The Waters of Heterodoxy

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A Review of Gerald Pollack's *The Fourth Phase of Water*

In *The Fourth Phase of Water*, Gerald Pollack offers an elegant new theory of water chemistry that has profound implications not only for chemistry and biology, but for the metaphoric foundation of our understanding of reality and our treatment of nature.

Let me emphasize that this is not a New Age book by someone of questionable scientific credentials. This is a book on chemistry, albeit one easily accessible to lay people. Pollack is a highly decorated professor at the University of Washington, author of numerous peer-reviewed papers, recipient of the 2012 Prigogine Medal, and editor of the academic journal *Water*. I mention this because in a field fraught with what some call pseudo-science, but what I'll politely call speculative inquiry unburdened by scientific rigor, paradigm-busting theories attract an inordinate degree of hostility.

Indeed, Pollack devotes one of the early chapters to two such episodes: the polywater debacle of the 1960s, and the water memory controversy twenty years later. These illuminate some of the politics of science-as-institution and means by which dissident views are suppressed. Furthermore, as I will touch on later, they also reveal some of the sacrosanct metaphysical assumptions underlying science as we know it – assumptions that the present book indirectly violates. It is no wonder then that it has encountered a mixed, and in some cases decidedly chilly,

reception in scientific circles. Notwithstanding all that, *The Fourth Phase of Water* avoids any of the stridency or persecution stories that sometimes color heterodox books. The tone is courteous, conversational, and cautious when presenting more speculative ideas.

One would think that after two hundred or more years of modern chemistry, something as fundamental and seemingly simple as water would be thoroughly understood by now. Before reading this book, I took for granted the explanations my high school and college textbooks offered for evaporation, capillary action, freezing, bubble formation, Brownian motion, and surface tension. Everyone else assumes the same thing, which may be why the conventional explanations are seldom scrutinized. However, as *The Fourth Phase of Water* demonstrates, a little creative scrutiny reveals severe deficiencies in conventional explanations.

The crucial concept in the book is that of “exclusion zone water,” or EZ water for short. Imagine a beaker of water in which hundreds of thousands of plastic microspheres are suspended. Standard chemistry would expect that these would be evenly distributed throughout the medium – and they are throughout most of the water. However, near the sides of the beaker (and any hydrophilic surface submerged in the water), the water remains clear, free of any spheres. Why? Standard chemistry predicts an exclusion zone a few molecules thick might exist next to the glass, where polar water molecules stick to the distributed charges, but the exclusion zone Pollack observed was at least a quarter millimeter – several hundred thousand molecules thick.

Pollack and his colleagues proceeded with caution, testing and ultimately eliminating various conventional explanations for the phenomenon (e.g. convectional flows, polymer brushing, electrostatic repulsion, and leaking materials). They also began investigating the properties of the exclusion zone, with intriguing results: EZ water excludes almost everything, not only suspended particles but solutes as well. It exhibits an electromagnetic absorption peak at 270nm, and emits less infrared radiation than bulk water; it has higher viscosity and a higher index of refraction than bulk water. Most surprisingly, they discovered that the exclusion zone had a net negative charge, and that the water outside the zones had a low pH, indicating that protons had somehow been ejected from the EZ water.

With this information, Pollack and his collaborators hypothesized that the exclusion zone is composed of a liquid crystalline form of water, consisting of stacked hexagonal layers with oxygen and hydrogen in a 2:3 ratio. Of course, ice also consists of stacked hexagonal sheets, but in the case of ice the sheets are held together by the extra protons. Pollack proposes that EZ sheets are “out of register” – aligned so that the oxygens of each layer are frequently next to the hydrogens of the adjacent layers. The alignment is not perfect, but it creates more attractions than repulsions, enough to create cohesion as well as a molecular matrix tight enough to exclude even the tiniest of solutes.

Where does the energy come from to create this charge separation? It comes from incident EM radiation. When a water sample is shielded from incoming radiation and heat flux, no EZ forms.

The bulk of *The Fourth Phase of Water* is devoted to applying this hypothesis to various phenomena in water chemistry. In my mind, his greatest strength as a scientist is to ask seemingly naïve questions that no one else is asking. For example, he questions the conventional explanation of surface tension, which invokes the hydrogen bonding pressure on the water surface. Could the extraordinary surface tension of water really be explained by the energy in a layer less than one nanometer thick? He asks, why don't gels, which can be over 99.9% water, leak water? Why do charged aerosol droplets of water coalesce into clouds instead of repelling each other and dispersing evenly throughout the sky? Why does hot water sometimes freeze more quickly than cool water (the Mpemba Effect)? Why does the steam rising from a cup of hot coffee come in discrete puffs? Why do boats leave a wake of relatively still water behind them sometimes 15 or 30 minutes after passing?

This book offers extraordinarily economical answers to these questions and more. The experiments he cites are straightforward and compelling. While they offer highly unconventional answers to basic questions in chemistry, he does not invoke supernatural or paranormal forces. Nor does he question fundamental physical laws (of thermodynamics, relativity, quantum theory, etc.). One cannot help but wonder: Why, then, is his theory ignored?

I think the reason goes beyond standard Kuhnsian resistance to paradigm

shifts. Pollack is not, after all, the first scientist to get into trouble for advancing theories about water that suggest it is more than a generic, structureless substance, more than a medium for chemistry and a raw ingredient for chemistry. Something else is going on here.

