

A person is shown in silhouette, sitting in a meditative lotus position on a large rock in the middle of a calm lake. The background is a soft sunset or sunrise sky, with the colors of the sky reflected in the water. The person's reflection is clearly visible in the still water below them.

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Current Research and Insights

Beyond Neuroscience

The Challenge of Yoga

By Donald J. DeGracia

The Fourth Phase of Water

Beyond Solid, Liquid, and Vapor

By Gerald H. Pollack

EdgeScience #16

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Why EdgeScience? Because, contrary to public perception, scientific knowledge is still full of unknowns. What remains to be discovered—what we don't know—very likely dwarfs what we do know. And what we think we know may not be entirely correct or fully understood. Anomalies, which researchers tend to sweep under the rug, should be actively pursued as clues to potential breakthroughs and new directions in science.

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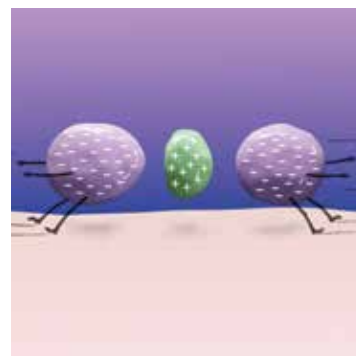
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Jim Baggott

Fairy-Tale Physics

Modern physics is heady stuff. It seems that we can barely get through a week without being assaulted by the latest astounding physics story, its headlines splashed gaudily over the covers of popular science magazines and, occasionally, newspapers. The public's appetite for these stories is seemingly insatiable, and there's no escaping them. They are the subjects of innumerable radio and television news reports and television documentaries, the latter often delivered with breathless exuberance and lots of arm-waving, from unconnected but always exotic locations, against a background of overly dramatic music.

We might agree that these stories are all very interesting and entertaining. *But are they true?*

What evidence do we have for super-symmetric "squarks," or superstrings vibrating in a multi-dimensional spacetime? How can we tell that we live in a multiverse? Is it really the case that the fundamental constituent at the heart of all matter and radiation is just "information"? How can we tell that the universe is a hologram projected from information encoded on its boundary? What are we really supposed to make of the intricate network of apparent cosmic coincidences in the laws of physics?

Now, modern science has discovered that the reality of our physical existence is bizarre in many ways, but this is bizarreness for which there is an accumulated body of accepted scientific evidence. There is, however, as yet *no* observational or experimental evidence for many of the concepts of contemporary theoretical physics, such as super-symmetric particles, superstrings, the multiverse, the-universe-as-information, the holographic principle, or the anthropic cosmological principle. For some of the wilder speculations of the theorists there can by definition *never* be any such evidence.

This stuff is not only not true, it is not even science. I call it "fairy-tale physics." It is arguably borderline confidence-trickery.

Matters came to a head for me personally one evening in January 2011. That evening the BBC broadcast an edition of its flagship *Horizon* science series, entitled "What is Reality?" This began quite reasonably, with segments on the discovery of the top quark at Fermilab and some of the more puzzling conclusions of quantum theory. But beyond this opening, the program went downhill. It became a showcase for fairy-tale physics.

There was no acknowledgement that this was physics that had long ago lost its grip on anything that we might regard as descriptive or explicative of the real world we experience. *Horizon*, like its American counterpart *Nova*, has an impressive reputation, and I became deeply worried that many viewers might be accepting what they were being told at face value. Conscious that I was now shouting rather pointlessly at my

television, I decided that it was time to make a stand.

Although I accept what modern physics has to say about the nature of our physical reality, when it's based on the body of observationally or experimentally grounded scientific fact, we have to realize that even in this "authorized" version of reality there are many grey areas, where we run out of hard facts and have to deal with half-truths, guesses, maybes, and a little imaginative speculation. This description is the nearest we can get to reality given the current gaps in our knowledge.

It's true that our knowledge in this authorized version goes very deep, but it does seem that we have paid a very high price for it. We now know much more about the physical world than we ever have at any time in history. But, I argue, we comprehend and understand much less.

We were obliged to abandon Isaac Newton's clockwork universe quite some time ago, but there was an inherent comprehensibility about this description that we found familiar and maybe even comforting (unless you happened to be a philosopher). The world according to quantum theory remains distinctly unfamiliar and uncomfortable. "Nobody understands quantum mechanics," declared the charismatic American physicist and Nobel laureate Richard Feynman, with some justification. And today, more than a hundred years after it was first discovered, the theory remains completely inscrutable.

Some modern theoretical physicists have sought to compensate for this loss of understanding. Others have tried to paper over the cracks with theories that are clearly not up to the task. Or they have pushed, with vaulting ambition, for a



final “theory of everything.” These physicists have been led—unwittingly or otherwise—to myth-creation and fairy-tales.

I want to be fair to them. These physicists have been wrestling with problems for which there are as yet no observational or experimental clues to help guide them towards solutions. They are problem-rich, but data-poor. Rather than simply plead ignorance or focus their efforts on more tractable problems, they have chosen instead to abandon the obligation to refer their theories to our experience of the real world. They have chosen to abandon the scientific method.

In doing this some theorists have railed against the constraints imposed by a scientific methodology that, they argue, has outlived its usefulness. They have declared that the time has come to embrace a new methodology for a “post-empirical science.” Or, if you prefer, they have given up.

With no observational or experimental data to ground their theories in reality, these theorists have been guided instead by their mathematics and their aesthetic sensibilities. Not surprisingly, ever-more outrageous theoretical speculations freed from the need to relate to things happening in the world that we experience have transported us to the far, wild shores of the utterly incredible and downright ridiculous.

This is not a wholly new phenomenon. Speculative theorizing has always played an important role in scientific development. However, under the stark, unyielding gaze of the scientific method, in the light of new observational or experimental data such speculations have either become absorbed into mainstream science or they have fallen by the wayside and been rigorously forgotten.

But contemporary theoretical physics seems to have crossed an important threshold in at least two senses. Speculative theorizing of a kind that cannot be tested, that cannot be verified or falsified, a kind that is not subject to the mercilessness of the scientific method, is now almost common currency. The discipline has retreated into its own small, self-referential world. Its product is traded by its advocates as mainstream science within the scientific community, and peddled (or even mis-sold) as mainstream science to the wider public.

Secondly, the unprecedented appetite for popular science and its attractions as an income-stream have proved hard for the more articulate and eloquent of these advocates to resist. The result is that virtually every other popular book published on aspects of modern physics is chock-full of fairy stories. It is pseudo-science masquerading as science.

Of course, arguing about whether superstring theory, the multiverse, and other products of fairy-tale physics are exercises in metaphysics rather than science offers something of an entertaining distraction, but, you might ask, what’s the big deal? Why get so worked up? After all, what does it matter if a few theorists decide that it’s okay to indulge in a little self-delusion? So what if they continue to publish their research papers and their popular science articles and books? So what if they continue to appear in science documentaries, peddling their metaphysical world-views as science? What real harm is done?

I believe that real damage is being done to the integrity of the scientific enterprise. The damage isn’t always clearly visible and is certainly not always obvious. Fairy-tale physics is like a

slowly-creeping yet inexorable dry rot. If we don’t look for it, we won’t notice that the foundations are being undermined until the whole structure comes down on our heads.

But, even then, consumers of popular science may simply wish to be entertained. They may wish to have their already boggled minds further boggled by the latest “scientific” thinking, through a rapid succession of “Oh wow!” revelations. Blimey! Parallel universes!

To take this view is, I believe, greatly to underestimate the people who consume popular science. It also shows an astonishing lack of respect. I suspect that many readers might actually like to know what is accepted science fact, and what is science fantasy. Only the hard facts can illuminate the situation sufficiently to judge the nature of the trick, and to decide if it involves a betrayal of confidence, or even a betrayal of the truth.

Put it this way. If we were to regard fairy-tale physics as a lively branch of contemporary *philosophy* rather than science, do you think it would continue to receive the same level of attention from funding agencies, universities, popular science publishers, the producers of radio and television programs and the wider public? No?

This is the big deal.

JIM BAGGOTT is an award-winning science writer based in the UK. His latest book is *Farewell to Reality: How Modern Physics Has Betrayed the Search for Scientific Truth*, from which this article has been excerpted. Jim started out as a chemical physicist, and won academic awards for his experimental research. He now works as an independent business consultant, but maintains a broad interest in science, philosophy, and history. He has been studying and writing about quantum physics for more than 25 years.

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Donald J. DeGracia

Beyond Neuroscience: The Challenge of Yoga

The mind-body problem, the link between our subjective and objective natures, has been a perennial intellectual concern. Cognitive neuroscientists tend to consider that mind emerges from brain activity. But recent advances undermine this notion. Here we discuss these advances in a context recognizing that, over 2000 years ago, Indian Yogis found a means to reconcile our dual existence as both objective and subjective beings. But to understand how yoga might help us bridge the limitations of modern science, we must begin our journey with classical philosophy, where modern understanding began. We then move on through 21st century cognitive neuroscience, whose discoveries bring paradox to the fore, thereby necessitating an exploration of the ancient practice of the mystical science of yoga, which offers modern science both a challenge and a choice.

The Mind-Body Problem

For those not familiar with Western philosophy, it might come as a surprise that one of its core preoccupations is to understand the nature of the mind and awareness, and to understand the relationship between our mental experience and the fact of our physical reality. The mind-body problem, as it is called, is one of the most complex and confusing issues in Western thought and has occupied philosophers for centuries. Modern understanding of this problem was formulated in 17th century Europe, often by the same people who gave birth to modern science.

An early scientist-philosopher who garnered much attention was Descartes. He not only invented the Cartesian coordinates learned by all students of science but his approach to the mind-body problem is taken by many as the point of departure on this topic. Descartes concluded that mind and body, or subjective and objective, were completely different categories of being, and he could find no obvious means to relate them. Descartes's dualistic thought bifurcated into two radically different viewpoints that today we call "materialism" and "idealism."

Materialism amounts to the idea that the mind, subjectivity, is caused by objective events. Though no one person "invented" materialism, Isaac Newton might well be its poster-child. Newton insisted that both space and time were objective and existed independently of human minds. Others have used his science to uphold a materialistic banner. Within space and time is objective "stuff" called matter, and we humans are made of matter. Therefore, whatever mind is, it must be made of, and caused by, matter. This view more or less underlies all science today and has been the main driver in the evolution of the neurosciences.

