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BOOK REVIEW

The Fourth Phase of Water: Beyond Solid, Liquid, and Vapor by Gerald H. Pollack. Ebner & Sons, 2013. xxv + 357 pp. $34.95 (hardcover), $29.95 (paperback). ISBN 978-0962689536.

This book describes an accomplished scientific revolution which, however, and as usual (Barber 1961), awaits recognition by the mainstream. Water, it turns out, does some extraordinary but well-attested things that have never been explained and which have been largely ignored for many decades. Gerald Pollack studied these anomalous phenomena in detail and presents explanations that stem from radical new insights. Thomas Kuhn's description of scientific revolutions (Kuhn 1970) applies perfectly here: Anomalies are ignored by the mainstream. Their resolution requires a fundamental change of mindset. The mainstream does not engage because it thinks so differently (the new and the old theories are "incommensurable"). Time has to pass before the mainstream incorporates the new understanding.

The conventional wisdom acknowledges that water has some unique properties: very high surface tension, very large latent heat, and that the solid phase is less dense than the liquid. All these are explicable as consequences of uniquely strong hydrogen bonding between water molecules. I learned that many decades ago as I studied chemistry to the doctorate level. Then I carried on research on electrochemical phenomena in aqueous solutions for several decades, and had no occasion to doubt the conventional view—until I came across this book.

I had ***not*** known about some things water can do that are well-attested and long-known—but known only to those who are familiar with specialist literature, some of which dates to more than a century ago. For example, there is Kelvin's water-dropper: Water drips from a container through two separate outlets into two metal beakers, each of which is attached to a rod ending in a metal sphere. The two spheres are placed near each other. After a while, a spark bridges the gap between the spheres, even though no electrical voltage or current has been applied! (Free Science Lectures). And, of course, everyone knows that pure water doesn't even conduct electricity. Still, take two beakers of water whose lips are touching, apply a voltage across them through immersed electrodes, and a bridge of water will form between the lips—and the beakers can then be slowly moved apart while the bridge remains, without even drooping, as the separation between beakers becomes as great as several centimeters. Explained by hydrogen bonding?

Start reading this book not at its beginning but at Chapter 1, where these and other astonishing phenomena are described, and you'll be hooked.

Little if any technical background knowledge is needed to follow the descriptions and explanations in this volume, but you may need to read it quite slowly, as I had to, because the basic insights on which explanations build are so unfamiliar:

In the presence of any hydrophilic surface, water spontaneously undergoes a separation of charges, thereby storing energy that can be drawn off. Incident electromagnetic radiation provides the energy needed for the initial charge separation.

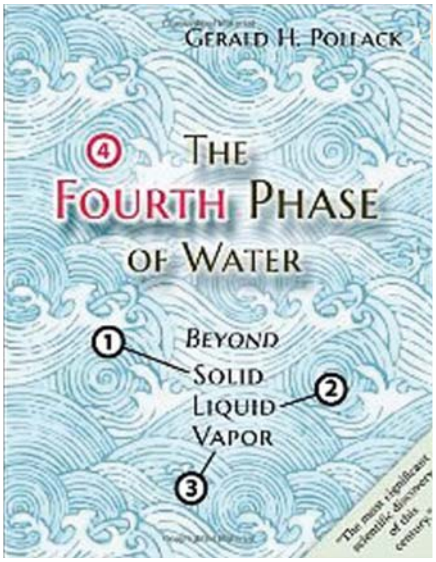
These assertions seem so bizarre that I would have rejected them out of hand if the book had declared them at the outset. Instead, the text begins with evidence. Following descriptions of well-attested anomalies such as the water bridge and the Kelvin dropper comes an account of yet another extraordinary phenomenon. Inside a tunnel through a gel, place water filled uniformly with microspheres: After a while, the microspheres move to the center of the tunnel, leaving the space near the gel completely free of microspheres—they have been ***excluded*** from that space, which was therefore christened the "exclusion zone" (EZ) by early investigators.

The water inside EZs is unlike bulk water: For example, it is more dense, more viscous, it absorbs electromagnetic radiation at about 270 nm—and it bears a negative charge. It is less acidic than the solution outside the EZ.

That EZ water is unlike bulk water brings recollections of "polywater": the claim, originally by Russian scientists but subsequently confirmed by others, that water in narrow tubes differs from bulk water, for example in being more dense and more viscous. Polywater was eventually dismissed as a mistake stemming from the presence of impurities leached from the glass walls of the capillary tubes, but Pollack cites personal sources to the effect that the distinguished Russian chemist, Boris Derjaguin, did not believe that contamination was the whole explanation, even as he agreed publicly with that explanation for political reasons (p. 47).

Pollack infers that EZ water is composed of a stack of planar networks of water molecules interconnected in hexagonal arrays. Forming the necessary bonds ejects protons, which generate the hydronium ions that make the bulk water more acidic and leave the EZ less acidic as well as negatively charged.

