The Ocean's Roots

by Jacques-Yves Cousteau

TUMBLING down the mountainsides, cutting through rock itself, the ageless rivers of the world run their jagged course to the ocean, each year faithfully replenishing its volume with 35 trillion tons of water. They lead to the sea as arteries lead from the heart to the other muscles or as the roots of a tree lead to the trunk, their vital fresh waters circulating around and around the globe, nourishing the towns, the nations, the transient civilizations along their banks. The counterpressure of the tide—the pulse of the sea—registers far upstream, beating out the rhythm of the days and years and millennia. "The water that flows into the distant sea returns anon in the shallows of the transparent pool," wrote the Chinese poet Li Po. "Who can tell the end of the endless changes of things?"

It is in fresh water in the small Lake Harvey, near Vermont, that I made my first free dive—fifty-six years ago—at the age of ten. Also, in fresh water at the Carola Springs, in Alsace, France, that, fifteen years old, I tried simple underwater-breathing devices. Later, when the *Calypso* team explored Lake Titicaca, and we found fossils of marine animals on the shores of the lake, at an altitude of about 13,000 feet, I had a personal vision of how intimately freshwater and saltwater systems of the planet had been linked in the course of geological time. Finally, during our expeditions in Lake Tanganyika and its associated rivers in Africa, I realized how similar was the competition between man and wildlife for the vital access to the shores of lakes, rivers, and of the ocean itself.

Though we cannot mark the birth of the rivers, we can use the rivers to mark the birth of civilization. The Euphrates and Tigris valleys cradled what appear to have been the earliest agricultural settlements, dating back to about 7000 B.C. Drinking water was the first attraction; then man discovered that the valleys were fine farmlands.

Little by little, man learned that he could tame the river even as he tamed his animals. Irrigation ditches allowed him to broaden the expanse of fertile lands; the earliest canal system, in Mesopotamia, watered 7 million acres. He found that he could ride the back of the river just by floating on bound papyrus reeds. And with a contraption of paddle wheels and flat stones, he milled his flour in a fraction of the time it took him to do it by hand.

The river, however, was not to be easily harnessed. There was no way to escape the tumultuous floodwaters that surged through the towns and cities that had sprung up along the river's edge. So many millions of Chinese drowned in the Hwang Ho (Yellow River) floods or starved as its waters receded that the river is now called "the scourge of the Sons of Han." The story of Noah and the flood, which occurred when God decided to destroy the human race save for Noah and his family, was recorded with remarkable similarity by the Assyrians, Sumerians, and Babylonians. The Greeks, too, told of Prometheus's son Deucalion, who built an ark to escape the wrath of angry waters. Modern archaeologists believe that all these tales are based on fact—an actual deluge produced by the swollen currents of the Tigris or Euphrates.

AND so, despite the fact that man had uncovered a few of the secrets of taming wild currents, he continued to live in awe of the river's might. Tales of mystic currents and streams percolated through myth, music, and even religion. Eden, it is written, flourished at the point where four rivers met; and Jordan, with its milk-and-honeyed shore, is pivotal in Judeo-Christian writings.

Nor were underground rivers forgotten. Greek souls were ferried across the dark waters of the Styx; and Lazarus, carried by angels to Abraham's bosom, listened as the wicked rich man cried out for a sip from Hell's high waters. Centuries later, the river still coursed through literature. Milton wrote of Lethe, the "river of oblivion"; and T. S. Eliot's words mirrored his own reverence for the river's might:

> I do not know much about gods; but
> I think that the river
> Is a strong brown god—sullen, untamed and intractable.*

Even as the savants praised the river's mystery, the common man continued his struggle to dominate its waters. His efforts paid off exponentially—in some ways. But many of the miracles that man has wrought in river control have reversed themselves, come back to him with even more difficult problems.

Man's most concentrated efforts centered on the prevention of floods, which claim $300 million in damages in the United States each year. Although dam, levee, and reservoir building began in ancient days—Emperor Ming Ti commissioned elaborate levees for the Hwang Ho in A.D. 69—most progress on construction has occurred only in the past century. The unexpected benefit of controlling turbulent waters with dams was the discovery of the hydraulic turbine, which could change river power into electric power. The availability of electricity, as a result, grew in leaps and bounds. In 1933, for example, barely 3 percent of the farms in the Tennessee River Valley had electricity; fifteen years later, more than 85 percent of the farms had power.

But dam building proved to be a mixed—and temporary—blessing. What the dam builders ignored was the complicated puzzle of erosion.

