The Politics of Water and Access to Clean Water

January 11, 2019

By Thomas Cain, for Quest Club

Basic Biology

The relationships between humans and water is as old as life on earth. Although science is exploring several theories as to how RNA formed out of the primordial soup of the earth, more than three billion years ago, to then become DNA and then into proteins that then created single celled organisms we call bacteria, it is clear that water plays an essential part of that creation. Simple creatures are bathed in the mineral-rich waters of the oceans, deriving their subsistence from it, and then with the development of photosynthesis, the ability for plants to synthesize more complex foods developed. Animals, able to subsist on the food creation of other organisms could now exist. The food chain was now in motion.

Jump ahead a few billion years. Sea creatures and plants have evolved to spread onto the land, creating new means of deriving sustenance in this less hospitable environment. Cells that once were bathed in nutrients and water now are supplied by specialized systems to acquire nutrients, process them, transport them and eliminate wastes. Water still plays an essential role in these processes, as it is the solvent that continues to make it all possible.

Nearly 60 % of human body mass is water. The composition is not quite that of modern sea water since a lot more minerals have concentrated in the seas since animals came to land, but, we still carry around our own personal oceans to keep our cells bathed in seawater, essentially just like our single celled predecessors. The balance between water volume and the minerals dissolved in it is very carefully regulated by the body. A loss of 25% of bodily water over as little as 3 to 5 days will cause functions to cease and death occurs.

Nearly 70% of the earth is covered by water, but only 2.5% of it is fresh. Of that total, only 2/5ths of all fresh water is available to humans in liquid form, with the remaining 3/5ths locked up in snow and ice. It is astounding to contemplate how vast water resources are in the world, that most of the world's biology lives in water, and how very much on the marginal edge is human life and its dependence on accessible, fresh water.

Land creatures evolved to derive this fresh, liquid water in many ingenious ways. The ability to be mobile allowed species to expand into larger ranges than immobile species. But water always had to be accessible for survival.

The Quest for Stable Water Supplies

Let's skip ahead until a little less than 1 million years ago. This is when scientists have learned of the beginnings of human community. Human survival was enhanced by collectively discovering and sharing information about food and water resources. As groups became tribes and tribes became nations, with ever-increasing knowledge and development of social structure, successful groups gained access to the best survival resources, especially water. Only about 12,000 years ago did modern humans settle into permanent locations to cultivate food sources, and relieving them of the onerous task of hunting and gathering food. Growing food requires water resources. Growing food allows human populations to increase in density and number. Water resources sometimes have limits, therefore limiting food production, especially during times of climate change. People either starve or they leave and find new water and food resources. Food resources can be developed in new places and humans learned to expand into increasingly inhospitable places on the planet. Food resources can also be taken by force from neighboring communities, an especially effective technique when your community is starving.

It is in these essential roots of human survival and prosperity that conflicts still emerge between human groups over access to water.

Skipping ahead again a few thousand years, we find that humans have amassed into towns and villages, in greater densities than the local oasis, natural seasonal stream or pond can supply. As early as 8500 BC, wells were being dug to access groundwater as a more reliable, less seasonal water source, and a source available in dry places lacking precipitation. The great Bronze Age Minoans were harvesting and filtering rainwater, collected from roofs, and stored in underground cisterns in 2000 to 1500 BC on the island of Crete, and had other extensive running water infrastructure bringing in both fresh, drinkable water as well as using it for waste disposal. By 100 CE, Rome was a city of 1 million people, requiring substantial water infrastructure for its existence, much of its technology borrowed from the Minoans, from 1000 years earlier. In 321 BC, Roman Emperor Appius Claudius had constructed the Aqua Appia, the city's first aqueduct. At 11 miles long, only 300 feet of it was underground. Most early aqueducts were at-grade channels, functioning like man-made streams, and not as closed pipes. That technology emerged later, in places where having the open trench made the water subject to abuse.

It is only in advanced societies with well-organized political structure that such technology and cooperation of resources can emerge to support a growing, stationary population.