During Newton's lifetime, Bishop George Berkeley, an Irish theologian and philosopher, proposed another solution to the mind-body problem, one known as idealism. Idealism is the position that the world is made not of matter but of mind, of soul stuff. Berkeley's point of departure was the obvious realization that the human mind could never be completely eliminated from any explanation of the natural world because *all* understanding, *all* knowledge, *all* awareness, occurs *within* our human minds. "Does a tree falling in the forest make a sound if no one is around to hear it?" stems from Berkeley.

By the mid-1700s, it was clear to those familiar with the issues that the idealistic position was more fundamental because any so-called "objective" thing we humans observe requires not only observation by our senses, but also for sense impressions to be processed by our minds. Immanuel Kant, the German philosopher whose major work was the *Critique of Pure Reason*, formalized this understanding with his distinction between "things-as-we-know-them" and "things-in-themselves." Ideas and sensations in our mind are different entities from the things as they exist outside of our mind. Somehow, our nature has a means to make a copy, a representation, of what is outside of our minds. It is these copies we deal with in our perception and thinking. Thus, we can only know the copy, the representation. But since we can only know representations, we can never know the thing-in-itself.

Kant defined the nature of our experience such that there was an unbridgeable gulf, a "ring pass not," between our knowledge of things and the things-in-themselves. This is the essence of Kant's transcendental idealism. Unlike Berkeley, Kant did not deny an objective world outside of our minds, but concluded that, whether or not this world exists, it is forever inaccessible to awareness.



Credit: ChrisGorgio/Stock

Neuroscience

History shows us that science ignored Kant's conclusions. Science evolved along its own independent trajectory assuming that the objects of our sensory perceptions *are* the things-in-themselves. This view became dominant in 20th century neuroscience as reflected in the "open model" of brain function.

The open model starts at the sensory organs: the eye, ears, skin surface, taste and smell, as well as other senses not widely recognized, such as sensors in blood vessels, GI tract, lungs, and bladder. It is now understood how sensor cells act to transduce some specific form of energy in the environment (or inside the body) into changes in the voltage of sensory neurons. The voltage changes are converted to nerve impulses, called action potentials, where the time pattern of the action potentials constitutes a code we still have not cracked, and convey information into the brain about the sensory world.

The open model posits that patterns of nerve impulses delivered by the sensory systems *cause* patterns of activity in the higher parts of the brain, specifically in the cerebral cortex where it is believed that conscious awareness occurs. The cortex is associated with conscious awareness for many reasons including: (1) people lacking a cerebral cortex, (e.g. from disease or injury), display no evidence of conscious behavior; (2) damage to specific parts of the cerebral cortex cause loss of the function associated with that part of the cerebral cortex; and (3) centrally-administered anesthetics predictably alter the electrical activity of the cerebral cortex, and correlate with loss of conscious awareness.

It had long been known from studying nervous system gross anatomy that sensory systems make "relay pathways" into the brain. The relay systems start at each sensory organ (eye, ear, skin, viscera, etc.), from which nerve impulses ascend up white matter tracts through circuits that are anatomically distinct for each sensory system. The sensory systems go to a deep brain structure, the thalamus, which in turn plugs into the cerebral cortex. Based solely on this anatomy, the thalamus was considered the "gateway" to the cerebral cortex, and it was inferred that nerve impulses from the thalamus to the cortex caused conscious perceptions of the sensory world.

The cerebral cortex is the visible, crinkly, outer surface of the brain. It is a sheet of cells about 2-4 mm thick containing 100,000 neurons/mm². It had been long established that different areas of the cortex corresponded to different mental functions. The occipital lobe in humans is dedicated to vision. The parietal lobe is associated with skin sensations and navigating in space. The temporal lobe contains auditory, visual, memory, and emotional functions. The frontal cortex moves skeletal muscles. The prefrontal cortex is associated with human personality, including decision making, logic, and conscious emotions.

Thus, there appeared to be a linear, sequential organization to nervous system function. Patterns of electricity, in the form of action potential time series, were generated at the sensory receptors. The electrical patterns ascended in their respective relay pathways and ended in very specific regions of the cerebral cortex. The essence of the open view of brain function was *to assume that the electrical patterns in the cerebral cortex*

were caused by the input from the sensory receptors.

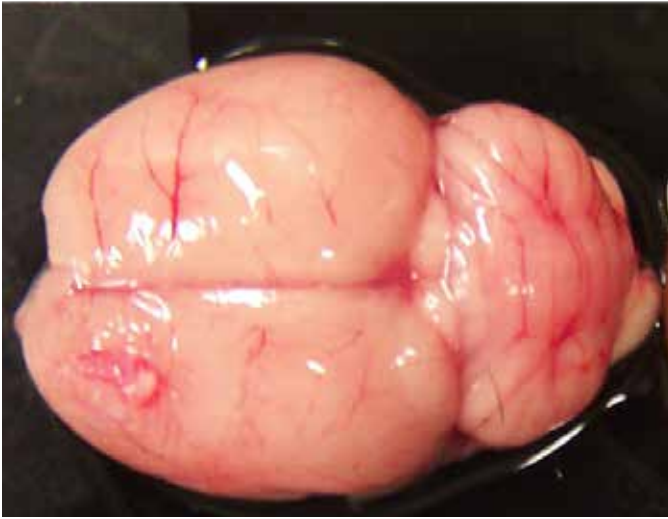
One can imagine how the brain might generate conscious awareness in the open model. The brain might work like a three dimensional photocopy machine, perhaps using holography principles, to generate a representation, an internal copy of the sensory world. The brain would use this internal copy of the world to get around in the real world. While sounding plausible, scientific evidence has eroded the open model of brain function, shutting the door to such possibilities, and instead ushering in a paradigm shift to a new "closed model" of brain function.

State-of-the-Art Technology and the Closed Model of Brain Function

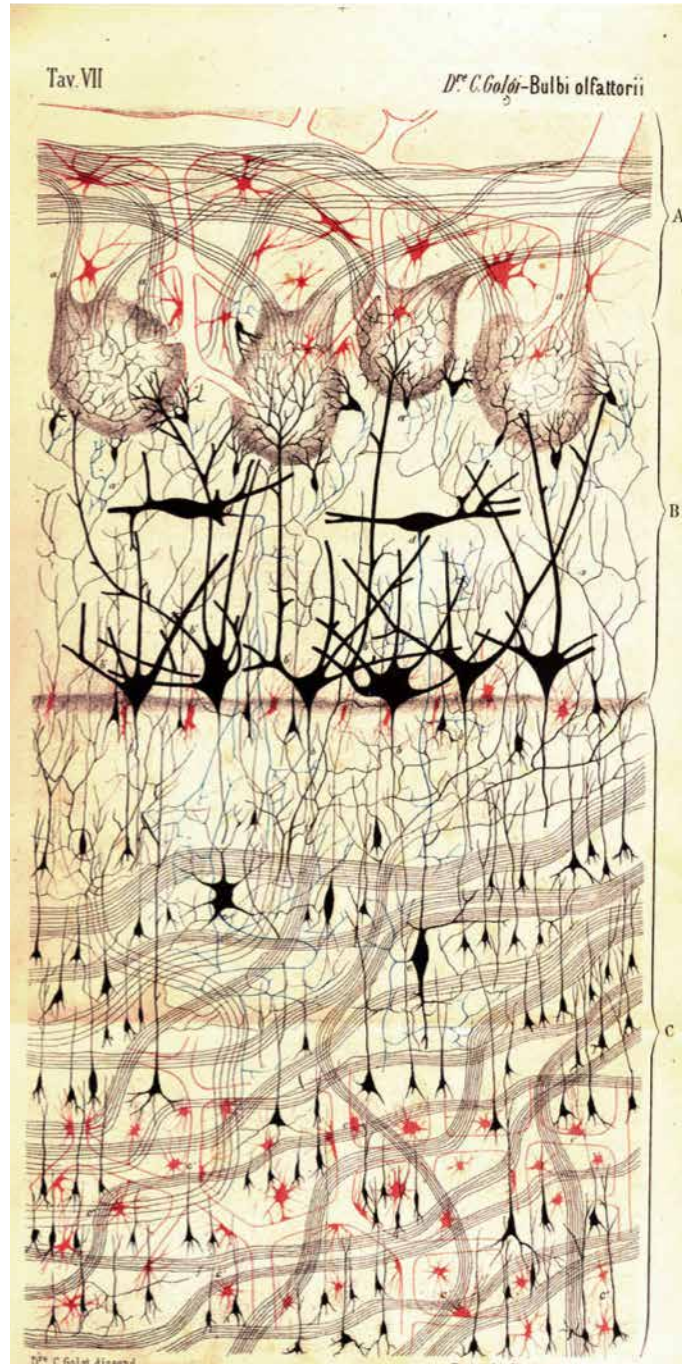
From studies dating to the 1920s, the connections of brain neurons were recognized to form complex feedback loops that cause self-sustaining electrical activity. As technology improved, it has become apparent that feedback circuits are more important, functionally and quantitatively, than linear "feedforward" flows undergirding the open model. For example, by the 1990s it was known that any given region of the cerebral cortex had, on average, 25 inputs and 25 outputs (Van Essen et al., 1992), an observation inconsistent with any simple feedforward model of brain connectivity.

Additionally, it was discovered that the connections between the thalamus and cerebral cortex were bidirectional: not only does the thalamus project to the cerebral cortex, the cerebral cortex plugs back into the thalamus. One can quantify thalamic input connections. For the visual system, the optic nerve accounts for 20% of the inputs to the visual thalamus, but the visual cortex accounts for 40% of the inputs (Llinás, 2001). Thus, the supposed end of the visual relay chain, the visual cortex, inputs more information into the thalamus than the eye itself! From such data, the idea of "thalamocortical loops" emerged. This idea indicated that the relationship between the thalamus and cortex was not $A \rightarrow B$, as the open model suggested, but instead was a feedback loop of $A \rightleftarrows B$.

