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EARTH'S CLIMATE REGULATOR

The correlation between atmospheric concentrations of greenhouse gases (particularly carbon dioxide) and the recent trend of rising average temperatures on Earth's surface has been the focus of considerable scientific and political concern. What is often overlooked in this brouhaha is that water (in the form of clouds and atmospheric vapor) is one of the most important regulators of planetary temperatures. As a result of water's ability to store heat energy and to absorb much of the Earth's outgoing radiation (i.e., the source of greenhouse heat), water is the only planetary substance that can exacerbate or ameliorate global warming on a short-term basis. Moreover, it is the oceans—not the continents—that control most of the flux of carbon dioxide between the atmosphere and the planet's surface. So, could global warming represent just another manifestation of our many water challenges.

ELECTRIFIED CLOUDS

Most people readily associate the torrential rains of thunderstorms with the familiar lightning bolts that electrically connect massive clouds with the planet's surface. Although liquid water is the stuff that most often falls to the ground, ice crystals located in the tops of thunderhead clouds are primarily responsible for lightning and Earth's so-called *global electric circuit*. Thousands of meters above the ground surface, water-coated ice crystals collide with one another to generate the static electricity that is discharged in the form of lightning. Meteorologists have recently discovered that, in addition to the familiar cloud-to-ground lightning, there is another type of lightning that shoots upward and connects the cloud tops to the atmosphere's uppermost reaches (where electrically-charged solar particles are stored). Ice serves as an important generator of the electricity that links our globe and, perhaps, that connects Sun and Earth.

A SOUND ENVIRONMENT

While most of us recognize the oceans as the largest ecosystem on Earth, fewer of us realize that this massive realm (containing 97% of the planetary water) is also full of sound. This sound is created by sources as diverse as underwater volcanoes, sliding tectonic plates, singing whales, and droning ship propellers. Moreover, the mix of sounds detected in the ocean differs as a function of location and depth, owing to the peculiar way that sound bounces around the oceanic depths (often confining itself to discrete channels). The physical properties of seawater (e.g., temperature and salinity), along with the seafloor topography, serve to fine-tune the oceanic symphony. So, who's listening? Well, most marine creatures rely more on sound or subtle vibration than they do on vision because seawater transmits pressure waves more efficiently than light waves. We landlubbers still have a lot to learn about this symphony.

UNDERWATER MUSIC

Perhaps the most enchanting and frequently recorded of all ocean sounds are the complex songs of the humpback whale. Despite decades of research, scientists are still puzzling over both the purpose of and message underlying the songs. In fact, we are not even sure how the whales, which lack any vocal cords, produce their sounds. Their tendency to sing near seamounts (a favorite hub for their winter breeding grounds) has prompted whale researcher Roger Payne to ask whether they may be broadcasting their message across vast expanses of ocean. Humpback songs evolve from year to year as their composers add and delete complex musical phrases. Their songs are often compared to human music, as well as to sounds made by other animals or the Earth itself. Recently, the sonic well being of all marine creatures has been questioned with regard to extremely loud noises produced by controversial human activities.

DNA's SECRET INGREDIENT

Considering the recent interest in genetic engineering, it is worth noting that the structure and functioning of the DNA molecule is dependent on water. Millions of water molecules link themselves together into a network that envelops the DNA crystal, permitting it to fold and maintain a 3-D helical configuration that is absolutely essential to its storing and transmitting the codes for biological organisms. Besides this so-called hydrating water, there is another type of water that is situated within the tiny nooks and crannies of the DNA molecule itself. This *integral* water is characterized by physical properties that are quite different from those of water that we recognize as part of our everyday world. Moreover, this unusual type of water bridges or "glues together" the more familiar components of a DNA molecule (e.g., bases, strands). Some naturalists claim that water essentially mediates biology's genetic code.

THE STRANGEST ICE

The ice that forms on Earth is known as *hexagonal* ice, which creates predictable and familiar crystals. However, there is another type of ice that is formed exclusively in outer space and that has no definable crystalline structure. This unstructured form of solid water is known as *amorphous* ice, which is very strange because solids are, by definition, crystalline. So, what's the deal with this bizarre ice or so-called glassy water? It appears that amorphous ice is formed from water molecules present in outer space where temperatures dip below -260 degrees Celsius. Recently, two NASA scientists hypothesized that this amorphous ice is able to flow (not unlike liquid water), permitting gases trapped in the ice to combine with one another and form simple organic molecules. The scientists surmise that these simple molecules, when transported to Earth by cosmic water, may represent the precursors to biological life.

OCEAN MEMORIES

Moving silently within the cold abyssal depths of the world's oceans is a massive "river" of water that is known (scientifically) as the thermohaline circulation, denoting that it is driven by temperature and salinity differences in seawater. This global conveyor belt is not truly a river, but instead consists of seawater and a series of large-scale vortices (i.e., gyres) that are contributed by all of the world's oceans. According to some oceanographers, this oceanic conveyor belt also transports temperature signals from polar to tropical regions, where the planet's climate regime is ultimately regulated. In addition to transporting the signals that induce climate change, seawater is able to retain a planetary history or memory of climate change that spans hundreds of years. Interestingly, many ancient insights proclaim that water is able "to remember" as a result of its travels through Earth's body and even through the stars.

