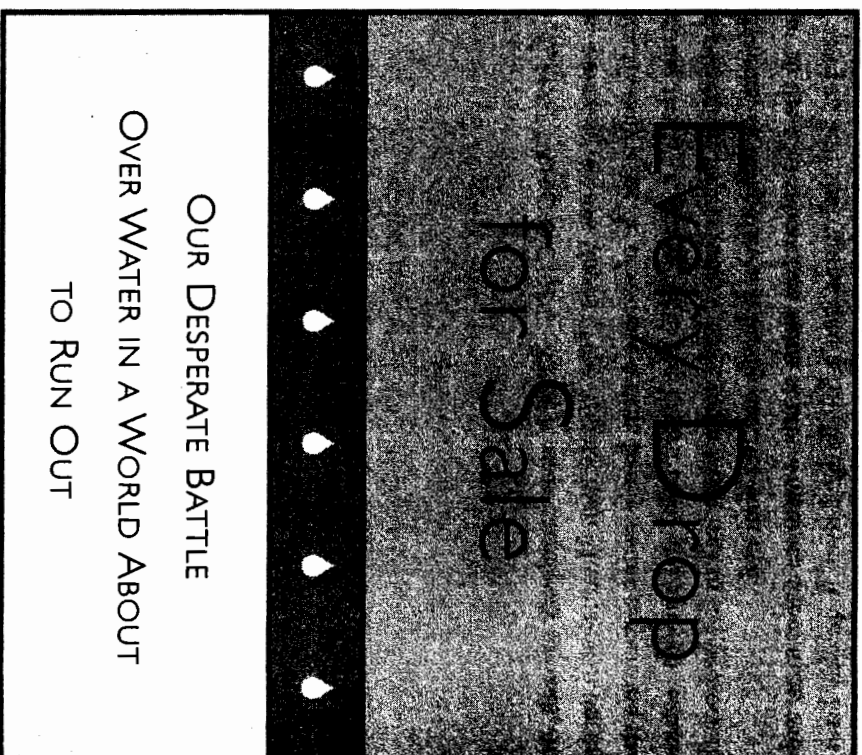


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Beginning: Scenes of a Crisis

*There went up a mist from the Earth,
and watered the whole face of the ground.*

GENESIS 2:6

THE CHATTAHOOCHEE RIVER rises harmlessly enough. At its source, caressing the low slopes of the Appalachian Mountains in northern Georgia, it's only a trickle of water—a thin, barely visible serpentine streak dampening the hills, giving them the brown color and smooth texture of turned pottery. In that setting, it looks more like a leak in the bedrock than a headwaters, so insignificant it barely catches your eye.

But as the Chattahoochee skirts south, consumes tributaries, widens into a stream, and then turns into a full-fledged river, it quickly loses its innocence. Even before completing its 130-mile stretch from the Appalachians to Atlanta, the Chattahoochee becomes the object of a nasty tug-of-war. Three states—millions of people—are fighting over who owns the river's water. It seems so improbable, while canoeing its rapids or sitting by its waterfalls in the rural highland valley, but this dispute—and everything surrounding it—is killing the Chattahoochee.

In Georgia's view, the Chattahoochee is its domain. The river is the sole water supply for Atlanta's metropolitan area, which has come to be the

embodiment of worst-case urban sprawl. The city's uncontrolled population boom—from 2.2 million in 1980 to 3.7 million in 2000—has forced it to stretch into its surrounding areas, building tract homes, housing developments, shopping malls, office parks, and industrial centers.

Providing water for this expansion has severely taxed the Chattahoochee. To put the problem in perspective: when Atlanta's largest treatment plant opened in 1991, it tapped 3.8 billion gallons of the river's water each year; now it pumps nearly 20 billion gallons annually. Moreover, the increase in demand occurs as the Chattahoochee is becoming more and more polluted, mostly the result of runoff from new roofs that are being constructed and asphalt in the river's watershed as soil gives way to concrete. If, as expected, Atlanta's population reaches 5 million by 2025, the Chattahoochee won't be able to handle the load. The river will be bone dry, at least as a water source, and the city will run out of freshwater.

That specter isn't slowing down Atlanta's growth. Instead, the city is aggressively making plans to squeeze even more water out of the Chattahoochee by building as many as a dozen additional dams and reservoirs on the river and its tributaries. This, in turn, has raised the ire of Alabama and Florida, the two downstream states that rely on the Chattahoochee for water as well. Both claim that Georgia is stealing the river for itself, hoarding its waters and depleting the supply available for them. And farmers in southern Georgia are siding with Alabama and Florida against Atlanta, as their irrigation allotment is threatened.

This water war has created a pitched level of distrust in the Southeast, as everybody tries to gain control of as many last drops of water as they can get. John "Bubba" Johnson, who farms five hundred acres on the Flint River (which runs into the Chattahoochee at the Florida border), impressed upon me how deep the suspicions are running and how critical this water fight is becoming as we walked near a field of alfalfa. He twisted his work boot into the ground, turning his toe left and right as if he were crushing a bug. Then he lifted his shoe.

"Touch the boot," he said. "It's dry."

It was, caked only with a loamy, pitted soil; there was no moisture. His land always used to be wet, Johnson said, as water freely seeped upward

from the Flint's aquifers. A few years ago, just a bare amount of pressure from his boot would have created a puddle of water.

"If I lose my water, I'm out of business," he said. "That's how important it is. We have a right to what God has put down here for us."

Locked as they are in the middle of this struggle—and blinded by their own need for water—everyone involved in this dispute is missing the point. This isn't just a regional issue or an anomalous little argument between neighbors. The American Southeast is just one of many places that have failed to adequately manage their water supply and that are now running out of usable water. Just as the Chattahoochee is drying up because it can't keep pace with increasing demand, the pipelines that support Los Angeles and the other desert towns in the Southwest are emptier as well. Meanwhile, in midwestern cities, where most of the great rivers have been channeled and dammed, pollution and floods make the search for freshwater more critical every day.

In the United States, the water crisis is perceived as a series of local problems, serious enough but resolvable. And while we may accurately use the phrase "running out of water" to describe the dilemma, it's difficult for even the most pessimistic of us to envision the prospect of literally not having enough water to drink or take a bath. But in other countries, that's exactly what this phrase means.

In Vietnam, for instance, only 50 percent of urban residents and 25 percent in the countryside have access to water in their homes—and that water is often not sanitary. The water purification plants and pipeline systems throughout the country are archaic, built by the French during the first part of the twentieth century. In many regions, exposed-pit latrines are the only means for carrying waste from the houses to the sea.

And in areas where no water pipes exist, it's not uncommon to see open pools dug behind homes to catch the rain. Residents use this water untreated for cooking, drinking, and washing. Some hospitals are reusing water left in basins and sinks for more than one patient, because there isn't enough freshwater to go around. Most jarring, the percentage of Vietnam's population with access to safe drinking water is dropping precipitously—to about 36 percent in the mid-1990s, from 45 percent ten years earlier.

To counter this crisis, Vietnam's water chief has put together a plan that will by 2020 provide on average 120 to 150 liters of safe water per day to each resident of Vietnam, more than three times what they receive today. But even if the country is able to raise the tens of billions of dollars the plan will cost, the average Vietnamese citizen would still receive just a bit above the absolute daily minimum amount of water needed for survival. The country would remain far, far behind the United States, for example, where the availability of more than enough water is barely ever doubted—even in regions where it should be—and San Pellegrino sipped casually during a meal equals one person's total daily water allotment in Cambodia and Mozambique.

Peter Gleick, one of the cofounders of the Pacific Institute for Studies in Development, Environment and Security, has developed a fascinating formula for determining how much water people need each day to survive. While most minimum daily water targets set by organizations like the World Bank and the World Health Organization consider only drinking and sanitation, Gleick's numbers include two other basic needs: bathing and cooking. Taking all four into account, Gleick came up with a figure of 50 liters per day (lpd) as the amount of water each individual requires to meet a minimum quality of life. The breakdown is 5 lpd for drinking, 10 lpd for cooking, 15 lpd for bathing and 20 lpd for sanitation.

Put in context, these numbers are remarkable. Most toilets in the United States—that is, those built before the mid-1990s—flush 23 liters down their pipes with each use. That's about half Gleick's daily benchmark. At the same time, nearly 2.2 billion people spread out among sixty-two countries—one-third of the world's population—live below the minimum water level. Some quite a bit below. The worst conditions are in Haiti and Gambia, where people subsist on an average of 3 liters of water per day. Imagine having less than two large bottles of Poland Spring as your entire water ration for the day. More developed countries are also on the list. In India, only 31 lpd per person is available for domestic consumption,

and families pay 25 percent of their income for drinking water; in Kenya, 36 lpd; in Bolivia, 41 lpd; and in the Dominican Republic, 48 lpd.

Even regions that have an abundance of water face similarly dire situations. Lima, Peru, for instance, gets a plentiful supply of water from the Amazon as well as runoff from the Andes, yet its residents pay up to two dollars—in many cases, more than half of their daily salary—for 500 liters of often-contaminated water. By contrast, each resident of the United States and Canada uses at least that amount of clean water per day, and the percentage of their salaries used to pay for it is so negligible that most people in those countries don't know how much water costs them.

