the cat knows if it is alive or not.* And this, I believe, is in part why he selected a cat for this gruesome yet entertaining thought experiment, since we are more likely to empathize with an adorable cat than we are with many other critters, much less a ball. Somehow, the

deliberate murder of an innocent kitty in this outlandish scenario underscores the outlandishness of the beliefs Schrödinger is ridiculing.

Einstein agreed with Schrödinger's analysis, and he continued to deride antirealist interpretations of quantum mechanics throughout his life. In a 1950 letter to Schrödinger, Einstein wrote,

> You are the only contemporary physicist, besides Laue, who sees that one cannot get around the assumption of reality, if only one is honest. Most of them simply do not see what sort of risky game they are playing with reality—reality as something independent of what is experimentally established. Their interpretation is, however, refuted most elegantly by your system of radioactive atom + amplifier + charge of gun powder + cat in a box, in which the psi-function of the system contains both the cat alive and blown to bits. Nobody really doubts that the presence or absence of the cat is something independent of the act of observation.[14]

The theoretical arguments raged on for many years. It appeared that no definitive experimental evidence would tip the balance one way or the other, and that left both sides to rely upon intuition, common sense, and appeals to parsimony to make their cases.

This would change with the publication of a remarkable paper by John Bell in 1964, although it would take many years for scientists to appreciate the paper's significance.[15] Entitled "On the Einstein Podolsky Rosen Paradox," Bell's paper imagined an experiment on entangled particles that had the potential to definitively rule out the existence of hidden variables. The experiment was first run in 1972 and has been reproduced with refinements many times since, always with an eye toward eliminating any possible loopholes. And the results have been consistent: the Bell experiments appear to rule out the possibility of hidden variables, and with it, the principle of local realism. Scientific evidence was now weighing in on the side of the antirealists.[16]

But this didn't convince the realists to throw in the towel. Indeed, it gave rise to a host of alternative realist interpretations, including "many-worlds" and "decoherence" approaches, which preserve "objectivity" by rejecting the very notion of collapse. I cannot deal with these theories here, other than by pointing out that they all eliminate the role of observation, mind, or consciousness in their explanations of quantum reality. But the alternatives they offer are no less complex, no more intuitive, and no more parsimonious, than are the collapse theories.

This summary should be sufficient to see why at least some physicists, compelled by evidence on the antirealist side, held that a robust scientific account of quantum phenomena was impossible without reference to consciousness and mind. Some of them dabbled in Asian philosophy for precisely this reason, as they believed that Asian monistic philosophies of

supposedly ancient heritage had some kind of handle on consciousness and its integral relationship with the manifest world. This interest in things Asian predated the best-selling books by Capra and Zukav by several decades. Heisenberg is reputed to have met the Bengali poet Rabindranath Tagore in India in 1929 and to have been impressed by what he learned of Indian philosophy.[17] Niels Bohr had a yin-yang symbol emblazoned on his 1947 coat of arms, along with the Latin words *contraria sunt complementa* (opposites are complementary; fig. 1). David Bohm began a series of dialogues with Jiddu Krishnamurti in the mid-1960s that continued for many decades, and Evan Harris Walker claimed to have a Zen enlightenment experience in 1966.[18] In short, contemplating the mysteries of quantum mechanics had a way of turning hard-headed scientists into Eastern mystics. In time, the plight of Schrödinger's cat—which was originally intended to be an amusing *caricature* and *repudiation* of a harebrained interpretation of quantum mechanics—came to stand for the very opposite. That Schrödinger's cat is in some mysterious fashion simultaneously alive and dead came to embody the "believe-it-or-not" strangeness of the quantum world.

Now to turn to Song Dynasty Chan Buddhism and the plight of a similarly innocent creature, Nanquan's cat. This story is probably best known as Case 14 in the *Gateless Barrier of the Zen Tradition* (*Chanzong wumen guan* 禪宗

FIGURE 1. Niels Bohr's coat of arms, designed by Bohr upon being awarded the Danish "Order of the Elephant" in 1947.

無門關), a popular compendium of "public cases" (*gong'an*, Japanese: *kōan*), but it also appears in the *Record of the Transmission of the Lamp Compiled in the Jingde Era* (*Jingde chuandeng lu* 景德傳燈録), the *Blue Cliff Record* (*Biyan lu* 碧巖錄), the *Book of Serenity* (*Congrong lu* 從容錄), and other Chan case collections.[19] The protagonist of the story, Nanquan Puyuan 南泉普願 (748–835), aka Master Wang (*Wang laoshi* 王老師), is one of the most famous disciples of Mazu Daoyi 馬祖道一 (709–788). Nanquan prominently features in four cases in the *Gateless Barrier*, six in the *Blue Cliff Record*, and three in the *Book of Serenity*. The other person featured in this anecdote, Nanquan's student Zhaozhou Congshen 趙州從諗 (778–897), is similarly celebrated in the tradition and a source for many Chan cases. The following version of Nanquan's cat is taken from the *Gateless Barrier*.

