

WATER IS ...

THE
MEANING
OF
WATER

**Nina
Munteanu**

PIXL PRESS

Praise for *Water Is...*

“We can’t live without it, so maybe we should start respecting it; this beautifully designed book by a limnologist looks at water from 12 different angles, from life and motion and vibration to beauty and prayer.”

—Margaret Atwood, author of *Year of the Flood*

“This book leaves me impressed. Impressed by the variety of approaches, sources, ideas and philosophies that are assembled, discussed and spiced up by comparisons to personal experience. From science to science fiction, from philosophy to religion, from history to fairytale, the role of water is illustrated and illuminated. Water is probably the best investigated and least understood substance on this world, yet we still don’t know how to describe it in a better way than calling it H₂O. This book tries to zero in on the missing part, the great unknown of water, and it does that in a very intelligent and charming way.”

—Elmar C. Fuchs, WETSUS Program Manager

“Kudos to Nina Munteanu for sharing her deep wisdom, experience and knowledge of humanity’s greatest natural resource! As Leonardo da Vinci said, “We forget that the water cycle and the life cycle are one.” We forget at our own peril and so I am deeply grateful for this book by so highly qualified an author!”

—Elisabet Sahtouris, evolution biologist, futurist,
author of *Gaia’s Dance: The Story of Earth & Us*

“Nina Munteanu takes you on an astounding journey of wonderful phenomena, of experiences, of scientific insight, of wisdom, and of the beauty of what “water is”. A journey, as it seems to me, that will never end—somehow like that of water itself. The author uniquely combines the merits of a scientist with those of a writer with an artistic spirit. It is a joy to be taken by the insightful and elegantly written chapters to so many and so different scientists, philosophers, writers, artists and pioneers of wisdom such as Leonardo da Vinci, Albert Einstein, or Paul Feyerabend, who declared war on the dogma of the scientific method.”

—Michael Jacobi, physicist, Institute of Flow Sciences Herrschried, Germany



A percentage of the proceeds of book sales will be donated to a water charity.

“A sumptuous collection of treasures...from the basics of matter itself to the social and spiritual aspects of this substance, which touches our lives so much and is still not really understood.”

—Dr. B. Kröplin and Regine C. Henschel, “World in a Drop”, Germany

“If you don't want to read all those other books on water, just read this one.”

—John Stewart, *Mississauga News*, Ontario, Canada

“[Nina] is immersed well enough in water to tell us about how we should think about it. And the way she goes about it in this book is awfully good... A fine achievement.”

—Joseph Planta, *The Commentary*, Vancouver, Canada

“This book emotionally connected me with water. As a result it fed my perception about the value of life. It reminded me that life reveals in each space a complex system that is full of surprise and beauty. A system of which I am part, without separation.”

—Laura Fres, *One Deep Sustainability*, Barcelona, Spain

“Wow, just wow. I have no idea where to begin to describe all that I have read and learned from this 583 page book on water. I believe this book should be a must read for all the younger generations. I thank the author for sharing her knowledge and her personal journey.”

—*Goodreads* Review (Ivana Ciglar, Croatia)

“Little sips of this book make for a thirst quenching read... Thank you the bursts of enlightenment.”

—*Amazon* Review (Ro Omrow, Canada)

“An absolutely fascinating read. Nina Munteanu digs deeply into our world to show us the depths of our greatest treasure. Her book gleams with chapter gems, reminding us how water affects us in every way... The world needs more books like this.”

—Craig Bowsby, author of *Empire of Ice*

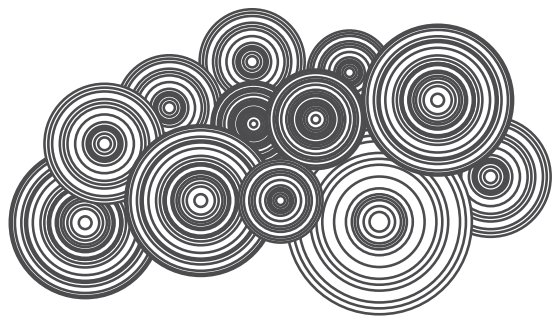


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Water Is...
The Meaning of Water
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For Kevin.
The future is yours...



Foreword

In July 2015 an email from my agent dropped into my inbox. It was a forwarded message from Nina Munteanu, a name I recognised from my Twitter timeline, asking if I might be interested in reading her upcoming non-fiction book *Water Is... The Meaning of Water* and possibly writing a foreword for it.

The timing was not what you would call ideal: I was wading — or rather, swimming — neck-deep in the final chapters of my second novel, with a deadline looming over my head like a giant icicle ready to drop at the slightest disturbance. Nevertheless, my immediate instinct was to say yes. I had written my first novel *Memory of Water* about an imaginary future world haunted by climate change and water shortages, and had researched the topic thoroughly. I was fascinated by the promise of Nina Munteanu's approach to the subject matter, to which I had never stopped feeling close. I responded that I would be interested in reading the book, at the very least, but a lot depended on the schedule. When would she need my contribution?

