

January 29, 2022

RE: Nomination of Gerald Pollack, PhD for 2023 Japan Prize in Life Science

Dear Managing Director / Secretary-General Yasuhiro Mashiko:

It is a privilege to nominate Gerald Pollack, PhD, for the 2023 Japan Prize in the field of Life Sciences for his discovery of a fourth phase of water and its central role in health, fluid flow, and biological energy production. Fourth-phase water is a “liquid crystalline” ordering of water molecules different from solid, bulk liquid, or gas phases that forms the foundation for a comprehensive new understanding of water. Fourth-phase water explains phenomena not heretofore understood and that have profound implications for the living things to function and for their health. Dr. Pollack has created nothing short of a new science of water.

Water is everywhere. It is the single most prevalent molecule in every cell. Understanding water is one of the most powerful ways to better comprehend the complex and subtle mechanisms underlying the activity of all living organisms. The better we understand water, the better we understand life, and the better we understand life, the more we can improve health.

In this letter, I will describe Dr. Pollack’s contribution to the science of water, and its implications for life science and for the broader world around. I believe his work is perfectly aligned with the stated goals of the Japan Prize in the field of Life Science in the area of Life Sciences, Agriculture, and Medicine. I will briefly describe who Dr. Pollack is, what my qualifications are for making this nomination, and close with summarizing the potential impact on the world of Dr. Pollack’s work.

Dr. Pollack’s fourth phase of water (also termed “fourth-phase water” or “structured water”) is a crystal lattice structure that, unlike ordinary bulk liquid water, is so tightly ordered that it excludes all solutes. Fourth-phase water forms next to hydrophilic surfaces; can extend hundreds of thousands of molecules wide and has a density, refractive index, light absorption, and viscosity all different from that of bulk water. Fourth-phase water is a distinctly different chemically, electrically, and organizationally from ordinary bulk liquid water.

The mechanism of the formation, persistence, and the effects of the fourth phase of water is charge separation — fourth-phase water is negatively charged, with a corresponding zone of positive charge located a distance away. This forms essentially a “water battery”, whose energy can be harvested to do

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work. The energy that is required to form fourth-phase water -- the creation of ordered fourth-phase water from disordered ordinary bulk water -- comes from light (or other radiant energy). It is analogous to how plants use light to conduct photosynthesis. Dr. Pollack has demonstrated that water is, in effect, a potent energy transducer, absorbing radiant energy from the environment to form fourth-phase water, thereby creating a water battery that can be used to perform useful physiochemical, optical, electrical, and mechanical energy work. The implications of this are staggering, as I will outline later in this letter.

Dr. Pollack has built a new science of water using his discovery of fourth-phase water and its mechanism of formation as the cornerstone. Old phenomena are cast in new light; hitherto unexplained phenomena now have simple explanations. Here is an example from a basic science perspective that is illustrative of just how revolutionary these ideas are: Pollack's theory provides an alternative explanation to Einstein's view that Brownian motion arises from thermal energy; i.e. heat increases molecular kinetic energy and thereby causes tiny particles to move. Pollack suggests that it is not heat but incident radiant energy instead (e.g. infrared radiation, visible light, ultraviolet light) that drives Brownian motion—the absorbed energy causes fourth-phase water zones to form around the particles, thereby creating charge separation, and the separated charges then generate forces of attraction and repulsion that drive particle movements. This explanation can account for Brownian motion phenomena not easily explained by Einstein's thermal model, such as the coordinated non-random movement of particles in a given direction and the absence of particle displacement within colloid crystals.

Fourth-phase water explains many fundamental mechanisms underlying biological and chemical phenomena that are otherwise not well understood. With its attendant charge separation, fourth-phase water provides a unifying explanation for osmosis (the movement of water from a compartment with a lower concentration of solutes to a compartment with a higher concentration, which is the underlying basis by which water moves in and out of living cells across membranes) and diffusion (the movement of solutes from an area of higher concentration to an area of lower concentration). Osmosis and diffusion are core mechanisms for how cellular metabolism and complex physiological systems function. These explanations in terms of fourth-phase water are remarkably straightforward; and they account for many features otherwise not understood both inside and outside life science. For example, they explain why substances within a crowded cell move much faster than anticipated from pure, random movement.

