THE DESERT EMPIRE

In its desperate search for water, the American West meets the limits of the technological ideal

by George Sibley

Anyone interested, for whatever reason, in the study of water in the West will in the end concentrate on the Colorado, wildest of rivers, foaming, raging, rushing southward—erratic, headlong, incongruous in the desert. —John McPhee
Encounters with the Archdruid

THIS IS A STORY about a river, but it is also about the desert. I should begin by admitting that I am no lover of the desert. I find a certain fascination in its strange, disturbing beauty; but I am ultimately repelled—by the heat, by the dead stillness when it's still and the spinning dust sentinels when it's not, but most of all by the dryness.

I don't think a lack of love for something like the desert precludes a basic understanding of it. The first time I was out in the desert, I was coming up through the Navajo reservation. It was a magnificent afternoon: thunderheads rolling up, lightning firing back and forth—I was on a motorcycle, so I naturally thought I was in for a soaking. But there were only the *birga*—the teasing trailers of rain starting toward the earth, then fading away to nothing, vaporized by the heat rising off the desert floor.

Anyone who has spent a few afternoons in the desert has probably seen the clouds billow up and try to rain on it, but the trailing gray sheets and ribbons of rain (often woven with segments of rainbow) are vaporized by the desert's shield of heat long before they can reach the ground. And when the rain does manage to find its opening and pour in a cloudburst, the earth is baked so hard that even then it fights the downpour; the water doesn't stay with the ground but goes ripping off, itself frustrated and raging by then, to see what it can find to tear up, break down, and generally raise hell with.

The desert, in short, rejects water; and being myself not much more than an uncountable number of minuscule water vessels, I feel the rebuff: whatever rejects water rejects me, and the feeling is mutual. I resolve the antipathy by generally staying away from deserts.

What this story is about, then, is the temptation that periodically comes over people to take the rebuff as a challenge to go fight the desert—"make it bloom," as they say. Many of our great ancestral civilizations—Egypt, the so-called Fertile Crescent, Persia, India, central Mexico—evolved in areas with a semi-arid or arid climate. The key technology here has always been the ability to divert and spread the water of rivers onto lands otherwise too dry for agriculture.

It is a part of our own cultural tradition to think of these ancient civilizations and their great temple-cities as evil and corrupt places—they were, after all, the Egypt from which Moses led the faithful, the Babylon whose towers God cast down, the Sodom and Gomorrah from which the righteous fled, all of them sprung from the alienated seed of that Cain whose "innovative agriculture" the old I Am of the desert refused to accept. If we can accept that it was the destiny of what we call Western civilization with its "Judeo-Christian heritage" to come to America, then we should probably also accept that at least part of the effort we have been gearing up for, in a thousand years of phenomenal technological advance, was our own confrontation with the same age-old nemesis and challenge, in the presence of the Great American Desert west of the Rocky Mountains and its mad river, the Colorado.

George Sibley, a former newspaper editor and owner, is a free-lance writer living in Colorado.

A modern miracle

THE COLORADO RIVER BASIN is interesting no matter what the weather—I have been living in the upper part of the basin for eleven years, and one of my greatest appetites is for anything having to do with this region's development. But there is a more specific reason for wanting to look at the Colorado River Basin this year—1977 has been a very dry year in the West.

It is the driest year on record, and it follows like death after disease on the heels of a relatively dry year in 1975-76 (the "water year" begins in October). The last year of comparable drought in the Rocky Mountains was 1934; the Sierras haven't seen a winter and spring so bad since 1924. The summer months' precipitation has been closer to normal for most of the region, but the entire West is most heavily dependent on the snows that feed its rivers, and there was simply next to no snow last winter.

A strange thing about this year of drought in the West is that, while nearly all of the few humid and many semi-arid areas of the continent west of the Rockies are running short of water, the very heart of the Great American Desert (if a desert could be said to have a heart) is hardly suffering at all. The disaster of drought in the West—notably in Northern California—has received a great deal of morbidly statistical press attention this year, but a much more interesting story has gone more or less unnoticed, and that is the degree to which the drought in the West—notably in Southern California—is not a disaster. Not this year, at any rate; not yet.

At a water-project hearing this spring in Grand Junction, Colorado, an Aspen lawyer made the rather lawyerly distinction that a "drought" is not automatically a "disaster"; a drought is only a shortage of water, and a shortage of water is only a disaster if someone was dependent on the water that didn't materialize. But in the driest year in recent history, Southern California is not yet suffering a serious shortage of water.