The lack of usable water in a large portion of the world exacts an enormous toll. Upward of 10 million deaths per year, mostly among the young and elderly, are caused by water-related diseases, chiefly cholera and dysentery. Nearly 250 million new cases are reported annually. The leading cause of infant death worldwide is unsafe water. This huge gap between water haves and have-nots has actually grown in the past decade; in 1990, 1.1 billion people—half the current number—in fifty-five countries fell below the minimum.

"It's a human tragedy, which could explode into a human bloodbath," Gleick says.

Initially I had a difficult time grasping the importance of his statistics. I had become too inured to global tragedy, as many of us in developed nations are. Extreme and endless poverty, natural disasters that seem unimaginable, inexplicable wars between ancient tribes—all of these resulting in millions of deaths a year in undeveloped countries—are endemic or occur with regularity in hundreds of nations. But they're barely talked about anymore in the rest of the world. A combination of elements makes them even less newsworthy than the dog-bites-man story: they're (take your pick) too commonplace, too incomprehensible, too alien, too far away, or too heinous to report.

It's the same with Gleick's grim analysis of water scarcity: it's disturbing but not surprising that a large number of people are dying of thirst and living in unhygienic squalor. It's easy for people in the developed nations to

dismiss Gleick's prediction of a coming human bloodbath over environmental conditions—over water starvation—as something that will probably take place a fair distance away and thus won't affect us very much, if it happens at all.

Then something unforeseen occurred. One hot, muggy evening in summer, during my second shower of the day, as limitless water poured over me, I couldn't escape the disquieting observation that in just a few moments under the cooling spray, I used up the entire daily water ration of a person in Mali or Somalia. Pregnant, diseased, or just hot and dirty, residents of those countries got a measly 10 liters per day at most, Gleick had said; I consumed that much water under the shower in the time it took to think about the inequity. That was a turning point for me. I could no longer avoid putting a human face—or more accurately, many human faces—to Gleick's statistics. And what made this realization more disquieting was that it occurred again and again at inconsequential moments when water was usually not even on my mind: doing the third load of wash, turning on the dishwasher, running a faucet for nearly a minute to warm the water before brushing my teeth at night. Such trivial moments, to me, turn out to be the essence of life to someone someplace else.

By quantifying the water problem with such an unambiguous benchmark, Gleick made an impact on me that all the dense position papers and hand-wringing of water policy experts never could. The idea that 50 liters per day is a dividing line between an individual's survival and slow, spiraling demise was such a tangible and troubling expression of the water crisis that it haunted me.

That's how this book took shape. I decided to investigate and experience the world's water crisis—all sides of it—and to explore how serious it actually is, in other words, to do firsthand what I was already doing in my mind: put faces to the grim statistics. I set out to examine the world's hot spots that have the least amount of water, as well as the places that have so much of it that plans are in the works to sell the excess to the highest bidder, wherever the highest bidder may be. I wanted to find out which ideas about water management have failed us and left us with such widespread inequity and at the brink of apparent disaster. I hoped to unearth solu-

tions—to meet people who had the power to do something about the water dilemma and who actually were taking steps to fix it. And I wanted to answer the most difficult question: What happens if we don't resolve the crisis?

I talked to people in Europe, Asia, Latin America, Africa, and the United States, some in developing countries, some in high places, and some so far in the back woods that they have no reliable communication systems. As different as these regions are, the similarities of their feeble water management strategies—and their inability to learn from mistakes and then to try different, saner approaches—was striking. It isn't only the poorest countries, I found, that are increasingly desperate to devise ways to deliver water to their residents. Some of the richest regions are also panicking. In the past, they used their wealth to paper over water shortages. Now, with water scarcity growing, they can't do that as easily anymore, and places like southern California have become so frantic about finding more water that they're digging dry holes in the desert hoping to uncover a gushing aquifer underneath. In my research for this book, I met people who were willing to die for 50 liters per day, and others who controlled water and wanted to charge so much for it that, indeed, dying might be the only way for those who need it to get it. And I visited the scarred survivors of the bizarre water practices we've instituted—the attempts to manage and control water that actually accomplished just the opposite, producing any number of disasters ranging from deadly floods to pollution to carcinogen-carrying dust storms.

I discovered one disturbing fact almost immediately, a fact that's probably the primary reason for the mess we're in. Water may be the single most critical element of life—it is the largest and most complex habitat on Earth, nourishes every species on the planet, and is the primary material of all living things—but we don't have a clue about its true nature. To be sure, we have scientific knowledge of it, but that hasn't helped, because water is too unpredictable. It defies simple rules. Unlike anything else on the planet, water doesn't bend to brute force and machines, the tools we've otherwise used to tame our environment. Water reacts differently, its own way, from one situation to another. It's almost emotional and emotionless

in its responses—a combination that we're not particularly equipped to handle. Consequently, we've been powerless to mold it to fit the structure of our political, social, and environmental systems, so much so that it may as well have come from Mars (which could actually be the case).

At the root of our confusion about water is the sheer amount of it that exists on Earth. We'd like to believe that the supply of it is infinite, and at first glance it seems to be. But the truth is, even though our planet is 70 percent water, we're running out of freshwater. Actually, there wasn't very much to start with: only 2.5 percent of the water on Earth is not salt water. And with much of that frozen in northern glaciers, humans have access to less than 0.08 of 1 percent of the total water on the planet.

But even that amount is dwindling, and not only because of thirsty people. Individual humans use less than 10 percent of our planet's freshwater. Much more, from 60 to 70 percent, goes to irrigation, and the rest is taken up by industry. With population growth and expanding economies, demands for water are skyrocketing, even taking into account conservation measures. In fact, the 6 billion people on Earth today—projected to grow to 8 billion by 2025—share the same amount of water that was available to less than one-sixth of this population at the turn of the nineteenth century. And while dozens of studies predict what future water requirements will be, the consensus is that the total amount of water needed for people, for producing food for the swelling population, and for industry will increase by as much as 45 percent in the next twenty years.

Freshwater is renewable only by rainfall, which produces 40 to 50 cubic kilometers per year. The High Plains Ogallala Aquifer, which runs thirteen hundred miles from Texas to South Dakota, is being used up eight times faster than nature can refill it. In Mexico City, pumping exceeds recharge by as much as 50 to 80 percent a year. In Israel extraction exceeded replacement by 2.5 billion cubic meters in the last twenty-five years. In Africa the aquifers barely refill at all—they're being depleted by 10 billion cubic meters per year. The water table under Beijing dropped 37 meters in the last forty years. The land under Bangkok has actually sunk due to overpumping.

With Earth's ecosystems bundled so tightly together, destruction of

forestland is at least partly to blame for the depletion of aquifers. Under the best conditions, the vast ground cover of forests filters and seeps water slowly underground, where it can be stored for people to use. In the continental United States, for instance, national forests, which account for only 8 percent of the nation's acreage, are responsible for nearly 15 percent of aquifer replenishment. But sprawl and commercial development have eaten up forestland—as much as 50 percent of it around the world since the beginning of history, according to the World Resources Institute, an environmental think tank. And as the forests have dwindled, there's less soil and earth to stop rainfall from driving directly toward rivers without stocking the water table first.

What's more, our rivers, streams, and lakes—essentially our main water supply—have been so mismanaged by decades of damming, diversion, and industrial pollution that the amount of usable water they provide is falling rapidly. In the United States, only 2 percent of the rivers aren't dammed. Almost none of the water in the Colorado and the Rio Grande ever reaches the sea. With the completion of the Aswan High Dam in Egypt, the Nile stopped flowing freely, and much less of it now empties into the Mediterranean. The Ganges in India is in the same predicament. In England, 30 percent of the rivers are down to one-third their average depth. The Aral Sea, in the former Soviet Union, once the world's largest body of freshwater outside North America, has shrunk to half its previous size and is now little more than three salty lakes. Lake Chad in Central Africa, which once encompassed 10,000 square miles, has been pumped dry by excessive irrigation. It now covers only about a tenth of its former area. As less freshwater makes its way to the sea, the Earth's ability to replenish its water supply is reduced. That's because most water evaporation, the precursor to precipitation, takes place in the ocean.

Meanwhile, pollution of freshwater stocks is also diminishing the amount of available water. Seventy-five percent of Poland's rivers are so polluted, the water is unfit even for industrial use. Thirty-seven percent of America's freshwater fish are at risk of extinction, 51 percent of crayfish, 40 percent of amphibians, and 67 percent of freshwater mussels—mostly from poisoned water running off from agriculture.

In short, what looked like an endless supply of water when the first aqueducts, dams, and water diversion schemes were devised perhaps as many as eight thousand years ago—projects that continue to be built even now—has become an unbalanced supply-and-demand equation.

This widening inequity is already beginning to destabilize certain regions of the world. In fact, with water scarcity worsening, many people believe that if there is a World War III, it will be fought over water. Some countries are already nearly at war over it. Botswana and Namibia are arguing about who has rights to the Okavango River. Malaysia is threatening to cut off Singapore's water supply. Turkey opposes Kurdish independence in part because the Kurds live in the mountains where the water is. And Syria, fearful that the Turks could control its water supply if they gain control of the Kurdish region, has dropped its long-standing support of the Kurds and ingratiated itself with Turkey. Israel, Jordan, and other Middle Eastern countries are fighting over water—so much so that even after signing a peace treaty in 1994 with Israel, the late King Hussein of Jordan remarked that the only thing he could imagine the two nations going to war over was water.