BIRTHING A STAR

During summer the amount of water vapor in air, as measured by the relative humidity, becomes very apparent to many of us. In addition to its myriad roles here on Earth, water vapor is believed by astrophysicists to play a critical role in our galaxy. As massive interstellar clouds of dust and gas are gravitationally compressed into newborn stars, it appears that water acts as a kind of midwife. As the interstellar cloud is compressed, it heats up as a result of shock waves that also act to create water molecules from the cloud's hydrogen and oxygen atoms. The newly created water vapor (along with hydrogen gas) then cools the heated cloud, permitting it to be compressed into a star. The amount of water in interstellar space increases dramatically during the star birthing process, and some of this water ends up on the newborn star's planetoids. Hence, much of the water on Earth may have been used originally to birth our Sun.

WATER'S GEOMETRY (part 1)

While most of us are familiar with the six-pointed geometry of snowflakes, the fact that liquid water also produces a variety of 3-D geometries is not widely known. These liquid water geometries exist only on the molecular scale, which is billions of times smaller than the scale of snowflakes. Scientists have used sophisticated X-ray technology to discover that liquid water molecules bond with, or connect to, their four nearest neighbors in order to create 3-sided pyramids known as *tetrahedra*. Moreover, it appears that water molecules are constantly "changing-out" their bonding partners, so that the water tetrahedra are re-created as many as a trillion times per second! Research suggests that water's frantically creating and destroying these molecular pyramids underlies its ability to behave as a liquid (albeit a strange one) and yet retain some of the molecular structure of a solid (ice).

WATER'S GEOMETRY (part 2)

So, liquid water can create geometric (and necessarily ephemeral) structures using its component molecules. Besides the 3-sided pyramid (tetrahedron), water also creates a more spherical 12-faced geometry known as a dodecahedron. The dodecahedron, which closely resembles a soccer ball, is composed of twenty water molecules and is used to contain or envelop a wide variety of substances that are dissolved in water (e.g., oxygen). Recently, a British scientist proposed that liquid water also creates an icosahedron, which is a 20-faced rounded geometry that is composed of 280 molecules. While definitely representing a molecular-scale geometry (composed entirely of water molecules), this icosahedral *cluster* is enormous compared to the individual tetrahedra that comprise it. It is interesting to note that many ancient cultures associated an icosahedron with the elemental substance of water.

NETWORK COMPLEXITY

The discovery that liquid water is best described as a complex network of interconnected molecules is one that has completely changed the thinking about how it may function. Systems theorists postulate that relatively simple dynamic networks can account for a wide range of complex behaviors due, in large part, to rules that govern the switching of connections between elements. For water's network, the elements are represented by water molecules and the connections by hydrogen bonds, which are a magnetic type of intermolecular linkage. These bonds are switched so rapidly (up to a trillion times per second) that scientists cannot even begin to decipher the governing rules, as they can for simpler networks. Theorists maintain that these kinds of systems are able to self-organize and interact with their environment without the need for "programming" in a conventional sense. What can complexity theory tell us about water's ultra-dynamic network and how it functions?

STRUCTURING WATER

As more is understood, or at least inferred, about the molecular structure of water's network, an obvious question arises as to the effects (if any) of structural changes on biological organisms. Because water is so fundamental to both the building and functioning of human bodies, it is not surprising that the purposeful structuring of drinking water has become commonplace. There are a plethora of structuring agents (e.g., gases, crystals, metals, powders, vortices, magnets, and even so-called pranic energies) that have been employed to produce "healthy" waters. Anecdotal accounts of the health benefits associated with drinking these waters are plentiful; however, scientific evaluations are rare. While clustered waters may constitute a better aqueous elixir than are purified waters, all biological molecules and surfaces ultimately restructure water according to their internal structures and requirements once inside the body.

ENIGMATIC SEAWATER

Although it comprises 97% of the planetary water, seawater's molecular structure is less well understood than that of pure (non-saline) water. The salts, or ions, in seawater appear to affect water's network by forcing the molecules to surround the ions, thus minimizing electrical and structural disruptions to the network. The grouping of water molecules around salts is believed to create more static and predictable molecular geometries than those characterizing pure water—perhaps even creating a different type of network connectivity. Science maintains that seawater's major ions were introduced by the weathering of the planet's rocks and that the relative amounts of these ions have been constant for the last 600 million years. How the Earth has maintained seas of such constant salinity is not known, but oceanographers have identified a number of common processes that both contribute and extract salts.

