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WATER, WATER EVERYWHERE

By Milton Kaletsky

MOST fundamental of all chemical substances, but one about which we scarcely ever think, is that familiar yet strange liquid—water, which makes us and our world what we are. For though its unusual, unique properties, especially its extraordinary ability to dissolve chemicals, water is more than just necessary to life, it is the very essence of life itself.

Millions of years ago, in some unknown manner, life was born in the water of the oceans, born out of water and salt and some carbon compounds. For millions of years living creatures existed only in water. Even when the first adventurous animals crawled up on land and succeeded in breathing air, life could not break free from water, for every plant and animal still begins in water. Plant seeds must find the proper conditions of moisture before they can sprout. Animals begin as sperm cells swimming in water or watery fluids towards an egg cell that is mostly water; and the developing embryo always lies in wet surroundings until birth.

Every one of the many physical and chemical reactions that occur in our bodies depend on water. The air we breathe is of no use until its oxygen is dissolved on the moist surfaces of the lungs. Only then can oxygen be absorbed into the blood and carbon dioxide be removed. The food we eat is as useless as sand to the human body until digestion has changed insoluble fats, proteins and carbohydrates into soluble fatty acids, amino acids and sugar. Then and only

● Milton Kaletsky, well-known fan and writer of former years, makes his return to science fiction with an interesting article on the most familiar of substances, water.

● This article is an experiment. Do you, the readers, wish scientific articles to leaven the science fiction in our stories? Your answers, in the form of letters, to that question will determine our future policy in that regard. Let us hear your *Viewpoints* on the matter.

then can bread and meat and fruit, which do not dissolve in water themselves, serve their purpose. What the body cannot change into a solution it cannot use and must expel as superfluous waste.

Every bit of food that is used, all the waste that is produced by the body, all the hormones manufactured by the glands and all the vitamins and minerals needed for healthy living, all these travel about your body dissolved in the watery part of the blood, the serum. In fact, a person could live without eating and drinking and without his stomach and intestines if he received large injections of water solutions of all the end products of digestion. Hospital patients who cannot eat are fed this way.

Some day, perhaps, a single daily injection will be all the food and drink anyone will take.

Every organ in your body is bathed by a watery liquid. Your joints and intestines are lubricated by oily water. Your

eyes are filled with clear salt water and their entire surface is covered with the same fluid. The semi-circular canals in your ears, which help you keep your balance, are also filled with water. In the inner ear, nature uses a tube filled with water as part of the system which transmits sound from the ear-drum to the auditory nerve, because water is an excellent conductor of sound. Your muscles would not respond to your will if they were not always bathed by a film-like layer of calcium compounds dissolved in water. And the evaporation of perspiration—as much as four quarts on a hot day—helps keep you cool and comfortable and prevents death by overheating. If we didn't perspire, we'd never live through summer, not even through one really hot day. And certainly no one could ever live in the Tropic Zone.

WHEN you're sick, water often comes to your aid. If you have a cold or hay fever, the mucous membranes of your nose pour out water in an effort to wash away the irritating substances. This discharge from your nose is not the cause of a cold; *it is the body's attempt to cure the cold.* When something gets into your eyes, out pour the tears to wash it away. And if you unluckily get certain intestinal illnesses you suffer from diarrhea, which is another attempt by your body to wash away germs.

Two-thirds of your body's weight is water, and only one-third is solid matter. Ninety percent of the body's fat and fifty percent of its protein (muscle) could be lost without much danger, but the loss of only *ten* percent of its water would be serious and of twenty percent probably fatal.

Physically, a human body is hardly more than a large water solution enclosed in a water-proof bag and hung on a bony framework.

Pure water is completely tasteless and odorless and, in thin sheets, colorless and transparent. But pure water is never found in nature or in faucets. Even rain is not pure as in falling it carries down dust, bacteria, pollen, oxygen, carbon dioxide and many impurities poured into the air by factories. Trickling through the ground, water is sometimes cleaned by filtering, but it may acquire new impurities by dissolving rocks and picking up microscopic plants and animals. Then your city waterworks adds germicides, so that by the time rain reaches your drinking glass it contains a long list of chemical substances and organisms, living and dead.