The book's argument becomes even more radical in Chapter 8, which explains how "like attracts like," the very opposite of what everyone knows. Actually there is no contradiction: Spheres with negatively charged EZs surrounding them, suspended in water, ***attract one another***. Even though



their like charges do ***repel*** one another, the geometry of the spheres together with the ***positive charge*** in the liquid between the spheres brings the spheres closer together. This illustrates why the book cries out to be read ***slowly***: Several phenomena are explained on the basis of unfamiliar axioms of the sort that "like attracts like" under particular circumstances.

My mind was further stretched as Pollack points out that the terms "heat," "temperature," and "energy" are ill-defined, ambiguous, and even mutually incompatible as encountered in common usage, including in the technical literature. Thus it requires energy input to bring order to water molecules as entropy decreases in the formation of EZs; yet EZs radiate less infrared energy than the bulk water, which would normally be interpreted as being at a lower temperature: What then happened to the input energy?

Pollack discusses a wide range of phenomena in convincing fashion: Brownian motion, diffusion, osmosis, water as a lubricant; why car batteries regain a bit of charge after standing for a while; properties of clouds; radio transmission around the globe with only slightly attenuated signal strength; why "steam" comes off hot coffee in puffs; how bubbles form in liquids, and the exact and detailed mechanics of boiling; Kelvin's water dropper, of course; the exact nature of water's "surface tension," explaining some astonishing structure found even in open ocean waters and to amazing depths. How water is able to rise hundreds of meters inside tall trees. Why warm water can be made to freeze faster than cold water, and much else about freezing that draws on the discussions of heat, temperature, and energy, as well as EZs. Why water has its greatest density not just above its freezing point but instead at 4°C. How rainbows form: After all, splitting light into its component colors requires either a prism or an ***evenly spaced*** grid, neither of which is available under the mainstream view of tiny droplets ***randomly*** sized and spaced.

Chapter 18 reviews the chief tenets of Pollack's insights:

1. EZs constitute a genuine fourth phase of water, not solid or liquid or gas, and perhaps best described as a "liquid crystalline" phase.
2. Water stores energy in the form of charge separation and ordered structure.
3. Water gains energy from light, electromagnetic radiation, and not only at those wavelengths where infrared radiation is strongly absorbed.
4. Likes attract likes via intermediate unlikes.

No further explanation is needed than those assertions, as to why Pollack's insights have yet to become part of mainstream discourse. But several contributing factors are pointed to in the book:

1. The polywater episode left the conviction that any claims of unusual water structure and properties must be owing to impurities. The aftertaste of that 1960s episode was further strengthened circa 1988 and in subsequent years by claims of "water memory," that homeopathy works because water can somehow "remember," "retain" the structure of substances earlier dissolved in it (Davenas 1988, Aïssa 1997, Schiff 1995, Sheaffer 1988).
2. Water is so common, surely everything about it must have been understood long ago.
3. Scientists always resist startling novelty.
4. It is dangerous for scientists' careers to follow unconventional paths.

I've corresponded intermittently with Gerald Pollack over some years, not about this work or this book but because of his interest in finding ways to fund non-mainstream research. This volume illustrates why such funding could pay enormous dividends.

This is a one-in-a-million book for learning entirely new things. It exemplifies the approach that the Society for Scientific Exploration stands for and wants to see manifested in the *Journal of Scientific Exploration*. It is a rare exemplar of truly empirical, evidence-based science. It is a book to savor, to read and re-read, to urge on your best friends.

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References

Aïssa, J., Jurgens, P., Hsueh, W., & Benveniste, J. (1997). Trans-Atlantic transfer of digitized antigen signal by telephone link. Congress of American Association of Immunologists, San Francisco, February.

Barber, B. (1961). Resistance by scientists to scientific discovery. *Science*, *134*, 596–602.

Davenas, E., Beauvais, F., Amara, J., Oberbaum, M., Robinzon, B., Miadonna, A., Tedeschi, A., Pomeranz, B., Fortner, P., Belon, P., & Benveniste, J. (1988). Human basophil degranulation triggered by very dilute antiserum against IgE. *Nature*, *333*, 816–818.

Free Science Lectures. Walter Lewin Makes a Battery out of Water and Cans. http://www.youtube.com/watch?v=oY1eyLEo8_A&feature=related

Franks, F. (1981). *Polywater*. Cambridge, MA: MIT Press.

Kuhn, T. S. (1970). *The Structure of Scientific Revolutions.* Chicago: University of Chicago Press.

Schiff, M. (1995). *The Memory of Water: Homeopathy and the Battle of Ideas in the New Science*. London: Thorsons (HarperCollins).

Sheaffer, R. (1998). Psychic Vibrations—e-mailed antigens. *Skeptical Inquirer*, *22*(#1, January/February), 19.