

INTRODUCTION

Until recently, the paradox between Biochemical Evolution and the Second Law of Thermodynamics has had no viable explanation. However, recent studies have completely changed our concepts of the structural and structuring properties of water and the way in which it most likely drove and directed the evolution of natural molecules.

Based on current concepts, each water molecule in the liquid state is hydrogen-bonded to three or four other molecules by dynamic point-charge attachments to form coordinated clusters. Bonding is weak (1.3 to 2.8 kcal/mole relative to the gaseous state) and involves rapid exchanges in bonding between molecules.⁵ However, recent neutron irradiation studies indicate that, at any instant, a linear trimer forms spontaneously with two water molecules more-firmly hydrogen-bonded to a central molecule.¹² The trimer is unstable, lasts only about 10^{-12} seconds (a million millionth of a second)¹³ and, in contrast to most molecules in liquid water, appears to be tied together by “covalent” hydrogen bonds with electron clouds enveloping a central proton - the same as the bonding in ice.⁵ Since the energy of the covalent bond is 4 to 5 kcal/mole lower than the point-charge bond,⁶ trimers lose 8 to 10 kcal/mole of energy as they form and absorb similar units of quantized energy as they degrade.⁹ The energy exchange is important because it corresponds to that of the terminal phosphate bond of the adenosine triphosphate molecule which provides the energy for most processes in living cells.

The same trimer and linear tetramer form on the surface of liquid water at 25°C with the terminal oxygen atoms of the trimer 4.5 Angstroms apart (6.8Å for the tetramer) and 2.76Å between adjacent oxygen atoms.¹⁴ However, most of the molecules are 2.9Å apart - far enough to permit rotation but close enough to form point-charge bonding. Although the high surface tension of water may be due primarily to integrated point-charge bonding, repetitive trimer and tetramer formation may contribute as well.

At the interface with non-hydrogen-bonding hydrocarbon molecules, like those in gasoline and oil, molecular orbital calculations indicate that linear elements of five and six water molecules form spontaneously at the interface.⁷ Again, these short hydrogen-bonded linear elements last only about 10^{-12} to 10^{-11} seconds but they form so rapidly in particular orientations that, when integrated over time, it is as if the surfaces are coated with layers of hexagonally-bonded water molecules⁸ - similar to the layers in ice.⁵

In fact, as each covalent bond forms between water molecules on a hydrocarbon surface, it loses 4 to 5 kcal/mole of energy to adjacent point-charge bonded water molecules.^{5,6} However, as that covalent bond breaks and the water molecules move back to point-charge bonding, similar units of energy are absorbed from the hydrocarbon molecules and they are moved from randomness toward order.^{16,17} Thus, as small water molecules oscillate rapidly back and forth between two types of hydrogen-bonding on hydrocarbon surfaces, energy moves unidirectionally from more massive, slower-moving hydrocarbon molecules to convert them from random-moving entities toward coordinated order.¹⁶ By conforming with the Second Law of Thermodynamics and moving spontaneously from order toward disorder, surface water absorbs energy from hydration-ordering surfaces and moves molecules within those surfaces from states of high energy and high entropy to states of lower energy and higher order as Schrodinger had concluded.^{1,17}

The same reversal in thermodynamics drives the spontaneous folding and assembly of proteins in living cells.^{8,9,17} As polypeptides are released from ribosomes, transient covalent linear elements of hydration which form adjacent to series of peptides with hydrocarbon side chains, remove energy from the peptides and transform them into coils and beta sheets as surface water moves from its unstable covalent state to its more dynamic liquid state.^{8,9} By forming and degrading rapidly in particular orientations, covalent elements of hydration not only drive polypeptide folding, they most likely assist in directing assembly as well.^{7,11}

Thus, as proteins form, most peptides with hydrocarbon side-chains are left inside forming the anhydrous core while small water-binding peptides, like glycine, serine and aspartame, are left outside increasing stability and solubility. However, some hydration-ordering regions remain on surfaces to permit associations with other proteins; to bind substrate and regulator molecules and activate functions. Since covalent elements of hydration must bind within those regions in their unstable open states, it should come as no surprise that the dimensions of neurotransmitter and hormone molecules correspond to mean dimensions of linear elements of hydration.¹¹ Thus, as primordial polypeptides began to form, covalent linear hydrogen bonding between surface water molecules might well have played a critical role, not only in the formation of stable functional proteins, but in the selection of molecules which fit perfectly into hydration spaces to hold proteins in active conformations.^{11,29}

