

H₂O—Element of Life

Water, a unique, colorless, odorless, tasteless liquid plays a vital role on earth, carving and shaping the land, supporting all living creatures, and serving mankind in countless ways

By Barbara Tufty

► WATER is only a simple combination of three atoms of gas—two of hydrogen and one of oxygen—yet it is one of the most fascinating and essential forces on our planet.

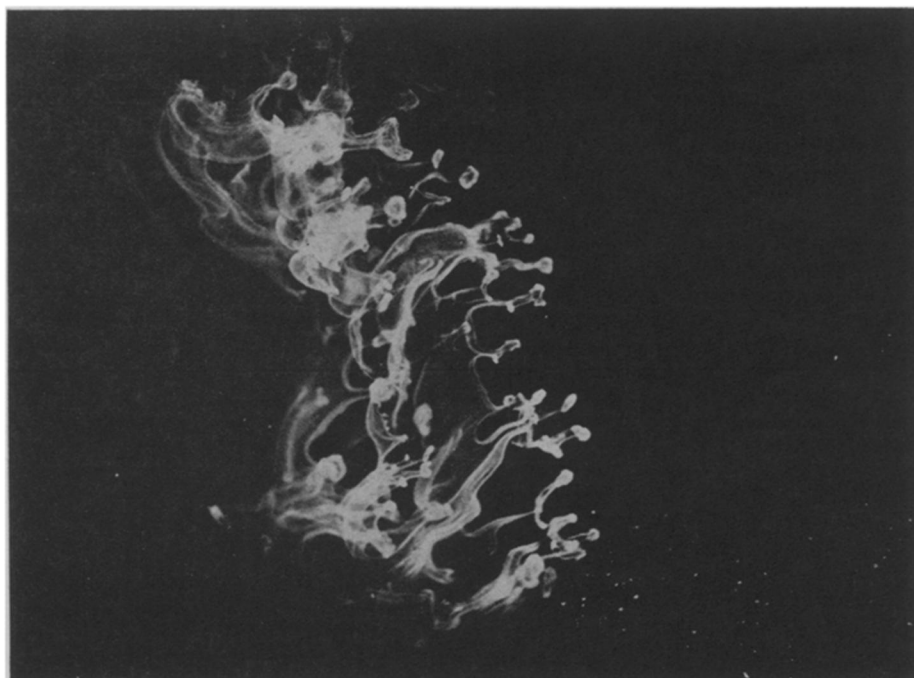
Sometimes locked in ice such as in slow-moving glaciers or falling snow, sometimes flowing as liquid thundering over a waterfall or coursing deep within the earth, sometimes drifting in the atmosphere as gaseous vapor rising from restless oceans or from a steaming cup of tea—water exists in all three fundamental states of matter: solid, liquid and vapor.

This condition is possible essentially because of two fortuitous factors: the size of the earth and its specific location in the solar system. The earth is massive enough and has enough gravity so that water and other objects do not fly off into space by means of centrifugal force. Spinning around the sun at a distance of about 93 million miles, this planet orbits within the one relatively narrow zone where temperatures permit water to exist in the three states. Closer to the sun—on Mercury or Venus, for instance—water apparently exists only as vapor; while farther out in the solar system—on Neptune, Pluto and other distant planets—temperatures are so low that water may exist only in a frozen state.

Ever since the first clouds formed in the earth's atmosphere and the first rains fell some three billion years ago, water has been moving in an enormous and endless circuit known as the hydrologic cycle. In constant repetition, water falls from the sky to earth, flows downstream in rivers or through underground soil to the oceans, where it evaporates and is lifted once again to the sky.

The total supply of water in the earth's system always stays the same. It is neither diminished, nor increased. There are the same 326 million cubic miles of water today in the earth's system as there were when the earth first began. The water you drank last night might once have flowed in the Nile beneath Cleopatra's barge, or flooded across the plains of China millions of years ago before man had evolved.

Water can never be used up. Sometimes it is kept "in storage" for long periods of time, but eventually every



General Electric

LIVELY DROP OF WATER—In an experiment of seeding a cloud with dry ice, this water droplet is undergoing its first stage of transformation into snow. The picture was taken a few seconds after initial seeding, by scientists at General Electric Company, Schenectady, N.Y.

drop becomes actively involved again in the water cycle. For example, a drop of water spends an average of only 12 days passing through the atmosphere. It may remain frozen in a glacier for 40 years, or at the bottom of a lake for 100 years, or it may lie in the ground for tens of thousands of years, depending on how deep it has penetrated. Sometimes water may become trapped so deep underground, from half a mile to three miles below the surface, that it is unable to move until an earthquake or other earth movement sets it free.