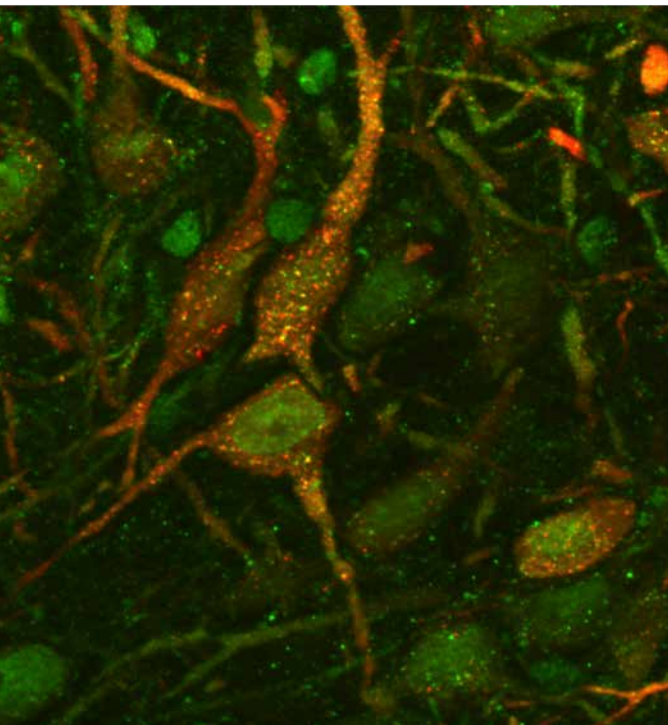
The development of voltage sensitive dyes (VSD) over the past decade has revolutionized the understanding of neuron behavior. VSDs are dyes whose light emission properties change when voltage changes. VSDs can be absorbed by living neurons which can then be videoed using sophisticated microscopy, allowing measurement of the electrical activity of hundreds or thousands of neurons simultaneously. By studying neurons with VSDs, it has become clear that neurons do not conduct in concert with the pattern of sensory inputs. Instead, at any given time, hundreds or thousands of neurons are simultaneously active in brain tissue *whether or not the tissue is stimulated by sensory input*. When neurons are active in the absence of sensory stimulation this is called "spontaneous activity." Prior to VSDs, electrical signals measured from neurons that did not conduct in concert with sensory input were considered random, precisely because they did not mirror the sensory input. However, VSDs allow us to literally see that neurons conduct in very complex patterns in both space and time. Today, this spontaneous activity is not interpreted as



The intact rat brain contains 56 million neurons forming complex multileveled structures regulating all aspects of the animal's behavior and physiology.



1875 hand-drawn view of the dog olfactory bulb by the famous neuro-anatomist Camillo Golgi reveals the complex network architecture of this brain region. Each brain regions has its own complex micro-architecture.



Individual neurons are densely packed in a meshwork of biological wires called dendrites and axons.

random, but as nonlinear, and results from the complex microscopical network wiring among neurons in brain tissue.

One important study that contributed to getting past interpreting neuron activity patterns as random was that of MacLean et al (2005), conducted in Raphael Yuste's lab at Columbia University. In this experiment, Yuste and colleagues studied neuronal activity patterns, at single neuron resolution, of living brain slices where the connections between the thalamus and cerebral cortex were maintained intact. They compared the neuronal activity patterns in thalamically-stimulated brain slices to the spontaneous activity patterns in un-stimulated brain slices. Without going into the details, the final result was quite amazing: they could not statistically distinguish stimulated from un-stimulated brain slices.

Experiments like Yuste's have led to efforts to decode the complex spontaneous electrical patterns of neurons in terms of network dynamics (Sporns, 2011). Given that there are over 100 billion neurons and 100 trillion synapses in the brain, there are an astronomical number of possible spontaneous electrical patterns, or microstates, in brain tissue. It is important to emphasize that the microstates are built into the brain. They are not caused by any external source but result from the intrinsic dynamics of the microscopic architecture connecting neurons.

We thus come to the essential difference between the open and closed models of brain function. The open model saw sensory input as causing the activity of the cerebral cortex. In the closed model, sensory input does not cause activity in the cortex but only perturbs it to shift from one intrinsic microstate to another. The MacLean et al (2005) study showed that microscopic electrical states are statistically indistinguishable, whether caused by sensory input or not. Thus, brain activity is built into the brain's structure, and not caused by anything external: hence, the "closed" model.

The Closed Model Does Not Extricate Us from Kant's Dilemma

In the closed model everything in our awareness is generated inside of the brain. One must distinguish between global brain states such as being awake or asleep, and what happens within a global brain state. Within a global brain state such as wakefulness, the specific contents of awareness such as sensory perceptions, thoughts, emotions, urges, etc. are, by the closed model, microscopic patterns of electricity in the brain. There is no "real" world per se, at least not one accessible to our awareness, only microscopic electricity patterns that we interpret in various fashions: as an external sensory sensations, as thoughts, emotions, and so on.

Sound familiar? These notions are strikingly similar to Kant's transcendental idealism and this is recognized by neuroscientists (Behrendt, 2003; MacLean et al, 2005). But neuroscientists who cite Kant as justification for the closed model of brain function are fitting the square peg of idealism into the round hole of materialism. For such smart people, they are missing the fundamental distinction between idealism and materialism, and missing Kant's main point: the things we are

aware of are not the things-in-themselves.

We have sensory and cognitive experience of brains, relay pathways, neurons, electricity, genes, molecules, atoms, math equations, etc. But these are all elements in our awareness, and so, by Kant's reckoning, none can be things-in-themselves. Neuroscience, like all science, assumes that the things-we-perceive *are* the things-in-themselves. Said differently, neuroscientists have been snared in the trap where the mind fools itself into believing it has transcended its limitations, a trap unambiguously identified by Kant. All scientists are so snared, but neuroscientists lay claim to explaining consciousness, so the paradox becomes acutely obvious.

Thus we are faced with this quandary: We can either ignore Kant's dilemma, at the expense of self-delusion, or we can accept Kant's critique that we are apparently forever trapped within our own minds. It is only when we have boxed ourselves in thus that we can appreciate that yoga offers us a

The Qualia Problem

Whether considering the open or closed model of brain function, we run into the Achilles' heel of the neurosciences: the "qualia" problem. If awareness is caused by brain biology, then how do the qualities of our awareness arise? Why a blue sky, or the timbre of a piano, warmth or cold, love or hate? How do presumably insentient atoms and cells give rise to these qualities in consciousness? The closed model insinuates that qualia are brain electrical microstates. But how do electrical patterns in one part of the brain cause experience of a blue sky, and in another part of the brain cause the experience of being in love?

The only remotely defensible materialistic position on this question is offered by the Colombian neuroscientist Rodolfo Llinás (2001) who suggests that qualia derive from cell irritability, the property of cells to respond to environmental stimuli. He analogizes thus: muscles contract because of machinery inside muscle cells, therefore neurons must generate consciousness because of some machinery *inside* of neurons. By this statement Llinás concedes that electrical patterns *amongst* neurons cannot adequately explain qualia. However, there is a potential infinite regress: if hypothetical machinery inside neurons fails to explain qualia, must we then consider the molecules that make up the neuronal machinery, or the atoms inside the molecules, or the subatomic particles inside the atoms? Where is the difference that causes the qualia of subjective experience?

A less problematic explanation is possible. One can link the yoga of Patanjali to ideas expressed 300 years ago by the great German scientist Gottfried Leibniz who postulated irreducible quanta of consciousness he termed "monads." Matter does not create consciousness. Instead, matter is animated by monads. It seems hardly a coincidence that Leibniz' monads would perfectly fit between the moments of time that lead to Kaivalya. (see page 11)

possible way out of this dilemma, a means to get past Kant's "ring pass not."

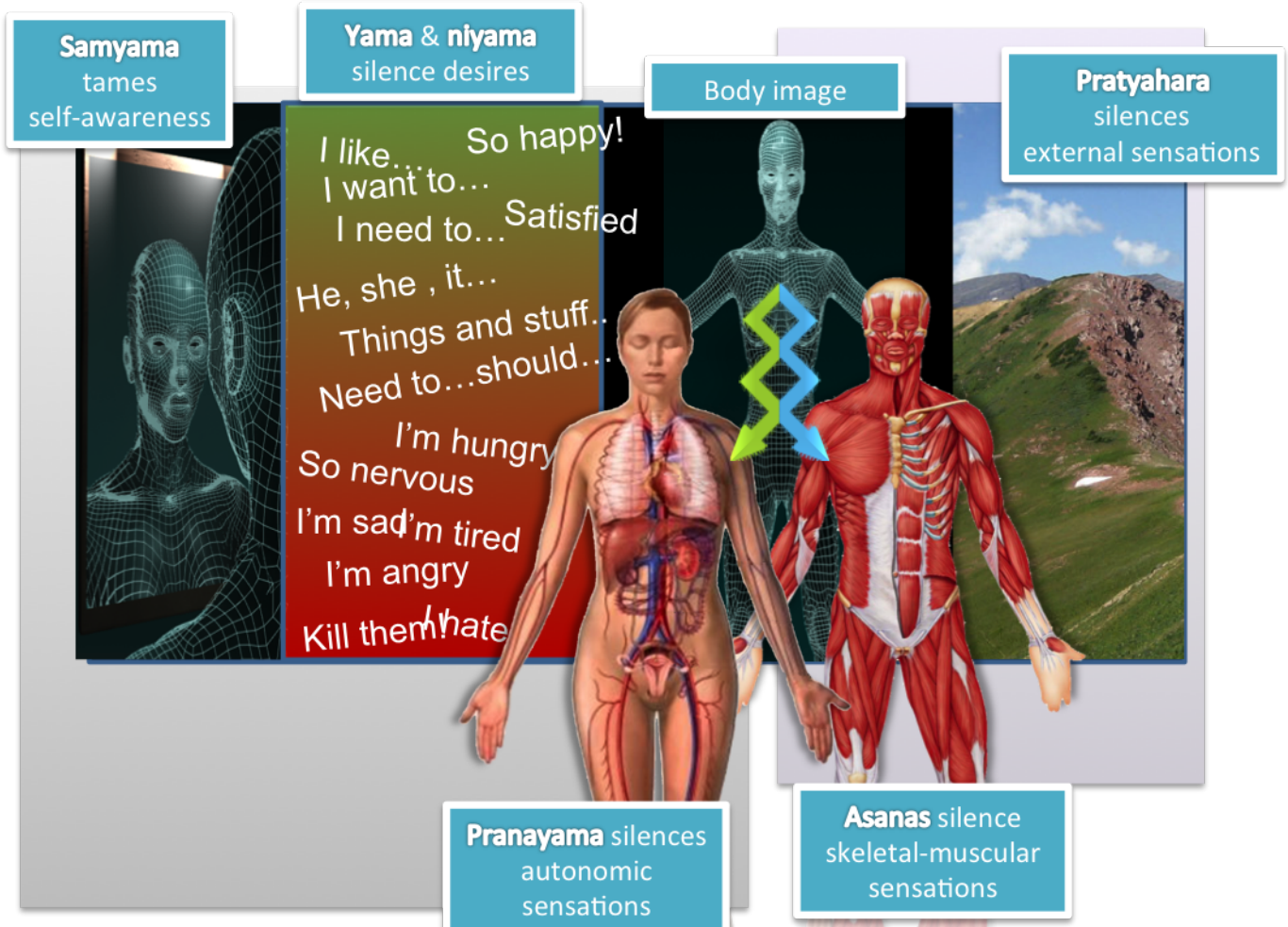
Yoga

It may also come as a surprise that yoga's main focus is the study of consciousness. But yoga does not study consciousness simply for knowledge's sake. Yoga has a definite end goal that goes by many names: enlightenment, nirvana, cosmic consciousness, satori, moksha, and the one we will use here: Kaivalya. The motivation for performing yoga is to find the truth of the self. Yoga constitutes a set of methods and procedures, different from science, different from intellectual philosophizing, for answering the perennial questions of our being. Yoga is complex, very old, and its origins lost in the mists of antiquity. Because there are many types of yoga, we focus here on one specific form of yoga, Raja or Ashtanga Yoga, described in the *Yoga Sutras* of Patanjali, a text that may be 2200 years old.