By 600 CE, the Hohokum Tribe, native to the Mesa area of Central Arizona, had started to develop an extensive system of canals to bring water to deserts to grow crops of beans, corn, squash and cotton. This was more than 900 years before the Spanish landed in the New World. The decline of the Hohokum is still not fully understood, but they declined around 1450, possibly due to floods destroying their irrigation infrastructure, rival groups, or, most likely, the loss of their political leadership infrastructure. Lacking political organization, they likely disbanded and left the declining civilization that had been successfully operating for 850 years.

This survival water infrastructure was vulnerable to destruction by rivals. Dropping dead bodies and human waste into wells and cisterns, essentially poisoning it, was a sure way to destroy your competitor. Aqueducts could be broken or interrupted. Dams with reservoirs are more stable, but still could be drained down, remaining dry until the next rainy season could refill them. In the meantime, crops, livestock and people died.

As population densities increased, as the wealth and technology of a place grew, the need for water, and consequently water infrastructure to supply it, continually increased. The need for public protection also grew to protect this prosperity and infrastructure from others lacking it. Rome grew to become the empire of the Mediterranean because it learned on the backs of other, earlier civilizations, the need to supply and manage water resources for their survival.

Rome had its armies to protect water resources, but the Egyptians used religion as a motivator to protect water. Hapi was the god of the Nile, worshipped for the annual flooding that deposited fertile silt over the floodplain fields and which then supported great crops. Of course, the Egyptian military was also there to ensure outsiders and non-believers also respected the divinity of the water.

In Abraham Maslow's 1943 paper, "A Theory of Human Motivation", he notes that in the pyramid of humans' hierarchy of needs, the foundation of all human motivation is grounded in physiological needs of food, water, warmth and rest, followed in the next tier up by security and safety. Without a secured and safe water supply, human civilizations would never have flourished. Without a political infrastructure to protect water supplies and their infrastructure, humans would be very thirsty indeed.

Something Safe to Drink

Until the advent of the Western Industrial Revolution, most water usage was for agriculture, domestic sanitation and small scale product production. Note that I did not include for drinking. It was understood 4000 years ago that even clear water was not necessarily safe to drink, but that boiling the water made it safe. Unfortunately, boiled water loses its air, and obtains a flat, unappealing taste. Boiling herbs such as chamomile, bergamot and mint with the water gave it flavor and imparted medicinal and healthful elements as well. Some of the best known boiled water flavorings may be right in front of you. Coffee was discovered in Ethiopia in the 11^{th} century. At that time, it was only the leaves of the coffee tree that were boiled, imparting "healthful properties". It wasn't until 1555, under the reign of Sultan Suleiman the Magnificent that coffee seeds (or beans, as we now call them) were roasted, finely ground and then slowly cooked with water. Coffee beans were now a stable, shippable product and could be widely distributed, strengthening alliances between nations which had been rivals. It became a most popular way of flavoring dull boiled water. The caffeine buzz was also welcome. A culture of drinking coffee in shops emerged in the early 1600s, starting in Venice and quickly making their way throughout Europe, not unlike Starbucks in the late 20^{th} century. Social discourse developed in such watering holes, befitting and supporting enlightened Renaissance thinking. Much of it was undoubtedly quite rational, some likely quite political, in contrast to dialog emerging from drinking alcoholic beverages in taverns, which, by the way, was an alternate way of sanitizing local water and preserving it.

Way earlier, Chinese legend has it that in 2732 BC, Emperor Shen Nung discovered wild tea leaves had blown into his pot of boiling water, leaving it with a pleasant scent and flavor. In 200 BC, the Chinese symbol for tea was created to indicate how tea brought human kind into balance with nature. Tea was first introduced to Portuguese priests and merchants in Lebanon in the 1500s, likely from Silk Road trade, and it was popularized in Europe during the 1600s, especially by King Charles II of England through his Portuguese wife. Trade with China and East Asia quickly emerged to provide this new exotic flavoring for boiled water to all who could afford it. Seafaring countries such as Spain, Portugal, the

Netherlands and Britain quickly rose in economic status and wars were fought over their ability to bring this precious commodity back from the East. The British colonists in America were quite upset over King George III's unreasonable taxation of the colonies, including taxes on precious tea, resulting in a very famous tea party one night in Boston Harbor.