Based on the hypothesis that dielectric transient linear elements of hydration form between ions and molecules, it is those linear elements which provide for quantized integrated motion between the tremendous variety of molecular forms within the living cell.¹¹ In fact, recently it was reported that the spin of protons in water molecules, at significant distances apart, couple together in a Quantum Mechanical process called "entanglement."¹⁹ This coupling of proton spins, ties water molecules together for about 10^{-15} seconds with the exchange of quantized units of energy. In a sense, it ties all of the components of living cells together as one gigantic molecule. Thus, hydrating elements of mean lengths may provide for local order and energy exchange while entanglement may provide for long-range communication and integration.^{11,19} In fact, proton entanglement wave-formation in the brain may be responsible for consciousness, thought and extra-sensory perception.

If Dr. Schrodinger had been informed of these properties of water, he would have pointed out that they should have been expected - protons in water are like electrons in metal - they are sub-atomic entities which should exhibit both wave and particle properties.²⁰ Protons in water provide the same property of energy exchange as electrons in a wire except that water molecules in the liquid state have more freedom to align between charge centers than orbital electrons in solid-state systems. Although conduction of charge by protons through water requires transient linearization, anionic phosphate groups in phospholipids on the inner walls of myelinated nerve fibers are the same distances apart as hydration trimers.¹¹ As high charge potentials develop between nerve endings and nodes during depolarizations, water aligns along the inner walls and proton pulses pass through at almost super-conductive speeds with very little resistance.²¹ If nerves were filled with metal rather than water, we would be combusted by the resistance. Nanotechnology today is searching for superconductivity in electrons - perhaps nature has already found it in protons.

The question is: “When is the scientific field going to acknowledge that biological systems, based on ions and water, assemble spontaneously and function more efficiently than electrons in solid-state systems?” When are they going to realize that it was water, as transient linear elements of hydration on surfaces and between charge centers, which drove and directed the formation and selection of such a unique set of molecules in the earliest phases of evolution that they could assemble spontaneously and function in such an integrated and harmonious manner that they could produce the living cell?”^{3,18}

Sunlight provided the energy to tie atoms together when biomolecular evolution began but it was the kinetic, thermodynamic and hydrolytic properties of surface water, in conjunction with the bonding energy between atoms, which defined which ones would be stable, which ones would form functional complexes and which ones would be torn apart hydrolytically by surface water.²⁹ If we look closely at the surfaces of molecules which compose living cells, we find that each one has a unique spatial distribution of ionic, polar and non-polar groups to regulate the orientation and degree of order in surface hydration.^{11,29} Spectroscopic, NMR and crystallographic studies of fully-hydrated polysaccharides, nucleic acids and collagen and muscle, as far back as the 1970’s, support the view that water adopts preferred orientations and distances on surfaces^{7,15} and, as pointed out above, studies now support the view that it is the protons in water molecules within living cells which tie all parts together in almost instant communication.¹⁹

However, the first vital molecules to be produced on earth most likely were not amino acids or fatty acids but formaldehyde (CH₂O). For, if formaldehyde is dissolved in water containing calcium, hydroxide and cyanide ions, its molecules spontaneously bond together to form a complex mixture of sugars with the formula (CH₂O)_x²² with glucose (CH₂O)₆ as the most stable molecule.²³ In fact, the same reaction is utilized in plants today to convert carbon dioxide into formaldehyde and then into glucose.²⁴ Thus, glucose, as the carbon and spatial analog of the hexagonal form of water, (H₂O)₆, is one of the most abundant molecules on earth today and may have been one of the most abundant when molecular evolution began.^{18,29}

As you read what follows, you will be amazed, not only by the correlations in spatial properties between natural molecules and transiently-ordered covalent linear elements of surface hydration, but that even the most complex molecular systems, like ribosomes, which contain huge nucleic acids and numerous proteins, assemble spontaneously and function with extreme precision as long as they are in unadulterated water. In fact, the same property of covalent linearization in surface water which assisted in bringing forth molecules in the beginning, continues to provide for the incredible phenomenon we know as life. As you continue reading, you will realize that water is indeed, “The Matrix and Mother of Life”²⁵ and each living cell “A Miraculous Molecular Creation.”²⁹

If you would like more information with regard to the possible role of water in the formation of proteins, the binding of regulator molecules in receptor sites or the stabilization of double-helix DNA, check out www.linearwater.com or www.proteinhydration.com.