In yogic teachings, consciousness is thought of as a container with different types of patterns in it. The patterns include all our mental activities: sensory, emotional, cognitive, etc. This container is not closed but has a "hole" in it, called a

bindu, or center of consciousness. We can image the container of consciousness to be like the inside of a blown-up balloon. The inner walls of the balloon are like a screen, on which is projected the patterns inside of consciousness. The images are projected onto the screen of consciousness by processes occurring at the center of consciousness. The goal of yoga is to find the center of consciousness and pass through it. Yoga teaches in no uncertain terms that this allows exit from the individual container of consciousness. Exiting the container of individual consciousness is the experience of Kaivalya, which means "alone."

My central thesis is that we can equate the experience of Kaivalya with exactly what Kant thought was impossible: to experience things-in-themselves. But Kaivalya reveals not things-in-themselves, in a plural sense, but *thing-in-itself* in a singular sense. This thing-in-itself is unified and indivisible. When perceived within the container of individual consciousness it is experienced as multiplicity. In the *Yoga Sutras* the thing-in-itself is called Purusa, the self. Purusa is our very nature, but this nature is masked by the multiplicity of our waking consciousness. Yoga, as we shall see, is the elimination of the "embellishments" of Purusa so that it is alone within itself. It must be strongly emphasized that Kaivalya is an



altered state of consciousness and cannot be experienced in the waking state. There is no deductive proof of Kaivalya, no phenomenological experience in our normal state of consciousness to prove Kaivalya is real. One must go beyond mere intellectual understanding, and practice yogic methods to experience Kaivalya. However, yoga methods are rational, and logically link our waking awareness to Kaivalya.

The *Yoga Sutras* is a procedure manual and resembles a scientific laboratory manual by providing step-by-step methods. However, the *Yoga Sutras* is written in the highly compact aphorism style intended for memorization and oral transmission, before writing was commonplace. Thus, each statement, or aphorism, requires elaboration, found in many commentaries by authors over the centuries (my interpretation here is based primarily, but not exclusively, on I.K. Taimni's commentary). Further, some methods are only hinted at, or described in obscure terms because the details were meant to be imparted by a teacher (guru) who already knew the techniques. In spite of these limitations, the overall logic of the methods is quite clear.

Aphorism 1.2 of *Yoga Sutras* states: “yogah chittavritti nirodhah.” This means “yoga is silencing the modifications of the mind.” More literarily this translates to “the joining is caused by cessation of the mind-whirlpools.” But what is joined with what? Purusa joins its fundamental nature. This is accomplished when the mind is made silent, when the patterns in awareness are suppressed. Patanjali describes eight techniques (“ashtanga” means “eight limbs”) that are used to silence the mind and penetrate deep into consciousness in order to find the center of consciousness to effect this joining.

The first five methods or limbs are called “**bahiranga**,” or external, yoga techniques. These eliminate external influences from consciousness. The classic image used in yoga to explain the bahiranga methods compares the mind to a lake. If the lake is covered with waves, one cannot see into the depths. If the lake is calm, one can see into the depths. And so, by calming “the waves of the mind,” known as “vrittis”, one can penetrate into the depths of consciousness.

Each bahiranga technique eliminates specific types of external patterns from consciousness. **Yama** and **niyama** practices silence desires and emotional attachments. **Asanas** are postures used to eliminate sensations of the skeletal muscular system from awareness. The study of asanas is Hatha yoga, the most familiar yoga in the West. **Pranayama** are breathing techniques that allow voluntary control of autonomic functions, used to eliminate awareness of visceral sensations. Pratyahara is perhaps the hardest to understand, but is something we experience every time we sleep. In sleep, we lose consciousness of the external sensory world of waking consciousness. Pratyahara is voluntary control of this same process. Pratyahara eliminates perceptions of the external world from consciousness. Thus, bahiranga methods eliminate vrittis due to external sources. All that remains in consciousness are internal mental experiences, including the self-reflective awareness of the person.

The last three limbs of Patanjali's yoga are “**antaranga**,” meaning “internal,” because the techniques occur only in the

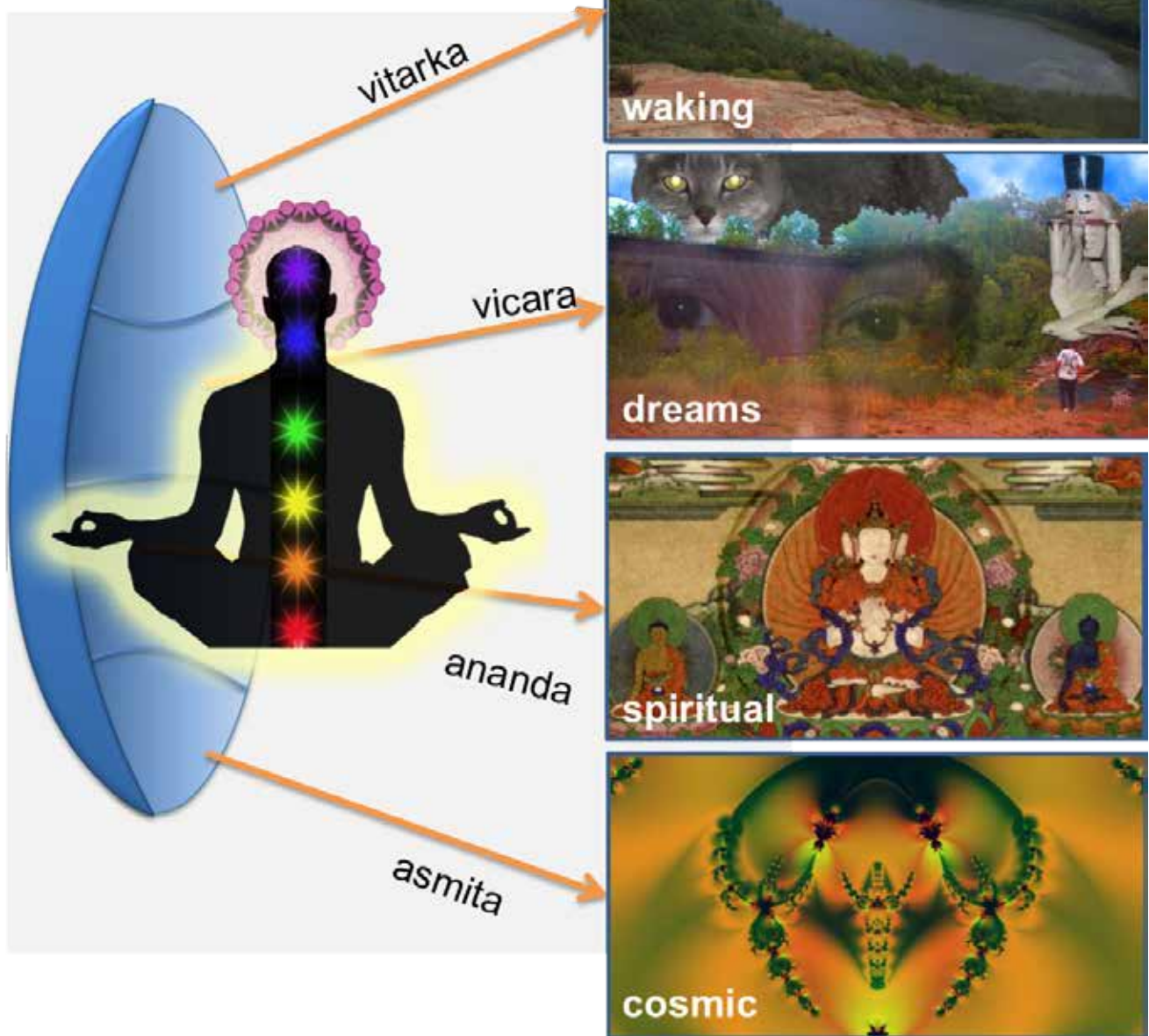
mind. These limbs form a single process, called “samyama,” which discipline the flow of consciousness. The common notion of “meditation” refers to these three limbs. The first of the last three limbs is **dhyana**, which is the method of holding only a single thought, or vritti, in the container of consciousness. Mantras and mandalas are examples of single thought objects, called a “pratyaya,” when used for this purpose. Our normal stream of consciousness is an incessant transformation of one thought into the next. It is very hard to hold a single thought in the focus of attention for any length of time, as any attempt to do so will illustrate. Next is **dharana**, the ability to hold the single thought for a sustained period of time, preventing other vrittis from intruding into awareness. Sustained focus on the single thought causes two transformations in consciousness that lead to **samadhi**: (1) consciousness concentrates to a point (as opposed to normal thinking, which is diffuse because it constantly shifts), and (2) self-awareness merges with the single thought. The net result of samadhi is an amazing effect: it provides the means to voluntarily move amongst altered states of consciousness. To make this relatable, falling asleep moves consciousness from waking to dreaming. Samadhi is a tool that allows voluntary control over such processes, and is used by the yogi to descend through consciousness to find the center.

The *Yoga Sutras* prepares one for the descent into consciousness by describing four “layers” or global states of our consciousness. The description of these in the *Yoga Sutras* is more advanced and inclusive than any description by Western sources, whether ancient (i.e. Plato) or modern (i.e. Ken Wilber), because the levels of consciousness described in yoga are not mere intellectual ideas, but are real levels of experience that emerge from practicing yoga.