In 1869, the Brits, in control of the land between the Mediterranean and Red Seas, constructed a substantial piece of water infrastructure, but not to provide water to the surrounding desert. Rather, they built the Suez Canal, to greatly shortening shipping time and distances between Europe and their colonies in India, Africa and other parts of Asia, where tea and coffee were widely grown.

All of this over flavoring boiled water.

Who Owns the Water?

Often, water rights are based on ownership of the land upon which the water rests or flows. Under English Common law, the basis adopted by the US and many other democratic nations, any rights asserted to 'moveable and wandering' water must be based upon rights to the 'permanent and immovable' land below.

On streams and rivers these are referred to riparian or littoral rights, which are protected by property law. Legal principles long recognized under Riparian principles, involve the right to remove the water – for drinking or irrigation- or to add more water into the channel – for drainage or effluence. Under riparian law rights, the water is subject to the test of 'reasonable use'. The judiciary has defined the 'reasonable use' principle as whether it is injurious to other parties or not.

It is important to recognize that there are both private and public 'rights' associated with the water, but that ownership of the water under common law is likened to claiming to "own" sunlight. Water must be legally appropriated before it is 'owned', and regulations on appropriation are typically controlled by government agencies and case laws today. Who has domain over water is typically based on who owns the underlying soils, but Local, State and Federal regulations often limit the amount and type of uses to which water can be used in order to protect downstream users rights. At some point, before the water reaches the ocean it amasses sufficient size that the underlying lands become owned by the Nation or State in which they are situated. At this point (defined as the upper limits of navigation) individual rights give way to the superior rights of the public."

The upshot in all of this is that, over time, people have designed political processes to solve disputes in the use and rights to water.

Some Case Studies

In the US, water resources are relatively flush in the eastern half of the country and coastal Pacific Northwest. However, large industrial bases and dense populations have required substantial engineering to ensure delivery of water to where it is needed. The much larger central and western US is a different story. Vast areas receive very low levels of natural rainfall, including some of the highest populations in the country in southern California. Here are a few illustrations of how communities in the US have met the challenge of meeting water demands.

Colorado River Basin

The Colorado River watershed is among the largest in the continental US. At 1450 miles long and covering a quarter of Wyoming, at its headwaters, half of Utah and Colorado, a bit of western New Mexico, and nearly all of Arizona, one wonders how a river of any size could exist in this primarily dry, desert climate between the west coast mountains and the Rockies. It is in fact those mountains that capture wet, Pacific Ocean air masses and drop precipitation at high elevations as snow which becomes a natural reservoir that replenishes this watershed annually. During much wetter, ancient climate conditions, with even more water in this basin, the massive Grand Canyon was carved out. This basin is fully west of the US continental divide, and the River's mouth is at the Gulf of California, in Mexico.

With this basin being such a naturally dry place, and with increasing pressure to settle this part of the US into the 20th century, complex water legislation was devised along with numerous dams, resulting in the ability to store 3037 billion cubic feet of water, or four times the natural annual flow from this river, in reservoirs such as at Lake Mead at Hoover Dam and Lake Powell at the Glen Canyon Dam. These two dams alone hold 80% of all the stored water in this watershed and are primary water sources for Las Vegas, Phoenix, and Los Angeles, itself located hundreds of miles outside the Colorado basin. In the upper basin, 50% of the water flow is diverted to east of the continental divide, serving Denver and agriculture in the Great Plains, at the base of the foothills.

The Colorado Basin states were anxious about their shares of the Colorado River as early as the 1900s. Then as now, growth within the state of California was viewed with concern, as burgeoning expansion meant increased water demands. The signing of the Colorado River Compact in 1922 became the foundation for the law of the river. This compact included the seven Colorado River Basin states, and apportioned water from the Colorado River between the Upper and Lower Basin states. The parties to the Colorado River compact were not unduly concerned with Indian water rights, nor did the Compact include provisions to protect the environment.

In 1963, a U.S. Supreme Court decision stated the amount of water to be apportioned among the lower-basin states, as well as the amounts that had been historically reserved for Indian tribes and federal public lands. Because of this landmark case, tribes are now considered to have the best water rights along the Lower Colorado River. Water projects must now also thoroughly research various environmental-impact studies in accordance with federal environmental protection legislation.