With tension over water escalating in these and dozens of other places, awareness is growing that international security is vitally and sensitively linked to the environment. In response, national security cabals that are focused solely on water diplomacy have quietly been formed in almost every major country and at key worldwide economic organizations, such as the Agency for International Development. Their main purpose is to identify potential water-war hot spots and open diplomatic channels to stop disputes before they erupt into full-scale war.

People have always tried to manage water for political and economic gain, to keep it from hurting them in the case of floods, and to provide for their basic needs. But controlling water is a risky venture—one that ultimately almost always carries a price. In this instance, it was a steep one: we've slowly depleted the amount of water available for our use. This depletion took place even while our need for water increased—a need that was partially spurred, ironically, by the political and economic gains that water management helped provide. It occurred to me chillingly that for thou-

sands of years we've been playing a zero-sum game without knowing it—and we've been losing.

That conclusion convinced me that the world's water crisis is at a serious stage, as region after region struggles to provide enough clean water for its residents, its agriculture, and its industry. And as the scramble for water worsens, there's been a significant new development in water's world order: the emergence of a strong private market where water is being bought and sold as a commodity. It was inevitable. With demand rising, supply dwindling, and traditional water management approaches producing more problems than solutions, the real value of water is increasing rapidly. Suddenly companies, like countries before them, see the potential for profits in water.

As a result, all kinds of new private ventures have arisen to move water from one place to another and to deliver water to people who don't have enough of it. Some companies are transporting it in huge, sausage-like bags pushed by tugboats, others in hulls of ships. Some are using old-fashioned pipelines and thereby hauling water over much longer distances than ever before; and still others are taking over water supply management from public utilities and imposing strict income-and-loss scenarios on pricing where there were none before. Two French firms, Vivendi SA and Suez Lyonnaise des Eaux, own or control water companies in 120 countries on five continents and distribute water to almost 100 million people—giving them the kind of buying power over water that a near monopoly like De Beers has over diamonds. In addition, speculators who see the prospects for huge paydays when worldwide water markets go into full swing are grabbing up water rights.

The water entrepreneurs remind me of the people who founded high-tech start-ups in the 1990s. Their language is hip corporate modern and full of New Age optimism. They're part of a fast-changing business with huge upside: water has the potential to be more profitable than oil. And being first is critical, while being ready as the business environment takes off is essential.

It's hard not to get caught up in their excitement—until you realize that what they're talking about is water, nature's most essential element, where life began. Looked at that way, the international water business is

disquieting. In effect, the growth of the private sector thrusts water into the heart of globalization; it's just another item to be bought and sold—like oil, stocks, money, computer chips, or automobiles—in an economically interdependent world.

Think of the ramifications, though. When the market places a value on water—not as a natural element but as a commodity—economic market forces and not environmental considerations determine its future. And ultimately ours. It sounds suspiciously like what we've been doing, in one form or another, for five thousand years by putting development and controlling water for commercial purposes first, and the protection of water supplies second. Will it be another minus in the zero-sum game?

I met some people from Cochabamba, Bolivia, a city in the Andes, who warned me of the dark side of water globalization. The city turned its water system, admittedly not very efficient in the first place, over to Bechtel Corporation, a U.S. company. To pay for fixing up the infrastructure and modernizing the pipelines into homes and businesses, Bechtel raised water prices to a level higher than those in Washington, D.C. This in a city where most of the people have less money than the homeless in the United States. Riots broke out over the privatization of the water supply—"Dirty water is better than water we can't afford," one of the Cochabambinos told me. During the riots, the Bolivian police killed a seventeen-year-old boy in the streets, and thousands were injured. Bechtel gave up and left town, but it was a hollow victory. While dirty water may be better than water out of your price range, it's no substitute for clean water, which the Cochabambinos still don't have.

This incident reflects a fundamental change that water globalization has brought about. Embracing the philosophy of privatization, world trade and political leaders have replaced the concept of water as a human *right* with the concept that water is only a human *need*. It's a subtle difference semantically, but it carries with it a disconcerting meaning: that water isn't a shared natural resource that must be provided to everyone, to the greatest extent possible with no compromises, but rather a commodity that people need but have no birthright to.

This shift in attitude—endorsed even by some environmentalists who

have somehow adopted the skewed view that unless a price tag is placed on water, people won't value it enough to protect it—has only exacerbated the possibility that the struggle over the world's water could be a desperate one, more a free-for-all than a cooperative effort. The aims of its participants can be described simply: to control, through physical and political management, the world's limited water supply. Whatever countries, companies, or people achieve this control will command the lion's share of power, capital, and influence in the world, especially as the amount of usable water per person dwindles during this century.

Therein lies the full importance of Gleick's data. The fight over water, at its least complicated, is actually being waged to determine who will have enough water tomorrow and who will go thirsty—the boundary line in Gleick's statistics. The nations capable of delivering at least the minimum required amounts of water to their citizens will be the dominant survivors; they will influence and control countries that can't. Similarly, the most successful private companies will be those best able to profit from satisfying the growing water needs of those who already have enough, while providing badly needed water to those who don't.

This book takes a look at a world that is already in crisis over water, politically, environmentally, socially, and economically. But it's impossible to explore water without, in effect, examining who we are. Water is the only natural element that provides a reflection of ourselves; long before mirrors, it alone showed us what we looked like. It is doing that metaphorically now as well. The world's water crisis is forcing us to face our limitations and the limitations of nature. It's making us look at ourselves to see if we have the capacity to figure out how to share what nature has provided to sustain us, or if we can only fight over it.

These are human issues, as I found in researching this book, played out on political and economic stages. But people whose relationship to water is far less complicated face them more quietly every day; people whose lives moved me deeply: flood victims; women struggling to raise families in regions where rusted pipes drip a few drops of water once a day; odd coalitions of longtime ideological and territorial foes, now united to protect the river environments they share; people whose land was stolen out from

under them for the water rights and are victims of the environmental disasters that ensued. Too often their stories get lost in the noise of the water wars, in the high-level geopolitical maneuvering and the scramble for profits. In this book, they're the foundation for the broader narrative. The reason for this approach is as logical to me as Gleick's data: humans can survive for weeks without food but only days without water. Our bodies are made up of about 65 percent water and our brains are 75 percent. Water is a right, not a need. And we forget too easily that what we're fighting over is nothing more than the simple action of having a drink of water.

Controlled Fury

*The hollow sea-shell . . . when held against the ear . . .
we hear the faint, far murmur of the breaking flood . . .*

*It is the blood
In our own veins.*

EUGENE LEE-HAMILTON, "SEA-SHELL MURMURS"

IT WAS SIMPLE to overlook the fact that Canyon Lake Dam even existed. About twelve feet above the waterline and five hundred feet across, in the high summer heat the leathery-faced earthen structure faded into the sun-baked background in Rapid City, South Dakota. At other times of the year, it resembled nothing more than a cracked wall pounded by bitter winds, a blot more than an attraction.

It wasn't all that useful anyway. It was just a recreational dam, one that had outlived its own life span; it didn't irrigate any farms or produce any hydroelectricity. Its only real purpose was to keep neglected Canyon Lake, which had been carved out of the dam's flooded back plain, from spilling into Rapid Creek.

When the dam was built in the late 1800s, the brochures said that the new lake it created would be an idyllic spot for Rapid City residents, perfect for fishing, boating, swimming, even wooing under the moon. Nearly a century later, there was little if any of that going on at Canyon Lake. Local residents found it convenient enough to drive to better-stocked fishing holes on the Missouri River, a few hundred miles to the east, or to haul a

boat to one of the many big wide-crested lakes in Montana to the northwest, or to fly to a more picturesque and romantic spot on the Pacific Ocean.

But on June 9, 1972, Canyon Lake Dam finally put itself on the map. In the midst of a driving rainstorm, its tiny spillway filled with debris and sediment from the waterlogged lake bed. With the spillway clogged and water unable to flow freely anymore through Canyon Lake Dam, the searing pressure of the lake behind it and Rapid Creek rising in front of it sandwicked the dam like a vise, eventually rending a three-hundred-foot breach in its muddy wall. Ripped apart, Canyon Lake Dam crumbled at its own feet, letting loose a torrent of water that shot out with the force of a battering ram and engulfed all of Rapid City below it. Two hundred thirty-six people were killed, more than in any American flood in recent memory.

In the days that followed, as bits of earth and mud—the debris of Canyon Lake Dam—floated like body parts in the creek, more Rapid City residents trekked out to gawk at the misshapen structure than had ventured there in the entire decade or so before. They looked at their feet to the now-free-flowing, placid water in the creek. And then they glanced southward to the rubbled city, the site of the disaster, where homes and cars were piled every which way, wherever they had landed after being plucked from their moorings by the water, weightless like toy figurines. Some shook their heads in disbelief.

