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The Inference to Intelligent Design is Independent of Any Religious Claim: The Wonder of Water

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In this short letter I explain, as someone agnostic about most religious claims, why I find the inference to design or ID very hard to refuse, on any consideration of the evidence of environmental fine-tuning for life as it exists on Earth. I describe here various properties of water that convey an irresistible impression of having been fine-tuned specifically for life as it exists on Earth. These include the various unique properties of water which make possible the hydrological cycle (which in turn makes terrestrial life possible), water's unique fitness for forming both the medium of the circulatory system and the matrix of the cell — including the latter's hydrophobic property, which plays an essential role in generating the higher-order supramolecule structures in the cell — and its various unique thermal properties, which make possible warm-blooded organisms and play a vital role in climatic amelioration. This truly amazing ensemble of instances of fitness manifest in the properties of water can have only one reasonable explanation: intelligent design.

It is important to state unambiguously at the outset that the inference to design is not, as is sometimes claimed, in any way based on religious belief, although it has, of course, religious implications, and has been alluded to by apologists in defence of theism over the past four centuries that have elapsed since the scientific revolution (i.e. by Newton, Paley, Alfred Russell Wallace, by many others, and by present day advocates of ID). As many supporters of ID have pointed out, the

inference to design is embraced in many different disciplines, and with respect to many different phenomena. Researchers in archaeology and criminology, or scientists seeking evidence of intelligent life in outer space, must in many instances judge an artifact, particular pattern, or occurrence to be the result of design rather than chance. In such cases — *self evidently* — inference to design has absolutely nothing to do with religious belief. In my view there is, in fact, not the slightest difference between the sort of inference to design employed in various secular disciplines and that made by fellows of the Discovery Institute.

On a personal note, although through most of my life I have been relatively agnostic as regards the claims of many of the world's leading faiths, and while I do not currently belong to any church or attend any religious services, I believe the inference to intelligent design to be inescapable on any sensible consideration of the fine-tuning of the environment for life as it exists on Earth. I should point out, however, that I do not think it supports any of the various religious claims made with respect to the nature of that intelligence — such as whether or not, for example, that intelligence is providential, as is claimed by apologists for the specifically Judeo-Christian conception of God. This point was also stressed by Bradley Monton, in his recent paper "How Can an Atheist Defend Intelligent Design". [1]

Incidentally, without entering into a detailed review of Monton's paper, I do agree with his view that if the universe is infinite, then this poses a severe challenge to intelligent design. However, at present I am not aware of any convincing evidence for the claim that it is so. Unless the universe is indeed infinite, then I would argue that given the evidence of the extraordinarily exact environmental fine-tuning for life evident in so many natural phenomena (such as the suitedness of water for so many diverse ends, as described below), design rather than chance is the only rational option.

I consider here several of the very remarkable ways in which the properties of water are fine-tuned for life — not just simple cellular life, but also beings of our biological design — which I believe can only be explained by ID in a finite universe, irrespective of any prior philosophical or theological beliefs.

Consider, first, water's unique fitness for the hydrological cycle, a cycle vital to all terrestrial life on Earth (including ourselves). To begin with, it is *the only sub-*

[1] Bradley Monton, "How Can an Atheist Defend Intelligent Design?", *Filozoficzne Aspekty Genezy* 2022, Vol. 19, No. 2, https://doi.org/10.53763/fag.2022.19.2.202.

stance which is capable of existing in three material states — liquid, gas and solid — in the ambient temperature range on the Earth's surface. It is this unique capacity that enables the grand hydrological cycle, enabling liquid water to evaporate from the sea as a gas (water vapor), condense into drops of water in the clouds, and fall to the ground as rain (liquid water) or snow (solid water), before eventually flowing back via rivers of liquid water or glaciers (rivers of solid water) to the sea.

Thus, because of its *unique capacity to exist in the three material states* under the ambient conditions obtaining on the surface of the Earth, water is uniquely fitted to enable the hydrological cycle, and thus to provide a continual supply of water for terrestrial life.

Nevertheless, life on land requires, in addition to water, a continuous supply of the essential elements of life. The four main atoms of organic matter — C, H, O and N — are derived from the atmosphere, but the other essential atoms, including Na, P, S, Cl, K, Ca, V, Cr, Mn, Fe, Co, Ni, Cu and Zn, must be leached from the rocks (which are their only source for land-based life) as the rivers return to the sea, and distributed to the terrestrial hydrosphere, making them available to land-based life. But what is *truly amazing* — these words are carefully chosen — is that water possesses an additional ensemble of properties that are profoundly suited to eroding the rocks and leaching the essential minerals from them.

These additional elements of fitnes include: (1) water's being an excellent solvent; (2) its possession of a low viscosity (close to the lowest of any liquid) and consequent high mobility which, in conjunction with the tiny flakes of rock it carries, promotes erosion of the rocks; (3) its having a high surface tension (one of the highest of all the fluids we are familiar with) which draws water into the crevices in the rocks, where (4) in higher latitudes and altitudes water's expansion on freezing (itself virtually unique) causes more cracking of the rocks, further assisting the erosional process; (5) when water reacts with CO_2 in the air a mild acid solution (carbonic acid) is formed, which further promotes the dissolution and weathering of the rocks. [2]

[2] See Michael Denton, **The Wonder of Water: Water's Profound Fitness for Life on Earth and Mankind**, 1st edition, *The Privileged Species Series*, Discovery Institute Press, Seattle 2017, Chapter 1.

