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FEATURE
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n ancient buddha said:

For the time being stand on top of the highest peak.
For the time being proceed along the bottom of the deepest ocean.
For the time being three heads and eight arms.
For the time being an eight- or sixteen-foot body.
For the time being a staff or whisk.
For the time being a pillar or lantern.
For the time being the sons of Zhang and Li.
For the time being the earth and sky.
–Eihei Dogen (, translated by Kazuaki Tanahashi and Dan Welch)

FOR THE TIME BEING, my knees are killing me. It's the second day of the sesshin, a seven-day meditation intensive at the Rochester Zen Center, and I'm in big trouble. The stiffness in my legs has not gone away. I'm hot, tired, and clammy under the brown robe. Worst of all, I cannot find my way in into a deeper, more concentrated sitting. I'm not engaged in meditative absorption. I am not breaking through to insight and enlightenment. Instead I'm stranded, left with nothing but the pain in my legs and my endless exasperating thoughts. The bell marking the new meditation round fades, and I sit staring straight into a thirty-five-minute Death March of boredom and discomfort. As a theoretical physicist, I'm fairly well versed in human speculation about time and its subtle nature. Now I'm getting a lesson on its not-so-subtle nature. Time, that most elusive and slippery concept, has abruptly jumped from the realm of the abstract into the domain of the concrete. And all that concrete is crushing my knees.

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Every culture in every era has its own way of understanding and making use of time. From Stonehenge to the digital chronometers staring down on Times Square, humans have always woven their idea of time into the organizational fabric of their societies.

Contemplative practice, on the other hand, takes us beyond our mere concept of time and forces us to engage with it directly. For better or worse, the flow of moments is the raw material of meditation. The nature of time is also central to the work of physics as it attempts to reveal the fundamental laws shaping physical reality. The dialogue between science and the contemplative tradition of Buddhism is still a relatively new addition to the contentious four-century-old "religion and science" debate. The first wave of that dialogue, focusing on relatively silly New Age enthusiasms for quantum physics, has passed (at least one hopes) among those who take the conversation seriously. Now the real work (and fun) can begin. Any attempt to understand and points of contact exist between the great investigative traditions of contemplation and science requires an open mind, sharp skepticism, and perhaps a little taste for mischief. Given the centrality of time in both the Buddhist and the scientific worldviews, it just may be the right place to begin a search for authentic parallels between them.

Buddhism's essential insight on time's passage is its fundamental lack of substance. As Shunryu Suzuki put it, "You may say, 'I must do something this afternoon,' but actually

there is no ‘this afternoon.’ At one o’clock you will eat your lunch. To eat your lunch is, itself, one o’clock.” In his great work , or , the thirteenth-century Zen master Eihei Dogen drew a direct link between time, being, and the self. For Dogen, they were all of a piece, unfolding through a present that is essentially dynamic and creative, an elemental self-revelation of all that is. “The way the self arrays itself is the form of the entire world,” says Dogen. “Thus the self setting itself out in array sees itself. This is the understanding that the self is time.” Dogen’s writings are nuanced and complex, but the lightning bolts of illumination in his description of time can strike even a novice reader like myself.

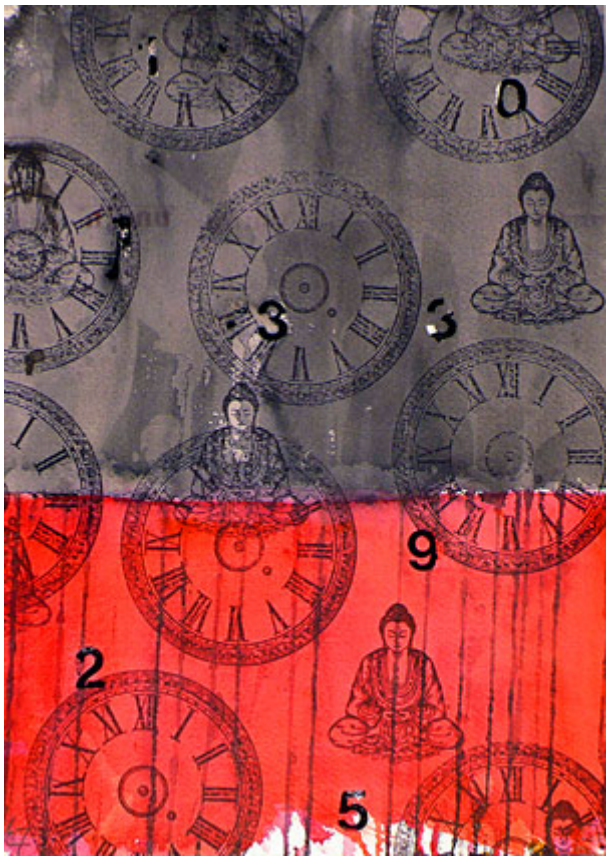
When Dogen says, “Time runs from present to past,” it can seem nonsensical, but as Kazuaki Tanahashi writes in his introduction to , “Time, according to Dogen, is experienced moment to moment; actual experience happens only in the present. Past was experienced in the past as the present moment, and future will be experienced in the future as the present moment.” But past and future always collapse into the experiencing of now, for that is all there is. Tanahashi continues: “Yet past is remembered as past in the present moment as future is expected as future in the present moment. Each moment carries all of Time.” Time can only disclose or unfold itself in our now, and as it does, all of time and all the world unfolds too. They cannot be separated. We stand in the center of what Dogen calls “arraying ourselves” as simultaneous observers, participants, and creators. Fields, grass, flowers, and wind always appear in the “now” that is ever one and ever renewing. Dogen has a word for this unity: being-time, or . To be is to be time. “As the time right now is all there is,” Dogen writes, “each being-time is without exception entire time.” In the context of Dogen and, perhaps, much of Buddhist understanding, the presence of the present is the only time you have.