The apportionment of the waters of Colorado River has been the cause of a great deal of controversy. The impact of dams and canals along the Colorado has spawned widespread debate on river development and the ecological role of instream flows. Given projected growth in its region, these controversies and debates will continue for some time."

Today, the Colorado River's water never even makes it to the Gulf of California. The last bits of water are siphoned off by Mexico to serve agriculture near the US border. Most of the time, any remaining trickle sinks into the ground several miles from the ocean.

The impacts on wildlife have been enormous, and, until relatively recently, disregarded. Plants and animals have had no direct voice in political and governmental actions until the 1960s environmental movement resulted in the creation of the Environmental Protection Agency (or EPA) in 1970, under President Nixon.

With decreasing precipitation in the mountains that supply the Colorado, attributed to climate change, the volume of water available under the 1922 law and 1963 decision is lessening, causing great angst among users already demanding more water than will be available.

Science now better understands that reducing flows of rivers into the ocean can profoundly change bio-habitats in delta areas and in riparian environments along rivers. Less fresh water pushing out from the land allows more salt water to intrude upstream and into subterranean aquifers, changing the conditions for the myriad life forms that had adapted to the original conditions.

Quality, not Just Quantity in the Great Lakes

The great lakes constitute 20 % of the world's liquid fresh water. Its watershed covers large areas of the US and Canada, holding about 6 quadrillion gallons of water. Most of the water drawn from it is used by the US. US states and cities with very little shoreline on the Great Lakes are, ironically, the largest users of water, with Chicago in the lead by a long shot, taking in 700 million gallons per day, followed by Cleveland and Detroit.

The need to protect water quality for drinking and recreation has long been understood, but water used in sanitation posed a threat when it mixed with water needed for drinking. Old timers understood that one should never place the outhouse upstream from the well. Chicago faced this very problem, as it dumped its sewage into the Chicago River, which fed into Lake Michigan, the city's drinking water source. After extending water intakes far into Lake Michigan, it became apparent that rainstorms would continue to push polluted River water farther and farther into the Lake. In 1900, a canal was constructed, connecting the head of the South Branch of the Chicago River to the Desplaines River, a tributary of the Illinois and Mississippi Rivers. Now, Chicago's pollution could be dumped on some rural area downstream instead of into Chicago's drinking water. St. Louis filed suit as did numerous other communities along the Illinois River. Oliver Wendell Holmes defended Chicago (and won), claiming the infusion of fresh, Lake Michigan water was actually improving water quality, and noting that St. Louis and other communities upstream from it were dumping their own sewage into the rivers at the time, so how could Chicago be blamed? Holmes' arguments were convincing, although not well supported by environmental science, as the field was not yet well established. Later evidence showed the rivers were actually being more polluted by Chicago's waste, and Chicago was forced in 1929 to treat its sewage prior to emptying it into the rivers.

More recently, Federal decree has further lowered the level of pollutants allowed into the Chicago River, requiring more sewage to be treated before entering waterways. Chicago has constructed several enormous underground tunnels which intercept raw sewage during major rain events, holding it until dry times, until sewage treatment plants can treat it during dry periods. Chicago has also required use of porous pavements, green roofs, and bioswales to reduce rainfall concentrations into the sewer system. Fort Wayne, under a similar EPA mandate, is taking similar steps to improve water quality in the Maumee River basin, which leads into Lake Erie. Chicago now treats 1.3 billion gallons of sewage daily to protect communities downstream.

The Cuyahoga River fire in Cleveland in 1969 raised the profile on just how dirty surface waters were that fed Lake Erie. Floating debris and oil sparked by a passing train caused a conflagration that caught the attention of the nation, even though the fire was out in 40 minutes. Massive algal blooms, fed by phosphorous based detergents and farm runoff into Lake Erie in the 1960s and 1970s consumed so much of the Lake's dissolved oxygen that fish suffocated by the millions, then washing up on the shore where they rotted.