Master Nanquan came upon [the monks] of the eastern and western quarters arguing over a cat. Thereupon Nanquan held up [the cat] and said: "If one among you can speak the truth, you will save the cat. If not, I'll slice it in two." No one responded, so Nanquan sliced [the cat] in two.

That evening Zhaozhou returned and Nanquan raised the incident with him. Thereupon Zhaozhou took off his sandals, placed them on top of his head, and walked out. The Master said: "Had you been there, you would have saved the cat."

Wumen comments: Now tell me, what is the meaning of Zhaozhou putting his sandals on his head? If you can give me a single transformative word in response to this, then you will see that Nanquan's injunction was not a pointless exercise. If not, beware!

[Wumen's] verse:

> If Zhaozhou had been there,
> He would have turned things around,
> Snatching away the knife,
> With Nanquan begging for his life.

南泉和尚。因東西堂爭貓兒。泉乃提起云。大眾道得即救。道不得即斬卻也。眾無對。泉遂斬之。晚趙州外歸。泉舉似州。州乃脫履。安頭上而出。泉云。子若在即救得貓兒。無門曰。且道。趙州頂草鞋意作麼生。若向者裏下得一轉語。便見南泉令不虛行。其或未然險。頌曰。趙州若在。倒行此令。奪卻刀子。南泉乞命.[20]

In order to unpack this delightful anecdote, a bit of background is in order. Larger Buddhist monasteries in China, at least by the Song period (when the *gong'an* genre came into being and many of the cases were composed), were divided into two halves. The western half was reserved for monks engaged in religious practice, while the eastern half was occupied by those engaged in the administration of the monastery and its land holdings. The anecdote doesn't mention what the quarrel was about, but presumably cats were valued in monasteries as they kept rodents at bay.[21] However, the fact that the text uses a binom with a diminutive suffix for

"cat" (*mao'er* 貓兒)—perhaps better translated as "kitty"—suggests that the rival groups simply fancied the cat because it was cute.

That we are not told what the quarrel is about has a certain conceptual elegance. We know only that there are two sides, each with its own conflicting interests, views, and perspectives. In other words, the precise content of the dispute is beside the point. The quarrel over the cat offers the Buddhist master a "teachable moment"—an opportunity to demand that his disciples rise above their contingent, bifurcated, and self-interested frames of reference, and respond from the perspective of the absolute. He demands that they *daode* 道得 or "speak their attainment"—an overdetermined compound that means both "attain the Way" and to "express" (*dao*) what is thereby "attained." But this is precisely the *vikalpa* (discriminative construction) problem: the conditioned and contingent world that is known to us through the senses is the product of the biologically, linguistically, and culturally determined distinctions imposed by our cognitive apparatus. Buddhist practice is directed toward the attainment of the ultimate—a nonconceptual (*nirvikalpa*, *wufenbie* 無分別) and unconditioned (*asaṃskṛta*, *wuwei* 無為) state or understanding. By definition, then, such a state must transcend, or be free of, all distinctions and, hence, cannot be captured or transmitted through words. Nor can it be signified through silence, as silence is meaningful only insofar as it has something to say, and that too entails discrimination. To even posit such a state—to imagine a "goal" toward which the student of Buddhism can aspire—is already to be thrown into dualism and error. What is one to do?

Nanquan's demand for a true word is thus a trap—any attempt to respond, including responding through a pregnant silence, is destined to fail. The two quarreling sides each want a whole cat—a real, intact, living cat—but they shirk from the challenge thrown at them, which is to express or manifest their wholeness. So they end up with a sliced or *dual* cat—a parsed or disaggregated product of the conceptually constructed world in which we find ourselves.

So why does Zhaozhou succeed while the other monks fail? He knows that there is no place to stand, no true word to be given, no "view from nowhere." But he also knows that a bodhisattva—a being dedicated to the attainment of Buddhahood—is compelled to transmit the dharma and thus has no choice but to respond. So he upends things, figuratively and literally, placing his sandals on top of his head. Many commentators insist that Zhaozhou's action is a meaningless non sequitur, and that this is precisely its meaning. That is to say, it signals the impossibility of making an adequate response, since the demand is for something ultimate or true, yet any response must, by necessity, be conventional. But Zhaozhou's gesture is more than a mere refusal to be drawn into Nanquan's trap. There is

a dramatic and conceptual eloquence in his mute response: placing his soiled footwear on his head is a profane and vaguely offensive act that suggests disapproval, if not censure. At the same time, it represents a reversal or upending or turning of the tables.[22] In this way Zhaozhou not only escapes Nanquan's trap, but also manages to one-up his teacher in a gesture that suggests playful ridicule. Nanquan, delighted by Zhaozhou's audacity, acknowledges that Zhaozhou would have saved the cat.

