2021-2024

PLASTIC SEA ISLANDS

There is a new twist to the ocean's giant regions of plastic waste, such as the Great Pacific Garbage Patch, that has apparently surprised marine biologists. Coastal marine organisms such as anemones and rock-dwelling polyps that inhabit nearshore or even intertidal environments are now being found attached to plastic trash in the middle of oceans. Although scientists surmise that nearshore species may have hitched temporary rides on degradable oceanic "vehicles" (e.g., logs or flotsam) in the past, their permanent residence in the open ocean is novel. This observation raises questions about whether the immigrants are competing with resident pelagic species for food, space and other resources and whether they may eventually evolve adaptations for better exploiting their plastic environment. In any case, it appears their new anthropogenic habitat is continuing to expand.

LITHIUM FROM WATER

A growing concern about global climate change has accelerated the replacement of gasoline-powered vehicles with electric ones that require large quantities of lithium for the batteries. Large-scale terrestrial mining of lithium is damaging to the environment; hence, researchers are looking to water as a more benign source. Highly concentrated salt solutions, known as brines, are available from geothermal and lacustrine sources that can be further concentrated in evaporation ponds or supplied with an energy-efficient heat source (e.g., solar) that expedites evaporation. Because lithium represents such a small percentage of seawater's ions, its use as a source is generally not practical. However, an electrochemical method that enhances lithium's separation from the more abundant ions is now available. Perhaps the brines produced by desalination can one day serve as a lithium source.

OPTIMAL DRINKING WATER? (part 1)

Whereas the emphasis on water quality has traditionally been removing contaminants to reduce health related issues, the topic of beneficial attributes for water (either naturally-occurring or additions following treatment) has received considerably less scientific attention. Potentially healthful benefits of drinking water have focused on minerals such as calcium, magnesium and potassium; however, their bioavailability from water is variable and dependent on an ion's valence state, a person's gut flora and their concurrent intake of food. Water provides less than 5% of our requirement for most essential minerals, although calcium and magnesium can reach 20%. As such, communities characterized by harder waters have been associated with lower rates of cardiovascular disease, hypertension and other diseases, perhaps because magnesium is a common mineral deficiency. Still, food remains our major source of minerals.

OPTIMAL DRINKING WATER? (part 2)

Besides the dissolved minerals in drinking water, there are several other physical/chemical attributes (e.g., molecular structure, pH, ORP, deuterium content) that have been postulated to affect human health. Molecular structure is the most controversial of these attributes because it is difficult to measure and the persistence of clusters following ingestion has not been demonstrated, particularly in light of the processes by which water enters living cells. So-called alkaline (high pH/low ORP) water has been portrayed as an anti-oxidant and acid neutralizer; however, its ability to retain these physical properties long after ingestion is also frequently disputed. Similar to alkaline water, the benefits of deuterium-depleted water are based mainly on treating health problems, rather than maintaining health; however, the mechanisms by which normal biological processes favor hydrogen over deuterium are recognized.

SAVING A GLACIER

The recent discovery of massive cracks in the ice shelf of Antarctica's Thwaites Glacier has concerned scientists because if the tongue of the glacier breaks off, it could precede its entire loss and subsequently raise sea levels by as much as 10 feet worldwide. Hence, there are a number of proposals to buttress the glacier using artificial braces, berms or islands that would buy time (probably a few hundred years) to cut greenhouse gas emissions and maybe stabilize the climate. Another proposal is to install anchored curtains around the ice that would redirect the warm dense waters that are melting the ice from below. Logistical, legal, and engineering challenges (not to mention the costs) associated with these alternatives are huge and their probability of success is unknown—as are their unanticipated effects on the local environment. It comes down to a question of what's the riskiest path.

RED SNOW

Whereas algal blooms most often occur within the warm liquid waters of oceans, lakes and ponds, there are algae species that prefer the colder media of snow. They are red in color and darken the surface of the snow that, in turn, absorbs more heat (as sunlight) and melts it more rapidly. As melting snow is linked to warmer temperatures associated with climate change, scientists are interested in whether the increased snow melt and organic carbon production (due to algal photosynthesis) is offset to any extent by the CO_2 captured by the same process. It seems that the extent and duration of red snow is enhanced by the time interval between snowfall events because newly fallen snow blocks the sunlight required by that algae that are present in previously fallen snow. As snowfall events become more infrequent during winter in some locations, the effects of red snow could prove to be important.

WATER AND LOANS

Water conservation and sustainability has become such a hot topic that a major bank (BBVA) is now using water footprint analyses to determine whether they will loan money to a company. Essentially, these water footprint loans are applicable to companies that use water intensively in their production of energy, foods, and textiles, which are also the industries most cited for polluting waters. This represents BBVA's solution to the sustainable financing market and permits the loans to be structured as either bilateral or syndicated, thus serving as an incentive for companies to transition to more water-conscious operations in generating their products. The water footprints are focused on current water consumption and wastewater discharge, while also encouraging a reduction of 50% by 2030. The companies with smaller water footprints are preferred loan recipients and pay lower interest rates.

WASTEWATER EPIDEMIOLOGY

As a consequence of modern wastewater infrastructure that uses water as a transport medium to carry human wastes, researchers have been able to use wastewater analyses to paint a surprisingly detailed picture of local populations. Data as diverse as the rise and fall of viral epidemics (e.g., Covid-19), the use of new cosmetics or recreational drugs, and the kinds of foods preferred by people in the service area are collected. Whereas sampling at the wastewater treatment plant generally includes a very large and diverse cross-section of the local population, sampling sewer laterals from specific neighborhoods or even streets can provide more focused data. Given the specific information that wastewater analyses provide about people's personal activities, there has been concern that these investigation techniques may violate privacy rights. If not, what goes down the drain becomes public knowledge.

SYSTEMS & A.I.

The management of water resources and their associated anthropogenic technologies are increasingly addressed by systems theory and artificial intelligence (A.I.). The advantage of a systems approach is that it describes interactions among water resource or watershed components as spatiotemporal relationships through which matter and energy are cycled. The emphasis is on a water system's organization and connected components for identifying the controls and feedback dynamics that govern its properties and behaviors. A.I. functions in a similar manner by identifying patterns and then making decisions based on what is learned from them. Computer algorithms use data inputs to perform a number of functions that include locating water losses (leaks), predicting water consumption, suggesting energy-related water savings, and designing water monitoring networks.

A LIVING BEING

In early 2023, more than 190 countries agreed on a United Nations treaty protecting the ocean's health and biodiversity within the so-called "high seas" that lie beyond the 200-mile territorial limits of individual nations. While this treaty has been debated and anticipated for decades, some marine scientists are calling for a more profound recognition of the oceans as a "living being" with rights similar to those of humans. They note that oceans are still not represented by international laws that would recognize their possessing value as an intrinsic worth, rather than as just a resource or property. Humans' footprint on the oceans is enormous in terms of species extinctions, decimated fisheries and coral reefs, chemical pollution, plastic wastes, and the absorption of carbon and heat associated with climate change. The oceans' role in climate stabilization alone has been invaluable.