The purest natural water is dew. Contrary to popular opinion, dew never falls. It either rises from the ground (look at the *under* side of some grass on a dewy morning), or else settles directly out of the air onto leaves and grass.

Southern Europe used to be terrified by "blood" rains until chemists analyzed the red water and found the color was due to red sand from the Sahara Desert which was blown across the Mediterranean Sea and then washed from the air by rain.

Moisture in the air produces many interesting and beautiful phenomena. Rainbows are caused by refraction of sunlight or moonlight by a falling sheet of rain. Ice crystals, floating high in the atmosphere, produce coronas and haloes. Coronas are the white or colored bands surrounding the sun and moon, while haloes are arcs of lights separated from the sun or moon by angles of $22\frac{1}{2}$ degrees or 45 degrees.

These are best seen at night, coronas appearing twice weekly and haloes once a month.

Atmospheric water takes many other forms: clouds, fogs, hail, frost and snow. A fog is a cloud in the wrong place, down on the ground where it is a dangerous

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nuisance instead of up in the air where it is harmless. Hail and frost are crop-killing enemies of farmers; but snow is the farmer's friend because it forms an insulating blanket on the ground in winter, which keeps some warmth in the soil and prevents the cold air from freezing roots and seeds.

LIFE on earth would be impossible if water didn't have a certain peculiar property. Most liquids contract when they freeze and the solid substance, being heavier than the liquid, sinks to the bottom. A pool of alcohol or glycerine or melted glass or almost any other liquid would freeze at the *bottom* first and would freeze solid, killing anything that might be living in it. Water does exactly the opposite. It *expands* on freezing, so that ice is lighter than water and floats. Lakes and seas therefore freeze at the *top* first in winter, and the layer of ice protects the water underneath from the cold air above and so prevents complete freezing. This remarkable and unusual property of water kept the oceans from freezing into a single huge cake of ice during the cold glacial ages of the past. Had the oceans frozen, all living things would have perished.

Water is nature's great irresistible force. It wears down mountains, eats away continents, and scrapes off the soil-skin of the ground. High on mountain peaks, rain seeps into cracks in rocks, freezes at night, expands as it changes to ice and splits the rock like a wedge. In this way, over thousands of years, frost and chemical action pulverize the rocks and change them into soil which man can use—until melting snows and heavy rains come tumbling down to wash it away again.

Rain can do so much damage because of the unbelievably large quantities that fall. A one-inch rain deposits 65,000 tons of water on each square mile, and a wide-

spread storm drops as much as *three billion* tons altogether.

While rain and rivers bore from within, the ocean attacks the edges. Wind-driven waves, crashing incessantly on the shore, take a bite out of a continent every time, and eventually the continents will be worn down to low reefs. When the oceans will have swallowed all the land, when the insatiable waves will sweep unhindered over a completely water-covered world, the ocean will still be filled because there is so much ocean and so little land. Only three-tenths of the earth's surface is land. The other seven-tenths is water. And the ocean is much deeper than the mountains are high.

Seven-tenths of the surface of the earth—water! Water enough for the bath of a Titan!

There's enough water in the seas to cover the entire earth to a depth of two miles! That's two and a half quintillion tons of water, about 2,500,000,000,000,000,000,000 quarts, almost all salt water. Water, water everywhere, and hardly a drop to drink!

Against this great mass, against the overwhelming power of sun and wind and wave, stands man with feeble dams and sea walls and mathematics. Man can win only a small, temporary victory by diverting some flood water into irrigation systems and reservoirs. But the final victory is water's. Inevitably, inexorably, rain and frost and waves will destroy the continents. Yet even in this conquest water will defeat itself; for the ocean bottoms, overloaded with the sediment of ages, will sink and force the continents upward once more. When the tumult and shouting of mother earth in labor will die, new continents will be born; and water, undiscouraged, untired, insatiable, will begin again its million-year-cycle of destruction.

THE END