AS THE MEDITATION round continues, I struggle to find a way into this elusive present moment. The silence is broken by a flock of geese honking sharply as they fly overhead. I can almost feel the birds’ smooth trajectory through the autumn sky and the infinitely subtle dance of forces that turn air and wings into the grace of flight. Not just above, this dance is everywhere: in the light reflecting off the wall in front of me; in the gamboling atoms that constitute each breath. Then, suddenly, my instincts as a scientist become a part of my effort. The universe revealed so powerfully through physics flows in its own way, and for an instant it fills the room. That universe, as it has played out for generations of scientists before me, offers a very different but equally startling vision of time.

Physicists, too, must do away with culturally conditioned notions of time. The deepest revolutions in physics have often turned on a radical reenvisioning of time. From Newton to Einstein, rethinking time has led to conceptual earthquakes that have shaken science to its foundations, razing the prevailing sense of what is both real and true.

Nowadays our planet is tiled with time zones, and we meter moments into ever finer intervals for everything from sports to commerce to communications. A new kind of time has emerged over the last few centuries, which in one sense can be considered the creation of a single man. It took Isaac Newton just a few years to reinvent the world with his radically new physics, and Newton started his revolution with time.

Most people associate Newton with his theory of gravity. But before he could even formulate his ideas of falling apples and orbiting planets, he had first to imagine a framework, a stage, on which to build the most basic description of forces and their effects. To accomplish this, he created what we now call Newtonian "mechanics," a universal description of the interplay between matter and motion. Resting at the base of this mechanics, this new theory of physics, was a powerful new vision of time.



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Newton imagined the flow of time to be absolute and universal. Time was like a smoothly flowing river running through all creation with unwavering constancy. Ten

minutes on my watch must be the same as ten minutes on yours, no matter where or when in the universe we may be. Time for Newton was separate and unique. It stood apart from people and events and animates his equations as a kind of omnipresent heartbeat against which all change, in all places, could be meas ured with infinite precision. In a very real sense, Newton's time was God's time.

While others such as Galileo and Descartes preceded him in developing the new physics, it was Newton's powerful vision, resting on an absolute time, that truly set the Scientific Revolution in motion. The Industrial Revolution followed close on its heels, as precisiontimed machines made from Newtonian mechanics transformed human life. In the sky, planets moved with clockwork predictability through their orbits. On Earth, men and women in burgeoning cities clocked into factories for their perfectly metered workdays. In both pure physics and the organization of human society, time became an innate property of an objective reality. The time we now experience in our socially structured daily lives is, for the most part, Newtonian time.

THE GEESE HONKING overhead continue on their southward path. I listen as their calls fade into the distance. The zendo returns to its deep collective silence. Then the monitor slides from her cushion, pads quietly to the altar and retrieves the , the "wake-up" stick, as I like to think of it. Whack! Whack! The sound of her quick strikes to the shoulders of my fellow meditators reverberates through the zendo. Each sharp strike connects the stick, their backs, and my ears. Each staccato crack draws the room together in a web of relationship—a matrix of events, sound, and attention—breaking the silence and the silent flow of moments.

In 1905, Einstein published his first paper on relativity. In just a few pages, he swept away Newton's absolute time. In its place the young Einstein showed us the counterintuitive truth that time is malleable. It can bend and stretch. To truly understand the nature of physical reality, Einstein found that his theory needed to merge time and space into a larger whole. The understanding that time could flow at different rates in different frames of reference arose as Einstein attempted to understand the universe as an interconnected web of "events" strung together by light waves. Time and space, separate and uniform, disappeared for him and no longer served as an unchanging bedrock for physics.