The first level, **Vitarka**, is our normal waking consciousness. Vitarka means “specific” or “particular.” In waking consciousness we are aware of particular things: specific people, specific trees, specific locations, specific times, etc. The second, **Vicara**, is dream consciousness, but the disorganized dreams remembered by most people are only a piecemeal glimpse of vicara consciousness. Classical occult terms such as “astral plane” and “mental plane” give a more inclusive understanding. Vicara is perhaps best translated as “archetype,” so in vicara consciousness, what is experienced are archetypal forms, not specific instances. The third layer, **Ananda**, can be thought of as a “birds-eye view” of the vicara level, revealing the inherent relationships amongst archetypes. Human mythological constructions, and deep religious, philosophical, mathematical, or scientific insights, are all feeble reflections of ananda consciousness. The fourth layer is **Asmita**, meaning “lacking an identifying mark.” In asmita consciousness wholeness encompasses differences; the archetypes are present, but unmarked, and what is experienced as relationship in ananda consciousness is realized to be different facets of a unified wholeness. Asmita experience is extremely subtle and feebly reflected in insights about the unity of reality.

Patanjali instructs to silence the mind successively at each of these levels of consciousness as the necessary prerequisite to find, and pierce, the center of consciousness.

Four Layers of Consciousness



Kaivalya

Silencing the mind in asmita consciousness reveals the center of consciousness. The experience is extremely abstract. The *Yoga Sutras* describes how one becomes aware of an apparent nothingness between the moments of time. The yogi is instructed to perform samadhi on the intervals of nothingness between the moments of time. This allows awareness to transfer out of time. The *Yoga Sutras* calls the exit from time into the timeless intervals **dharma mega samadhi**. This is the transition, the exit out of the container of consciousness, out of time and space, and into Kaivalya.

Consciousness is no longer in time. Consciousness is “alone.” Aphorism 1.3 of *Yoga Sutras* describes: “Then the Seer abides in its own nature.” What is Kaivalya? All mystical literature is an attempt to describe the “Alone” state in words. These attempts are more like poetry than rational discourse because Kaivalya transcends words, intellect, reason, and time. Kaivalya has no reason, no cause, no purpose. It just is. Being alone, it is relative to nothing and therefore perfectly free. In *The Conquest of Illusion*, J.J. van der Leeuw describes dharma mega samadhi and Kaivalya:

“The experience of going through the center of consciousness and emerging, as it were, on the other side is very much one of turning inside out. In our ordinary consciousness we are turned outwards towards the world-image which we externalized around us. In going through our consciousness the entire process is reversed, we experience an inversion...that which was without becomes within. In fact, when we succeed in going through our center of consciousness and emerge on the other side, we do not so much realize a new world around us as a new world within us. *We seem to be on the surface of a sphere having all within ourselves and yet to be at each point of it simultaneously...*the outstanding reality of our experience...is the amazing fact that nothing is outside us.”

Ultimately, Kaivalya is an ineffable experience. But the claim of yoga is that it provides means to experience what is outside of the individualized mind, Kaivalya, and thereby overcome Kant’s “ring pass not”.

The Challenge

Yoga turns away from sensory experience as a means to truth, recognizing sensory experience only as an element at the most superficial level of human consciousness. Yoga methods purport to allow us to dive to the depths of our individual consciousness and discover that all conscious experience is a projection of appearances from a point. Exiting individualized consciousness through this point, one experiences not things-in-themselves, but the thing-in-itself, alone, self-contained, with nothing outside it; a unity that appears as time, space, and multiplicity within the cave of waking consciousness.

Compare this now to the picture that has come from the detailed study of our sensory experience, which we call science. Science obviously has led to technological marvels. But we must weigh material gains against the price of our scientific advance. Consider the fruits of our labors: the speed of light, black holes, light cones, the observable universe, irrational numbers, Gödel’s incompleteness theorem, the Uncertainty Principle, the Second Law of thermodynamics, the sensitive dependence on initial conditions. In our rational sensory experience, truth always seems to be just beyond our grasp. The fruits of our science tell us that no matter how detailed the descriptions of our sensory experience, there will always be horizons we cannot overcome. Not because it is beyond our present means, but because it is, in principle, impossible. Such is the gift of our rational minds. And a gift it is indeed because, properly interpreted, it is a sign pointing to something beyond itself.

Yoga offers a counterpoint that does not reject reason or sensory experience. Instead, both are given their due in a broader spectrum of human experience. Yoga offers us a challenge and a choice. Yoga is not mere philosophy, and so challenges armchair intellectuals to explore the validity of the yogic methods. The choice is that we can willfully ignore, or attempt to rationalize away, the yogic teachings and nihilistically accept

the innate ignorance built into our sensory experience, or we can strive to embrace the fullness of experience that defines our nature as human beings.

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What's Next? ■ By Dean Radin

IN SOME WAYS, yogic knowledge is thousands of years ahead of where science is today. The development of refined introspection by generations of disciplined minds has presented solutions to problems about subjectivity and awareness that science continues to struggle with from the “outside.” To gain a better foothold on the nature of consciousness, we may have to approach this issue more seriously from the “inside.”

When science begins to consider the full range of phenomena associated with ancient contemplative practices, and when advanced practitioners of those methods begin to embrace the value of objective scientific studies, both traditions are likely to benefit. There are a few fledgling research programs aimed at achieving this integration, but the mainstream is mostly burdened with aged prejudices and the woo-woo taboo, and it's not quite ready to go there yet.

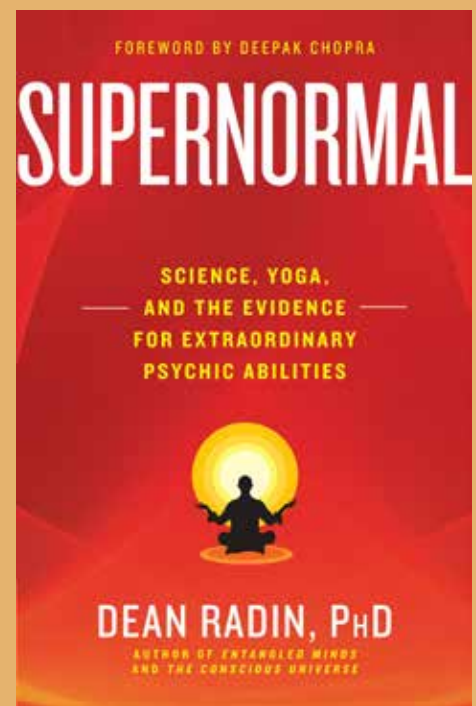
What might happen when this ancient-modern integration becomes a reality? On the beneficial side we can anticipate improved health care through a vastly better understanding of the mind-body relationship. We may see development of technologies that treat aspects of the mind-body system that are well understood in the wisdom traditions but are ignored by Western medicine (for the most part). This includes phenomena such as “subtle energies.” We may see a substantial reduction in interpersonal conflict through a broader recognition of the interconnectedness of all life. As the boundaries between subjective and objective realities are better understood, the communications and energy industries may be radically altered.

On the other hand, we are likely to find that some aspects of the wisdom traditions are seriously distorted and in some cases are dangerously wrong. We may find growing societal resistance at the prospect of being “absorbed” into an increasingly powerful collective mind. And we may pass through a time when horrifically powerful weapons are created that reshape space-time and possibly even alter history.

As science and society begin to appreciate that some of the siddhis are real, and that other aspects of yogic lore also provide legitimate road maps of reality, we can anticipate that some scientists and scholars, especially those who have bet their careers on past theories, will become increasingly marginalized and resentful. But the teeth grinding will eventually settle down as younger investigators, who were not so entrenched in passé prejudices, reach their prime.

From what I've seen in recent years, this transition has already begun. When it reaches fruition, humanity may finally find itself at childhood's end.

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Excerpted from the book: *Supernormal: Science, Yoga, and the Evidence for Extraordinary Psychic Abilities* by Dean Radin, PhD. Copyright 2013 by Dean Radin, by arrangement with Deepak Chopra Books, a division of Randomhouse, Inc.

Gerald H. Pollack

The Fourth Phase of Water: Beyond Solid, Liquid, and Vapor

How can a Jesus Christ lizard walk on water? Why do pollen grains jitterbug in a puddle? Why do fair weather clouds form such lovely puffy white shapes? Why do your joints work without squeaking? Why does water show a density maximum at 4°C?

Answering these questions requires an understanding of water. Given water's simplicity and pervasiveness through nature, we presume that water must be completely understood, but in fact precious little is known about how water molecules line up—until recently.

Students learn that water has three phases: solid, liquid and vapor. But there is something more: in our laboratory at the University of Washington we have uncovered a fourth phase.¹ This phase occurs next to water loving (hydrophilic) surfaces. It is surprisingly extensive, projecting out from surfaces by up to millions of molecular layers. And it exists almost everywhere throughout nature, including the human body.

The existence of a fourth phase may seem unexpected. However, it should not be entirely so: a century ago, the physical chemist Sir William Hardy argued for the existence of a fourth phase, and many authors over the years have found evidence for some kind of “ordered” or “structured” phase of water. Fresh experimental evidence not only confirms the existence of such an ordered, liquid-crystalline phase, but also details its properties. Those properties explain everyday observations and answer questions ranging from why gelatin deserts hold their water to why teapots whistle. But more importantly, the presence of the fourth phase also carries many surprising implications and potentially useful applications.

Does Water Transduce Energy?

The energy for building water structure comes from the sun. Radiant energy converts ordinary bulk water into ordered water, building this ordered zone. We found that all wavelengths ranging from ultraviolet through visible to infrared can build this ordered water. Near-infrared energy is the most capable. Water absorbs infrared energy freely from the environment, and it uses that energy to convert bulk water into liquid crystalline water (fourth phase water)—which we also call “exclusion zone” or “EZ” water because it profoundly excludes solutes, i.e., substances that create a solution when dissolved in a solvent. Hence, the buildup of EZ water occurs naturally and spontaneously from environmental energy. Additional energy input creates additional EZ buildup.

Of particular significance is the fourth phase's charge:

commonly negative (Figure 1). Absorbed radiant energy splits water molecules; the negative moiety constitutes the building block of the EZ, while the positive moiety binds with water molecules to form free hydronium ions, which diffuse throughout the water. (Hydronium is what you get when you put water and hydrogen ions together.) Adding additional light stimulates more charge separation.