“I guess they should never have built this thing,” said a seventy-year-old man as he rubbed his callused hands through his thin hair. His daughter and son-in-law had died in the flood. “It never seemed to do us any good.”

He said this absentmindedly, lost in his own mourning, to no one in particular. But nearly thirty years later, his words have taken on a significance that would have been ill mannered to even consider back then, standing in the well of the deadly disaster’s aftermath.

Without even attempting to, and speaking more from his emotions than from his intellect, this man put his finger on arguably the fundamen-

tal explanation for the water crisis we face today. Throughout history, from the very earliest civilizations, people have built hundreds of thousands of dams and projects that piggyback on dams—abatements, levees, canals, navigational pools, and irrigation ditches—blindly and arbitrarily, without considering the consequences. We constructed them with one purpose: to alter for our own needs the natural course of water. Many of these water projects, as the old man observed, should never have been built, and many of them haven’t really done us any good.

In one sense, we had no choice but to try to control water. It was almost an involuntary action. People, as we’ve learned clearly by now, are driven more than anything by market forces, by the desire to improve their lives with commerce, transactions, robust economies, and profits. As we have strived to fulfill these aspirations, water has been both an impediment and an opportunity. Unmanaged, it’s a natural and geographical obstacle, flooding away whole communities at will, and in the process destroying carefully constructed economic systems, while making it difficult and expensive to move products and raw materials from one place to another because of its ubiquity on Earth. But water also offers a potential advantage: those who were wealthy or creative enough to control the water supplies or the irrigation channels or the barge canals—or perhaps those with the most and best weapons—produced societies with larger, healthier, better-employed, and more innovative populations, with more items to sell to more places around the world and more ways to get their products to buyers.

To control water, thus, has long seemed to be obviously the better option; all the benefits were on that side of the equation. The other course—not to build dams or otherwise restrict water’s movement, and not to make water a partner in the search for profits and commerce—in other words, opting not to harness this powerful force—simply would have gone against our desire for progress and wealth.

Managing water has always been easy to justify even without having to admit that economic gain was the propelling reason behind it. Many high-minded goals and achievements could be offered. Irrigation, for instance, allows modern farming, greatly expanding the world’s food supply. Flood

control projects stop rivers from spreading into local communities and killing thousands of people each year. Reservoirs store water in wet periods for use in drier times by farmers, industry, and cities. Hydroelectric plants extend power to even the most rural areas everywhere in the world.

These were tangible and in some cases extremely worthwhile results. But in almost all instances the potential for environmental and social damage wasn't considered; it was overwhelmed by the passion for more and bigger water projects. The upshot has been an imposing record of water management activities that crisscross every region of the world and every civilization that has inhabited them. The first dams were likely built as long as eight thousand years ago in the valleys of the Tigris and Euphrates rivers. There, it is believed, ancient civilizations constructed sophisticated agriculture irrigation canals, which were filled by streams diverted by tiny dams of brushwood and earth.

The earliest unearthed remains of dams date from about 3000 B.C. and belong to the complex water system that served the town of Jawa, in what is now Jordan. The largest of these dams, which redirected water into a series of interlocking reservoirs with underground pipelines, was 13 feet high and 262 feet long. A few hundred years later, construction began on a dam on the Nile. Intended to be a massive 46-foot-high structure of sand, gravel, and rock retained by 17,000 blocks of cut stone, it was washed away before it could be completed. Wisely, it would be nearly five thousand years before the Egyptians would attempt to build another dam on the river.

Few societies, however, viewed the failure of the Nile dam and many other subsequent ones as a warning. Because water management frequently accomplished its main purpose of generating profits as well as commercial and political power, in the thousands of years since the first dams were constructed, efforts to control water became increasingly aggressive and increasingly irrational.

The first attempt to harness water purely to mollify megalomania may have occurred in twelfth-century Sri Lanka. At that time King Parakrama Bahu, who could only generously be termed a tyrant, went on a water management spree during which he claimed to be responsible for more than four thousand huge dams. One of them was a massive fifty feet tall and eight

miles long, the biggest dam in the world by volume until the early twentieth century. According to anthropologists, since most Sri Lankan villages used small man-made ponds for irrigation, Bahu's dams were nothing but monuments to his potency. His less-than-subtle message was that he was so untouchable—so macho, in modern-day usage—that he could even conquer water. Unfortunately, Bahu's actions were more than just an isolated result of an oversized ego. Many leaders after him—in free nations and dictatorships alike—would use the control of water to magnify their public images.

In a classic example closer to our time, Josef Stalin after World War II built a series of hydroelectric dams in western Russia and Ukraine under a project that he touted as the Great Stalin Plan for the Transformation of Nature. It succeeded in turning the Volga, Europe's longest river, into a chain of spindly, polluted reservoirs. But Stalin had company. During the preceding decade or so, Franklin Roosevelt had ordered the construction of massive dams on some of America's greatest rivers, including the Colorado, the Columbia, and the Tennessee, changing their course forever and cementing his legacy as an economic master planner. Not to be outdone, Mao Zedong, in the Great Leap Forward of the late 1950s, put his name to the greatest burst of dam building in history to meet unreachable targets for China's gross national product.

If one were to list the most bizarrely outlandish displays of water management in history, near the top of it one would have to put the system of dams and aqueducts built in the first half of the twentieth century to funnel water hundreds of miles to the crowded megacities in southern California, a desert region that has almost no water of its own and, as such, should be little more than a cluster of small towns. But the scale of even that poorly conceived project is minuscule compared with many of the other disruptive water management schemes that have been completed even more recently. There are 40,000 dams fifty feet tall or higher on the world's rivers now. All but 5,000 of these so-called large dams have been built since 1950. China is the world's leader, with 19,000; it had only eight in 1949, at the time of its revolution. The United States is second with 5,500 large dams, although it has 96,000 smaller dams as well.

Almost no natural body of water—that is, one unaffected by some kind

of management or diversion scheme—exists anywhere in the world today. A single statistic stands out to indicate how widespread water management activity has been: worldwide, reservoirs and impoundments have a combined storage capacity of upward of 10,000 cubic kilometers, about five times the volume of water in all the rivers on the planet. That means that freshwater rivers—perhaps the most essential ecosystems on Earth because they provide water to the oceans, where most evaporation, the precursor to precipitation, takes place and because they shelter so many diverse species of marine and land animals—are essentially being managed to depletion. According to a study by the Swedish Landscape Ecology Group, 80 percent of the water in the largest rivers in the United States, Canada, Europe, and Russia is “strongly or moderately” diverted by channels, dams, and other management schemes.

Less availability of freshwater for people, due to a destabilized hydrological cycle, is just one of the consequences of dams. Widespread pollution is also a factor, as water’s drainage systems that otherwise wash natural and man-made sediment out to sea are crimped. That problem, too, cuts into the amount of water available for everyday use. In the United States alone, twenty thousand river segments, lakes, and estuaries now fail to meet national pollution standards. And while industrial and agricultural waste as well as sewage may be the direct cause of pollution, waterways strung by dams and impoundments are incapable of cleaning themselves adequately. The damage to habitat is significant: more than one hundred fish species have become extinct in just the past century, and hundreds more are now endangered.

As serious as all of this is, perhaps the most devastating effect of dams is the one that’s talked about the least: the large number of floods they cause. That dams are responsible for floods at all is itself an irony, considering that one of the many reasons given for aggressive water management projects is to prevent floods. Dozens of floods occur each year; in some areas of Africa and Asia, they’re so commonplace that most of the rest of the world doesn’t even hear about them anymore. But many well-chronicled floods that have taken place throughout history rank among the world’s worst disasters. Thousands of people were killed in floods, for instance, in the Yellow River in

China, the Gambia River in western Africa, the Okavango River in southern Africa, in rivers on the Caribbean coast of Latin America and even in small towns like Johnstown, Pennsylvania, and Buffalo Creek, West Virginia, in the United States. More people die and more property is lost as a result of floods each year than from any other type of natural disaster.

In instance after instance, floods occur when dams and their abatement systems are unable to withstand the increasing pressure from swelling reservoirs and rivers seeking their natural course in rainy seasons. Usually many years after the dam or navigation canal or irrigation ditch is built, what is essentially a plumbing backup produces a sort of domino effect. When the first barrier falls, others follow, and each subsequent one tumbles more easily from the growing strength of the suddenly unloosed water. The outcome is not just tremendous human suffering and economic devastation; the world’s water supply is also seriously affected. Two-thirds of available freshwater on Earth is lost each year to floods that wash the water into the seas.

Floods are so bewildering because they tend to strike without pattern, attacking water-rich and water-poor regions alike, usually with little warning. In areas where people are starving for freshwater, to have family members killed or their few possessions destroyed by a flood is the ultimate indignity, a mocking, unfair reminder of the severity of their lives, as exemplified by the water they lack. One moment there’s too little water—and their children are dying of it—and the next moment, there’s too much water, with the same result. It’s almost impossible for these people to make peace with that fact.

In places where water is seemingly plentiful and where turning on the tap—and leaving it running for ten minutes to fill a bath—barely merits attention, living through the ravages of a flood can be equally traumatic, producing enduring nightmares and day frights in those who have experienced it. To them, it’s as if the thread separating life and death as woven by nature is suddenly clearly visible, and it’s so thin that it’s transparent. It’s unsettling to suddenly see oneself so distinctly as living at the whim of nature, rather than in control of it, and to see water—the vital element of life—transformed into an impregnable adversary.