Fourth-phase water fills all our cells. Dr. Pollack has shown that an abundance of fourth-phase water is necessary for proper cell function, and that various simple expedients known to promote health may do so simply by building fourth phase water. Several recent papers deal with that subject. A number of substances used to promote health (e.g. turmeric and probiotics) expands the zone of fourth-phase water next to hydrophilic cell surfaces.

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Of direct relevant application in the Life Sciences area, Dr. Pollack's group has shown that it is not just the heart that drives blood through the cardiovascular system, but it is also the blood vessels themselves that propel blood forward in non-pulsatile flow. In the laboratory, his team identified spontaneous flow in various tubular materials, driven by (infrared) light energy, which builds fourth-phase water. Then, in an animal (chick embryo) model, they found persistent flow even when the heart was stopped. This implied the presence of another driving source, beyond just the heart. They then demonstrated the signature feature of the tubular flow mechanism in the chick embryo: flow was faster in the presence of infrared energy than in its absence. Blood flow is powered not just by the heart but also by the blood vessels themselves through the mechanism of fourth-phase water and its electrical properties.

We all know that plants generate energy by photosynthesis powered by sunlight. An analogous energy generation paradigm likely exists in non-plant biologic life in which light (radiant energy) + fourth phase water produces electrical energy. Dr. Pollack has obtained a patent demonstrating that fourth-phase water and light can produce electrical energy. The electrical energy produced by the activation of water by light operates in the biologic sphere as well. It may provide an explanation for the efficacy of light therapy in treating depression.

Fourth phase water explains many ordinary phenomena that we experience every day. Among them: Why is ice slippery to walk on but ice cubes stick to fingers? Why is there delayed coalescence of bubbles that sit on an underlying pool of water (the bubble membrane itself may be fourth phase water)? Why do clouds cohere? Why do bubbles form first against the sides of a pot of heated water? Why are some insects able to walk on water? Why do underwater divers begin to experience a more rapid descent at some distance below the water surface? Why can red blood cells flow through capillaries *narrower* than the cells that pass through them — without significant pressure drop.

All this work is beautifully summarized in his book *The Fourth Phase of Water: Beyond Solid, Liquid, and Vapor*, which reflects a professional career consisting of more than 300 publications, three books, hundreds of invited lectures, numerous awards, and a thriving and active research laboratory at the University of Washington in Seattle where Dr. Pollack is Professor of Bioengineering. (CV attached).

Permit me a brief paragraph of introduction as to my qualifications for nominating Dr. Pollack for the Japan Prize. My name is Mark Smith. I am a physician and serve as the Innovator-in-Residence for MedStar Health, the largest not-for-profit provider of healthcare in the Washington, DC region of the United States. I was the Founding Chief Innovation Officer at MedStar Health. I am an emergency physician and computer scientist by training and practice, and hold the faculty position of Professor of Emergency Medicine (and past chair of Emergency Medicine) at the Georgetown University School of Medicine. My job is to find paradigm-changing ideas and technologies that will improve health. I can think of no better example than fourth-phase water.

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True innovation always starts with thinking differently about the world. Dr. Pollack has taken water, the most common and pervasive of all substances, one that makes up two-thirds of a person's mass and >99% of a person's molecules, and he has created a whole new science that opens the possibility for great innovation to occur.

Dr. Pollack is one of those rarest of individuals who homes in on where things do not make sense, detects anomalies in patterns, hears the dog that does not bark, and then figures out why things really are the way they are. Per the Nobel biochemist Albert Szent-Gyorgi, "Discovery consists of seeing what everybody has seen and thinking what nobody has thought."

The impact of Dr. Pollack's work is breathtakingly profound at multiple levels

In terms of the applications and implications of Dr. Pollack's new theory of fourth-phase water:

1) The reach of his theory is broad. Every day we encounter diverse phenomena that are explained by fourth-phase water --- the formation of bubbles and droplets, the coherence of clouds, the boiling of water, the waft of vapor from a hot beverage – and people can now see and understand them in a new light. All great ideas are simple. This is one of them. His insights are understandable to everyone.