Figure 1. Diagrammatic representation of EZ water, negatively charged, and the positively charged bulk water beyond. Hydrophilic surface at left.

This process resembles the first step of photosynthesis. In that step, energy from the sun splits water molecules, with hydrophilic chromophores (light absorbing molecules) catalyzing the splitting. The process considered here is similar but more generic: any hydrophilic surface may catalyze the splitting. Some surfaces work more effectively than others.

The separated charges resemble a battery. That battery can deliver energy in a manner similar to the way the separated charges in plants deliver energy. Plants, of course, comprise mostly water, and it is therefore no surprise that a similar energy conversion takes place in water itself.

The stored electrical energy in water can drive various kinds of work, including flow. An example is the axial flow through tubes. We found that immersing tubes made of hydrophilic materials into water produces flow through those tubes, similar to blood flow through blood vessels (Figure 2). The driving energy comes from the radiant energy absorbed and stored in the water. Nothing more. Flow may persist undiminished for many hours, even days. Additional incident light brings faster flow. This is not a perpetual motion machine:

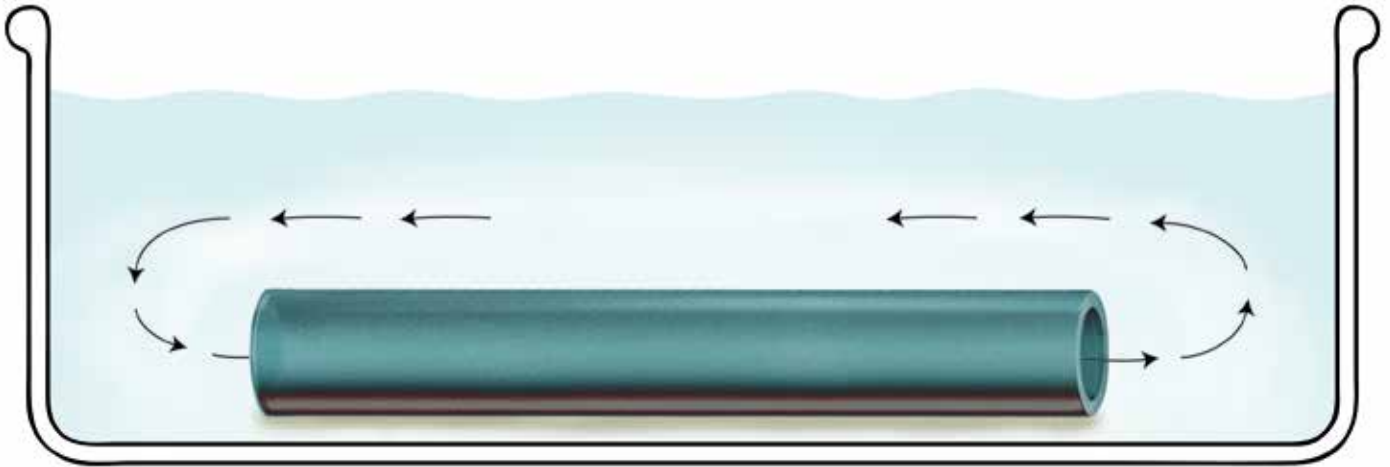


Figure 2. Practically incessant flow occurs through hydrophilic tubes immersed in water.

incident radiant energy drives the flow in much the same way that it drives vascular flow in plants.

Applications in Biological Flow and Atmospheric Science

The water-based energy conversion framework is rich with implication for many systems involving water. These systems may range from biology and chemistry all the way to atmospheric science and engineering. The fourth phase appears nearly everywhere: all that's needed is water, radiant energy, and a hydrophilic surface. The latter can be as large as a slab of polymer and as small as a dissolved molecule. The liquid crystalline phase inevitably builds, and its presence plays some integral role in the system's behavior.

Let me provide a few representative examples.

One example is the human body. Two thirds of your cells are water—by volume. By molecular fraction, more than 99% of your molecules are water molecules because water molecules are so small compared to the other molecules. Modern cell biology considers 99% of your molecules mere background carriers of the “important” molecules of life such as proteins and nucleic acids. Conventional wisdom asserts that 99% of your molecules don't do very much.

However, EZ water envelops every macromolecule in the cell. Those macromolecules are so tightly packed that the enveloping liquid crystalline water largely fills your cells. In other words most of your cell water is liquid crystalline, or EZ water. This water plays a central role in everything the cell does.²

What we have discovered in our lab is the role of radiant energy: incident radiant energy powers many of those cellular functions. An example is the blood flowing through your capillaries. That blood eventually encounters high resistance: capillaries are often narrower than the red blood cells that must pass through them; in order to make their way through, those red cells need to bend and contort. Resistance is high. You'd anticipate the need for lots of driving pressure; yet, the

pressure gradient across the capillary bed is negligible. The paradox resolves if radiant energy helps propel flow through capillaries in the same way that it propels flow through hydrophilic tubes. Radiant energy may constitute an unsuspected source of vascular drive, supplementing cardiac pressure.

Why you feel good after a sauna now seems understandable. If radiant energy drives capillary flow and ample capillary flow is important for optimal functioning, then sitting in the sauna will inevitably be a feel-good experience. The infrared energy associated with heat should help drive that flow. The same applies when you walk out into sunlight: we presume that the feel-good experience derives purely from the psychological realm, but the evidence implies that sunlight may build your body's EZs. Fully built EZs around each protein seem necessary for optimal cellular functioning.

A second example of the EZ's central role is weather. Common understanding of weather derives from two principal variables: temperature and pressure. Those two variables are said to explain virtually everything we experience in terms of weather. However, the atmosphere also contains water: it is full of micrometer-scale droplets commonly known as aerosol droplets or aerosol particles. Those droplets make up atmospheric humidity. When the atmosphere is humid, the many droplets scatter considerable light, conferring haze; you can't see clearly through that haze. When the atmosphere contains only few droplets, you may see clearly over long distances.

Our lab at the University of Washington has presented evidence for the structure of those droplets. It shows that EZ water envelops each droplet, while hydronium ions occupy the droplets' interior. Repelling one another, those internal hydronium ions create pressure, which pushes against the robust shell of EZ water. That explains why droplets tend toward roundness.

How do those aerosol droplets condense to form clouds? The droplets' EZ shells bear negative charge. Negatively charged droplets should repel one another, precluding any condensation into clouds. Those like-charged aerosol droplets should remain widely dispersed throughout the atmosphere.

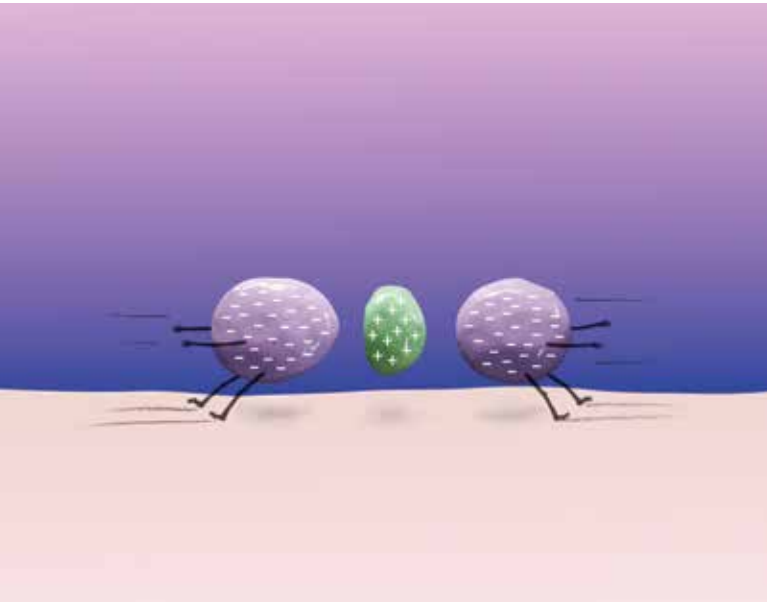


Figure 3: Like-charged entities attract because of an intermediate of opposite charge.

However, droplets do often condense into clouds, and the question is how that can happen.

The reason they condense is because of the unlike charges that lie in between the droplets. Richard Feynman, the legendary Nobel Prize physicist of the late 20th century, understood the principle, opining that: “like-likes-like because of an intermediate of unlikes.” The like-charged droplets “like” one another, so they come together; the unlike charges lying in between those droplets constitute the attractors (Figure 3).

The like-likes-like principle has been widely appreciated but also widely ignored: after all, how could like charges conceivably attract? A reason why this powerfully simple concept has been ignored is that the source of the unlike charges has been difficult to identify. We now know that the unlike charges can come from the splitting of water—the negative components building EZ shells, while the corresponding positive components provide the unlike attractors. With enough of those attractors, the negatively charged aerosol droplets may condense into clouds.

These two phenomena, radiant energy-induced biological function and like-likes-like cloud formation, provide examples of how water’s energy can account for phenomena not otherwise explained. The fourth phase is the key building block that allows for construction of an edifice of understanding.

Anomalies Resolved

Water science has brought many anomalies.³ Anomalies imply something amiss with current understanding, and I would suggest that the new paradigm containing a fourth phase of water has the capacity to resolve many of those “anomalies.” Here I consider two of them: water’s unexpectedly high heat capacity and its paradoxical density maximum at 4°C.

The central feature of the fourth phase paradigm is the radiant-energy-induced buildup of EZ water. Energy builds order and separates charge. A major driving source for this buildup is infrared energy—heat. Heat builds order and separates charge; i.e., it yields potential energy (which can drive flow; see Figure 2).

This energy buildup changes the way we look at water. The common perception is that radiant input to water goes solely into raising the temperature. However, that is not so: much of the energy gets used to build potential energy. For that reason the water doesn’t “heat up” as much as anticipated—which is another way of saying that water’s heat capacity is anomalously high.

A second “anomaly” occurs when water is cooled down. Cooling increases water’s density every so slightly. Once the temperature descends beyond 4°C, however, further cooling brings expansion, not contraction. When additional cooling eventually turns the water to ice, the volume expands appreciably (Figure 4). Ice floats on water.

Responsibility for this seemingly inexplicable density maximum at 4°C lies in the presence of water’s fourth phase. Fourth phase (EZ) structure resembles the structure of ice. Ice consists of parallel honeycomb planes linked together by protons. Removal of those protons creates EZ. Or the reverse: beginning with EZ, add protons and obtain ice (Figure 5). We found that the transition from water to ice requires passing through the EZ phase.