Nanquan is sitting at the opposite end of the realist-antirealist divide from Schrödinger. Whereas Schrödinger is arguing that there must be *some* mind-independent truth of the matter, Nanquan's challenge is predicated on precisely the opposite—the antirealist insight that there is no *outside*, no place to escape the contingency of our subject position. They both use a cat (or kitty) to dramatically drive home a point. And in both cases, as a public-relations ploy, the gambit works. In the popular imagination, Schrödinger and Nanquan are known for one thing and one thing only: their wanton murder of a cat.

Notes

This essay was originally prepared for the conference "Buddhist Beasts: Reflections on Animals in Asian Religions and Culture," held at the University of British Columbia, April 20–22, 2018. Thanks to Elizabeth Horton Sharf for her comments and suggestions on earlier drafts.

1. Fritjof Capra, *The Tao of Physics: An Exploration of the Parallels Between Modern Physics and Eastern Mysticism* (Boulder, CO, 1975); Gary Zukav, *The Dancing Wu Li Masters: An Overview of the New Physics* (New York, 1979).
2. Amit Goswami, *The Self-Aware Universe: How Consciousness Creates the Material World* (New York, 1995); Evan Harris Walker, *The Physics of Consciousness: The Quantum Mind and the Meaning of Life* (Cambridge, MA, 2000); Fritjof Capra, *Uncommon Wisdom: Conversations With Remarkable People* (New York, 1988); Gary Zukav, *The Seat of the Soul* (New York, 1989).
3. On the Fundamental Fysiks Group, see esp. David I. Kaiser, *How the Hippies Saved Physics: Science, Counterculture, and the Quantum Revival* (New York, 2011).
4. For a critical account of D. T. Suzuki and the roots of his understanding of Zen, see esp. Robert Sharf, "The Zen of Japanese Nationalism," in *Curators of the Buddha: The Study of Buddhism under Colonialism*, ed. Donald S. Lopez Jr. (Chicago, 1995), 107–60.
5. The term "Copenhagen interpretation" was first introduced in 1955 by Werner Heisenberg, and there is some question as to whether it accurately captures Niels Bohr's views on the issues. On the history and contested use of the term, see esp. Don Howard, "Who Invented the 'Copenhagen Interpretation'? A Study in Mythology," *Philosophy of Science* 71, no. 5 (2004): 669–82. Howard notes that Bohr never endorsed the notion of "collapse" and argues that, pace Heisenberg, Bohr's position is not antirealist.

6. Werner Heisenberg, "The Representation of Nature in Contemporary Physics," *Daedalus* 87, no. 3 (1958): 99.
7. The Nobel Prize winner Eugene Wigner (1902–95) put it this way: "It was not possible to formulate the laws of quantum mechanics in a fully consistent way without reference to the consciousness.…It will remain remarkable, in whatever way our future concepts may develop, that the very study of the external world led to the conclusion that the content of the consciousness is an ultimate reality"; Eugene P. Wigner, "Remarks on the Mind-Body Question," in *The Collected Works of Eugene Paul Wigner; Part B: Historical, Philosophical, and Socio-Political Papers*, vol. 6, *Philosophical Reflections and Syntheses*, ed. Jagdish Mehra (Berlin, 1995), 248. This article was first published in *The Scientist Speculates: An Anthology of Partly-Baked Ideas*, ed. Irving John Good (London, 1961), 284–302.
8. Albert Einstein flirted with a "hidden variables" approach in his earlier arguments against antirealism, notably in a paper presented to the Prussian Academy of Science in Berlin in May 1927, entitled "Does Schrödinger's Wave Mechanics Determine the Motion of a System Completely or Only in the Sense of Statistics?" But he quickly abandoned this approach and never published the paper. Around the same time Louis de Broglie proposed a "pilot-wave" theory, which was reworked several decades later by David Bohm into a full-blown hidden-variable model. See Jim Baggott, *The Quantum Story: History in 40 Moments* (Oxford, 2011), 116–20, 297–305.
9. Albert Einstein, Boris Podolsky, and Nathan Rosen, "Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?," *Physical Review* 47, no. 10 (1935): 777–80.
10. Einstein first used the phrase in a letter to Max Born dated March 3, 1947; see Max Born, *The Born-Einstein Letters: Correspondence Between Albert Einstein and Max and Hedwig Born from 1916 to 1955, with Commentaries by Max Born*, trans. Irene Born (London, 1971), 158. The original German was "*spukhafte Fernwirkung*."
11. On the correspondence, see Arthur Fine, *The Shaky Game: Einstein, Realism, and the Quantum Theory* (Chicago, 1986), 64–85; John Gribbin, *Edwin Schrödinger and the Quantum Revolution* (Hoboken, NJ, 2013), 172–86; and Baggott, *Quantum Story*, 149–58.
12. Fine, *Shaky Game*, 78–79; Gribbin, *Edwin Schrödinger*, 180–81.
13. Erwin Schrödinger, "The Present Situation in Quantum Mechanics: A Translation of Schrödinger's 'Cat Paradox Paper,'" trans. John D. Trimmer, *Proceedings of the American Philosophical Society* 124, no. 5 (1980): 328. Originally published in three parts under the title "Die gegenwärtige Situation in der Quantenmechanik," *Die Naturwissenschaften* 23 (1935): 807–12, 823–28, 844–49.
14. Nicholas Maxwell, "Induction and Scientific Realism: Einstein Versus van Fraassen Part Three: Einstein, Aim-oriented Empiricism and the Discovery of Special and General Relativity," *British Journal for the Philosophy of Science* 44, no. 2 (1993): 290–91. Note how Einstein is misremembering and has substituted gunpowder for cyanide. Einstein was increasingly critical of quantum mechanics; Arthur Fine quotes him as saying: "This theory [the present quantum theory] reminds me a little of the system of delusions of an exceedingly intelligent paranoiac, concocted of incoherent elements of thoughts"; *Shaky Game*, 1.
15. John Bell, "On the Einstein Podolsky Rosen Paradox," *Physics* 1, no. 3 (1964): 195—200.
16. See, for example, Alain Aspect, "Bell's Inequality Test: More Ideal than Ever," *Nature* 398 (1999): 189–90. There is one possible loophole left, namely, "super-