SOLAR WATER

The Sun is certainly not a location that one would expect to find water; nonetheless, water definitely exists there and on other stars in our galaxy as well. Even water vapor cannot exist at temperatures approaching 6000 degrees (Celsius), which characterize the surface of the Sun; however, there are solar locations where the temperatures are somewhat less extreme. Astrophysicists have discovered that temperatures associated with so-called sunspots are cool enough to keep the water molecule from being torn apart into its component atomic and subatomic particles. So, what is water doing on the Sun? One answer is that water influences the electromagnetic (solar) radiation that escapes into interplanetary space, thus making the Sun and other stars appear more opaque than they would otherwise. There are other suspected functions of this "fire water" (i.e., very hot steam) that may be soon confirmed by scientists who study its spectral properties.

A LEGENDARY MEDIATOR

Whereas modern science has recently discovered that water mediates the transfer of energy and information between various components of the biosphere, geosphere, atmosphere, and cosmos, ancient understandings of water have identified water as a kind of universal mediator. Many ancient cultures proclaimed that water mediates the appearance of matter (i.e., physical forms) from its assumed ultimate and unmanifested source. Water's mediation was often attributed to flow forms (e.g., whirlpools, ripples) or rhythms (e.g., tides, sounds). Some ancient peoples considered water and the mysterious aether (representing the unseen world and source of life force energies) to be intimately connected, such that the former symbolizes the latter. The universality of water's mediation was based on a common ancient understanding that everything in the material world ultimately enters and exits through water.

ETHERIC SYMBOLISM

Recent books authored by the Japanese photographer Masaru Emoto have captured the attention of readers and the media alike. His work includes microscopic photos of very different-looking ice crystals formed from waters that were reportedly exposed to various words and sounds. Emoto attributes his controversial results to water's ability to reflect *hado*, which he describes as an energy that pervades all matter. The proposed relationship between life force or etheric energies and water has some very old roots. For example, ancient Hawaiians apparently used water to symbolize both the pathways and transformations of *mana* (life force) that corresponded to various aspects of humans. Similarly, many Christian traditions recognize so-called living water as the source of life provided by God. Finally, the Platonic solids that represent water (icosahedron) and aether (dodecahedron) are reciprocating geometries and related to matter (cube) via the renowned golden ratio.

A WATER CRISIS

Is there a water crisis? The answer depends upon who is asked. Whereas many of the world's people struggle daily to collect enough clean water to sustain themselves, most of us postmodern Westerners simply turn on the tap and use however much we please. We tend to think of a water crisis as something that threatens other humans; however, this represents only one aspect of the so-called crisis. The very actions we take to secure "our" water have denied other (nonhuman) users of their access to water and contributed to global environmental change. Moreover, our view of water as a right to be demanded from political or financial institutions, rather than as a gift for which to thank Nature or the Earth (as do many indigenous cultures), has created the illusion that humans reign supreme over planetary water. Is the water crisis something that happened to us or is it something we created from our ignorance and arrogance?

HUMMING ALONG

One of the most puzzling discoveries in geophysics during the late twentieth century was that Earth continuously vibrates at a very low frequency—about 12 octaves below the hearing threshold of humans. The planetary hum, which is considerably more complex than sounds produced by earthquakes or volcanoes, had been previously noted by scientists; however, it was considered to be background noise. Interestingly, the hum owes its existence to water on more than one account. First, the source of the hum is believed to be the winds that continuously blow over the planet's surface and result from the solar heating and phase changes of water. Second, the vibration is transmitted from the planet's surface to its interior via seawater, which is able to efficiently transmit mechanical waves. Hence, perhaps the most fundamental vibration of our planet is facilitated, in part, by the ubiquitous presence and unique properties of water.

PRIMORDIAL WATERS

According to many ancient traditions, a primordial sea represented the infinite, undifferentiated, and formless *chaos* that was believed to have existed before the division of the cosmos into heaven and earth. In fact, some of the earliest written history (i.e., Sumerian) apparently refers to this primordial state or Absolute as the *waters of chaos*. Why was water (particularly freshwater) such a popular ancient metaphor for the origin of the physical universe? While the answer is not known for certain, modern theories suggest that ancient understandings of water's formlessness and unmanifested possibilities, along with its mysterious ability to mediate between the seen and unseen worlds, are likely candidates. This purported mediation, which has been reiterated by some modern naturalists, currently lacks a scientific explanation. Did ancient people intuit something about water that most modern people do not?

CHANGING PERCEPTIONS

The dawn of the 21st century finds humanity in a precarious position with respect to this planet's water. From the quality and quantity of freshwater resources to the pollution and over-exploitation of seawater resources, it may be time that we perceive water as more than just a resource or financial commodity. The postmodern Western view of water (as a human right) is unique among human civilizations, which have historically treated water with respect, reverence, and awe. Our ancestors seem to have known or intuited something about water's role in the physical world (and particularly in creating its myriad forms) that we simply do not grasp. While it is unlikely that we will ever perceive water in the same manner as our ancestors, we may discover a true reverence for water within the context of a modern world. Such a change in perception could lead us to actions that will ultimately meet our challenges with water.