EZ structure is denser than ice and also denser than water. This is known from the fact that EZ’s refractive index exceeds that of water. It is higher by up to 11%. The higher density makes sense structurally: because charges in one plane abut opposite charges in the adjacent plane, the honeycomb planes pack tightly next to one another. That tight packing produces especially high density.

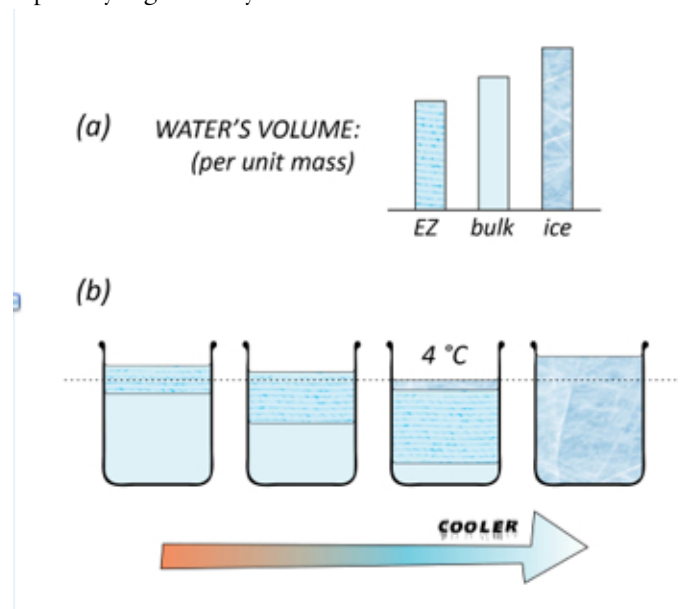


Figure 4. (a) The densities of EZ, bulk water, and ice differ. (b) With cooling, the volume changes in a way predictable from the quantity of each phase.

When considering temperature-dependent density changes, then, it's necessary to consider what phases may be present in the water at each temperature. At high temperature, water is largely bulk water. When the temperature descends, experimental evidence shows increasing amounts of EZ water; therefore the mean density increases. As the temperature descends further, isolated EZs begin turning to ice, bringing expansion. Finally, massive ice formation begins at approximately 0°C, and the density diminishes appreciably.

Hence, the density maximum at 4°C has nothing to do with any idiosyncratic feature of the H₂O molecule. It is a reflection of the dominating fraction of EZ water, whose density exceeds that of bulk water and ice.

Practical Applications

Beyond pure science, the discovery of the fourth phase has practical applications. They include flow production (already mentioned), electrical energy harvesting, and even filtration. I briefly mention the latter two applications.

Filtration occurs naturally because the liquid crystalline phase massively excludes solutes and particles in much the same way as does ice. Accordingly, fourth phase water is essentially solute free. Collecting it provides solute-free and bacteria-free water. A working prototype has confirmed this expectation. Purification by this method requires no physical filter: the fourth phase itself does the separation with the energy coming from the sun.

Energy harvesting seems straightforward: light drives the separation of charge, and those separated charges constitute a battery. Harvesting electrical energy should be realizable with proper electrodes. This technology development is underway in our laboratory, and has the potential to replace standard photovoltaic systems with simpler ones based on water.⁴

Water and Healing

During childhood illness, grandmothers and doctors will often advise: “drink more water.” In his now-classic book, titled *Your Body's Many Cries for Water: You Are Not Sick, You Are Thirsty*, the Iranian physician Fereydoon Batmanghelidj confirms the wisdom of this quaint advice. The author documents years of clinical practice showing reversal of diverse pathologies simply by drinking more water. Hydration is critical.

Batmanghelidj's experience meshes with evidence of healing from special waters such as those from the Ganges and Lourdes. Those waters most often come from deep underground springs or from glacial melt. Spring waters experience pressure from above; pressure converts liquid water into EZ water because of EZ water's higher density. So, spring water's healing quality may arise not only from its mineral content but also from its relatively high EZ content.

The same for mountain water: it too should have high EZ content. Our studies have shown that ice formation requires an EZ intermediate: bulk water does not convert directly to ice; it converts to EZ, which then converts to ice. Similarly for melting: melting ice forms EZ, which subsequently converts to

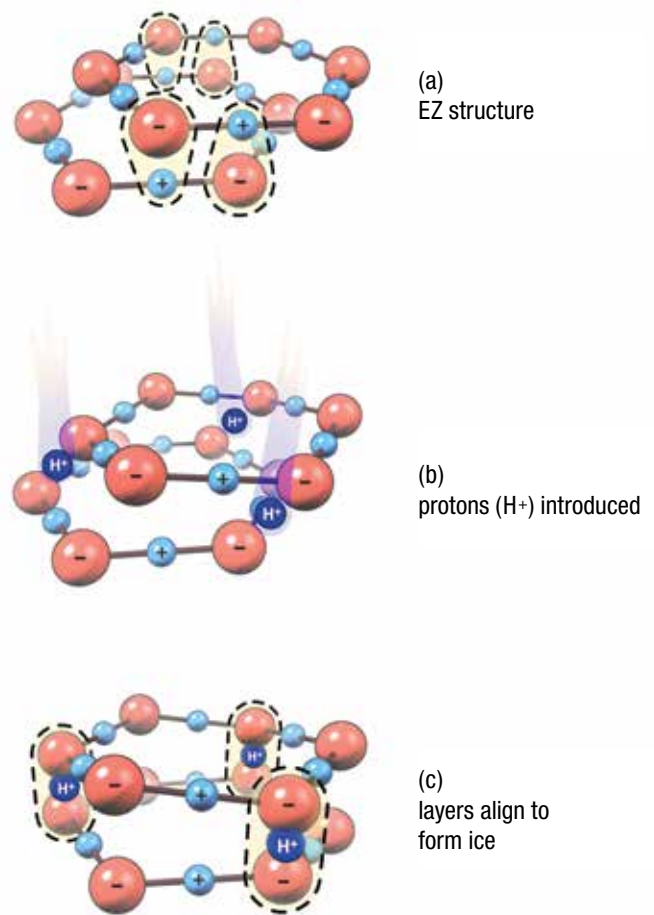


Figure 5: Transition from EZ (a) to ice. The transition requires protons (b) and planar shift (c).

bulk water. Fresh ice melt contains abundant EZ water.

For spring water and fresh ice melt, then, the high EZ content may explain the recognized health benefits. EZ water should rehydrate tissues better than ordinary water because of its higher dipole moment. To appreciate this argument, picture a bean, with positive charge localized at one end and negative at the other. The positive end of that dipole orients toward the negatively charged cell, which then strongly draws in that dipole. The larger the dipole, the stronger will be the draw. Since EZs contain masses of separated charges, or large dipoles, EZ water should hydrate cells better than ordinary water. That's why EZ water may particularly promote good health.

Negative Charge and Antioxidants

Humans are considered neutral, but I suggest that we bear net negative charge.

Physical chemists reasonably presume that all systems tend toward neutrality because positive charge attracts negative charge. The human body being one of those “systems,” we assume that the body must be neutral.

Not all systems are neutral, however. The earth bears net

negative charge, while the atmosphere bears net positive charge. Water itself can bear charge: Anyone watching MIT professor Walter Lewin's stunning demonstration of the Kelvin water dropper, where separated bodies of water eventually discharge onto one another, will immediately see that bodies of water can bear net charge.⁵ If any doubt remains, then the experience of getting an electric shock from touching certain specially prepared drinking waters (which my colleagues and I have personally experienced) should eliminate that doubt.

Charges can remain separated if input energy keeps them separated—something like recharging your cell phone battery and creating separated negative and positive terminals. Since we constantly absorb external energy from the environment, the theoretical possibility exists that we may bear net charge.

Consider the arithmetic. Cells make up some 60% of our body mass, and they are negatively charged. Extracellular tissues such as collagen and elastin are next in line, and those proteins bear negative charge and adsorb negatively charged EZ water. Only some of the smaller compartments are positively charged with protons (low pH), and they commonly expel: urine, gastrointestinal system; sweat, and expired air (containing hydrated CO₂ or carbonic acid). They help rid the body of positive charge.

So, the arithmetic shows not only that our body bears net negative charge, but also that the body makes every effort to maintain that negativity by ridding itself of protons. It is as though maintaining negativity is a “goal” of life. Plants do it easily: they connect directly to the negatively charged earth; animals need to struggle a bit more to maintain their body's charge, in exchange for greater mobility.

How does our body's negative charge relate to the benefits of antioxidants?

Answering this question returns us to basic chemistry. Recall that “reduction” is the gain of electrons, while “oxidation” means electron loss. Oxidation strips molecules of their negative charge, working against the body's attempt to maintain high negativity. To guard against that loss we employ anti-oxidants. Antioxidants may keep us healthy simply by maintaining proper negativity.

The Future

Water's centrality for health is nothing new, but it has been progressively forgotten. With the various sciences laying emphasis on molecular, atomic, and even sub-atomic approaches, we have lost sight of what happens when the pieces come together to form the larger entity. The whole may indeed exceed the sum of its parts: 99% of those parts are water molecules. To think that 99% of our molecules merely bathe the “more important” molecules of life ignores centuries of evidence to the contrary. Water plays a central role in all features of life.

Until recently, the understanding of water's properties has been constrained by the common misconception that water has three phases. We now know it has four. Taking into account this fourth phase allows many of water's “anomalies” to vanish: those anomalies turn into predictable features. Water becomes more understandable, and so do entities made

largely of water, such as oceans, clouds, and human beings.⁶

The insights described here arose out of a departure from the mainstream science route. They were gleaned mainly from simple observations and logical interpretations. I have purposefully ignored the usual foundation of the “generally accepted,” having some skepticism that all accepted principles are necessarily valid. I believe this skepticism has brought us some gains.

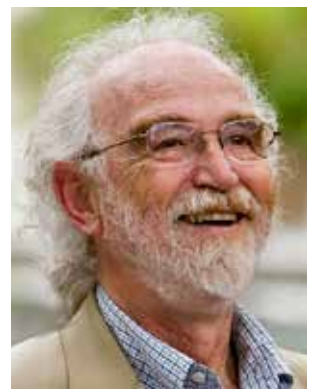
If this outcome is representative, then similarly unorthodox approaches in other fields may yield rich bounties, especially in those fields that have shown little signs of real progress.

I hope this example inspires other such unconventional approaches.