There is a "mandatory conservation" program in effect for Los Angeles and other water districts in the Los Angeles–San Diego megalopolis, but this is due more to "technical difficulties" and the limitations of the water-transportation system than to any actual water shortage; even if the 11 million residents of these coastal cities were to go on actual rationing, there would be no danger in the foreseeable future of the "total dry-up" that is threatening some municipal water districts in the northern part of the state.

And out in the irrigated desert of the Imperial and Coachella Valleys, it has been agribusiness as usual this year. Where the 1934 drought cost Imperial Valley farmers around $10 million in lost crops, this year they will bring in normal harvests with a total value approaching $500 million.

When you stop to consider that nearly all of Southern California is arid land receiving less than ten inches of precipitation a year (ten to twenty along the coast)—with all of the agricultural lands getting five or less—it seems evident that in this driest of years a "miracle" as well as a "disaster" has occurred in the West.

The "miracle," if such it be, can be traced directly by a number of supply lines back to the Lower Colorado River. Eighty percent of the water for all uses in Southern California comes from the Lower Colorado—and when I say "all uses," I mean all: we have not just moved into the desert with a canteen and washbasin; we've gone in with the kitchen sink, flush toilet, watered lawn, and swimming pool; every use that man has invented for water we've taken out into that desert and supplied with water from the Lower Colorado. And a great deal of that water is taken over strange terrain to distant places the river would never have dreamed of going on its own.

A great deal has been written about the lack of aesthetics in what amounts to dismantling a living natural river and reconstructing from the parts a mechanical waterworks. Counter to that criticism is the argument that there are aesthetics and there are aesthetics: the quest for predictability, efficiency, and full use of resources constitutes an aesthetic, too. And advocates of the "new river" will now be able to point to two proving years: 1952, when Hoover Dam and Lake Mead damped down one of the largest spring floods on record to a manageable flow below the dam; and 1977, when the storage behind two great dams negated the driest year. Maybe from a river-lover's point of view it looks plumb awful in a normal year, but the point is, it looks just as plumb awful in an abnormal year; from field and city, what looks pretty good is a river that is regular, dependable, efficient, and well run.

None of which you could have said about the old river, no matter how, well, riverine it might have been.

Marching Song

This vast plain of opulent soil—the mighty delta of a mighty river—is rich in the potentialities of production beyond any land in our country which has ever known the plow. Yet here it has slept for ages, dormant, useless, silent. It has stood barred and padlocked against the approach of mankind. What is the key that will unlock the door to modern enterprise and human genius? It is the Rio Colorado. Whoever shall control the right to divert these turbid waters will be the master of this empire.

