

## 2005-2008

### 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 understand 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 financial commodity. The postmodern Western view of water (as a commodity) 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.

## QUANTUM WEIRDNESS

It turns out that water's hydrogen-bonded molecular network is even more enigmatic and indescribable than scientists first imagined. Recall that the ultrafast dynamics of this massive and complex network permits water to exhibit its strange properties. Hydrogen bond dynamics owe their indescribability to a quantum phenomenon known as "zero-point vibrations," which are not related to the common laws of motion (i.e., kinetics), but rather to an energy that exists even after all conventional energy disappears at a temperature of absolute zero. This energy is sometimes designated as belonging to the aether or A-field, denoting a realm that contains energy (and perhaps matter) but is not part of our observable world—although it does affect our observable world. It is interesting to note that many ancient descriptions of water suggest that it acts as a mediator between the seen and unseen worlds. What is water's connection to the aether?

## WATER AND ROCK

While water and rock are often considered to be mutually exclusive, the former actually plays a pivotal role in the formation and properties of the latter. Most rocks composing the crust of the Earth are produced from extensive ridges lying at the bottom of the world's oceans. The presence of water in molten rock affects its temperature and, ultimately, the thickness of the rock layer that we refer to as "solid earth." When Earth's crust is recycled (or subducted) back into the molten core, water not only lubricates the subduction of one rock slab past another, it also travels with and influences the melting rock. Besides serving as a component of the hard rocks we commonly encounter on the planet's surface, water is also a component of the molten rock we observe only during the eruption of some volcanoes. It should be noted that water occurs as part of the hard rock's crystalline matrix and not as a separate liquid.

## ROCK AND WATER

In addition to affecting rock, water can also be affected by rock. Water's molecular structures and dynamics are obviously influenced by geologic-scale processes; however, tiny bits of rock suspended or dissolved in water (as either colloids or ions) can also transform water. Whereas ions are often detected by water's salty taste, suspended rock is usually indicated by water's cloudy appearance. Finely pulverized rock influences many of water's physical properties (i.e., surface tension), as well as the reported health of those who drink it. Some researchers have postulated that mineral colloids are able to create very small molecular clusters within water that serve to better hydrate biological cells and, thus, reduce the damage caused by aging and pollutants. Even more mysterious (and controversial) is the observation that water need not directly contact the rock to produce some of these physical and biological effects.

## PHARM WATERS

In addition to the suite of pesticides, herbicides, industrial chemicals, and fuel components that are routinely found in freshwater ecosystems, there is a relative newcomer to the list. As a result of the Western world's addiction to prescription drugs, trace levels of bioactive substances have shown up in the rivers, lakes, and groundwater aquifers of North America and Europe. It was originally posited that these drugs, which treat everything from depression and impotence to heart disease and high cholesterol, were contributed primarily by pharmaceutical manufacturers that improperly disposed of their wastes. Now it appears that the bulk of the "drug load" is contributed by consumers who throw out or excrete these substances, which are resistant to degradation in wastewater treatment plants. Not only do these drugs adversely affect aquatic organisms, they occasionally end up in our drinking water supplies.

## THE DEEP WATER CYCLE

Besides the familiar water cycle that includes the oceans, atmosphere, and soils, there is another global water cycle that lies deep beneath the planet's surface. Often referred to as the "deep water cycle," geologists describe the dynamics of hydrous (water-containing) silicates and of hydrogen and oxygen atoms in solid, semi-solid, and molten layers of Earth's interior. Some researchers posit that this deep-water reservoir is greater than that of surface oceans and is, in fact, what keeps the seawater volume relatively constant. As previously described, water incorporated into the mineral matrix of rocks profoundly influences events such as earthquakes and volcanoes. Speaking of earthquakes, the 2004 megaquake responsible for the Indonesian tsunami left a huge scar in the Earth's crust and mantle that has apparently "healed" faster than anticipated due to water's lessening the stress within the affected rocks.

## CHAOTIC FRACTALS

Researchers have found that water's assembly algorithms, representing the rules by which it self-organizes at all hierarchical levels, are a result of fractal-like structures. Fractals represent patterns that remain exactly the same (i.e., possess identical proportions) on different scales (e.g., microcosm and macrocosm). Fractals produced by complex systems have been traced to so-called strange attractors that are associated with chaotic behaviors, a subset of which are applicable to water's hydrogen-bonded network. Moving from microcosm to macrocosm, both the complex motions of seawater within the oceans and the flow paths of surface or ground waters within watersheds can be described by chaos and fractal patterns. Water's patterns are even displayed as basic structural properties of the biosphere, such that common flow forms (e.g., spirals, ripples) are often mimicked in the morphology of aquatic animals and plants.