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- 1 This newly identified phase of water is described in detail in *The Fourth Phase of Water: Beyond Solid, Liquid and Vapor* by Dr. Gerald Pollack, published in 2013 by Ebner and Sons Publishers (<http://www.ebnerandsons.com>).
- 2 See *Cells, Gels and the Engines of Life* by Dr. Gerald Pollack, published in 2001 by Ebner and Sons Publishers.
- 3 An extensive list appears on the popular website of Martin Chaplin <http://www1.lsbu.ac.uk/water>.
- 4 More detail on these practical applications can be found in the Pollack laboratory homepage: <http://faculty.washington.edu/ghp>.
- 5 Shortcut to Walter Lewin's YouTube video: <http://tinyurl.com/2kom5w>.
- 6 Various hour-long talks, available on YouTube videos, describe these fresh understandings. One of them is a University of Washington public award lecture (<http://tinyurl.com/lna5cdg>). Another was delivered more recently (<http://tinyurl.com/kqof8lz>). A third is a recent TEDx talk (<http://tinyurl.com/lp5v6ko>).

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Book review by Massimilano Sassoli de Bianchi

Towards a More Mature Understanding of Out-of-Body Experiences

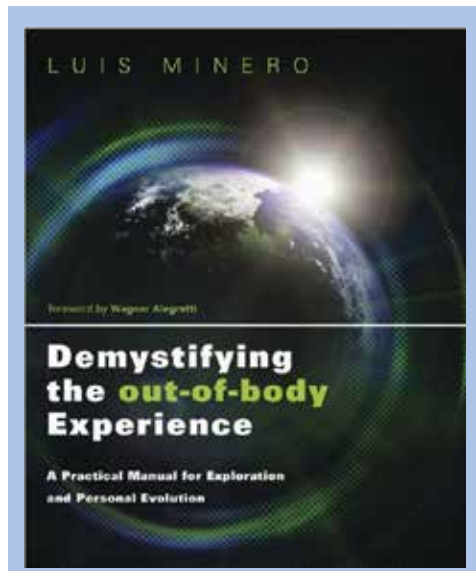
I was very pleased to learn that Luis Minero had written a book on the out-of-body experience (OBE). I bought it sight unseen, and I was not disappointed. It was back in 2002 that I first came across the author's name in a correspondence to the *Journal of Conscientiology*,¹ the peer-reviewed journal of the International Academy of Consciousness (IAC). In that letter, Minero analyzed with great accuracy, clarity, and thoroughness, the so-called “mind-split” hypothesis, proposed by author Robert Bruce to explain some of the puzzling factors of the OBE phenomenon, such as memory loss and dual consciousness.² I still remember how impressed I was when I read Minero's step-by-step refutation of Bruce's hypothesis, not only for the care and lucidity of his analysis, but also for his natural, didactical style and the balance with which he was able to strongly criticize weak points of some of the ideas presented, and at the same time give full credit to other innovative aspects of Bruce's work.³

I would start by saying that the book's title may possibly seduce the hasty reader in error. Indeed, the *demystification* in question is not the usual one, consisting in reducing the entire OBE complex of phenomena to a mere hallucination produced by the subject's physical brain, when his or her sensory inputs are altered in some way. Minero, quite to the contrary, considers OBEs as experiences describing real projections of the human consciousness through objective subtle bodies (vehicles of manifestations), which can exist independently of the physical body.

The book's demystification is, therefore, of a very different kind: It is about those more mystic-like and folkloristic aspects that have been historically associated with the OBE phenomenon, mostly based on immature, emotional, or superstitious thinking, and which have little to do with a more mature understanding of this fundamental topic.

A very important point to be emphasized: One can use a sound, scientific approach to the OBEs, without necessarily reducing these experiences to a mere phenomenon of autoscapy, i.e. the experiences of seeing one's physical body from an out-of-body perspective.

Minero stresses in many passages and chapters of his manual that the OBE is much more than this. OBEs are described as complex, highly articulated experiences, involving paramatter of a non-ordinary kind, obeying para-physical laws,



Demystifying the Out-of-Body Experience: A Practical Manual for Exploration and Personal Evolution by Luis Minero. Llewellyn Publications, 2012

different from the physical laws obeyed by the ordinary physical matter today studied by physicists.

OBEs are not characterized as the mere exteriorization of one's awareness to one's bedroom: To Minero, OBEs are about exploring physical and extraphysical environments, meeting other (more or less evolved) extraphysical (disincarnated) consciousnesses, providing assistance to intraphysical (incarnated) and extraphysical (disincarnated) beings, with the possibility of working with teams of more advanced and organized consciousnesses, which are referred to as extraphysical helpers.

Demystifying posits that OBEs are about understanding the process of death from a broader point of view, i.e. from a viewpoint that considers our biological vehicle as just one among different vehicles we can use to manifest, intelligently and self-consciously, in different existential dimensions.

Minero describes how individuals have used the OBE as inspiration for re-examining life's purpose, one's potential, or personal existential directives or priorities. Lucid projectors, those who experience OBEs frequently, often describe observing extraphysical individuals planning what they want to do when they acquire a physical “suit.” That is, projectors may observe the “intermission,” as University of Virginia psychiatrist Jim Tucker calls it: the period between two physical incarnations.

Minero suggests that the phenomenon of the OBE acquires all its meaning and potentiality when its theoretical study and practical experimentation is motivated by a genuine desire for achieving greater integral maturity (holomaturity), i.e. a condition of inner development that is not limited to the attributes developed in the ordinary physical world, or even just this lifetime. The volume, which is not only an instruction manual for self-exploration of the OBE phenomenon, also acts as a guide for stimulating personal evolution. It is organized into seven well-thought-out chapters. The first one introduces the basic concepts of the proposed scientific disciplines of *projectiology* and *conscientiology*, as coined by Waldo Vieira, M.D.⁴ The second one deals mainly with the subject of subtle energy (bioenergy, orgone, chi, biofield), and the importance of its mastery to obtain sufficiently controlled, frequent, and lucid OBEs.

Chapter 3 introduces a multi-vehicular (multiple-body, holosomatic) structure of human consciousnesses and the

characteristics of many extraphysical environments described during projections. Consciousness, in this context, is seen not as a property of self, not as the physical body or any other perceived “body,” but as a synonym for the self. In this work, rather than having or experiencing consciousness (awareness), one *is* a consciousness: a novel use of the word by Minero and his colleagues. Chapter 4 describes the different stages one may go through during an OBE. This is the chapter where the reader will find, very scrupulously described and logically organized, many different techniques one can use to achieve a lucid OBE. Chapter 5 considers many possible interactions and forms of communications projectors report, including the possibility of simultaneous or joint projections, whereby two or more individuals describe meeting while they have OBEs at the same time.

Chapter 6 includes suggestive neologisms, such as *holomaturity*, *assistentiality*, *evolutionary intelligence*, and *cosmoethics*, and finally, in Chapter 7, the author investigates compelling hypotheses, always considering them from the OBE perspective: *existential program* (life mission), *existential seriality* (reincarnation, death-rebirth cycle), *intermissive courses* (the training that a consciousness possibly takes to prepare itself for rebirth), and many others as well.

The extreme care with which the book is written can be seen in the details. The volume is equipped with a very useful Glossary, with the explanation of the most important neologisms used. At the end of each chapter, there is a practical summary of the key points that have been developed, and throughout the book one can find a number of text boxes, identifiable by specific icons, providing complementary information to the text, in the form of definitions, recommendations, firsthand OBEs, challenging questions, etc. Last but not least, the book is very carefully illustrated, with professional drawings that considerably facilitate the understanding of the topics covered.

To recapitulate, this is a professionally written text. Per its aim, it is an introductory textbook, which thanks to its pedagogical style will appeal to a wide audience. It is also, I believe, a book that will prove to be instrumental to all those scientists interested in the study of consciousness from an integral perspective, and who sincerely wish to move from the level of pure speculation, or research of third-person accounts, to that of lucid self-experimentation (first-person and second-person perspective research).

Indeed, as Minero rightly emphasizes in his Preface, direct experiences should be the first step toward a more mature understanding and study of OBEs and allied phenomena. And his volume is certainly a precious tool that can be used by scholars of all kinds to take a first step in that direction. This will help create a more ample, consensual basis for the discussion of the reality of the OBE, considering also that there is a small, but growing number of scholars who take seriously the importance of firsthand experience when the subject of the study is...oneself.

Now, while it is true that today's predominant scientific approach remains quite cold regarding disciplined self-study and self-experimentation of consciousness, it is also true that the current scientific debate is increasingly based on

experimental evidence, so that more and more researchers are starting to become more open to the possibility of engaging in first-person investigation of the hypothesis of the multi-dimensional nature of consciousness. When these researchers look for a reference manual, written in a sincere, and yet non-reductionist style, they will find in Minero's book a valuable companion. Surely, from now on, it will be the book I will recommend to those who ask me for a highly readable and professionally written reference on the subject.

Let me conclude by observing that, in the same way a beginning student of, say, quantum mechanics, has to undertake a long journey of study to obtain firsthand understanding, including acquiring all the necessary preliminary knowledge in physics and advanced mathematics, so too with regard to the possibility of reaching a direct understanding of the OBE phenomenon, which also requires a considerable amount of personal investment to develop those preliminary abilities described in this work (for example, the control of bioenergy). Without this discipline, it remains quite difficult to achieve sufficiently lucid, meaningful, frequent, recalled OBEs. The more individuals who can reach this degree of mastery, the more experiments can be repeated and reproduced.

To quote Minero: “In this current world of fast, easy solutions and short-term fixes, there are still no substitutes for personal effort, will, perseverance, and patience.” And the subjective and intersubjective investigation of the full multidimensional content of the OBE phenomenon posited in this work is no exception.

REFERENCES

- 1 Minero, L. (2002). Letter to the Editor. *Journal of Conscientiology*, 5(17), 63–71.
- 2 I rediscovered these same intellectual qualities in other writings of Minero, such as his suggestive 2002 essay, “Lucidocracy,” published in the *Journal of Conscientiology* [4(155), 47–65], a political proposal contemplating the possibility of a government system based on lucidity, with the main goal of facilitating the fulfillment of one's potential or life mission (existential program).
- 3 Bruce, R. (1999). *Astral Dynamics*. Charlottesville, VA: Hampton Roads.
- 4 Vieira, W. (1994). *700 Conscientiology Experiments (700 Experimentos da Conscientiologia* (in Portuguese)]. Rio de Janeiro: International Institute of Projectiology and Conscientiology.
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