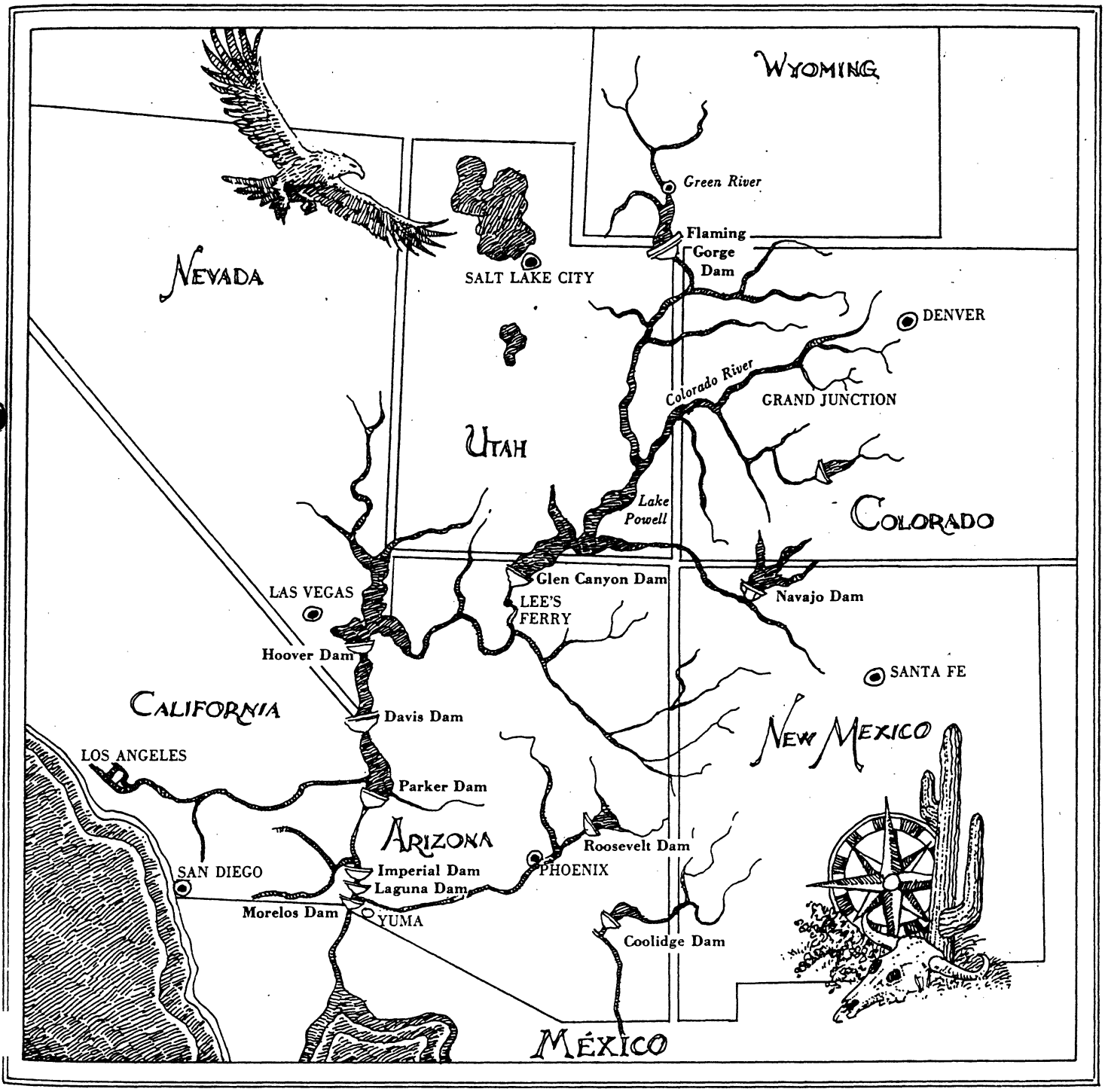
—William E. Smythe, *Sunset*, 1900

THE MODERN HISTORY of the Colorado River could be said to have begun at an out-of-the-way place called Lee's Ferry, Arizona. There's no longer a ferry at Lee's Ferry, but the spot is still important for its relatively easy access to what used to be America's most inaccessible river. Lee's Ferry—or "Lonely Dell," as John Lee himself called it—amounts to a pastoral incongruity. The river slides by quietly, greenish-clear today between green banks of the ubiquitous "well-drinker" shrubs, willow and tamarisk. But that pastoral quality ends abruptly within a few hundred feet of the river as the land slants up, becoming browner through clumps and croppings of saltbush and ricegrass, rabbit brush and yucca, then completely bare as red-brown sandstone sweeps upward into the Echo Cliffs on the east side, the Ver-

milion Cliffs on the west. The cliffs close in upstream where the river emerges from what used to be the Glen Canyons of the Colorado; downstream, the cliffs gradually open out to border the broad and barren Marble Platform—but the river there is no longer with the land; it has dipped again, gnawed down, and turned white and foamy at the bottom of a dark gash.

It was at this point, Lee's Ferry, that we divided the Colorado in two in 1922. That was only a "paper division" then, of course. But forty-one years after that paper division, the gates were closed on an impressive concrete structure just seventeen miles upriver, the Glen Canyon Dam; and that did the job for sure.

Glen Canyon Dam backs up a body of water, Lake Powell, which amounts to nearly the equivalent of what used to flow down the Colorado River in two years. The water flowing into the lake today mixes with the water from the past fourteen years; the amount of water that flows out of the lake reflects not the influx from upriver but demands from downriver.



This being the case, it seems almost fatuous and sentimental to continue to think of the Colorado River as a single entity. For all practical purposes there are now two rivers—interdependent, to be sure, but separate, and under separate management. To the extent that life is both more tenable and potentially enjoyable when one's aesthetic sense is reconciled to immutable realities, I for one intend to try to think of the Colorado as two rivers.