Luckily, things tend to work themselves out when something good is on the way. By the time I received the manuscript from Nina Munteanu, I had finished my own and happily moved on from the constraint of immediate deadlines, which meant I was able to give *Water Is...* the attention it deserved. I had the privilege of reading this book during a residency in Northern California in February 2016, and everything about it felt pressingly timely: California was in its fifth year of drought, and while the El Niño weather phenomenon had brought some much-needed relief to the area, throughout my stay I felt a pervasive sense of living on borrowed time — or water. What had once been the odd news article in the “Environment” section of papers had

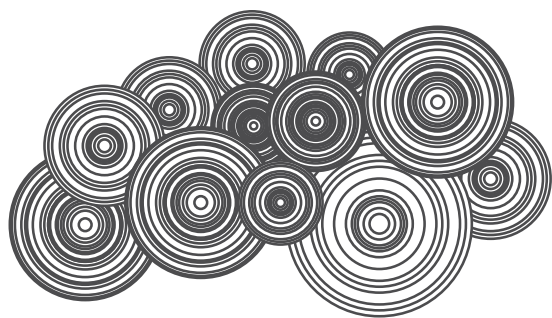
become a mainstay, with new studies and information about droughts as part of man-made climate change appearing in the mainstream media on an almost-daily basis.

If ever there was an urgent time to write and read about water, it is now.

Nina Munteanu is a science fiction author and creative writing instructor. She is also a scientist, with a background specifically in the field of limnology, or the study of inland waters. In *Water Is...*, she brings together her expertise in all these areas, creating an imaginative and informative portrait of the meaning of water in our world and beyond. The book begins as a study of the history and properties of water, but it is by no means simply another scholarly textbook. In a lyrical vein reminiscent of Rachel Carson's nature writings, Munteanu takes us on an absorbing journey, a kaleidoscopic, ever-changing look at the interaction between not just water and human life, but water and all life in our known universe. She writes about water through the changing prisms of movement and rhythm, harmony and vibration, communication, memory and spiritual significance. We see the image shift and ripple before our eyes, watch a portrait emerge that holds more than the measurable qualities of water as a natural element.

I would go as far as calling it a biography: probably the very first biography of Water you will ever read.

The originality of Nina Munteanu's writing lies in the fact that she treats water as a living being, a character in its own right, rather than a lifeless resource, let alone something to exploit or profit from. For her, water is a trickster, a wizard, a teacher, a quantum shape shifter deserving of our love and respect; after all, our entire existence depends on it. Munteanu's approach is decidedly poetic and holistic, and the argument she develops throughout the book is, first and foremost, a philosophical and spiritual one. Drawing from such diverse fields as limnology, anthropology, Jungian psychology, quantum physics, music and religion – to mention but a few – Munteanu observes the qualities



and meanings of water from different perspectives, giving it its own Hero's Journey in an adaptation of Joseph Campbell's work on archetype and monomyth. Against this backdrop, human history appears as a small but significant part of the picture, something that has changed the course of water's flow and consequently the surrounding landscape, but may also hold the potential for restoring it to its natural state. In this view, we are on the edge of a new awareness of our responsibility to our environment on a global scale.

The overarching notion — message, if you will — that emerges from *Water Is...* is deceptively simple on the surface, yet radical at a deeper level. In a world where the value of nearly everything is measured by profitability, it is nothing short of revolutionary to suggest that we should perhaps not see ourselves as separate from our environment and as entitled to exploiting it, but instead consider our lives to be an inseparable part of an intrinsic and complex network, an interconnected web where all living things share one thing in common: water.

“Water's journey is really our journey, and it is ultimately our journey home,” Nina Munteanu writes.

I encourage you to embark on the journey and let the flow of this book sweep you away. It is an adventure through landscape, time and thought, to the very core of human spirit and what makes life possible on our shared Earth.

Emmi Itäranta
Author of *Memory of Water*
February 2016
Silicon Valley





Author's Preface

Photo 1: Wave pattern in flowing water of the Upper Credit River, Ontario, Canada.



Photo by Nina Munteanu

“Water is the driving force of all nature.”
—*Leonardo da Vinci*

I'm a limnologist. Like other water scientists, I study the properties of water; how it behaves in a watershed. I help manage water in our environment; its flow, distribution, storage and quality. I look at how water changes the landscape, carving out huge valleys, forming deltas at river mouths, and polishing pebbles smooth on a lakeshore. I investigate the effects of its contamination by toxins, organic pollutants and disrespect. In its solid form, water has scraped out huge swaths of land and formed some of our largest lakes, dropping moraine in places and melt water from ice blocks elsewhere. In its gaseous form, water controls climate and weather.

And yet, what do we really know about water?

Water is the most common substance on Earth. Chemically, the water molecule is basically two atoms of hydrogen joined to one of oxygen. Simple. Not so simple.

For something so “simply” made, water is pretty complex. Its unique properties make water possibly the most important element of our existence and in ways most of us can't possibly imagine. Without water no life form could exist. Water is a universal solvent. It transports all kinds of things from the sediment of the Nile River to the oxygenated blood cells in your arteries. Water stores energy and heat. It responds to and changes the properties of all manner of things.