## MAKING MORE WATER

Can we simply produce more water? The answer depends on what exactly is meant by "producing" more water. There is plenty of oxygen gas in the atmosphere to create more water; however, hydrogen gas is not readily available in our environment---at least not in the required concentrations and locations. Hence, we are left to produce more usable freshwater either from unusable freshwater (e.g., currently inaccessible or polluted) or from seawater, both of which require large amounts of energy. There are a number of techniques available for capturing currently inaccessible water. Condensation is a method of converting water vapor to liquid water by cooling humid air; however, it too is energy consumptive. By contrast, practices such as permaculture, graywater usage, and rainwater harvesting have a tremendous potential to maximize water efficiency and to return us to a more "hands-on" relationship with water.

## WATER ETHICS

Have many postmodern people lost or compromised their ethics regarding water? A perceived lack of water ethics was recognized at the First World Water Forum, where the Director-General of UNESCO called for a "new attitude" on water. Unfortunately, a United Nations committee cannot simply impose water ethics, which are instead derived from people's individual and collective perceptions of water. Forcing people into an ethical relationship with water using legislation, litigation, regulation, or any other well-meaning externality has proven futile. Only when we begin to perceive water differently will we treat it differently; and it seems that an effective means of perceiving water differently is directly experiencing it in a manner that transcends its intellectual labels. Issues of water quality, scarcity, privatization, and allocation are just consequences of our perceptions, which may require a shift before any lasting solutions appear.

## WATER AND ENERGY (part 1)

Whether obtaining, refining, transporting, growing, or disposing of the fuels used to drive our present-day world, water is required to produce power and to cleanup the mess created by its production. Alternative energy sources like wind, solar (small-scale), and fuel cells pose the least water demands, whereas nuclear, fossil, and biomass fuels pose the greatest demands. Using bioethanol as a fuel source requires both a conversion of food to energy crops (diminishing the global food supply) and an expansion of the cultivated land under corporate agriculture (escalating the demand for and pollution of water). Interestingly, hydrogen can be produced in water by green algae, along with the combined efforts of two different types of bacteria, that collectively regenerate some of the precursors required for the continued hydrogen production. This microbiological process is an example of micro-scale sustainability in the production of a renewable fuel.

## WATER AND ENERGY (part 2)

Regarding alternative energy sources that are less water demanding, it is interesting to note that the greatest use of water for solar power (at least on a small-scale basis) is for manufacturing the hardware components for photovoltaics, solar panels, and batteries. Designers of the “water car” have demonstrated that converting automobiles to an onboard hydrogen-generating system is feasible, economical, and averts the problems associated with remotely producing, storing, and transporting large volumes of hydrogen gas. Essentially, the cars are equipped with an electrolysis cell that uses DC current to split water molecules into oxygen and hydrogen atoms, which then combine to form the gases that power the car. In switching from fossil fuels to alternative energy sources, we should keep in mind that the quantity, distribution, and quality of water available to support the switch may prove to be a limiting factor.

## SEQUESTERING CARBON

As humans look for a place to dispose of this century's most “inconvenient” contaminant (i.e., carbon dioxide) it should be no surprise that water tops the list. Perhaps the most popular carbon sequestration technique includes pumping liquid CO<sub>2</sub> into the deep ocean, where it is predicted to remain as a dense liquid waste. Even if it were possible to capture, cool, transport, and pump the carbon dioxide without utilizing the same fossil fuels that generate CO<sub>2</sub>, the act of disposing this liquid waste represents a huge stress on the local deep sea environment, where many biological organisms will be killed and changes in the pH and redox chemistry of seawater will likely ensue. In our zeal to mitigate global climate change, we should recall the lessons of burying other wastes—namely, [1] there are no isolated compartments within Earthly environments and [2] global carbon and global water cycles are intimately linked.

## CARBON FOR WATER

If not in the oceans, deep saline aquifers and depleted oil and gas reservoirs have been targeted as just the place to dispose of our excess carbon dioxide. While the subterranean burial of CO<sub>2</sub> is attractive, it could result in the blowout of injection wells, the leakage of CO<sub>2</sub> and other greenhouse gases (e.g., methane) to the atmosphere, the subsiding or uplifting of the ground surface, the initiation of shallow seismic activity, and the contamination of adjacent freshwater aquifers. A less grandiose technology listed under “carbon offsets” is the planting of trees in tropical and subtropical regions that have lost their biomass to logging or slash-and-burn agriculture. However, monoculture tree plantations often disrupt local hydrologic regimes (e.g., reducing surface water flows and increasing the salinity or acidity of soils), increase the susceptibility of trees to disease, and merely constitute a swap of carbon credits for water losses.