To describe the two rivers in the simplest possible manner: the Upper Colorado River is generally patterned after a "natural" river, with many sources and a single destination; the Lower Colorado River, on the other hand, is patterned more after, say, a municipal waterworks, with a single primary source and many destinations. The river managers refer to the two regions served by the rivers as the Upper Basin and the Lower Basin; but I think Upper and Lower Service Areas would be more accurate, because (especially in the Lower Basin) the water is frequently made to violate the most basic law of water flow in a "river basin": it has to flow uphill.

The Upper Colorado River almost exactly duplicates the course of the Old Colorado River and its major tributaries—the Green, Yampa, Grand (or Colorado), Gunnison, Dolores, and San Juan Rivers—until it reaches a point not far south of the confluence of the Green and the Grand in western Utah. There it flows into Lake Powell. Its primary function is obviously to provide a regular controlled flow to the headwaters of the Lower Colorado.

The Lower Colorado's headwaters are at the base of Glen Canyon Dam, where the "spent water" from power generation wells up from the turbine outflows—a scene not unlike what the upwelling burble of a mountain spring might look like to an ant watching from a rock.

The first section is operated primarily as a recreational facility, for Grand Canyon rafting—open from June through September. But from the end of the canyons at the upper end of Lake Mead, behind Hoover Dam, it is business first and pleasure when you can get it on the Lower Colorado. This river has to water what the Bureau of Reclamation calls a "desert empire," an empire made up of the states of California (south of the Tehachapi Mountains), Arizona, and Nevada.

It is my intention here to consider only the Lower Colorado River and elements of its story—far too big and involved a story to consider in its totality, but one that, I hope, we can get the gist of. Someday I hope to tell the story of the Upper River too. But to a great degree its story has yet to be written in fact and deed, while the story of the Lower Colorado River is in its last chapters. Or so it would seem at present.

The Old Colorado

IN A STATISTICAL summary of the world's great rivers, the Old Colorado would not be too near the top—in length and volume of flow, it would fall somewhere between the Euphrates (larger) and the Tigris (smaller).

Its most distinctive feature was probably its comparatively steep fall for its relatively short run—12,000 feet in just under 1,500 miles. A full third of this drop came after the river had accumulated the strength contributed by most of its tributaries. This wouldn't have meant a thing to the ancient Egyptians or Mesopotamians—it didn't, in fact, mean much but trouble to John Wesley Powell when he descended through those steep canyons around 1870. But by 1880 Thomas Edison had developed the light bulb, and the first practical turbines had just been developed.

The Old Colorado owed its "power potential" to an unusual tectonic event. Once upon a time, it was a mature stream that existed in a relatively harmonious symbiotic relationship with the now-barren highlands we call the Colorado Plateau. You can stand today at a place like the San Juan Goosenecks overlook and see the slow bends and sensuous meanders of a lazy river taking the longest possible route through the land it waters, as if so enjoying the relationship that it hates to get on its way, but today those meanders are carved into 1,000 feet of sloping shale and limestone.

What happened was that, under the influence of whatever tectonic pressures, the river's land began to rise—very slowly, of course: slowly enough so that the Colorado River could continue to flow down to the sea through the simple expedient of eating a little deeper into the land all the time. And so the river and its plane were separated: the land going dry and desolate as the water fell away, and the river wandering without beneficent purpose through its own deepening labyrinths of sterile stone.

The canyons the Old Colorado carved in the slowly rising Colorado Plateau massif are tremendously impressive, but to truly get a feel for the power the river had you need to go driving through the Imperial Valley, well west of the river in Southern California. After half a day of driving west and north toward Indio, through what resembles an overgrown Illinois dropped in the middle of the desert, you find yourself approaching the San Bernardino Mountains, with their rocky foothills in the foreground—and suddenly, there along the base of those rocky foothills, well above the level of the road, is an unmistakable waterline, the bathtub ring of an ancient sea. For the past three or four hours you've been traveling below sea level.

Geologists have pieced together the explanation for this old shoreline above the floor of the Imperial Valley. Once the Gulf of California extended all the way north to Indio, and a little beyond—about half again as long as it is now. But when you dig a hole the size of the Grand Canyon, you've got a lot of dirt to get rid of, and when the Old Colorado River was draining the last advances and retreats of the Pleistocene glaciations it must have been a river of unimaginable power, sweeping out of its ground-out canyons in a chocolate flood. It laid down its load of mud in an alluvial plain two and three hundred feet thick in places, then began pushing out into the gulf, until the spreading delta-cone completely diked off the upper end.