Photo 2: Nina Munteanu and friend Oli in Mahone Bay, Nova Scotia, Canada.



Photo by Kate Wylde

Scientific studies have begun to show some astonishing properties and behaviours of water. One is that water reacts to—and may even drive some—cosmic phenomena. Laboratory studies with water have shown that it is not always the same. Studies have revealed that water is influenced by shifts in the Earth’s magnetic field or by explosions on the Sun. Of course, most of us know about how the Earth’s great water bodies respond to the movements of the Moon around the Earth in the oceanic tides and the seiches of the Great Lakes. But we are learning that water is far more sensitive and responsive than most people ever imagined. And some suspect that water responds to and is interconnected in some way with all that exists in the cosmos.

While Earth is blessed with copious amounts of water, 97% is salty and 2% is locked up in snow and ice. That leaves 1 percent for us to drink, bathe, and grow our crops. Less, really, because some of that water is contaminated.

Since the dinosaurs quenched their thirst in the soupy marshes of the Triassic Period millions of years ago, to the rain falling on your house today, the amount of moisture on Earth hasn’t changed. However, scientists predict that by 2025, 1.8 billion people will live where usable water is scarce.

“Water is life,” says author Barbara Kingsolver in an article in the 2010 Water Issue of *National Geographic*. “It’s the briny broth of our origins, the pounding circulatory system of the world. We stake our civilizations on the coasts and mighty rivers. Our deepest dread is the threat of having too little—or too much.”¹ North Americans use about 100 gallons of water at home every day, yet the world’s poorest subsist on less than 5 gallons, many walking miles to get their water.

One of humanity’s greatest crimes is that we don’t treat water respectfully and with gratitude. It’s free, after all (unless it isn’t, that is). It’s everywhere, isn’t it? “Water is the ultimate commons,” says Kingsolver. All life is made up of from 50 to 95 percent water, with humans averaging 70 percent (babies generally containing more, close to 80%); this

Photo 3: Water drop on a hosta leaf.



Photo by Merridy Cox

ironically reflects the proportion of water on the planet. Some scientists now tell us that—although an adult human contains generally two-thirds water—on a molecular level, our water content is much higher. Water occupies over 98% of a human cell molecule.²

We are water.

What we do to water we do to ourselves.

Which leads me to one of the greatest ironies of human health: many of us blessed with living in a place where water is plentiful and readily available, simply don't drink enough—by choice. We starve our bodies of this miraculous elixir by choosing instead to drink other beverages (such as coffee, tea, juice or pop). We pollute our fresh drinking water sources, then buy bottled water that comes from somewhere else to drink. Instead of petitioning governments to protect the drinking water resources near our homes for free consumption, we let others put a price tag on it and take it elsewhere; we watch something that sustains us—that we can't live without—turn into something that some of us can't afford.

In choosing to buy bottled water, you are implying a choice against tap water. In doing that, you support the implication that water is a commodity to buy and sell, rather than a global heritage and the right of all citizens of this planet—with an associated individual, national and global responsibility to keep clean and sustain for our future generations and the planet's well being.

“Water must be seen as a commons that belongs to the Earth and all species alike,” says Maude Barlow, Senior Advisor on Water Issues to the President of the United Nations and National Chairperson of the Council of Canadians. “It must be declared a public trust that belongs to the people, the ecosystem and the future and preserved for all time and practice in law.”³ In fact, water belongs to no one; it is a gift from the universe, for all to use with gratitude and return in as good, if not better, condition. Like the air we breathe. Like the love we freely bestow and are, in turn, gifted with.

Photo 4: Ice formation on the shore of Lake Ontario, Toronto, Ontario, Canada.



Photo by Nina Munteanu

In a recent unprecedented move, Ecuador became the first nation on Earth to put the rights of Nature in its constitution; under their new laws, rivers and forests maintain their own right to flourish. “Under these laws, a citizen might file suit on behalf of an injured watershed, recognizing that its health is crucial to the common good,”¹ writes Kingsolver. She adds that other nations may follow Ecuador’s lead. “Just as legal systems once reeled to comprehend women or former slaves as fully entitled, law schools in the U.S. are now reforming their curricula with an eye to understanding and acknowledging Nature’s rights.”

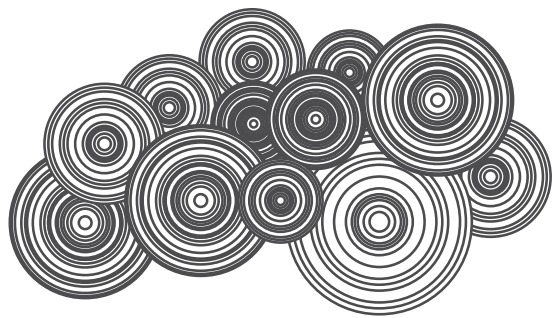
In the foreword to his book *Understanding Water*, Andreas Wilkens writes that water is “a substance which so well hides the consequence of our actions upon it. And which is seemingly so plentiful.”⁴ The consequences of our actions simply flow away. It is an unfortunate reality that most of us have remained indifferent to the effects of our actions on water. Perhaps this is because water, according to Wilkens, “is a master of concealment, withdrawing from so many phenomena, appearing in that which it simultaneously transforms: in the colors of the heavens, or the reflection of a shore on the surface of a lake. The more intensely it participates in a particular phenomenon, the more hidden it remains.”⁴

If things are defined by their behaviour, then water is an altruist.

