The Creation of Water

Introduction

Comets are our best evidence yet for extra-terrestrial life. Comets are composed mostly of frozen water. The water comes here from somewhere else. That somewhere else had water. Life as we know it depends on liquid water. Therefore, that somewhere else that is the source of comet water is also likely a place that supported life as we know it.

The source of water on planet Earth is not known with certainty, but there are some speculations. One is that all of it arrived on asteroids and comets that impacted on our planet. That leaves two unanswered questions –

1. Where did that water come from that rode in on these extraterrestrial visitors?
2. Why are not other nearby heavenly bodies loaded with oceans of water also, like Mars and the Moon? They were also bombarded and have visible craters to prove it.

Another speculation is that water is produced in rocks deep within the Earth. A third speculation is that ultraviolet light in the upper atmosphere provide some energy to bond hydrogen molecules with the oxygen in the ozone. This paper will speculate on another source grounded in chemistry and biology.

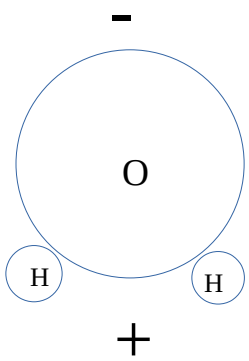
First, it is important to describe why water is essential to life. The basic reasons are –

1. Water is a universal solvent. It dissolves and mixes with many other substances needed for life, like nutrients, glucose, salts, vitamins, minerals, and others.
2. It transports these substances and oxygen to cells as a liquid.
3. It flushes out toxins and waste.
4. It has a high heat capacity to regulate temperature.
5. It's adhesion and cohesion properties allow it to flow in small channels by capillary action, as in trees and blood vessels.

Chemistry

Water is the third most abundant molecule in the universe after hydrogen gas H_2 and carbon monoxide CO. It is a polar molecule with two hydrogen atoms bonded to one oxygen atom, Figure 1, with the symbol H_2O.

Figure 1. Water molecule



It is a polar molecule being more positive on the hydrogen side and partially negative on the oxygen side. This is the primary reason for many of it's unique chemical properties as a solvent.

It is a stable molecule. It requires a little energy to get the three atoms to come close together and bond, then releases much more energy as it completes the bonding process. The formation of water molecules from free hydrogen and oxygen atoms is a net exothermic reaction which generates heat. It takes a large amount of external energy to separate the hydrogen from the oxygen – a process called hydrolysis. Water exists in a solid, liquid, and vapor form at all normal and extreme temperatures on our planet.

Hydrogen is the most abundant element in the universe and is present everywhere. It forms the plasma of stars in the nuclear fusion reaction. Being a fundamental element composed of one proton and one electron, it is no surprise that it should compose about 75% of all known matter. Hydrogen, being so light, is continually being lost to space from our planet, but is also being continually replaced.

The origin of oxygen is not as clear. It is believed to be produced during the decay stage of collapsing stars, along with other elements. A major source of oxygen on our planet is from photosynthesis of plants. Water must be present prior to the arrival of green plants, so elemental oxygen must have had another primeval source, which was probably dying stars. Oxygen is highly reactive. It bonds with most other elements, forming oxides. It “loves” hydrogen because of the shared electron outer shells.

Given all the hydrogen, along with some oxygen and their chemical affinity, they could naturally come together with a little energy trigger. The energy boost could have come from asteroid impacts or from the internal heat of the planet. Small quantities of water are known to be created in rocks where oxygen, hydrogen, and a source of heat are all present. So why is not water everywhere? The short answer is that it probably is universally distributed as it keeps coming in to us as ice on comets. This is strong evidence of life elsewhere in the galaxy. The reason we have an abundance on our planet could be animals.

Combustion

In some arid regions, select animals and insects are reported to never drink water for their entire lives. Supposedly, they get liquid water from their prey, but perhaps they manufacture some water also.

The most obvious process for producing new water is combustion. This is the burning of hydrocarbon fuels in the presence of oxygen. Water is a byproduct of combustion. Observe the tailpipe discharge from an internal combustion engine at cold startup and you will see liquid water dripping from the exhaust. After engine warm-up, the exhaust is continually discharging water vapor, in addition to some poison gases. Some water is produced in fuel cells as a byproduct of combining hydrogen with oxygen, however, that is an engineered machine and not a natural process.

In combustion, a hydrocarbon fuel source is present along with oxygen. There is no water to start. An ignition starts the reaction, which quickly becomes exothermic. The heat energy is what we are after and we harvest it. Some excess heat provides the energy for binding the escaping hydrogen and oxygen atoms. Water is produced as a byproduct. The process is self-sustaining.

Warm blooded creatures consume hydrocarbon food, breathe oxygen, separate the hydrogen from the carbon, use the carbon, then slowly combine the free hydrogen with some remnant oxygen to generate heat. Water is one of the waste products. This is a low level, controlled, combustion reaction. Humans consume oxygen and food, thereby contributing heat and water to the planet. The added heat and water contribute to climate change. Prior to the population explosion of humans, other animals contributed the same before their numbers declined. The net effect of the human mass to the planets heating and water is probably small. The bigger effect has been from combustion engines. They consume far more oxygen and fuel than humans and generate massive amounts of exhaust heat and water. Combustion depletes oxygen and adds water to the planet.

The Water Cycle

Water is not destroyed or consumed. It is continually being created through combustion. It moves in the environment, through animals and plants. All existing water is recycled water, many times through living creatures for millennia. Each cycle adds a little more water. Some is lost to space.

There is plenty of hydrogen around. There is also plenty of oxygen combined in mineral oxides and carbon dioxide in the atmosphere. Plants create new oxygen from carbon dioxide via photosynthesis. Animals exhale CO_2. The continual supply of new water depends heavily on green photosynthesizing plants that can dis-associate O_2 from CO_2 and the combustion process in warm blooded animals that combine hydrogen (from hydrocarbons) with oxygen. The process is one-way.

H_2O does not separate out again into H_2 and O_2 molecules without some energy input. The long term effect appears to be that water will continue to accumulate. Planet Earth is the evidence for this.

Theoretical Time Line

- Elemental hydrogen was always present
- Oxygen was first produced in stars, being very reactive it combined with almost every other element.
- Ultraviolet light from the sun combined with the CO_2 in the upper atmosphere to make free O_2.
- With a little energy from asteroid impacts, this free O_2 combined with H_2 to make a little water.
- Cyanobacteria produced much more oxygen making the atmosphere oxygen rich.
    - This, then, allowed other creatures, namely primitive animals, to thrive on this oxygen, consume other life and with a low level combustion reaction, produce heat and lots of water over time.

Conclusions

It is possible that some water arrived from extra-terrestrial origins. It is also possible that warm blooded animals produced much of the water on Earth today.

The irony of combustion engines is that humans pay for only half of the fuel. The other half, oxygen, is free to draw from the atmosphere but the cost is not zero. The monetary cost up front is small, just a little vacuum pressure to draw it in. The penal cost is monumental in terms of depletion of oxygen, displacing oxygen with toxic combustion products, the health cost of breathing poison gases, and the intangible cost of climate change.

On a geologic time scale, this scenario in not sustainable. Left unabated, the oxygen level will continue to decline, the planet will warm, and water levels will continue to rise. The planet, however,

has no conscience nor goal except to behave according to the laws of physics and chemistry. The planet will achieve a state of long term equilibrium. It’s future is probably devoid of animals.

Water arriving here from sources beyond our solar system provides hope that combustion processes in other living creatures elsewhere is indeed probable.

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