Primarily for that reason, above all natural tragedies such as earthquakes, fires, or twisters, floods produce the worst incidents of postdisaster shock, according to psychologists and trauma experts. But until you examine the raw details, the full meaning of this phenomenon doesn't register. The level of depression and despair and, in some instances, the breakdown of order that occurs in the aftermath of a flood is startling.

Mozambique is one of the most lurid examples. Virtually every year massive floods torture this tiny nation on the Indian Ocean in southeastern Africa—a particularly harsh fate for a country whose freshwater supply is so polluted and whose infrastructure is so nonexistent or so poorly maintained that each resident on average receives only 7 liters of water per day. The floods hit hardest in the area directly downstream from the Cabora Bassa Dam, which was built by Portugal in the late 1960s when it controlled Mozambique. With this project, the Portuguese wanted to harness for profit the powerful Zambezi River, before it was “wasted” out to sea, by producing hydroelectricity and then selling it to South Africa. In 1975, just a few years after the Cabora Bassa was completed, Portugal was ousted from Mozambique, and during Mozambique’s many civil wars since then, the dam has been a flashpoint for sabotage. As weakened as the dam now is, when the Zambezi swells in rainy seasons, the Cabora Bassa is unable to hold back the overflowing river, and it lets loose a torrent of cascading water that envelops towns like Caia and Chicoco.

In the floods of 2000, the scene was extraordinary. When the dam’s spillway broke open, the deluges happened so quickly that even those Mozambicans who were able to get out of their homes in time to avoid drowning there sought safety in treetops. Thousands of people were perched in the branches—moaning could be heard for miles around—and they watched in terror as the waters crept higher and higher up the brown bark. In one town, residents were stranded in high branches for five days and survived by eating the carcass of a dead bull and drinking the muddy floodwater that lapped against their toes.

In all, two thousand Mozambicans were killed in floods that year and 2 million others were displaced. Mozambique lost at least a third of its staple maize crop, a quarter of its agricultural land, and 80 percent of its cat-

tle. And when it was over, the country was dazed; residents appeared unable to piece their lives back together. The social structure broke down. Alcoholism and drug use increased significantly. The country was rife with “unusual behavior,” as Foreign Minister Leonardo Simão termed it. A woman bit off the ear of a child; children separated from their parents refused to speak or eat; and people were killed and others trampled as they fought over clothes and water supplied by relief groups.

It’s impossible to avoid the dismaying conclusion that in our thirst for profits, commerce, and power, our ignorance about water has been as deep as the ocean. Water is the most important, essential, and thus uncompromising natural force on the planet; there’s more of it, and it’s more critical to the survival of every form of life, than anything else in the world. Water, stated simply, is the difference between existence and death for every species. It doesn’t matter whether the cause has been a lack of imagination and insight, or a stunning distance from nature, or plain hubris and arrogance, but our miscalculation that we could arbitrarily and continually manipulate water for our purposes without severe reverberations was—and still is, because we continue to compound this mistake—dangerously foolish.

I was probably the only person thinking these gloomy thoughts at the Hoover Dam one November afternoon, a time of the year when the desert sparkles like the reflection of light in deep black sunglasses. Most of the other people at the dam—and there were hundreds—seemed transfixed simply by being in the presence of something so much larger and more powerful than anything they had probably ever seen. Of the millions of visitors who come to the Hoover Dam each year, probably no more than a handful realize that its sole purpose is to overwhelm and corral a huge free-flowing river that is the drainage basin for an area of 246,000 square miles—or consider whether building the dam may have been an unwise decision.

And who could blame them? At first sight, the Hoover Dam is indeed remarkable, even awe-inspiring. A 726-foot-high concrete barrier straddling the Colorado River from Arizona to Nevada, at its dedication in 1936 it was the tallest dam in the world. With its perfectly proportioned art deco

spillways accented by soaring arches, the geometric southwestern Indian designs in its terrazzo floors, and the two thirty-foot bronzed Winged Figures of the Republic statues at its entry point, the Hoover Dam is an artistic and engineering marvel.

President Roosevelt was effusive at the Hoover Dam's opening, saying that he came, he saw, "and I was conquered as everyone would be who sees for the first time this great feat of mankind."

By contrast, he was brutal in his description of the Colorado River and its surroundings: "Ten years ago the place where we are gathered was an unpeopled, forbidding desert. In the bottom of a gloomy canyon, whose precipitous walls rose to a height of more than a thousand feet, flowed a turbulent, dangerous river."

Taking this a step further, at another point in his speech, Roosevelt said: "As an unregulated river, the Colorado added little of value to the region this dam serves. When in flood the river was a threatening torrent; in the dry months of the years it shrank to a trickling stream."

While speaking of the Colorado's vicious floods, Roosevelt neglected to point out that much of the blame for perhaps its most startling deluge can be laid to another water management scheme that went awry. In the early 1900s, U.S. engineers, looking for ways to bring water from the Colorado to fledgling farms in California's Imperial Valley, decided to create the New River and the Salton Sea as irrigation ponds. To do this, they cut into the Colorado's banks and opened up a fresh intake, through which they hoped to send a small portion of the river westward to California growers. But the engineers made a fatal blunder. Instead of just a controlled stream of the Colorado winding its way west, the entire course of the river, drawn by gravity, raged through this new pathway. Water spilled over the artificial ditches, flooding uncontrollably over land as far away as 150 miles, before filling the New River and Salton Sea basins and eventually returning to its own natural course.

Roosevelt wasn't about to bring up this gaffe—and its role in the Colorado's flooding—at the Hoover Dam's inauguration. Instead, he spoke about how the Hoover Dam would be good for industry, for farmers, and for desert communities. But he said nothing about the damage that can

occur when a natural environment is transformed into an artificial one. The dedication had one message: that the Hoover Dam had defeated a fifteen-hundred-mile river, the centerpiece of the riparian ecological system in the Southwest—something that, as Roosevelt put it, "with the exception of the few who are narrow visioned," people were proud of.

Before the dam was built, the Colorado was indeed a wild and unruly river. It regularly broke down its own banks as it created and recreated the shardlike, equally untamed landscape of the desert. But it was completely vanquished by the Hoover Dam and the subsequent free-for-all by seven states that clamored to use the river for irrigation, hydroelectricity, and drinking water. There have been few victories of people over nature as thorough as this one. Now the river is so meek that only a relative trickle reaches its mouth at the Gulf of California, near Yuma, Arizona. Lake Mead, the Hoover Dam's reservoir, can bottle up 9.2 trillion gallons of water, or nearly two years of the Colorado River's annual flow.

The environmental consequences of the Hoover Dam are as severe and far-reaching as any that have occurred anywhere in the world. For one thing, the Hoover Dam made it possible to build aqueducts to carry the Colorado's water hundreds of miles away to the desert towns of southern California. That diversion, in turn, encouraged the questionable conclusion that no real limits needed to be put on population growth in the region, and it led to the development of sprawling metropolitan areas like Los Angeles, San Diego, and Palm Springs. Without the imported water, these cities would be almost uninhabitable.

Much of the Colorado, which now has as many as fifty dams up and down its length, replenishes so weakly that the water downstream is polluted; in many places, it's mostly thick, green and murky, and its oily topping seems to be flowing sideways, not downstream. As a result, the river's once-vibrant delta in the Gulf of California has become a barren wedge of desert and salt flats, its biologically rich wetlands a thing of the past.

As a habitat, the Colorado is now virtually useless. More than one hundred plant and animal species that live in the river are endangered.

I spent five hours at the Hoover Dam and spoke to a dozen or so visitors as well as some Department of Interior employees about my suspicion

that the dam might be a monument to our folly or, more dangerously, a testament to our misguided notion of environmental invulnerability. Nobody wanted to talk about this issue, not even to argue the other side and explain why I was wrong. Parents held their children closer to them, seemingly trying to protect them from my questions. The kids weren't listening anyway. And Hoover Dam staffers told me to speak to the press office in Washington, D.C.

The only person willing to even come close to addressing the topic was a tour guide, a woman in her fifties who said she grew up in the countryside south of Boulder City, Nevada, where the dam is located. Her earliest recollections are of learning how to swim on the Colorado River, which she described as moving so fast then that at times, while riding in the belly of a truck tire while her grandfather fished nearby, she felt as if it were going to carry her away.

"The Hoover Dam is like Disneyland," she said. "It's an amusement park, a place to come to when you want to see firsthand and believe, whether it's the truth or not, in the power of man, not in his faults. Nobody at Disneyland talks about the puny wages that the person making the T-shirts somewhere in who-knows-where is getting. And here we don't talk about the Colorado River."

She was right. Nobody does talk about the Colorado River here, unless it's to emphasize a point about the greatness of the dam. The Colorado has become a straight man, the Hoover Dam's captive sidekick. I felt a strong pang of sadness, standing on a perch at the top of the dam, listening to the weak lapping of Lake Mead, the embodiment of the Colorado River's defeat, as it tapped lightly—like a faint, near-dead knock on a door—against the walls of the inviolate structure.