Thereafter, the river seems to have developed the habit of running off the south side of its delta, into the Gulf of California, trying to fill *it* up (though Cocopah Indian stories indicate that from time to time it changed

its course and went off into the basin to the north). But the evaporation under the hot subtropical sun is six feet per year in Southern California, and the entire waters of the cutoff portion of the gulf might have disappeared in less than a century. As the post-glacial river dropped to its present quantity of flow—12 million to 18 million acre-feet a year*—the river couldn't get ahead of the sun in any attempts to refill the basin.

By the time the first Spaniards came north from Mexico more than 500 years ago, the Old Colorado might not have been the river it was when it was cutting its canyons and filling the gulf, but it was still as powerful, erratic, and rambunctious as a Greek god. Especially erratic. In a normal year its flow varied tenfold from low stage to high. Where it formed the shape-shifting border between Arizona and California, it would be a pathetic stream through most of the winter, trying to braid a way through great washes of alluvial junk and the rapid annual growth of the "well-drinker" willows. But, come May, it would begin to grow—no particular hurry, just getting a little bigger, broader, deeper, and browner by the day, creeping up into and then over the willows. It would gradually spread out to low ridges that one wouldn't even remotely connect with the winter river—its own self-made dikes and levees. It was not a wall-of-water flood running like an advance of berserkers under a storming sky; this was a flood that ran in an amiable and leisurely fashion under sunny skies, eating pleasantly at everything it could reach. Most years it ran comfortably between its own dikes; other years it ate them too, melted them like brown sugar, and went running off to play with fields and houses, horses and old trees. Then, in the same leisurely fashion, it would begin to drop off—and drop and drop, until once more it was a little creek picking its way through its own junk.

It had its wall-of-water rages too, to be sure: a sudden heavy thunderstorm up on the plateau, a wet-fall snow low in the piedmont, and in its salad days the Colorado had a *Doppelgänger* as well, a shadow-river that met the Colorado at Fort Yuma: that was the Gila, which was running either twenty feet below its bed or twenty feet above it. The Gila, with its major tributaries, the Salt and the Verde, the San Pedro and Santa Cruz, drained most of Arizona, when there was anything to drain. When there was, it mostly came all at once—and it is still capable of overrunning its check dams on rare occasions.

Everywhere the Old Colorado spilled and splashed its waters, it laid down a little more of the rich alluvial silt it carried. It was land that would grow anything—if watered. But except when the river was in flood, the soil lay baking under the desert sun. One of the first white men to cross the Imperial Valley was a Spanish captain, Juan Bautista De Anza; he was so disenchanted by the climate that he called the region *la jornada de los muertos*, "the journey of the dead."

Marching Song

Cultivators of the earth are the most valuable citizens . . . the most vigorous, the most independent, the most virtuous. . . . While we have land to labor, then, let us never wish to see our citizens occupied at a workbench. —Thomas Jefferson

BY THE TIME the tide of American settlement had washed up on the West Coast in the last quarter of the nineteenth century, some rather cherished ideals had fallen by the wayside—chief among them the ideal of the self-reliant homesteader, the sodbuster with rifle, plow, and Bible, the "Jeffersonian individualist."

The ideal of the free and independent individual can be traced back to a number of roots in Anglo-European society and philosophy—but, less obviously, it has its taproot in the humid climate of Northern Europe, where a landowner was always a land-and-water owner as well.

Colonists on the Atlantic seaboard found the same humid and fecund climate in America—and, indeed, who expected anything else? As the country first began to develop westward, there was the same fertility, and where the rolling lands of the Ohio Valley gave way to the glacial plains toward the Great Lakes, nothing could have been better for the overlay of a quarter-section grid and a Jeffersonian philosophy. From the Mississippi River westward, however, events unfolded like a bad joke. Early reports of a "great American desert" were simply ignored as inconceivable, impossible. But eventually the accumulation of evidence, including rainfall records, established beyond a doubt that west of the vicinity of the hundredth meridian—a line approximately bisecting the Dakotas and extending south to Laredo, Texas—nearly all the land below 8,000 feet, excluding the northwest coast, was too dry for unirrigated agriculture. And west of the Rockies it deteriorated to a lot of inhospitable desert.