Many researchers, scientists and wellness practitioners agree that frequency affects—if not in fact directs—the manifestation and eradication of disease. Beneficial frequencies have been identified, the same ones found in the Earth and in the Earth’s minerals. Just sitting on a granite boulder on a sunny day radiates frequencies flowing through your body. Water intensifies the flow and can heal.⁵

So, what is water, really? And what does it mean to you and your loved ones?

Some see water as a commodity like everything else that can make them rich; they will claim it as their own to sell. Yet it cannot be “owned”



or kept. Ultimately, water will do its job to energize you and give you life, bring beauty to the world, then quietly take its leave.

Water is magic.

Water is you.

Photo 5: Ski hut near the Matterhorn, Zermatt, Switzerland.



Photo by Nina Munteanu

Ecology, Schrodinger's Cat & the Holo-Universe

*"Discovery consists of seeing
what everybody has seen and
thinking what nobody has
thought."*

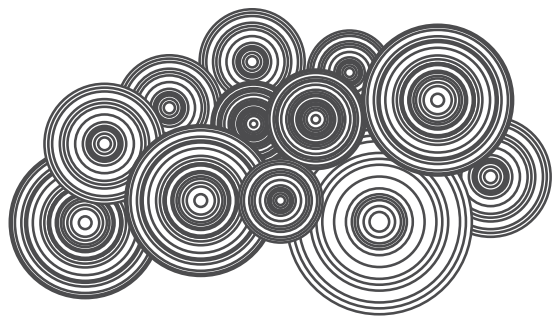
**—Albert Szent-Györgyi,
Nobel laureate**

Ecologists and environmental activists provide eloquent and convincing reasons for the preservation and conservation of pristine natural water in aquatic ecosystems and watersheds throughout the world. Excellent works devoted to water's rights and people's rights to water have followed humanity's journey with water throughout the ages; others have documented our social, political and economic struggles that have impacted water in many ways.

It's been my experience, however, that *knowing* and *feeling* a truth are not the same; one leads to vehement agreement but seldom to action; the other leads to quiet resonance and often to quiet action. Before you act you have to care. A lot.

Some will argue that the best way to solicit an appreciation for something is to give it an economic value. My experience with this argument is that it's a slippery road. Some suggest that the only way to protect water is to treat it as a commodity—to put a price on it. However, when something is assigned an economic value, its value becomes relative and compartmentalized; it loses an essential part of its perceived intrinsic value.

Scholar and writer Charles Eisenstein gives us four good reasons to shy away from evaluating anything—particularly Nature and water—economically.⁶ First, this view favours competition within a perception of scarcity as individuals seek to maximize self-interest. Second, competition and a perceived need for growth promotes the objectification of Nature as something separate from us, leading to abuse and the "Tragedy of the Commons".⁷ Third, valuing all things in a utili-



tarian and self-serving frame instils a dominating worldview through a “Conquest of Nature” ethic. And finally, this value system “echoes science’s onward march of quantification by converting a multiplicity of often qualitative values into a single metric of value called money.”⁶ It applies a reductionist approach to a holistic phenomenon. When that happens, we lose the meaning of the thing that we’ve turned into an object.

For most of us, perhaps chemists aside, when we think “water” we envision its archetype of liquid flowing in rivers, brooks, gurgling springs and surging oceans. We envision myths from the ancient creation stories to the current thoughts of today or of sacred rituals of which it plays an integral part. We think of its refreshing crystal clarity as the matrix of life. Water is “not a personality but more like a culture to itself, with laws, arts, and a unique history and geography,”⁸ says science writer Philip Ball in the preface to his book, *H₂O: A Biography of Water*. Water’s “public persona” has co-evolved with humanity through our various cultures and philosophical beliefs, fashion, and political and social change.⁸ Yet, throughout the millennia, water has remained water; it is we who have changed.

Water is a catalyst.

“We cannot avoid the conclusion that for humankind water is a force of social change—a precious resource to be treasured, nurtured and used wisely,”⁸ adds Ball. But water is far more than this; it is far more than “resource”, as Ball himself acknowledges in the very last page of his book, where he writes, “understanding water’s physics, chemistry, geology and biology can provide only a part of the answer,”⁸ and speaks to the wisdom of a relationship with water that lies outside science.

In that vein, I ask you to keep an open mind when reading these chapters. Some of what I write about may present itself with an appearance of what some call soft science, fringe science or even pseudo-science. Read these pages equally with your soul and heart as with your mind. Read the words as they flow along the pages and let them touch

Photo 6: British Columbia west coast stream, Canada.