Even so, this is not the end of the extraordinary ensemble of elements of suitedness for terrestrial life manifested in the hydrological cycle. The delivery of water enriched with the minerals of life would be of no avail without water retaining soils that are *essential for the growth of all plants and trees* that need a reliable and continuous supply of water. In water-retaining soils, the water is held in the micropores (preventing rapid drainage and loss of ground water) thanks to water's high surface tension (which, as was mentioned above, already plays a role in enhancing erosion by being drawn into narrow crevices and cracks in the rocks).

It is simply beyond belief that *the same erosional process* which ultimately leaches the minerals from the rocks *also generates* at the same time the *water-retaining soils* that hold the vital water, enriched with the necessary nutrients for life, in the soil, making plant life possible. And what physical force holds the water in the micropores in the soil? None other than the high surface tension of water itself!

Finally, perhaps the most remarkable aspect of the cycle is that the unique elements of suitedness of water for erosion and weathering of the rocks can only be exploited because of a *prior element of fitness*: namely, water's unique capability of existing in three material states under the ambient conditions on Earth. And again, the fitness of water's retention of the soils so essential for plant life can only be exploited because of *the prior fitness of water for the erosion of the rocks.*

What this means is that the properties of water which are exploited in the hydrological cycle form what is, in effect, a teleological hierarchy of fitness, where *one unique property of water enables the exploitation of a subsequent ensemble of properties to achieve a vital life-giving end*. I can think of *no single set of facts in all of science more suggestive of design.*

Curiously, another vital cycle — the circulation of blood in the body of complex organisms — is also dependent on various unique properties of water, which forms the basic medium of blood. Its excellence as a solvent is no less important as regards its role in the circulation than when it comes to leaching the minerals from the rocks in the hydrological cycle. And again, as was mentioned above, its low viscosity, which confers mobility on water in the hydrological cycle (enhancing the rates of erosion), is also another vital element of its fitness for the circulation — one which, together with the relatively low density of water, enables the heart to pump the blood through the capillary bed. Self-evidently, if the viscosity

of blood were even just slightly greater, making it similar to that of many other fluids, then pumping the blood through the capillary bed would be impossible. As it is, the energy that must be devoted to pumping the blood through the circulatory system is about 10 percent of the energy "budget" in man and many other vertebrates.

Consider, next, the suitedness of water to forming the matrix of the cell. This ensemble again includes its low viscosity (which provides a highly fluid medium for the rapid movement of molecules inside the cell), and its excellent powers as a solvent (enabling it to carry in solution a vast inventory of molecular species). But it also has another vital property — less well known, but essential for the generation of the higher structural order of the cell: water's hydrophobic property (or force) arising from the electronegativities of hydrogen [H] and oxygen [O], which differ considerably, leaving the oxygen atom in the water molecule [H_2O] negatively, and the hydrogen atoms [H_2O] positively, charged.

This results in water being a highly polar compound, and leads in turn to the formation of a highly polar hydrogen-bonded network which extends throughout every contiguous body of liquid water, including the matrix of the cell. Although polar and charged compounds can readily fit into the network and *are liked*, soluble, non-polar hydrocarbon chains (which are non-polar because the electronegativities of carbon [C] and hydrogen [H] are similar) occurring in phospholipids and in the side chains of many amino acids are *not liked* and cannot "fit into" the hydrogen-bonded network, with these rendered insoluble and forced to clump together in hydrophobic complexes away from contact with water.

It is this force — the hydrophobic force — which causes the formation of the lipid-bilayer cell membrane by forcing the insoluble (non-polar) hydrocarbon chains of the phospholipids into the centre of the cell membrane, away from the aqueous phase inside and outside of the cell. It is the same force which forces the non-polar side chains of amino acids to clump together in the centre of proteins during folding and stabilizes the mature native form after folding. The hydropho-

bic force is also responsible for stabilizing the DNA helix, [3] as well as many enzyme-substrate complexes. [4]

The importance of the hydrophobic force in ordering membranes and other higher-order structures in the cell can hardly be exaggerated. For it is hard to imagine how the higher structural order of membranes, proteins and DNA, etc., which arises spontaneously out of the action of the hydrophobic force, could be achieved in any other way. In other words, life, and indeed *the very existence of the carbon-based cell*, is critically dependent on water's *dislike* of hydrophobes or non-polar compounds. The protein chemist Charles Tanford was not exaggerating when he said that "[t]he hydrophobic force is the *energetically* dominant force for containment, adhesion, etc., in all life processes", adding that "[t]his means that the *entire* nature of life as we know it is a slave to the hydrogen-bonded structure of liquid water". [5]

Water's fitness to form the matrix of the cell is, as far as we know, completely unique. There is no other liquid we are aware of that could replace it in this role. In 3.5 billion years, no other liquid has been utilized for the matrix of the cell. If water did not possess the exact set of properties it does, *no carbon-based cell would exist and Earth would certainly be devoid of life*.