When ignoring the situation didn't make it go away, we tried to drive it away with myth and fantasy. Rain would follow the plow (because of the increased evaporation from worked soil); rain would follow the train (because of smoke particles for drops to form around); rain would follow the telegraph (because of electricity in the air). Soldiers had a saying "Rain follows a battle," so experiments were conducted in Texas with explosives and cannons. There were even those who came right out and said what everyone else was more or less hinting at: rain will follow settlement for no reason other than the presence of good people with a destiny to fulfill. On the basis of these myths, in the face of all evidence and good sense, the Homestead Act of 1862 was passed; it provided the basic vehicle for two failures in every three efforts, the demise of even a salvageable compromise of the Jeffersonian ideal, the

* One acre-foot is the amount of water that covers one acre of land one foot deep, the equivalent of 43,560 cubic feet, or 1,233.5 cubic meters, or 325,851 gallons. Assuming a use rate of 200 gallons per person per day, one acre-foot of water will just about meet the annual requirements for a family of five. Average use rates vary from area to area—less than 200 gallons per person per day in cooler and more humid areas, more than 200 in hot, dry regions; they also vary according to economic status—less than 200 gallons per day for low-income persons, and much more than 200 for the affluent.

accumulation of large land and water holdings by railroads and banks, and the storage of a great reservoir of resentment and frustration and hatred toward an indifferent and unaccommodating environment.

By 1890 nearly everyone west of the Mississippi was willing to admit that the Homestead Act and its variations, the Timber Culture Act and the Desert Land Act, had been failures; a landowner had nothing if he didn't have some water, too, and before the West was going to be settled it was going to have to be irrigated. But who was going to do the irrigating? How? There were very few people who had considered the matter at all—in fact, there might have been only one who had given it enough thought to advise on the matter. He had, in fact, been trying to so advise since 1877.

Reclamation and waste

Marching Song

Though some river rats will disagree with me, I have been able to conclude only that Powell's party in 1869 survived by the exercise of observation, caution, intelligence, skill, planning—in a word, Science. A man or a civilization could do the same.
—Wallace Stegner on John Wesley Powell
Beyond the Hundredth Meridian

IT IS ONLY NATURAL on that most contrary of rivers, the Old Colorado, that one of the first people John Lee met after establishing his ferry at "Lonely Dell" in 1871 was trying to get not across the river but down it. I don't know if Lee was down at the river to see it or not—but it must have been a strange sight: a small fleet of little wooden boats coming around the bend out of the Glen Canyons; and in, or rather on, the lead boat, sitting, like the lord of the river, in a captain's chair strapped to the deck, a small, bristle-bearded, one-armed man, Major Powell, on his second trip down the canyons of the Colorado.

By 1871, John Wesley Powell was a government scientist, having parlayed his fame as river explorer into a government contract to survey in the region of the "plateau province." Powell was among those who wanted to see the desert bloom with human settlement, and his foundation philosophy might finally have been described as Jeffersonian, modified by aridity. But he never suffered illusions about how much—how little, that is—of the desert could be brought under irrigation, or about the social and political implications of the irrigation plans. In all of the nonsense about "rain following the plow" prior to the drought of the late Eighties, his voice alone seems to have reflected a measure of sanity. It was generally ignored, of course.

In his famous, if unimplemented, *Report on the Lands of the Arid Region of the United States,* submitted in 1877, Powell outlined a proposal for the settlement of the West by irrigation districts of "any nine or more persons" who would draw up their own plan for the irrigation of the area they wished to settle, and be granted title to the land upon completion of their project. The most important aspect of it was that the right to water would inhere in the title of the land. The farmers would be land-and-water owners.

In 1890 Powell amplified on his larger picture for the settlement of the arid regions, suggesting "that the entire arid region be organized into natural hydrographic districts, each one to be a commonwealth within itself." And who was to build the dams, dig the canals? Even though he was a government scientist, working on government surveys, Powell was a Jeffersonian to the core here: "I say to the Government: Hands off! Furnish the people with institutions of justice, and let them do the work for themselves."