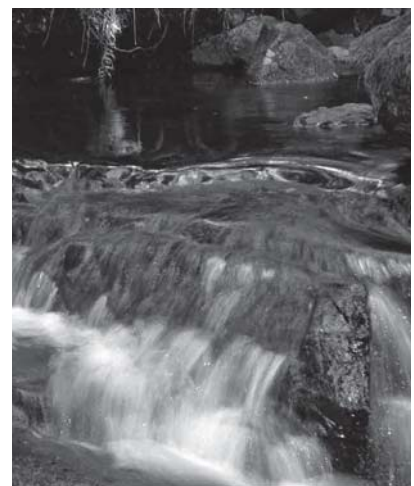


Photo by Nina Munteanu

your heart with deeper truths felt in your soul. I'm asking you to turn off your phones and calculators and listen with your heart for what is deep inside you.

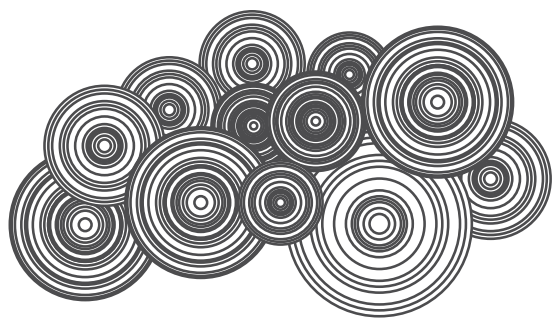
The Scientific Method & "Weird Water"

The ongoing evolution in scientific reasoning and investigation has spanned centuries, from the empirical measurements and observations of Aristotle and early Islamic hypothesis–experimentation, to the rationalism advocated by René Descartes and the inductivism of Isaac Newton and Galileo, to the hypothetico–deductivism of Popper and Kuhn in the 19th and 20th centuries.

Controlled experiments using “double-blind studies” were developed to compensate for “epistemic feedback” and “observer–expectancy effect” (or placebo effect) or other experimenter biases that would otherwise skew an objective experiment toward an “agenda” that was often hidden. The *observer effect* (Hawthorne effect) describes a type of reactivity in which individuals modify or improve an aspect of their behaviour in response to their awareness of being observed. This is something that, if taken into account, can be in of itself revealing; but if not, can bias the results toward erroneous conclusions.

Scientific archivist and professor at UC Berkeley, Paul Feyerabend, shared that many discoveries would not have come about had they been constrained by the limitations of the methodological monism prevailing at that time. Feyerabend suggested that some of the greatest scientific leaps ignored the current scientific method. He suggested that scientists adapt their methods to tackle new discoveries that could not be examined without breaking established rules.⁹

Biochemist Gerald Pollack of the University of Washington describes the “schizophrenic” nature of the current field of water science in his 2013 book, *The Fourth Phase of Water*. On the one hand, “main-



stream scientists employ computer simulations and technologically sophisticated approaches to learn more about water molecules and their immediate neighbours. Their results more or less define the field,” says Pollack. “On the other side are the scientists who explore the more provocative phenomena, dismissed by mainstreamers as ‘weird water’.”¹⁰ Consigned to fringe science, weird water phenomena are often placed in the same category as “cold fusion, UFOs and subtle energies,” adds Pollack, who includes an ‘out-on-a-limb-meter’ to some theories and discussions he forwards in his book.

Goethe, an accomplished polymath and scientist, said of the conventional approach in science: “Whatever you cannot calculate, you do not think is real.”¹¹

I believe that the mavericks of the scientific community, like our artists—because they have one foot inside and one foot outside—provide a wide and highly relevant perspective, unencumbered by tradition and the need for acceptance. So many Nobel laureates have chosen to follow untraditional paths in their pursuits—as if finally freed to pursue their imagination and dreams—that traditional science has given it a term: *Nobel disease*. But it was Einstein who said in 1929 that imagination is more important than knowledge: “Knowledge is limited; imagination encircles the world.”¹² While shared knowledge is valuable in forming a stable culture or tradition, imagination through creativity and art—while it may threaten an established hegemony—creates opportunity and needed change.

“In some cases, a new branch of the sciences ... can begin with a few mavericks (with a high Intelligence/Knowledge [I/K] ratio) whose research is initially dismissed as speculative,”¹² writes Kathleen Taylor, research scientist at Oxford University. “As their way of thinking gradually wins acceptance, it attracts recruits at an increasing rate until a paradigm shift occurs and allegiances transfer wholesale from the old establishment to the new. A period of growing stability follows in which knowledge is assembled (with a decrease in I/K ratio) which

Song of the Spirits over the Waters

*The human soul
Is as water:
From heaven it comes
To heaven it rises,
And down again
To earth it must,
Ever charging.*

*The pure jet
Streams from the high
Steep cliff.
It sweeps sweetly
In cloudwaves
To the smooth crag,
And, gently taken,
It flows down,
Veiling all,
Gently murmuring
Into the depths.*

*When rocks jut out against its fall
it foams dissatisfied
step by step
into the abyss.*

*In the flat bed
It steals its way to valley
meadows,
And in the smooth lake
All starry constellations
Delight their countenance.*

*Wind is the wave's
Sweet lover
Wind mixes foaming billows
From the very bottom.*

*Human soul
How like water you are!
Human fate
How like wind you are!*

J.W. von Goethe

supports the new ideas. Creative output falls, stagnation gradually sets in. Problems begin to emerge, which are ignored by all but a few ... and so the cycle begins again.”¹³

Despite the mandate of exploration and discovery in science, the scientific community can be rather harsh with those who threaten its established hegemony. Many scientists have been ridiculed and marginalized by their peers only to have their findings and conclusions vindicated much later. Sometimes, after they themselves have perished. I call it *artist syndrome*.