2) His insights are inspiring. Dr. Pollack paid attention to phenomena that each of us encounter on a daily basis, phenomena that have no clear explanation. He thought differently about many of them — not just a few but very many. This kind of open-minded creativity will inspire everyone around the world. It will cause people to look more closely at the ordinary and see the extraordinary behind it. Every person I know who has heard Dr. Pollack speak or read his books has come away a changed person. In my humble opinion, Dr. Pollack's new science of water may be the most important scientific insight of the last 50 years.

3) Water Filtration and Desalination for health. Dr. Pollack has created a "filterless" filter to produce clean water. The principle is based on the exclusion of particles and solutes from fourth-phase water. The mechanism underlying fourth-phase water creation is charge separation that leads to the spontaneous formation of a liquid crystal lattice tightly arranged in stacked hexagons. The crystal structure leaves no room for exogenous solutes. This is in fact the etiology of the term of "EZ water" (the original term for fourth-phase water) an "Exclusion Zone (EZ)" that eliminates everything other than pure water from its region. If this radiant energy-induced solute exclusion can be engineered at scale, one might have a model for industrial desalination, providing drinking water for those regions of the planet where it is in short supply. What could be more important for the health and well-being of the world than having clean desalinated water for drinking?

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4) Solar-powered water batteries: Pollack's new understanding of water likely has broad practical implications of great benefit to society. Water that is exposed to radiant energy (light) can transduce that energy and store it as charge separation. This conversion to electrical energy may well become a model for producing less expensive solar batteries using light-induced charge separation to perform work, in effect a liquid solar panel. This, all based on renewable resources -- water and light.

Dr. Pollack has shared his work extensively with the greater scientific community. In addition to his more than 300 research publications and the three books he has written, during the last decade he has delivered more than 200 keynote presentations and lectures, and probably another 100 - 200 more informal seminars. Most have been presented to the scientific community, but many also to the educated lay community (e.g. two TED talks). Dr Pollack runs the Annual Conference on the Physics, Chemistry, and Biology of Water, now in its fourteenth year. In addition, Dr. Pollack serves as the founding editor of the scientific research journal *Water*.

Dr. Pollack is extremely well connected to the Japanese scientific community He has visited Japan more than forty times and even speaks some Japanese, unusual for an American scientist. Water is of special significance to any island nation. And I know that the Emperor of Japan has had a lifelong interest in all things about water (both science and history) and has accepted the position of Honorary President of the United Nations Secretary-General's Advisory Board on Water and Sanitation (UNSGAB).

Dr. Pollack has published two books on water with a third coming out soon. His first book *Cells, Gels, and the Engines of Life* is devoted to the central role that structured water plays in cell biology. (2001). His second book, *The Fourth Phase of Water* (2013), is accessible to a lay audience and beautifully and brilliantly lays out the full theory and practice of structured water. The various roles of fourth-phase water appear in his forthcoming book, *Charged: The Unsuspected Role of Electricity in the Workings of Nature*.

For another perspective on Dr. Pollack's work (in addition to his book *The Fourth Phase of Water*) please take a look at his the website of his laboratory (<http://faculty.washington.edu/ghp/>). It is a beautifully constructed and clear explication of the substance and significance of the work he is doing.

Also, I recommend watching several of Dr. Pollack's presentations, links to several of which are appended to this nomination document as supplemental information. He is a masterful presenter, and I do think that the best way to gain a sense for the breadth and majesty of his ideas is to hear and see him present them in his own words. Nothing beats seeing the actual experiments that led to the discovery of this fourth phase of water as described by the person who made the discoveries.

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I predict that twenty years from now, Dr. Pollack's contribution to the scientific understanding of water, its implications for health and biology and the practical innovations that have flowed from it will be recognized as one of the towering achievements of early twenty-first century science. Unless of course the Japan Prize Foundation sees fit to award the 2023 Japan Prize for life Science to Dr. Pollack — in which case recognition of his monumental scientific achievement will come much sooner.

Yours truly,



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