A quick review of the history of the two controversies mentioned earlier, polywater and water memory, is instructive. In the first case, Russian chemists discovered that water in narrow tubes exhibited anomalous properties, neither liquid nor solid (the anomalies are exactly the same ones that Pollack describes). An uproar followed, and Western scientists accused the Russians of failing to eliminate impurities from the water – namely, trace amounts of dissolved silica from the glass tubes. In the end the Russians admitted that the water was impure, and the discovery was relegated to the dustbin of history. No one, however, offered an explanation of how dissolved silica could account for those anomalous properties. Pollack points out the truly pure water, the universal solvent, is nearly impossible to obtain. The substance of the Russians' discovery was never considered; rather, a convenient pretext was found to dismiss it.

The case of water memory is even more egregious. In 1988, Jacques Benveniste published a paper in *Nature* that claimed that a sample of water that had formerly contained antibodies still evoked an immune response from white blood cells, as if the water “remembered” their presence. *Nature* published the article (Benveniste was a top French immunologist), but then sent an inquisitorial squad to investigate, which included the professional magician James Randi and the fraud investigator Walter Stewart. Accounts differ as to what happened next, but everyone agrees that no direct evidence of fraud was found. The team concluded only that the results were not replicable, a claim that Benveniste strenuously denied to no avail: his funding was canceled, his laboratory taken away from him, and his academic career was ruined. To this day, his name is associated with pathological science and his obituaries are masterpieces of character assassination.

Notice how, in the previous paragraph, I put the word “remembered” in quotation marks, as if to assure the reader that I don't think water could literally have memories. The quotation marks imply that water can only, at best, behave *as if* it could remember. Because, after all, it is just water, right? It doesn't possess the complexity, the organization, the intelligence,

the experiential beingness that would be necessary in order to have actual memories. Modern chemistry holds just that: that water is a generic fluid, any two samples of which are fundamentally identical, differing only in temperature and the presence of impurities (and hydrogen isotope ratios for you sticklers out there).

Polywater, water memory, and Pollack's theory all violate that principle, which is really a kind of anthropocentrism. Our civilization, especially in its treatment of nature and in the sameness of its commodity economy, operates by the assumption that we humans alone have the qualities of a self. The rest of the world is just a bunch of stuff out there; therefore, we are at liberty to exploit it as we will, to impose our intelligence on a insensate substrate that lacks any of it. Any scientific theory or technology that violates this principle seems immediately wrong, even outrageous, to the mind that operates by it.

One way to view the transition our society is undergoing today is that we are assigning selfhood to more and more beings that we “othered” in the past. We've made some progress: today we recognize the full legal personhood of women and racial minorities (although unfortunately, racist and sexist beliefs persist with much greater tenacity than most white men recognize). We no longer see animals as insensate brutes, although again, the manner and degree of animal intelligence is poorly understood. Even plant intelligence is emerging as a hot topic of research, although it is the rare scientist who would say “plants are intelligent” or “plants have a subjective experience” without offering a thicket of disclaimers and qualifiers to the effect, “Of course I'm not saying they are *actually* intelligent.”

To be sure, Gerald Pollack isn't saying water is intelligent either. His research does open the door to such a view though, because it implies that any two given “samples” of pure H_2O are unique, with a structure that depends on what it has been in contact with. Why did I put “sample” in quotes here? It is because the very word implies that if I take a small amount of water from a larger amount, say a test tube from a bathtub, that the smaller will have the same properties as the larger. In other words, it implies that water, or anything sampled, is fundamentally isolable from its environment.

Pollack's research casts both assumptions – uniformity and isolability – into question. He does not go so far as to claim that water can carry information, but he comes close when he observes that the exclusion zone's properties differ for different materials. That is perhaps why homeopaths have seized upon his research (as they also did with Benveniste's). Homeopathy, of course, is the very epitome of quackery in the eyes of medical orthodoxy; its association with Pollack's work (though he never makes any claims for it himself) is surely one reason why the scientific establishment is wary of his work.

No sober observer would say that he has “proven” the validity of homeopathy, let alone the menagerie of water-based modalities and products one can find on the Internet. But if we accept his results – and I hope other scientists repeat and extend his experiments – at least one can no longer say that these modalities contradict indubitable scientific principles. Of course if any two samples of pure water are identical, then structured water products and medicines are bunkum. Thanks to Pollack (and a lineage of other researchers that he has uncovered in the scientific literature), this is no longer certain.

The Fourth Phase of Water contributes to a much larger paradigm shift that is proceeding across all the sciences, and indeed to a transition in the defining mythology of our civilization. In science alone, the implications of his findings, if verified, are profound, especially in areas like cell biology, plant physiology, chemical signaling, and of course medicine. Beyond that, they erode the story that we live in a dead universe of generic substances, that we, the sole intelligence of that universe, are therefore its rightful lords and masters. Pollack is part of the evolution of science toward a more shamanic worldview that understands that all things possess some kind of beingness.

Resistance to this shift is still strong, perhaps because its consequences are so huge. Even without realizing the enormity of the implications, orthodox thinkers instinctively attack any work that is aligned with it. A common tactic is to allege "contamination," which (along with fraud) is used as an all-purpose dismissal of anomalous results, in archeology and even astronomy as well as chemistry. It amounts to an accusation of sloppiness, of incompetence. No one wants to be thought a dupe; therefore, when the ostracism of iconoclasts such as Benveniste, Pollack, Pons and

Fleischmann, Halton Arp, etc. begins, those who are secretly sympathetic to them keep silence, fearing quite justifiably for their funding and careers.

While I suspect that Gerald Pollack is sympathetic to the larger transition in civilization's mythology, there is little sign of it in the book. He restricts himself to chemistry and, when he ventures into the realm of speculation, makes it clear that he is going out on a limb. Perhaps his unsensational tone, his consideration of alternative explanations, and his adherence to experimentally based assertions will do something to assuage the natural skepticism of the scientifically orthodox reader. But I doubt it. The radical implications of this work strike too close and too deep.

A translation of this essay into Chinese can be found here

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