Most Water in Oceans

Most water is contained in the oceans. At any one minute, some 317 million cubic miles, or 97.2% of the earth's total water supply, are flowing throughout the vast seas. At the surface, countless sun-warmed molecules are evaporated into the atmosphere—about 80,000 cubic miles a year. Water vapor is also rising from the lakes, streams, rivers, moist soil, and most important, from leaves and stems

of plants throughout the world. Even animals and human beings contribute a small share of moisture drawn up into the air.

This cloudy wind-blown atmosphere holds about 3,100 cubic miles of water vapor or droplets at any one time. In the form of rain, snow, sleet or hail, most of the atmospheric water falls back directly into the oceans, which cover most of the earth's surface. Falling upon the continents and islands, rain fills the lakes and inland seas, rivers and streams—a network of surface water that contains more than 55,000 cubic miles around the world.

Throughout the centuries, these surface waters have played important roles in the development of man and his civilization. As early man gradually changed from being only a hunter and learned the art of agriculture, he realized the importance of readily available fresh water to irrigate his crops. Many of the early great civilizations built their cities in the rich alluvial valleys—Mesopotamians between the

Tigris and the Euphrates, Egyptians on the flood plains of the Nile, the early Hindus along the Indus River and the Chinese along the Hwango-ho and Yangtse Rivers. Some early European cities grew beside rivers—Paris on the Seine, London on the Thames, Rome on the Tigris, and Frankfurt on the Rhine. These and other rivers served not only as sources of water, but as routes for trade, communications and occasionally invasions. Today man has made other, more sophisticated uses of these surface waters—for beauty and recreation.

Much of the water falling as rain, or melting from snow and ice, seeps down into the land where it forms part of that great underground reservoir of fresh water known as groundwater.

At any one time, more than two million cubic miles of this water exist under the earth's surface, lying beneath mountains, plains, forests, cities, and even under the huge dry deserts of the world. For instance, beneath the hot sands and arid regions of the Sahara lie an estimated 150,000 cubic miles of water.

Moving slowly between the soil particles and through rock cracks by gravity or pulled along by capillary action, this groundwater replenishes springs, rivers, lakes and water wells on its long downhill journey through the earth. Eventually it reaches the sea, where it is evaporated from the surface and once again rises into the sky.

Contamination Main Problem

In this ancient vast cycle, the water is dirtied, used, filtered and reused many times. The biggest problem facing the world today is not the supply of water, which remains constant, but the abuse and contamination of it.

Natural forces have been polluting the waters for eons. As water erodes mountains, carves out valleys and washes away the plains, it carries away particles of soil, rock and vegetable debris. This silt—sometimes the richest, most valuable soil on earth—is considered the major "pollutant" of many streams and rivers.

To this natural pollution is now added the pollution of man—sewage, chemicals and wastes from his fast-growing cities, farmlands and industries.

Man's use of water is now becoming so great that nature needs help in order to supply mankind with enough fresh water. Normally nature has a remarkable ability to clean up its own waters by processes of filtering through the soil, aeration in waterfalls and sedimentation in quieter waters.

But now the load of pollution is becoming too heavy, and rivers and lakes can no longer purify themselves. They are becoming eutrophicated, which means they are overburdened with nutrients and short on oxygen. The water becomes unfit to drink, even to wash with or use in any ca-

capacity; fish sicken and die; and the foul-smelling area is tragic testimony to man's careless waste and misuse of his most precious resource.

Yet people are beginning to awaken to the crisis in various parts of the world. They are beginning to clean up their messes before tossing them into the rivers. Many private industries and city, state and Federal agencies have undertaken expensive operations necessary to filter, settle out or chemically remove pollutant agents before water is returned to streams and rivers. Other industries are trying new methods of re-using water. Some of the biggest water users—the steel mills, chemical plants, paper mills and refineries which use enormous amounts of water for cooling—are turning to salty water and reclaimed sewage for their cooling processes instead of using fresh water.