The 1972 Clean Water Act established national standards for water quality for waters of the US. Originally defined as navigable waters, waters of the US have been redefined through court rulings in 2001 and 2006 to also apply to smaller water bodies which influence and flow into larger, originally defined waters. The EPA has caused phosphates to be been banned from detergents, farmers are protecting vegetation along drainage ways so they serve as filters for farm runoff, and cities like Fort Wayne have been mandated to reduce pollutants that degrade Lake Erie. President Trump has recently proposed excluding intermittent streams and wetlands lacking direct surface connections to included waterways. This would exclude more than half of total US wetlands from regulation.

Even the massive water resource of the Great Lakes can be overtaxed. The 1985 Great Lakes Charter was further developed and followed by the Great Lakes and St. Lawrence River Basin Water Resources Compact in 2008 to resolve long standing disputes among 8 US states and 2 Canadian provinces regarding water withdrawal and use. It now provides a management agreement to preserve the integrity of this major world water resource. Even so, powerful western states with burgeoning populations, especially in the Colorado River basin, have floated concepts which would pipe water from the Great Lakes across the country to meet their needs. Stay tuned.

Right below our Feet

In the Hydrological cycle, rain falls on the land. Much runs off and eventually ends up in the ocean, where the cycle begins again. Some, however, percolates through the soil until it hits an impermeable layer. It may collect there or may move laterally to an even lower strata of porous material, some of which may be rock. This migrating water may emerge to the surface as a spring or may simply accumulate underground over eons. Places with lots of precipitation and porous soils may have groundwater relatively close to the surface. So long as the rate at which water is removed from this underground reservoir does not exceed the rate it is replenished, no problem.

The vast Ogallala Reservoir, stretching below ground from South Dakota to Texas contains the majority of water available to the semi-arid western plains states. Heavy agricultural use has been mining this store of underground water for decades and there is evidence that it is becoming contaminated at more shallow levels with agricultural chemicals and that it is being drawn down at a rate faster than it is being replenished. In some areas, since 1940, the water table has dropped as much as 140 feet. Salts left after water evaporates from the irrigated soils, and never thoroughly flushed through from rainfall, will eventually render some of these irrigated soils incapable of supporting agriculture. A similar salinity problem has emerged in the Central Valley of California and other irrigated deserts. Such conflicts end up at the door of policy makers. Engineers and scientists search for solutions to prop up these economies. Concerns over protecting essential groundwater quality from potential petroleum spills has been a major hurdle to construction of the Keystone XL pipeline across the Cheyenne River on Sioux land.

In addition to receiving surface water from the Colorado River and reservoirs in the Salt River basin, Phoenix has a vast underground water aquifer that could supply its needs for the next 40 years. However, this aquifer does not easily replenish. Multiple layers of governments, including the Arizona Department of Water Resources, have established programs to protect watershed areas upstream as national forests, so recharge zones are not built over and so runoff into streams and surface reservoirs is unimpeded. Runoff from irrigation is sent back into the aquifer so it is not lost downstream.

At one time, Fort Wayne relied on wells to provide its drinking water. By the 1920s, it became apparent that this water supply would be inadequate for the city's rapidly growing population. The St. Joseph River, coming from Michigan, and a tributary of the Maumee River, was identified as a reliable surface water source. A new filtration plant, designed in the gothic revival style, was constructed at the confluence of the St. Joseph and St. Mary's Rivers in 1933. Outlying areas of the city still rely on wells for their water supply and suffer with minerals in the aquifer dissolved in the water.

It is not just the water in the earth which is at risk. Witness Flint, Michigan, once home of GM's largest plant, but in decline since the GM downsizing in the 1980s. The municipal water system, largely constructed in the early 20th century, contains miles of both public and private lead and iron pipes. The State of Michigan took over control of the city's water system in 2011 due to apparent local mismanagement. Until a new pipeline from Lake Huron could be completed, officials changed the city's water source to the Flint River. With different water chemistry than the previous source, and not treating the new water source with anti-corrosives, iron and lead pipes began leaching their metals into the new water. Former lime scale that had coated the interiors of lead pipes was etched away, leaving lead to leach into thousands of homes' lead plumbing pipes, a condition that is only remedied by replacing the pipes. Lead is understood to be especially toxic to children as it interferes with brain development. Huge volunteer resources amassed to provide temporary drinking water, but long-term solutions have not been devised or implemented. It is a burden that has fallen disproportionately on the poor of the city, as they are the most likely to live in the oldest housing stock containing the highest concentration of old lead plumbing pipes. It continues to be a politically charged issue.