The ancient Egyptians were one of the few civilizations that structured their day-to-day, month-to-month activities of life to match the patterns of a powerful and extremely complex water system. The Egyptians accomplished this significant feat by looking at water—and thus water management—through the prism of nature and nature's relationship to their gods.

It was an extraordinarily sophisticated environmental worldview, no less impressive six thousand years ago than it would be now, because it enabled the Egyptians to reject the belief, common even then, that controlling water was the only way to satisfy a society's commercial motives.

Most remarkably, the Egyptians understood the value of floods and viewed them as more important than dams. Instinctively, they grasped a guiding ecological principle: that floods are an essential part of water's activities on Earth, organic events driven by the necessity of rivers to seasonally spread out and then retreat back into their basins. The essence of a river is that it's dynamic, always in flux: eroding its bed, depositing silt, seeking a new course, bursting its banks, drying up.

Each year the Egyptians had a front-row seat to view one of the world's most convincing demonstrations of this fact. Cutting through the heart of Egypt is the Nile River, which at nearly 4,200 miles is the longest river in the world. In ancient times, for much of the year, the Nile was a relatively calm waterway as it flowed northward past Cairo into a turkey-necked delta and then out to the Mediterranean Sea. In these seasons, most of the river's water came from the White Nile, so called because of the pale color of the muddy liquid that it carried from the big African lakes as far south as Kenya and Uganda.

But in the deepest summer, when Egypt is as stark a desert as any the world knows, the Nile would be overrun by the beautifully crystalline waters of the Blue Nile, which poured out of the Abyssinian Mountains in Ethiopia as the snows melted. Its waters would transform the Nile into a fierce rushing river that stormed unimpeded into the hot, dusty landscape of Egypt, overflowing its banks and drowning the narrow farmlands running along its length on either side. As it flooded, the river would pick up bits of soil and plant life. Then slowly it would recede, leaving behind layers of nutrient-rich silt and food in the form of dead catfish, mullet, boliti, and perch. As a result, the deep black soil along the Nile was exceptionally fertile. Lying in a delta that totaled only about 3 percent of Egypt's landmass, it supported almost enough crops to feed the entire country.

To the Egyptians, who interpreted everything in terms of the relationship between natural and supernatural forces, this yearly cycle of the

Nile—and the incredible sustenance it brought—was nothing short of a miracle: a gift of the goddess Isis, whom they associated with rebirth. In the metaphors of Egyptian mythology, the Nile floodwaters were the tears Isis shed for her husband, Osiris, whom she resurrected after his murder by a jealous god. With such divine origins, the Nile, even at its most devastating, was obviously not to be tampered with. Building dams and other abatement was out of the question. The Nile was allowed to freely spin through its cycle, engorge with water from high in the hills, replenish the earth with its revitalizing liquid, and then return to its tomb in the mountains. To keep out of the river's way, people farmed on its banks but lived some distance beyond the point where its floodwaters crested.

This simple but extremely successful approach to water management ended in 1970. That year Egypt's founding father and longtime president Gamal Abdel Nasser, in one of his last official acts, ordered the building of the Aswan High Dam, a series of huge locks and gates on the Nile that trap the river water in a reservoir six hundred miles south of Cairo. By taming the Nile and setting up a network of irrigation ditches, Nasser reasoned, water could be distributed to farmlands throughout the year, even during droughts. The growing season would be extended, ensuring enough food for Egypt's rapidly multiplying population.

But the Aswan High project had serious flaws. Interfering with a water cycle as orderly and natural as the Nile's should never be done lightly, and Nasser ordered no independent environmental impact studies to determine the prospective repercussions of the project. One reason is that Nasser had another motivation for wanting to construct Aswan High: to ensure that he'd be remembered in Egyptian history long after he died.

Much like the great temples of the pharaohs (many of which were submerged by the building of Aswan High, while others were moved at great expense), this project was built to be noticed. The dam itself is nearly four hundred feet high and more than ten football-field lengths across. The reservoir impounded by Aswan High, called Lake Nasser, is one of the largest in the world, covering an area three hundred miles long and ten miles wide. The cost of the project finally totaled more than \$1 billion, a high price for a nation in poverty.

Nasser stopped at nothing to make sure the project was completed. During a low point, when the United States refused a request for additional funding because Nasser had gotten too friendly with the Soviet Union, the Egyptian president offered the Soviet Union almost all the revenue from the Suez Canal and a permanent military presence in exchange for \$300 million to finance construction.

Aswan High had its formal opening in 1970, just a few months before Nasser's death. And with that, the Nile's natural pattern of summer flooding—a yearly cycle dating back, no doubt, to prehistoric times—ended forever. As Nasser had promised, Egyptian farm output increased significantly. But the attempt to control the river produced serious side effects. Silt levels in Lake Nasser rose dangerously, because the Nile was trapped, setting the stage for widespread pollution in the reservoir and subsequently on the farmlands irrigated by this water. Meanwhile, to replace the nutrients that used to be carried by the Nile, downstream farmers overfertilized their land. When it rains, much of this fertilizer washes into the river and ultimately flows to the Nile's delta. With much less water available in the river to filter out the impurities, the entire lower Nile basin is also becoming polluted.

Moreover, without the sediment from the overflowing Nile to compact the land adjacent to the river, downstream banks are eroding. If this process isn't contained—and there are no plans or money to do so right now—then there will likely be floods on the Nile far more dangerous and powerful than those that used to occur seasonally. As a result, the gains in cropland upstream could eventually be diminished by the acreage destroyed by deluges downstream. And with the makeover of the Nile's natural course, the fish population in the river—even commercial catches like sardines and shrimp—is dropping rapidly. So Aswan High, intended in large part to increase the amount of food available to Egyptians, may actually reduce it over the long term.

On a more profound level, with the completion of Aswan High, Egypt cast off a unique relationship with water that will never be recaptured. It severed the bond between the Nile and the people who relied on the river for their lives and their livelihood and bartered it, it could be said, for

Nasser's \$1 billion legacy. What had made the connection between the people and the river so singular was that the Egyptians were not afraid of the Nile's floods; to the contrary, they welcomed them. They saw floods not as nature out of control—let alone as nature in need of control—but as a gift to be treasured.

This worldview is extremely unusual. Very few civilizations have understood that respecting water's natural course is more valuable and safer than rejecting it. The failure to understand this principle has had a devastating cumulative environmental effect and has enabled us to blindly believe we can remake our environment as we wish.

By pure coincidence, I arrived in Rapid City in June 1972, just a week after the Canyon Lake Dam collapsed and what's now known as the Big Flood occurred. At the time, I was a musician performing with a rock-and-roll band, and we were in the middle of a cross-country tour, driving a GMC van from city to city in the northern United States. We were supposed to play a show in Rapid City, stay a few days with some local people, and then go west to California. We ended up spending a couple of weeks in South Dakota, caught up in the residents' utterly fascinating attempt to search for explanations for the flood. None were forthcoming.

Upon first entering Rapid City, I was struck by its solitude. It had the look of the worst type of ghost town—the kind where the people are alive but the streets are dead. A hushed breeze skimmed over the vacant roads, carrying strafed pinecones torn out of the Black Hills. I kept hearing soft gusts that sounded like cars approaching from a distance, but when I looked around, the streets were virtually empty.

Here and there the inanimate signs of the disaster's aftermath jarred unexpectedly. A doll's head, bald and severed from its body, lay in the mud near the now torpid creek that cut through the town center; one gray eye was opened in a lifeless stare, the other shut tight.

The thickness of the air was suffocating. The city was so drenched in humidity it seemed to be perspiring, as water in the streets evaporated in

the bright sun. There were few people outside, but in the distance came the sounds of cleaning up: the deep motorized rasp of power tools and then the thud and clank of wood and metal being tossed onto piles.

Downtown, rows of stores had been boarded up with hastily cut sheets of plywood. In many cases, these attempts to save the storefronts had come too late. Beneath the thin plywood, which was mostly waterlogged and transparent, broken windows and shattered displays were visible.

Rapid City, on the far edge of the Great Plains, is a small town of mixed identity, neither entirely Midwest nor Wild West. It was settled as a mining center in 1876, after gold was discovered in the nearby Black Hills. That history gave Rapid City its initial reputation as a lawless western village of prospectors and, soon after, of loggers and cowboys.

But topographically, Rapid City isn't Big Sky country. With its softly paced hills and wide-open agricultural fields, it looks more like the breadbasket communities in Missouri and Minneapolis. This disconnectedness, poised uncertainly between East and West, difficult to categorize and place, has made Rapid City a mostly forgotten American town. It's known more for being close to Mount Rushmore, the Badlands, and Little Big Horn, or to the farms of Minnesota, Nebraska, and Iowa, than for being the center of anything.