I provide two examples that involve water research, which remain controversial after decades of debate.

The first was the discovery in the late 1960s by Russian scientists, led by surface physicist Boris Derjaguin, of “polymeric water molecules” found adjacent to surfaces. This “new phase of water”—water with higher stability, such as in a polymer—they called “polywater”. Water that was confined within narrow capillary tubes appeared to behave differently than surrounding bulk water, demonstrating a lower freezing point, higher boiling point, and much higher density and viscosity. When it was shown that the capillary tubes contained salts and silica leached from the surrounding glass tubes, the discovery was rejected by the scientific community and the Russians accused of careless experimentation. The significance of the results was abandoned in the hubbub of scientific embarrassment. “Contaminants” are natural features of water, given its impeccable universal solvent characteristics, and their presence in limited quantities does not necessarily imply that observed features are not relevant to water’s behaviour. The natural question abandoned by the community was this: *In the presence of contaminants, why does water take on the interesting features described by Derjaguin’s team?* Earlier work by Henniker and Szent-Györgyi had established that water organized itself close to surfaces such as cell membranes.^{14,15} This was later demonstrated by Gerald Pollack and his team at the University of Washington.¹⁶ Forty years after the polywater debacle, Pollack and

Photo 7: Windsurfers on Lake Ontario off Cherry Beach, Toronto, Ontario, Canada.



Photo by Nina Munteanu

other scientists discussed a fourth phase of water, an interfacial water zone that Pollack calls *Exclusion Zone water* or *EZ water*,^{10,17,18,19} given that it excludes materials. Interfacial EZ water was more stable, more viscous and more ordered, and according to biochemist Martin Chaplin of South Bank University this water was, “hydrophobic, stiffer, superfluidic and thermally more stable than bulk water.”¹⁹ Not the same as “polywater” but certainly related.

The second example of controversial research was the proposed ability of water to retain a memory of substances previously dissolved in it, undertaken by the late French immunologist Jacques Benveniste. Reported in a paper published in *Nature* in 1988,²⁰ Benveniste and his research team dissolved biologically active substances in water and successively diluted them until there was nothing left except water. The researchers demonstrated that both concentrated and diluted substance (essentially water) triggered the same impact, suggesting that water held information. Some of you will recognize this as the basis for the practice of homeopathy. The scientific community, while unable to fully discredit his work, rejected his conclusions and declared water memory a delusion. Thirty years later, scientists are confirming Benveniste’s results and more.^{16,21,22,23,24} These include, among others, Nobel laureate Luc Montagnier, who posited the transmission of information stored in water,²⁴ and the late materials scientist Rustum Roy in his work with epitaxy, nanobubbles and pressure effects.²⁶

Over a hundred years ago, in 1871, James Clerk Maxwell’s Cambridge University inaugural lecture expressed the mood of scientific achievement at the time: “In a few years,” he said rather smugly, “all the great physical constants will have been approximately estimated, and ... the only occupation which will then be left to the men of science will be to carry these measurements to another place of decimals.” A hundred and forty-four years later, we are far from tying off decimal points and remain poised to understand the great wonders of our universe, quantum gravity and the nature of reality. Perhaps—I say a little

Photo 8: Cruise ship passes under the Lions Gate Bridge as it leaves Burrard Inlet, Vancouver, British Columbia, Canada.



Photo by Nina Munteanu

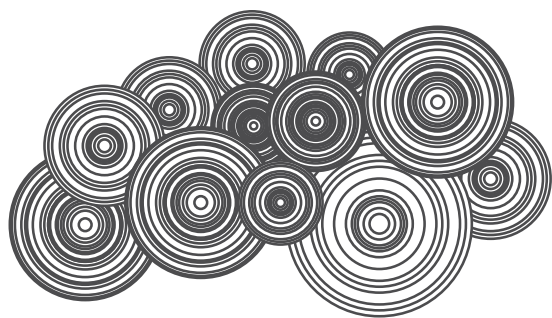
tongue in cheek—it is time for *the women of science* to forge ahead.

Which brings me to non-local phenomena, quantum entanglement and decoherence, Schrödinger’s cat, and the possibility of instantaneous long-range communication. What do these quantum concepts have to do with water and this book? Nothing ... Well, everything.

Entangled Life

In 1935, Schrödinger’s thought exercise spoke to the collision of classical physics and quantum physics—a chaotic dark thriller with a rather macabre baroque scenario involving a cat, a box and some poison. Schrödinger invented the term “entanglement” to describe the behaviour of two previously bound-together individual particles, separated and later behaving as a single entity.²⁷ In 1964 John Bell proved a theorem that allowed experimental tests to establish the existence of an instantaneous connectedness, what Einstein had called “spooky action at a distance”.^{28,29} Freedman & Clauser³⁰ and the Orsay experiments of Aspect et al.³¹ later demonstrated that if objects had interacted, what an observer chose to observe about one of them would instantaneously influence the result that an arbitrarily remote observer chose to observe for the other object. They were entangled.