Epilogue

Water is a strategic natural resource, and scarcity of potable water is a frequent contributor to political conflicts throughout the world. With decreasing availability and increasing demand for water, some have predicted that clean water will become the "next oil". Places in the world with plentiful water supplies will prosper. Other areas will reach the limits of technology and politics, making water a more precious commodity. Oil rich but water starved middle-eastern nations have turned to very expensive desalination processes for turning sea water into fresh water. The UN World Water Development Report of 2003 indicates that, in the next 20 years, the quantity of accessible fresh water available to everyone is predicted to decrease by 30%. Currently, 40% of the world's inhabitants have insufficient fresh water for minimal hygiene. More than 2.2 million people died in 2000 from diseases related to the consumption of contaminated water or drought. In 2004, the UK charity WaterAid reported that a child dies every 15 seconds from easily preventable water-related diseases; often this means lack of sewage disposal. The United Nations Development Programme sums up world water distribution in the 2006 development report: "One part of the world sustains a designer bottled water market that generates no tangible health benefits, another part suffers acute public health risks because people have to drink water from drains or from lakes and rivers. Fresh water—now more precious than ever in our history for its extensive use in agriculture, high-tech manufacturing, and energy production—is increasingly receiving attention as a resource requiring better management and sustainable use, in larger and larger political spheres. Geology and topography define water resource distribution, not political boundaries. Engineering has its limits, especially when driven by profit. Nations can no longer simply overpower their neighbors to grab water rights. The web of necessary local, state, national and international cooperation regarding water management is growing increasingly more complex, with more to come.

World Bank Vice President Ismail Serageldin predicted, "Many of the wars of the 20th century were about oil, but wars of the 21st century will be over water unless we change the way we manage water." If not actual wars, even the perpetual preparedness for war to protect water resources could be a huge drain on national resources.

The assigned topic was titled "The Politics of Water and Access to Clean Water". There are thousands of stories, large and small, local, regional, national, and international on this topic. I've been able to touch on only a few here in this limited time, but, if there is any common thread here, it is that the curve of history shows us that:

- Humans need water for survival.
- Humans need water for prosperity and to elevate our standards of living.
- Humans will push into places on the planet where water resources are not readily available to meet human needs.
- Humans will continue to engineer physical and political means to get water to where it is needed and to use it more efficiently.
- There isn't any more water being made on earth.
- With climate change, long frozen stores of fresh water are melting and joining the salty oceans, changing the ratio of fresh to sea water on earth.
- Climate change is predicted to change precipitation patterns on a planetary basis, therefore changing access to water from present patterns.
- Changing accessibility to water is sure to generate human conflict.

There is no question that access to water has been and will continue to be central to human interactions, with politics continuing to be a central means of addressing this basic human need.

Sources:

Google searches

How and when life was created on earth
Water and human physiology
Fresh water availability on Earth
When humans created permanent settlements
When humans created water infrastructure
Roman water infrastructure
Egyptian water gods
Hohokum water infrastructure and society
Maslow's theory of Human needs
History of safe drinking water
History of coffee
History of tea
Colorado River basin water rights/laws
Reversing the Chicago River
Creation of the Environmental Protection Agency
Climate change and the Colorado River basin
Chicago water use
Chicago sewage volume
Cuyahoga River fire
Clean Water Act
Phosphates in the Great Lakes
Maumee River pollution management
Great Lakes Water Law
Great Plains underground water
Flint, Michigan water
Future of water availability

Wikipedia

Water law, English common law

Water Encyclopedia

Colorado River basin laws

Articles

Trump Rule Rollback Bad for Water, Bloomberg Opinion Editorial

Trump Again Falsely Claims California Diverting Water, News Services

Study: Arctic Glaciers Adding Most to Rising Ocean Levels, Chris Mooney, Washington Post

Experts Discuss Arizona's Past, Present and Future Water Supply, Journal of the American College of Trial Lawyers