That's one of the perplexing aspects of the 1972 flood: No one would have wagered that of all midwestern towns, Rapid City would be the target of a flood of that magnitude. For one thing, Rapid City is anything but a river town. The only water that runs through it is a tiny trout stream that ambles along at a pace of a few hundred cubic feet per second. Rapid City is situated a few hundred miles west of the Missouri River and even farther from the Mississippi, both of which overflow their banks many times a year. It seems unfathomable that the town's one small stream would suddenly be transformed into a barnstorming, swollen river that took oxbows at speeds five hundred times its usual pace—that it would trump the big rivers of the Midwest in the severity of its flood. But midwesterners still cringe when they consider the enormity of the flood's toll. Two hundred thirty-six people were killed and three thousand others were injured in a

town of only 75,000 or so. One out of every ten homes was destroyed, and tens of thousands of head of livestock, horses, dogs, cats, and other animals were carried away, buried at the flood's mouth.

As I drove through town in the aftermath of the flood, the general store was one of the few shops that was still open. The proprietor, a gaunt, sad-faced, wan man named Chuck, with Peter Lorre eyes, was prone to gallows humor. I asked him how he had been able to clean up and reopen so soon after the flood, when everybody else was still struggling. "Disasters are good for business," he told me matter-of-factly.

Chuck's store usually doubled as a local social club. During good times, barrels lined with burlap stood near the counter, holding staples like feed, sugar, and flour, and doubling as leaning posts. People would linger there to engage in idle chatter, to avoid going back to work or to an empty house.

The day I visited the general store, though, no conversations were taking place, although there were about twenty people in the store, browsing the shelves and aisles. In fact, the shoppers, some of whom must have known each other, weren't even making eye contact or greeting each other. Virtually the only sound was the shuffle of boots on the hardwood floors, which were covered with sawdust to soak up the water that darkened the slats in uneven patches.

Chuck, however, was loquacious, and this librarylike stillness was getting on his nerves. He talked on about a variety of things, including his view that one good thing that came out of the flood was that the people of Rapid City found religion. There were more cars in the parking lot of the churches this past Sunday, he said, than on the speedways and at the drive-in movies the night before. That's the good part, he said, but something's still missing: "We got spiritual, but now we have no spirit.

"You want to really know why it's so deadly around here now," he continued, leaning forward on the counter, and speaking to me in a hush, as if he didn't want to talk about his neighbors in front of them. "It was a broken promise. We never had a flood around here. Never. Rapid Creek always seemed so lazy. Nobody ever expected her to destroy her own banks.

Let's face it, the creek itself was barely on anybody's mind—we hardly noticed her anymore.

"Then last week she changed the plan, suddenly, without warning. It was like we had an arrangement one day, then the next day we didn't. People are still trying to comprehend how that can happen. How the rules can change so quickly. And we're trying to get used to the fact that a couple of hundred of us were wiped out in no more than a few hours. Vanished like they were chosen to die. But there's no pattern there either. The good are gone and so are the bad. It's just the damnable mystifyingness of it all."

Chuck took off his sweat-stained glasses and slowly pulled a crumpled handkerchief out of his pocket. He wiped the lenses clean. When he had finished, he tucked the hooked ends of his silver wired frames back behind his ears, then looked at me with a dazed expression, like someone who was returning from having lost possession of himself for a moment. He couldn't remember why I was in his store. "What did you come in here for, again?"

"I need directions to Dark Canyon Road."

Thirty years after the Rapid City flood, we still have no easy explanation for the eight-hour rainstorm that produced it, a storm so unprecedented in the region that it seemed otherworldly. In fact, that this meteorological phenomenon has not been repeated only magnifies the mystery.

In the days, weeks, and even years that followed the disaster, numerous suggestions were offered to explain the storm and the flood. Perhaps an unfortunately timed cloud-seeding by the South Dakota School of Mines, part of a precipitation study, had something to do with the torrential rains. Or perhaps the massive dams on the Missouri River—the most straightened and locked waterway in the world, with billions of dollars of braces marking almost every mile of its journey northeastward from Montana to St. Louis—played a part in the sudden swelling of Rapid Creek, one of its tributaries. Or perhaps it was the work of an Indian chief, his name long forgotten, who a century before had prayed loudly to the skies for pain and

destruction to rain on the white man, soon after settlers broke agreements and forcefully snatched some of the Sioux's most sacred territory in Pine Ridge, Deadwood, and Wounded Knee.

Recently, teams of hydrologists and meteorologists throughout the Black Hills have been trying to recreate the events of June 9, 1972, on supercomputers. Most of their work has centered on building three-dimensional models that simulate the organization of thunderstorms. These digital depictions, based partly on weather information gathered in Rapid City the night of the flood, have reconstructed the rapid updrafts that led to cloud and precipitation formation.

But the best these scientists have been able to do so far is to piece together the singular climactic conditions that existed at the time. That they will figure out why the storm occurred remains only a distant hope.

The first event leading to the storm appears to have been the unusually high level of humidity that developed on the morning of June 9. Hundreds of miles to the east, hot, wet winds built up, then rushed westward over the Great Plains into Rapid City. By eight a.m., surface dew point temperatures, which measure moisture in the air, were in the mid- to upper sixties in western South Dakota, nearly twenty degrees above normal.

As the condensation-heavy winds cut a wide and noisy path through Rapid City, they hit an obstacle they couldn't breach: the east side of the Black Hills, the mountains that lie to Rapid City's west. With nowhere to go, the thick air was propelled upward in a vortexlike pattern. And when it hit the cold atmosphere above the Black Hills, clouds formed that quickly and progressively thickened. Eventually, they exploded into thunderstorms.

There's nothing especially strange about that scenario. The humidity was well above normal on June 9, but besides that, the meteorological activity was typical of the storm-producing weather pattern for the Rapid City area. Usually, though, the region's storms are pushed westward or northward away from the Black Hills, by a high- or low-pressure system that arrives from the south or the north. This time something strange happened. Two different pressure systems converged above the Black Hills simultaneously: a powerful one from southern Canada and the Great Lakes, driven there by an upper-level storm over eastern Canada, and a weaker one from Colorado

and the Southwest. Instead of propelling the storm away from the region, the combination of these two pressure systems formed a deep trough on top of the mountains. The heavy, humid air climbing the Black Hills was trapped in this sinkhole, where it repeatedly and hungrily fed on the cold atmosphere above the mountain to produce one thunderstorm after another in an unrelenting display of climatic power. It was as if the hydrological cycle of rainfall, evaporation, condensation, and then precipitation again were stuttering, stuck in place above the Black Hills and performing over and over in minutes what normally took hours or even days to complete.

None of the tiny waterways around Rapid City could handle the deluge. Rapid Creek started rising within a couple of hours of the first storm, which began at about four in the afternoon; it ruptured its banks by eight o'clock. The first damage was mostly to cars, which stalled out, their passengers trapped in the water that filled the streets. Then the homes nearest to the creek were hit as water poured into basements and then climbed through floorboards and windows into ground-level rooms. A few hours later, Canyon Lake Dam crumbled, and the spreading flood couldn't be stopped. The entire area was swept up in an uncontrollable cascade. Nothing—people, animals, foundations, or even concrete buildings—was strong enough to withstand the flood's intensity and might.

Researchers today view the storm as an anomaly and leave it at that. It is true that the School of Mines seeded the clouds the day of the flood, but the scientists discount that as playing a role. The amount of salt deposited in the air wasn't nearly enough to produce the storm that occurred. Besides, the clouds had been seeded many times before without similar consequences. As for the dams on the Missouri River or Sioux entreaties to their gods—the echoes of the Ghost Dance ritual that was practiced and then outlawed in the late 1800s, whose purpose was to rid the region of white settlers—researchers decline to connect these with the flood either.

In the three decades since the flood, Rapid Creek has been reinforced with a wide floodplain, strung by a bike path that runs through the center of town and into the hills. No new homes have been built close to the creek. The huge gates that splintered when Canyon Lake Dam failed were never reconstructed; now, there's a free-flowing spillway. The city is braced

for another cataclysmic downpour, but it probably won't happen again for hundreds of years.

Economically, Rapid City has grown much stronger since the flood. Dozens of new shops and restaurants have replaced the waterlogged stores. In the process, the city lost much of its tired Old West look. With its bucolic surroundings and its low-pressure lifestyle, Rapid City has attracted thousands of new high-tech, service-industry, and agriculture jobs. Unemployment rates have plunged to below 3 percent.

But a question persists about the flood: How much fault lies with the massive water management projects that had transformed the Missouri River into a controlled waterway? Did the Missouri's complex man-made plumbing system back up Rapid Creek, the largest tributary of the Cheyenne River, which in turn discharges into the Missouri, near Pierre, South Dakota? Researchers may discount this possibility, but Rapid City residents and many environmental scientists are still suspicious that the Missouri played a part.

The Missouri, which was brought to public awareness when Thomas Jefferson commissioned Lewis and Clark to explore it in 1804, is a fascinating river. For one thing, it's one of the world's longest, spanning 2,400 miles between its headwaters at the confluence of the Jefferson, Madison, and Gallatin rivers in Montana and its mouth just north of St. Louis, where it joins the Mississippi River. It's almost impossible to drive through the Midwest without repeatedly crossing the Missouri.

And only the most jaded would fail to be impressed by the expanse of the river's long-armed, octopuslike basin. It stretches out over nearly a hundred tributaries, encompasses more than 300 million acres, and drains about one-sixth the surface area of the continental United States.