Now consider another completely different vital phenomenon, endothermy, which confers many advantages for advanced terrestrial life forms such as our-

[3] Bobo Feng, Robert P. Sosa, Anna K.F. Mårtensson, Kai Jiang, Alex Tong, Kevin D. Dorfman, Masayuki Takahashi, Per Lincoln, Carlos J. Bustamante, Fredrik Westerlund, and Bengt Nordén, "Hydrophobic Catalysis and a Potential Biological Role of DNA Unstacking Induced by Environment Effects", *Proceedings of the National Academy of Sciences* 2019, Vol. 116, No. 35, pp. 17169–17174, https://doi.org/10.1073/pnas.1909122116.

[4] "The hydrophobic effect is responsible for the separation of a mixture of oil and water into its two components. It is also responsible for effects related to biology, including: cell membrane and vesicle formation, protein folding, insertion of membrane proteins into the nonpolar lipid environment and protein-small molecule associations. Hence the hydrophobic effect is essential to life. Substances for which this effect is observed are known as hydrophobes". "Hydrophobic Effect", *Wikipedia: The Free Encyclopedia*, https://tiny.pl/w5ncb [15.12.2022].

[5] Charles Tanford, "How Protein Chemists Learned about the Hydrophobic Factor", *Protein Science* 1997, Vol. 6, No. 6, p. 1365 [1358–1366] https://doi.org/10.1002/pro.5560060627 [emphasis in the original].

selves. [6] This is critically dependent on a set of unique thermal properties of water.

Firstly, its high specific heat (one of the highest of all the fluids we are familiar with) buffers the body against changes in temperature — a vital element of fitness for any warm-blooded organism that maintains its body temperature at a fixed level (37-40°C in birds and mammals), given that water makes up about 60 percent of the mass of the body.

Secondly, there is water's high latent heat of evaporation — *the highest of any molecular substance*. This is another vital element of fitness wherever the environmental temperature rises above body heat, as occurs in many geographical areas, and not just in the tropics. Why is water's high latent heat of evaporation so vital? Because the only way of reducing body temperature when the environmental temperature is above 37°C is through the cooling effect of the evaporation of water on the skin. Over vast areas of the Earth, life is only possible because of the cooling effect of the evaporation of water.

And, if this is not sufficiently remarkable, the other thermal property of water, its heat-conducting capacity, is one of the highest among common fluids — an element of fitness which assists in the transport of heat from the tissues to the capillaries, and from the capillaries to the skin at the periphery. So these three thermal properties of water are each in turn profoundly and uniquely fitted to enabling endothermy in advanced terrestrial vertebrates including ourselves.

Is it not *beyond remarkable* that, as well as possessing a unique fitness for the hydrological cycle, for the circulatory system, and for the matrix of the cell, water also possesses just the right properties for endothermy? Are there any more disparate phenomena than these?

One might be tempted to imagine that these three thermal properties of water enabling endothermy would have exhausted the number of thermal properties of water fit for life. But *no*, there is another thermal property which plays a completely different vital role for life on our planet: the expansion of water below 4°C, which brings the coldest water to the surface and which, in conjunction with the expansion of water on freezing (another almost unique property of liquid water),

[6] See Michael Denton, **The Miracle of Man: The Fine Tuning of Nature for Human Existence**, *The Privileged Species Series*, Discovery Institute Press, Seattle 2022, Chapter 7.

prevents water from freezing from the bottom up — and hence enables the existence of marine and freshwater life in the higher latitudes.

There are many other ways in which the properties of water play an essential role in vital processes and phenomena which enable life to flourish on Earth. Many of these are reviewed in my monograph *The Wonder of Water.* These include the way in which its thermal properties create the great atmospheric and oceanic currents that bring heat from the tropics to the cooler higher latitudes, ameliorating the climate of the planet. Then again, there is the fact that the tectonic recycling of the crustal rocks which ensures (and has ensured for billions of years) that the source of minerals for terrestrial life is continuously replenished is only possible because of a softening of the lithosphere by water, which lowers its viscosity and renders it mobile, enabling its upthrusting above subduction zones and the mid-oceanic ridges.

In conclusion, it is the sheer diversity and multiplicity of the elements of water's fitness for life on Earth that proves so compelling. What we have in the properties of water is surely one of the most extraordinary ensembles of fitness serving a particular end — in this case that of life on Earth — in all of nature.

Not one, but innumerable properties of water are supremely suited to fulfilling the diverse ends critical for life on Earth: from the matrix of the cell to the softening of the crustal rocks, from the circulation of blood to the erosion of rocks. *I rest my case*.

No matter what one's philosophical or theological bias happens to be, the facts speak for themselves. There is no rational escape from the inference to design. The universe, as Freeman Dyson put it some time ago, "must have known in some sense we were coming". [7] Surely Dyson was correct. The only explanation which makes any sense of the facts is that the properties of water were intelligently fine-tuned for life on Earth — including for beings of our biological design.

Michael Denton

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