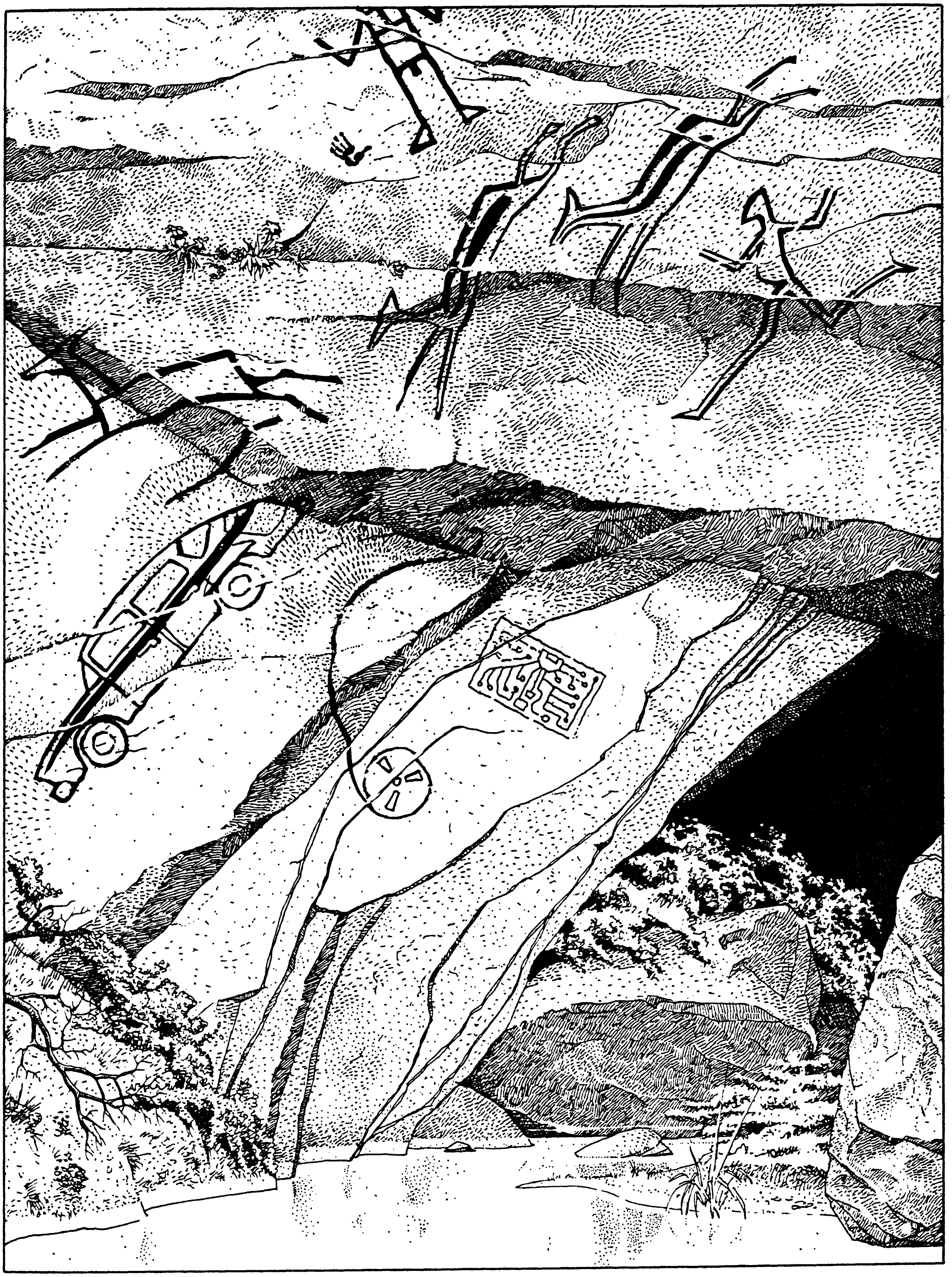
Twelve years later, the Reclamation Act established the Bureau of Reclamation, to undertake the further development of the West through the development of its water resources: to locate and survey all irrigable areas, to construct works for the storage, diversion, and development of water—in sum, to do the people's work for them. The cost of reclamation projects was all to be repaid by the water users, of course. And there were concessions to the form if not the substance of the Jeffersonian ideal: the most land one owner could have irrigated with "federal water" was 160 acres. But the consequences of the act were apparent from the start: instead of the unfeasible independent and self-reliant Jeffersonian with his "government which governs least," or the more feasible idea of Powell's "local government by hydrographic basin," it was going to be Uncle Sam in charge.