How does time's relativity show itself? Everything in Einstein's theory depends on "observers" who measure events. The motion of these observers (or their location near a massive object like a planet or a black hole) forms the key to linking time and space. To

be concrete, consider my round of sitting as an "event": it has duration, a beginning and an end, that can be measured with a clock. Everyone in the zendo is an observer. Any one of us could, in theory, look at the zendo clock and see that the sitting lasts 35 minutes.

In Newton's universe those 35 minutes are absolute. Everyone, everywhere in creation, will experience the same 35-minute interval, no matter where they are or how they move relative to each other. Not so for Einstein's new world: a Zen-monk-turnedastronaut traveling past the Earth at near the speed of light will look at the zendo and note something quite different. Instead of 35 minutes, our astromonk will clock the round at more than four hours. If he tries to time his own sitting to ours, he will stay in meditation for 241 of "his" minutes. (And I thought legs hurt.)

The stillness in the zendo returns. I hunker down, trying to forget the pain in my knees, and just follow my breath. But with every sound, every rasping scrape from people shifting slightly or breaking into a cough, my focus is shattered, and I return to agonized thoughts about pain, about the duration of the sitting, about anything, everything. The wind rises, and I hear leaves in the trees rustle. In response, a quieting thought slides across my attention. Who hears the leaves? I can imagine the physics, leaf brushing against leaf, the flow of wind converted to acoustic energy radiating through the air, but what of the essential presence that animates hearing the sound? What is the difference —is there a difference—between the sound and the hearing?

Physics, by its nature, deals with objective external realities. Einstein offered a deeper vision of how that reality could be described. But Einstein always imagined a universe of phenomena that exist independently of human action, agency, or consciousness. The "observers" in Einstein's theory can be anything marking the duration of an event: whether a zendo-bound roshi or a subatomic particle whizzing through the atmosphere, it makes no difference. No self-awareness is required.

If we want to take the vision of the true and real that physics offers and compare it with the subjective realities revealed by contemplative practice, we must never forget this fundamental difference. Retaining a firm grasp of the distinction is particularly crucial when we understand time through the lens of the other great revolution of twentieth-century science— quantum physics.

In the first years of the 1900s, physicists developed increasingly powerful instruments to probe the atomic and subatomic realms. The data from these experiments revealed a

world apparently not governed by laws familiar to scientists until then. To describe this new world, scientists were forced to invent an entirely new set of physical laws that came to be known as quantum mechanics. The list of examples of quantum weirdness is long. Here are a few:

A particle trapped in the nuclear version of an impenetrable box can escape by spontaneously disappearing from the inside and reappearing unbound on the outside.

A single electron traveling around an object seems to take two paths at the same time.

Two atoms separated by light years can each somehow manage to always know what the other one is doing.

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These are all sharp departures from what we think of as the "ordinary" behavior of things. Quantum mechanics reveals a world that is nothing if not bizarre. As the great Danish physicist Niels Bohr once said, "Anyone who is not shocked by quantum mechanics does not really understand it."

Ironically, except for in the all-important moment, no great revolution in our understanding of time came with the development of quantum mechanics. It is only at the precise moment that this quantum stuff is measured that things get weird. It's as if the act of taking a measurement—the explicit moment of observation— triggers a profound switch in the behavior of quantum systems. At the instant a quantum system is measured (or "observed"), physicists must stop using one set of rules and switch over to another—something unheard of in every other branch of physics. Out of that one instant of weirdness alone, countless popular books on science and Buddhism have been launched.

The apparent intrusion of conscious observation into the objective realm of physics has led many writers to claim that physics has affirmed the discoveries of Buddhism, Hinduism, mysticism, and whatnot. Since, some argue, Buddhism emphasizes consciousness rather than matter as the fundamental ground of existence, then it must be true that quantum mechanics, with its "measurement problem," recovers this emphasis and therefore confirms the realizations of Buddhism. This has been a particularly popular theme with New Age audiences, as exemplified by the maddeningly silly film or Deepak Chopra's profoundly misinformed writings on the subject. But neither physics nor Buddhism is that simple.

With a few notable exceptions—B. Alan Wallace (however much I may disagree with his conclusions), the astrophysicist Piet Hut, and the physicist Vic Mansfield, to name three —most writings on Buddhism and science are at best misguided and at worst so deeply wrong that they drive practicing physicists like me to breathe into a paper bag to stay calm. Their failure is an attempt to substitute wishful thinking for the hard work of rigorous thinking. By misconstruing the quantum mechanics raises (about time and measurements and reality) as that jibe with Buddhist tradition, they sidestep the most creative and fascinating part of investigation: not knowing where you may be led. But these failures serve an important function by demonstrating how a sincere dialogue between science and spiritual practice can go terribly wrong. Making tidy claims about tidy connections between science (à la quantum physics) and Buddhism (or some version of "Eastern mysticism") fails to do either one much justice. Indeed, such claims fail utterly to hit the essence of what makes both science and contemplative practice so dynamic, so interesting, and, ultimately, so worth our effort.