Even the schoolchild knows that improper land use will cause fertile soil to wash away. But rivers can steal much more than a farmer's topsoil. They have moved mountains and even continents. Geologists say that unless Asia is distorted by some now-unforeseen natural convulsion, the muddy Ganges will someday flatten Everest. Rivers have already accomplished more fearsome tasks: no vestige of the land above primordial sea level now remains; limestone and shale were collected by rivers, dropped on sea bottoms, only to be pressed into rock—dry land—once more as oceans shifted. "The tiger leaps in the valley where once the ming fish floated," wrote Li Po, "and a carpet of coral covers the ravine where in other days violets bloomed." It is estimated that 2.7 million tons of soluble material are carried to the sea by river water each year.

Man could not hope to meddle in such a fearsome process without finding, sooner or later, that the course nature had planned for the river was better than his own. As rivers slow, they drop their sediment. Inevitably, then, our reservoirs will fill with silt left by the rivers they were built to control.

The dam-and-erosion problem spins in a vicious circle. As reservoirs fill, more dams will be built. As more dams are built, more cities will spring up to exploit the electrical power. The cities, in turn, will denude the forests and natural vegetation, which are the best prevention against floodwaters.

The problems that come with erosion, faulty conservation, and dam construction resulted from the fact that technicians and civil servants failed to do an adequate job of assessing the impact of their actions. But a far more serious failing—something more appropriately called an outright sin—is the total disregard, the flagrant carelessness, that characterizes the way we have been dealing with pollution. We are turning our rivers into a massive sewage system, with few qualms about doing so and with no resolve to stop.

Detergents are dumped into rivers and streams in such quantities that clouds of suds billow from riverbanks, and a glass of tap water has a head on it as though it were a mug of Schlitz or Budweiser.

Detergents are not the only—nor are they the worst—man-made pollutants. Industry dumps tons of chemical waste—cyanide, arsenic—into rivers and lakes. Insecticides sprayed over croplands seep into underwater streams and find their way into the world's water system. Towns and cities dump raw sewage into rivers and lakes—creating a chemical brew far more noxious than the original wastes.

The decomposition of raw sewage dumped into rivers greedily consumes the oxygen in the water. When the sewage becomes excessive, fish and other water life lose out in the competition for oxygen, leaving the waters to bacteria that can live on unoxygenated decomposition products, such as hydrogen sulfide. This, in turn, produces gases—such as methane—that pollute the air, and eventually a black, gelatinous sludge floats lazily on the surface of the waters.

THE most fearsome entry on the devil's shopping list of pollutants is atomic waste. Nuclear scientists have discovered the way to draw power from the atom, but they have yet to discover how to dispose of the waste produced in the process.

Atomic garbage retains its destructive powers for hundreds of thousands of years. It is capable of mutating human genes and causing cancer. Nevertheless, low-level wastes from nuclear-power plants are being routinely dumped into rivers until scientists can find a better way to get rid of them—in about thirty years, they say. Meanwhile, radioactive material contaminates our river system. Algae—the base of the food pyramid—concentrate strontium, a highly radioactive substance, at a higher rate than that of any of the other living organisms in the aquatic community.

In one experiment carried out by Dr. Jack Marshall, of the University of Michigan, contaminated algae were passed

(cont'd)

From "The Dry Salvages," from The Four Quartets, reprinted by permission of Harcourt Brace Jovanovich, Inc.

from fleas to guppies—and along the whole food chain. By the thirty-fifth day of the experiment the concentration of strontium in the fish was 175 times that in the water. As Eugene Odum, professor of zoology at the University of Georgia, has put it, "We could give nature an . . . innocuous amount of radioactivity and have her give it back to us in a lethal package."

The biblical living waters are being turned into rivers of death; and the evil wizards who are devastating these waters are all around us—opportunist governments, blind municipalities, industries, power plants, nuclear reactors, housing developers. But the worst offender of all is each of us—each of us who remains silent while others spoil our world and the world of our progeny.

The damage that has been done is not completely irreversible. Proper care of land, air, and water around some polluted waters has cleaned them up considerably.

First we must change our attitude. We need not turn our backs on technology or condemn all scientists and technicians to forever navigate the river Styx. Rather, we must realize that nature, though powerful, is delicately balanced. Any alterations we make on the robes of the earth should be made with care; we must assiduously, even strenuously, assess the impact our technology will have on the future. And we must assign the job to men whose primary interest is with the future of mankind, not with the contents of their wallets.

Second, we should revise our system of regulating rivers, lakes, and the world's water system. We have already made the mistake of encouraging each nation to "rule" its "property" in the sea, ignorantly blind of the fact that the ocean—the fluid, elusive ocean—cannot be owned. It is time to realize that we must not continue to make this mistake on a domestic scale. We cannot manage streams separately from rivers, rivers separately from lakes; the whole of a watershed is a unit and should be treated as such. The Great Lakes will forever remain polluted if the surrounding states continue to claim their watery domains as though they were claiming chunks of blueberry pie.