The Missouri as it exists today is divided into approximately three equal sections. The lower third, the part that lies below Sioux City, Iowa, is straight and narrow—"channelized," in the language of flood control experts. The middle third, north of Sioux City, is impounded by six large dams. And the upper third, in the river's highest reaches, consists mostly of regulated "free flowing" stretches of water. Only one percent of the river's length is uncontrolled by humans.

The suspicion that the damming of the Missouri was responsible for the flooding of Rapid Creek won't die because four of the river's six dams are located in South Dakota. The largest is a rolled-earth megalith that forms Lake Oahe near Pierre, just fifty miles from Rapid City. No matter how powerful and unusual the storm was, the hunch still persists that if the Missouri had not been so relentlessly contained by dams, the swollen Rapid Creek could have emptied into the river's tributaries without having to overrun its banks. That hunch isn't unusual: when any environmental disaster occurs in the Midwest, the Missouri has become a usual suspect.

All of the attempts to redirect the natural flow of the Missouri have produced a river that, even many ardent anti-environmentalists admit, is most fittingly described by Chad Smith, a coordinator for the American Rivers Group: "It's a mess. There's no plan. There's never been a plan. People just got their hands on it and ruined it."

Floods were once an essential part of the Missouri's ecosystem, critical to the river's management of its own environment. By overflowing its banks seasonally—usually in spring, when rainfall was high and the winter's snow and ice were melting off of the mountains—the Missouri replenished its backwaters and maintained its braided channels, islands, and sandbars. For thousands of species, the rejuvenated sheltering crevasses of the river's sloughs, oxbows, mudflats, and marshes triggered their reproductive cycles. What's more, the floods provided an exchange of nutrients between the floodplain and the river.

Now the Missouri appears to be at its most natural when it's actually at its most artificial. Stand at sunset above Lake Oahe, the reservoir formed by Oahe Dam, and you can watch a shower of bright yellow stripes in the sky reflect and illuminate the vast darkness of the meekly rocking lake below. Listen to the stillness, the complete quiet except for the seesaw sound of the water, the echo of the terns' call, and the jump of the walleye in the lap of the river. It's torturously serene. And it's easy to forget, or to not care, that it's man-made, lacking all of the Missouri's original rough-hewn personality.

Ironically, while the Missouri was remade in large part to prevent it from flooding, the river still floods often. The dams and channels make the

Missouri deeper and faster-flowing than it was originally, and during a heavy rainy season, it crests much higher than it used to, easily overspilling levees that were built to protect the farmland and cities from flooding. Some of the worst floods have washed away hundreds of homes and belongings. In a few cases, whole towns have had to move away from the river.

But the attempt to control the Missouri has had its biggest impact on those species that once relied on the river's natural conditions. Thirty-three of the 156 fish species native to the Missouri River basin have now been placed on state and federal endangered species lists. Another seventy have been tagged as rare. Big river fish such as sturgeon and paddlefish, which used to be common in the Missouri, have been greatly reduced in numbers.

Only one family on Dark Canyon Road, the Lockharts, survived the Rapid City flood. Following the directions I got from Chuck at the general store, I drove up the sharp incline into the mountains, out of the town's business district toward the countryside. The Lockharts' home stood on two hundred acres at the very top of a bluff in the Box Elder Mountains. Every house below the Lockharts' that I passed had been lifted and moved by the flood a week earlier, coming to rest askew and ripped apart; none were unscathed, and no people were visible.

Land rich, but cash poor, Jim Lockhart, the father of ten children, earned a meager salary driving a freight train. The property was an inheritance. His great-grandfather had been deeded the highland acreage more than a hundred years ago, when he was one of the first sheriffs of Rapid City.

Jim was an outsized, boisterous man, full of virile energy, who had proved to be something of a hero during the flood. As the water headed toward the Lockhart home—it crested no more than a hundred feet below the property line—Jim and his seventeen-year-old son, Jim Jr., worked their way down the hill to try to save their neighbors. In hip boots and plastic coveralls, they literally grabbed people as they were being thrown into the maelstrom, desperately trying to swim when swimming was virtually impossible. During an exhausting hour or so, Jim and Jim Jr. had been able

to save a handful of people; the rest had been ripped away and sent tumbling in the cascading water down the mountainside.

Jim's wife, Teena, said that her husband knew he had done all he could to save his neighbors, so he wasn't tormented about what happened. He went back to work as soon as the trains were running again. But she couldn't shake it. A Rosebud Sioux, Teena grew up in these hills and learned there what it meant to seek balance with one's environment. She was taught to respect the forces of nature, because they were powerful; only those who showed deference would get respect in return.

She was soft-spoken and slight, with long flinty gray hair worn in a bun. For the first few days that I stayed with the Lockharts, Teena spoke little about the flood; it was too fresh in her memory. And her difficult-to-bury feelings that the flood might have been nature's angry response to the way people have treated the waters in Rapid City and nearby were too uncomfortable to think about, much less put into words. Her other contradictory thoughts were even less consoling: the flood might be a sign that nature lacks order or logic, placing in question the long-held beliefs that she and her ancestors lived by. Teena finally spoke to me about this during a walk we took through the woods toward a high ridge. It was eerily quiet—we heard just the sounds of birds and our footsteps trundling the wet soil. When we reached the clearing, on the ridge, an extraordinary sight took me aback. In the hills surrounding us, the exact spot where the flood had crested was dramatically recorded by remarkably distinct tree lines and water marks. It looked unnatural. The usually dark, overgrown Box Elder Mountains were treeless except for the very top, where there were thick stands, looking like lone wind baffles next to an ocean. Right below these isolated clusters of trees, the mountains were as brown and barren as the Badlands. Unmistakable sootlike water marks circled the Box Elders, measuring the relentless climb of the flood until it reached its high point.

Teena said the Box Elders looked strip-mined and alien to her now. The mere sound of the echoing wind crashing against the bare mountains frightened her.

"I used to sit on my porch with the kids at night, reading to them or

rocking them and feeling enveloped by the mountains," she said. "Now they haunt me. Those water marks recall the rings of the dead that we put on trees in the reservation, when relatives passed on."

One of Teena's most difficult memories was the reaction of her youngest children—a five-year-old and a seven-year-old—to the flood. "They were dancing, like kids do, in the rain, which was coming down in torrents," she told me. "And not understanding what was going on, they were laughing at the people and animals swept up by the flood. It looked like a giant water slide to them. It looked to them like the people that were dying were having fun."

Teena said she had to decide whether to scold the children for their out-of-place behavior or ignore it, since they didn't understand the seriousness of what was going on.

"I chose to leave them their innocence. You only have that once," she said. "Just because I was losing mine didn't mean that they should lose theirs."

Maybe, I said, the flood is the answer to the Indian Ghost Dances, the retribution, wrought finally after all these years, against the imperious white settlers. If so, then the flood and its aftermath would fit the notion that there is a logic to nature's actions, as she was brought up to believe.

"Even you—and you've just been here a few days—are searching for answers. You're looking for why so badly that you're willing to consider some old far-fetched Indian legend to explain why so many people are dead," she said. "Well, I guess if white people are willing to believe it, I'm not going to dissuade them. It's not the worst thing for more people to fear our witchcraft."

Teena's point, of course, was that even if there is a logic to nature, there are still no rational explanations that people can comprehend for natural disasters like floods, so why seek answers? The fact is, the only thing that we can really learn from floods is that they—and more important, water—are mostly out of our control. No matter what we do, no matter what kind of water management projects we attempt, we won't be able to eliminate floods, and often we'll worsen the situation. Still, this is such a diffi-

cult reality for people to accept that we ardently and often preposterously resist it.

In spring 2001, circumstances in Davenport, Iowa, drove this point home: Flood waters were cresting up and down the Mississippi River, and damage to houses and businesses was mounting. Unlike most other towns and cities on the river, Davenport didn't have a flood wall. Instead, during the prior decade, it had developed a parklike waterfront that depends on the river for much of its attraction, and had moved virtually all homes and businesses as far from the water as possible. Davenport officials justified this decision by saying that flooding is an inevitable part of life when you live on the Mississippi, so they chose to build their city around the possibility of floods and not try in vain to stop them.

Davenport has had plenty of critics, though, including Joseph Allbaugh, the head of the Federal Emergency Management Administration, who complained loudly during the 2001 flooding that "all of this could easily be prevented by building levees and dikes." That is one of the stranger statements about water that I've come across in my research. Allbaugh made those comments when almost every Mississippi River community within driving distance of Davenport had been overrun by the floodwaters. And practically all of these places had invested hundreds of millions of dollars in flood control structures so big that the communities were effectively walled off from the river that was their birthright—and still they were suffering significant flooding and significant damage. Even supporters of the water management projects were embarrassed, or amused, by the FEMA chief's scolding of Davenport.

To hear Davenport being chastised for its approach to flood control when no city or town had been able to avoid the Mississippi's waters, no matter what measures had been taken—and some sustained even greater losses than Davenport—seemed ludicrous. Yet perhaps it wasn't as absurd as it sounded. Allbaugh's attitude was typical of one we've always held, in foolishly thinking we can restrain raging waters. It occurred to me with some disappointment that when people are determined to avoid the obvious, not even a flood—or thousands of them—can get their attention.