MY KNEES BEGIN sending out alarms to neighboring body parts. Now it's my back and ankles that are on fire. How much longer can this stinking round last? I start wondering whether Tibetan or insight meditation intensives have shorter rounds and longer

breaks. Maybe they serve chocolate pudding at dinner, too! The intensity of the discomfort is so bad it forces me to focus deeply on my breathing just to get to the frontmost edge of the pain. For a moment, it works. On each out-breath the fire in my knees recedes to some distant place. Then, amazingly, these moments hold. They expand and open on their own. The agonizing march of seconds is gone, folding in on itself as my breathing expands to fill the field of attention. Without thinking about it, I am suddenly exploring the flow of moments with a quiet directness. It is new and different and graceful. Then someone coughs, and my attention shudders again. The moment breaks, and I come back to the pain and the slow crawl of seconds. Still, I have to smile. No doubt about it, that was pretty cool.

Clearly, we must acknowledge the differences between science and contemplative traditions like Buddhism. One can say that in meditation practice, one seeks to rediscover and confirm truths that have already been affirmed and refined by tradition. In science, one builds on the discoveries of the past, but progress is made by finding new truths and thus falsifying previous views. Yet, on a direct and personal level are the approaches toward truth so fundamentally different? As the ninth-century Zen master Rinzai taught, "Place no head above your own." That is a sentiment I could easily use with my astrophysics graduate students. Likewise, regardless of what we read or are told about practice, it's our own encounter, our own experience unfolding in time, that matters. For the student—and we are always students— .
Tradition guides, but experience teaches.

There is an even deeper issue, however, that touches the core notion of truth in each domain: Does it make sense to evaluate conclusions reached through a subjective investigation of the mind by holding them up to the scrutiny of the putatively objective physical sciences, or vice versa? The evolutionary biologist Stephen J. Gould once used the term to describe the idea that science and religion have separate domains and each should be happy to leave the other alone. Should this be our approach? If we are talking about contemplative practice and not some blind adherence to scripture, then I am not so comfortable with such clean and tidy boundaries. I learn things through both practice and science. Can they really have nothing to do with each other? Still, their means of investigation are so different that one should be justifiably suspicious of overlapping, conjoined claims of truth or falsehood. So where does that leave us?

Here it is important to remember the role of time and history. For more than four hundred years, all discussion about science and religion meant debate between science

and Western monotheism. The advent of the Buddhist perspective on this discussion is still fundamentally new. There is a profound difference between arguing whether Genesis is compatible with Darwinian evolution and asking how understanding gained in contemplative practice relates to understanding gained in scientific practice. (Of course, many scientists would argue that in fact nothing is gained in practice, but that is part of the new debate.) The first wave of the discussion, the silliness of "Quantum Buddhism," has passed, or at least one hopes. Now perhaps we can begin the hard work. The first step is deciding what—if any—are the appropriate questions that can be asked and answered about comparing two such complex, subtle, and different traditions.

Perhaps, going forward, what will matter most will be an exchange of metaphors allowing us to enliven what is already known (contemplation) and point us in new directions for what is not known (science). this were possible, such a dialogue would be fascinating. But perhaps there is even further to travel. I am no roshi, and I can imagine getting smacked upside the head by those who have invested far more hours on the cushion than I, but I say: Put it all on the table. The scholars of religion Elaine Pagels and Robert Sharf have each argued (in this magazine) that at any moment in history, religions will selectively choose to emphasize certain aspects from their own traditions and to ignore others to serve current needs, and in that way they remain vital. Pagels calls this "creative misreading." Thus no single "correct" understanding handed down through history ever exists, and there are always new ways to see, new things to learn. If Dogen is right, then we know what we know only in the moment, for there is nothing else. The truly creative response to questions of the true and real exists in that single unified moment; we cannot know beforehand where it will take us. Perhaps each tradition should remain radically open-minded and radically skeptical.

Finally, the bell rings. I've made it. The round of sitting is over. It seems to take me forever to unfold my stiff, numb legs and stand up. I draw a deep breath and let the exhaustion drain out of me. There is exhaustion, yes, but excitement too. In the midst of all that hard work something new has discovered itself within the unfolding moments. The bell rings again, telling us that it's time to file out to lunch. For a moment, I want to linger. Do I have to leave my new sense of time on the cushion? Or can I bring it with me into the meal, then out into the world, and then everywhere after? Only time will tell.

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