The rivers have always been the bloodstream of the earth. Their waters will pulse long after we are gone, just as they did long before we existed. Our puny dams and channels and pollutants cannot stop the river's flow—but they can change the nature of that flow. We may be cursing ourselves, and our future generations, with the kind of waters we once only imagined in legends and in literature. If we continue in our mindless ways, the gloomy Styx may be the river of the future; and we may settle on the banks of a nightmare—Coleridge's opium dream come true:

> Where Alph, the sacred river, ran
> Through caverns measureless to man
> Down to a sunless sea. ◉

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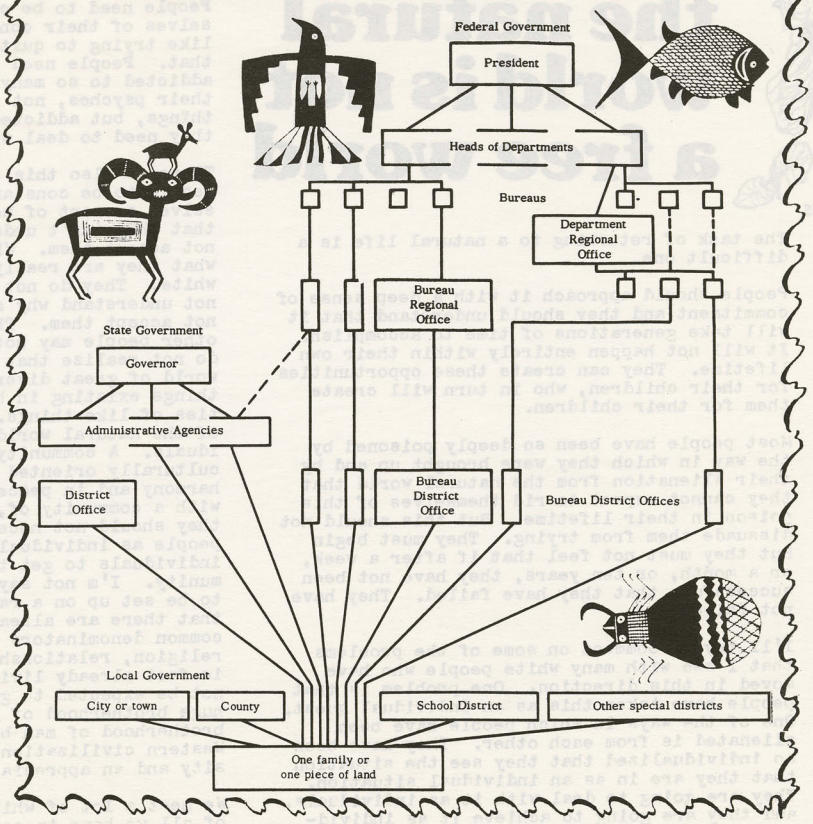
PATTERN OF DECENTRALIZATION IN THE UNITED STATES OF AMERICA



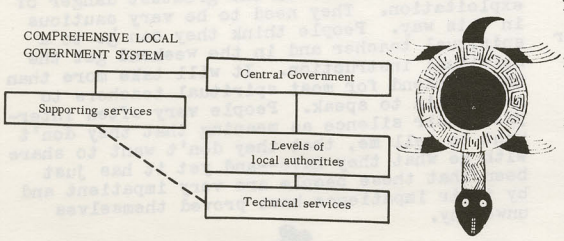
Thomas Jefferson formulated a theory of local government which remains a part of the American political folklore. The inspiration of this theory was predominantly Lockean. He proposed the division of the counties into wards. He settled the question of size by laying down the criterion that a ward should be small enough so that every citizen could attend its meetings and "act in person."

"Follow the principle," he told Samuel Kercheval in a letter of July 12, 1816, "and the knot unties itself." Jefferson's "principle" meant:

> "In government, as well as in every other business of life, it is by division and sub-division of duties alone, that all matters, great and small, can be managed to perfection ... And the whole is cemented by giving to every citizen, personally, a part in the administration of the public affairs."

source: The Political Theory of American Local Government, by Anwar Syed. © 1966 Random House, Jefferson quote: in Paul L. Ford, ed., The Works of Thomas Jefferson © 1905 G.P. Putnam's Sons.

SYSTEM: FOR THE ADMINISTRATION OF TECHNICAL SERVICES



1. Most government services at the local level are administered through multi-purpose local authorities.
2. A concept of substantial unity of purpose among representatives at all levels underlies the system.
3. The distinguishing feature of this system is that local authorities, rather than field units of central ministries, render all or almost all direct agriculture, educational, health and social welfare services that reach the individual.
4. Technical support must be high level and available at all stages of development.

source: Decentralization for National and Local Development, United Nations Technical Assistance Programme. © 1962