Water engineers are devising bigger and better methods of extracting fresh water from the sea by processes such as flash distillation, electric separation, freezing, and reverse osmosis. Other engineers are considering helping restore groundwater reservoirs by pumping fresh water back into the soil.

Man has long used systems of dams and surface reservoirs to catch and store the water in times of wetness, and disperse it in times of drought or summer dryness. Throughout the world, immense dam and waterway projects continue to be built—in the United Arab Republic, India, Italy, Russia, France, Africa and the United States. Water engineers are successfully reclaiming parts of the dry deserts and making them bloom along the northern edge of the Sahara and in Israel's Negev desert.

Even greater visions of water conservation and management are being dreamed of. NAWAPA (the North American Water And Power Alliance) is an immense plan designed to channel the water of North America and redistribute them through seven provinces of Canada, 35 of the United States and three states of Mexico. Long Island Sound has been described as potentially the largest fresh water reservoir in the United States, if dams were built at either end of the Sound and the somewhat salty water flushed out with fresh river and groundwater.

Man is beginning to realize the value of his most precious resource.

GEOLOGY

Freshwater 'Leaks' Spotted in Hawaii

► HAWAII is "leaking."

Fresh groundwater is leaking steadily into the ocean from 219 areas along the Hawaiian shoreline, the largest being Hilo Bay, about five square miles in size, where an estimated 100 million gallons of water are lost every day.

The leaks were revealed by variations in image tone on some aerial photographs indicating differences in water temperatures.

Fresh water, appearing darker than ocean water, was found to be about 12 degrees cooler by analysis of samples.

Sources of fresh water are of considerable importance to the people of Hawaii, for although the average daily rainfall is about 13,000 million gallons, only two to three percent is useful for human consumption.

"In seven-eighths of the Island's area, potable water cannot be practically recovered because of the high permeability of the volcanic rock, which allows water to sink to levels only a little above sea level," William A. Fischer of the U.S. Geological Survey, which conducted the study reported.

Now that aerial infrared photography has been used successfully to pinpoint the specific places where abundant quantities of fresh water are being discharged into the salty sea, plans may get underway for the possible tapping of some of the underground water supplies.

An atlas report of the freshwater leaks called "Fresh-Water Springs of Hawaii from Infrared Images" by Mr. Fischer, Dan A. Davis and Theresa M. Sousa has been published by the Geological Survey, Washington, D.C.

CONTACT LENS USERS! Our New EYE-MIRROR

Provides accuracy with Ease to Set Contacts Safely in Place. Newly invented EYE-MIRROR. 5 POWER, makes insertion of lenses fast, simple, precise. Insures full comfort, less risk of loss. Ideal, too, for eye make-up, removing foreign matter, etc. Optical glass, polished and aluminized, gives undistorted high reflectivity. 1 1/2" diameter. In hinged Lucite holder. See \$3.50 for yourself! Ppd.

HARRY ROSS 61-L READE ST. NEW YORK, N.Y.

COLLECT COINS?

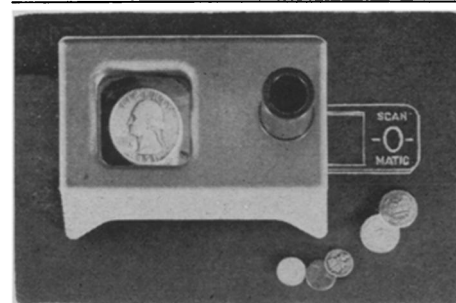
- AUTOMATIC
- ILLUMINATED

COIN VIEWER

Feed a stack of random coins into the "Scan-O-Matic" Viewer. Every mark, detail, flaw becomes plainly visible under the powerful, lighted magnifier. When you are ready, the coin automatically turns to the reverse side for further study. You may continue to flip the coin or eject it. Another coin automatically will take its place. An American-made instrument of excellent quality, the "Scan-O-Matic" makes a superb gift for collectors! (Shipped same day!)

EACH, Postpaid **\$12.50**

- Satisfaction Guaranteed or Money Back!



● WHAT ARE YOUR COINS WORTH? Big 52-page catalog of U.S. coins, illustrates, describes & gives valuations. Ppd. **\$1.**

COLLECTORS UNLIMITED, Dept. S-103, Box 269, Fair Lawn, New Jersey 07410