In a 2011 article in *Scientific American* entitled “Living in a Quantum World,” quantum physicist Vlatko Vedral describes how quantum mechanics no longer applies to small things—as formally thought.³² Vedral shares how quantum phenomena such as entanglement may be nurtured and exploited in living systems through biological processes from bird migration^{33,34} to photosynthesis.^{35,36,37} Birds use quantum processes in compass cells to navigate by sensing the Earth’s magnetic field. In 2010, a team led by Gregory Scholes at the University of Toronto in Ontario, Canada, reported coherence effects at ambient temperatures for photosynthetic cryptophyte algae.³⁶ Photosynthesis, the process that allows



plants and bacteria to turn sunlight, carbon dioxide and water into organic matter, is “arguably the most important biochemical reaction on Earth,”³⁸ says writer and former editor of *Nature* Philip Ball, who adds two other examples of quantum effects in nature. One is the movement of protons from one molecule to another in some enzyme-catalyzed reactions through a phenomenon called *quantum tunnelling*, in which a particle passes through an energy barrier rather than having to gather the energy to climb over it.³⁹ Another example is a controversial theory of olfaction, which claims that “smell comes from the biochemical sensing of molecular vibrations—a process that involves electron tunnelling between the molecule responsible for the odour and the receptor where it binds in the nose.”⁴⁰

According to Vedral, in quantum science it is entanglement—not time or space or even gravity—that is primary. “They interconnect quantum systems without reference to space and time.”³¹ Engel and other scientists predict an emerging discipline called quantum biology.^{35,38,41}

Some of the most eminent physicists have claimed that, when a nuclear particle is observed by a scientist—or when a measurement is made of it by an automatic instrument—the observation directly affects the particle. If, for example, its position is measured, the particle acquires a definite position at that moment—having previously been in an indefinite, “spread-out” state. According to this view, scientists intervene very directly in the phenomena that they study, both creating them as well as observing them. Four hundred years earlier, medieval scientist Francis Bacon wrote, “And the human understanding is like a false mirror, which, receiving rays irregularly, distorts and discolours the nature of things by mingling its own nature with it.”⁴² In the 1960s, Princeton University philosopher David K. Lewis proposed a *modal realism* worldview, in which all possible worlds are as real as the actual world.⁴³

What am I suggesting with this line of thought? Only that “there are more things in heaven and earth ... than are dreamt of in [our]

Illustration 1: Photosynthetic cryptophyte alga. A) the contractile vacuole; B) mitochondrion; C) nucleus; D) eyespot; E) a plastid; and F) a flagellum.

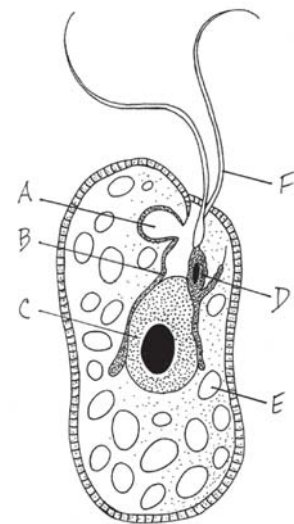


Illustration by Kerste Voute

philosophy,” as Shakespeare wrote in his play *Hamlet*. Good science—and good thinking—isn’t just about skepticism and proof; it starts with imagination and vision—and persistence. And who knows where our imagination—and persistence—may lead?

Symbiosis and a Cooperative Universe

Here’s an example.

Eukaryotic cells, with their many intracellular organelles, were long regarded as descendants of prokaryotes that grew more complex as the result of genetic mutations. Back in 1969, when her paper on *endosymbiosis* was constantly rejected by over a dozen scientific journals (because no one knew how to evaluate it), microbiologist and evolutionist Lynn Margulis stubbornly refused to stand down when critics in her scientific community shot down her “outlandish” theory.

Briefly, her *theory of endosymbiosis* posited that primitive cells gained entry into host cells as undigested prey or as internal parasites after which the “arrangement” became mutually beneficial to both partners.⁴⁴ Chloroplasts from cyanobacteria and mitochondria from bacteria are two examples. The theory challenged Neo-Darwinism by arguing that inherited variation, significant in evolution, does not come mainly from random mutations, but that new tissues, organs and even species evolve primarily “through the long-lasting intimacy of strangers.”⁴⁵

Margulis suggested that the fusion of symbiosis followed by natural selection leads to increasingly complex levels of individuality. She contended that evolution proceeds largely through *cooperation*, not *competition*. Her persistence paid off: what was once regarded as an absurd speculation is now—thirty years later—taken as self-evident truth. The Hobbesian view that engendered the concept of the “selfish gene” programming organisms to maximize reproductive self-interest is rapidly disintegrating in the face of new science that embraces symbiosis, co-

Photo 9: Water drops on a hosta leaf.