determinism"—the notion that absolutely everything has been determined from the time of the Big Bang.

17. Capra, *Uncommon Wisdom*, 43.
18. On Bohm's extended interest in Asian thought, see F. David Peat, *Infinite Potential: The Life and Times of David Bohm* (Reading, MA, 1997); on Walker's enlightenment experience, see Walker, *Physics of Consciousness*, 142–43.
19. The *Gateless Barrier of the Zen Tradition* was compiled by Wumen Huikai 無門慧海 (1183–1260) and published in 1228. It consists of 48 cases along with Wumen's comments in both prose and verse. Wumen culled his cases from a variety of earlier sources, primarily the "recorded sayings texts" (*yulu* 語錄) of renowned Chan masters. On the nature and pedagogical use of the "public case" genre, see esp. T. Griffith Foulk, "The Form and Function of Kōan Literature: A Historical Overview," in *The Kōan: Texts and Contexts in Zen Buddhism*, ed. Steven Heine and Dale S. Wright (Oxford, 2000), 15–45; and Robert H. Sharf, "How to Think with Chan *Gong'ans*," in *Thinking with Cases: Specialized Knowledge in Chinese Cultural History*, ed. Charlotte Furth, Judith Zeitlin, and Hsiung Ping-chen (Honolulu, 2007), 205–43.
20. *Taishō shinshū daizōkyō* 大正新脩大蔵經, ed. Takakusu Junjirō 高楠順次郎 and Watanabe Kaigyoku 渡辺旭, 100 vols. (Tokyo, 1924–1932), no. 2005: 48.294c13–22. Hereafter cited as "T." Texts in T are indicated by the text number followed by the volume, page, register (a, b, or c), and line number(s). The case also appears in the *Record of the Transmission of the Lamp*, T.2076: 51.258a3–7; *Blue Cliff Record* (case 64), T.2003: 48.195a14-b25; and *Book of Serenity* (case 9), T.2004: 48.232b25–233a27. Translations from the Chinese are my own.
21. On cats in China, see esp. Timothy Hugh Barrett, *The Religious Affiliations of the Chinese Cat: An Essay Towards an Anthropozoological Approach to Comparative Religion* (London, 1998); Timothy Hugh Barrett, "The Monastery Cat in Cross-Cultural Perspective: Cat Poems of the Zen Masters," in *Buddhist Monasticism in East Asia: Places of Practice*, ed. James A. Benn, Lori Meeks, and James Robson (London, 2010), 107–24; and Yaowu Hu et al., "Earliest Evidence for Commensal Processes of Cat Domestication," *Proceedings of the National Academy of Sciences* 111, no. 1 (2014): 116–20.
22. In the *Xin shu* 新書 by Jia Yi 賈誼 (c. 200–168 BCE), an important work of political theory from the Western Han Dynasty, feet or shoes represent the base of the realm (the barbarian subjects) as opposed to the head or crown (the ruler). Placing one's shoes on one's head is then an image of the upending of the natural social/political order. (Thanks to Michael Nylan for this reference.)