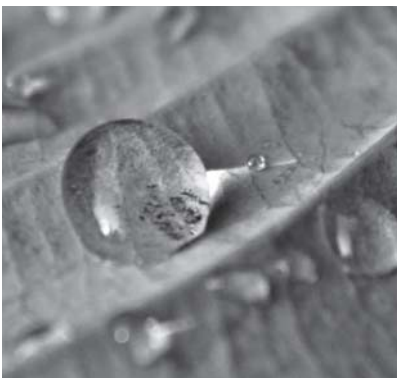


Photo by Nina Munteanu

operation and interdependency; traits not exclusive to civilized people. For instance, researchers are finding increasing evidence that all kinds of life demonstrate qualities of empathy and altruism.⁴⁶ We just need to look for it.

Does this quality need to be confined to life?

I hope that in some chance notion, event, or experience within the pages of this book, you—like I—will discover one important thing about water and one important thing about yourself and that these will entangle, linger and resonate with all that was, is and will be.

With Gratitude,
Nina

Photo 10: Snowy mountain stream in Whistler, British Columbia, Canada.

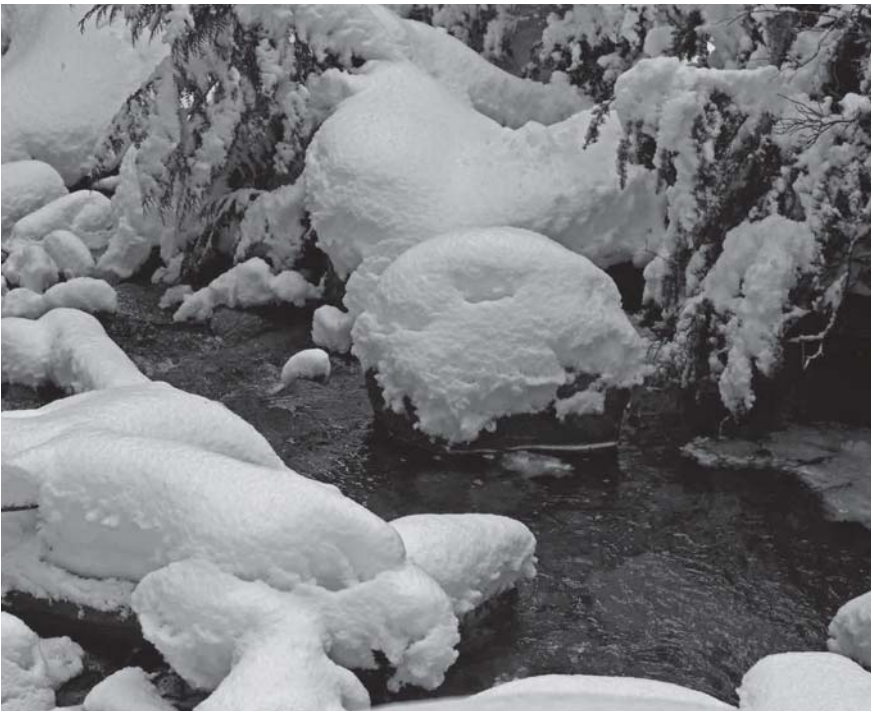
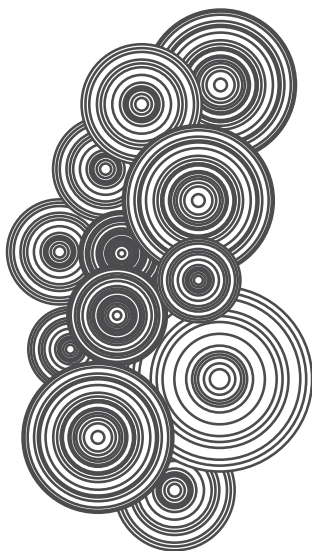


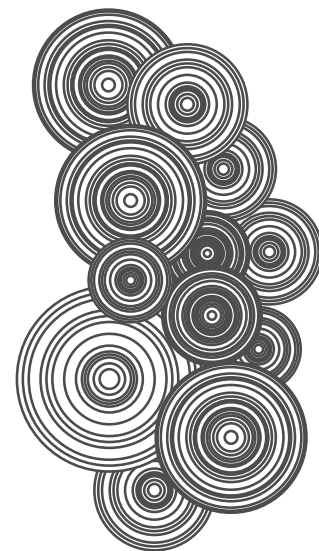
Photo by Kevin Klassen

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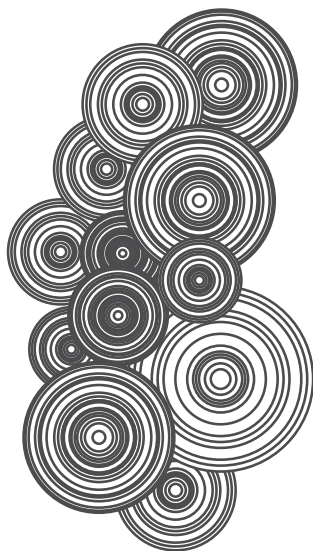
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