Powell's specific and radical ideas were never seriously considered: it was too late. Too many mistakes had been made and reinforced in the West by Anglo-Americans totally naive about the nature and problems of aridity. Already, for example, many of the best irrigation sites had been "homesteaded" or otherwise taken over by capitalist entrepreneurs who had put in a headgate or a pump and a set of ditches and were selling "water shares" to farmers whose resultant dependence on the company created a circumstance closer to vassalage than to self-reliance.

But the hydrographic integrity of the river basins was much more seriously confounded by such problems as the ridiculous and irrelevant designation of state boundaries—just as the Indians could never quite understand those invisibilities called "reservation boundaries," the rivers had no concept of state boundaries and continued to run as they always had. So the state of Colorado is tidily designated on the flat map as bounded by the 102nd and 109th meridians and the 37th and 41st parallels. But within that chartmaker's delight, four major rivers originate and none ends.

The crowning insult to any idea of political-environmental integrity was the United States negotiations with Santa Anna in Mexico for the final boundary between the two countries. The U.S. sent a railroad man from South Carolina whose only interest in the affair was the acquisition of enough land to accommodate a transcontinental railroad down the Gila Trail through Yuma. All James Gadsden knew about water was how to bridge it and pass it, and he effectively gave away the last forty miles of the only significant water in the far Southwest.

As a result of this truly titanic insensibility, the United States has to pass 1.5 million acre-feet of half-used and half-"virgin" (as they say in Tijuana) water



Martim Avillez

over the border every year, regardless of conditions, under a treaty negotiated in 1944. The "aesthetic value" of something like hydrographic integrity is seen to be very closely related to economics here: as a result of recent negotiations with Mexico over the quality of the water at the border, the United States is going to pay $100 million down and another million a year to desalinate part of that used, reused, and overused water from the desert empire.

Voice Crying in the Wilderness

I want to say to you ... there is not sufficient water to supply these lands. There is no water to put on half the lands now owned by the Government. There is not water enough in all the arid region to irrigate the lands which the Government has already disposed of ... there is not sufficient water to supply the land! —John Wesley Powell at the Second International Irrigation Congress

THE "KEY STRUCTURE" in the construction of the two-river system in the Old Colorado Basin was not a dam, but the Colorado River Compact of 1922. Before steps could be taken to make the use of the water possible, the seven states had to figure out who was going to get to use how much—or to bring it down to the real problem: five states had to be reassured that California wasn't going to claim rights-by-use to the whole thing before anyone else could get rolling. (The sixth state, Nevada, has usually acted like an extension of California in river negotiations.) It seems quite unlikely that, left to their own devices, the seven states would ever have managed to get together on a water-use plan—let alone managed the vast finances of projects on anything approaching the present scale.

All of the water development being done along the Colorado prior to 1921, with the exception of a couple of early bureau projects (the Laguna weir dam north of Yuma, some levee work, and the Uncompahgre Tunnel in the Upper Basin), was being done at the municipal or private level. There were a number of privately owned irrigation developments in the Palo Verde Valley, the Yuma Valley, and after the dredging of the Alamo Canal in 1901, the Imperial Valley. But for the most part these private developments were marked more by the water developers' desire to recoup their investments than by effective irrigation of a maximum of land with a minimum of water.

The extreme example of the misadventures of private enterprise in this kind of work was the California Development Company, which first tried irrigating from the Colorado in the Imperial Valley. Remember the geography: America's meanest river entering a sub-sea-level region on a built-up dike forty feet or so *above* sea level. No problem with gravity flow in the canals but generally a precarious operation. But the CDC's intake channel and gate silted up in 1904; being a little short of cash at that moment, the company risked an ungated intake channel through the river's levee. Within a matter of weeks, the whole river was coming through a widening breach; the fields were washed away; the Salton Sink became the Salton Sea; and the CDC declared bankruptcy.

Left in the hands of private enterprise, the modern history of the Colorado River Basin would probably have read like that 100 times over with variations.

The tragic notion that we might live in a finite world where not even technology, science, and rationalized economy can produce as much of everything as everyone wants is a recent notion in America. And when Herbert Hoover came west in 1921—"almost an ambassador, if you please," one writer said—notice was effectively served that the government was finally ready to pick up where first individual effort and then private enterprise had failed.

Recognizing that the problem between the seven states was the fact that California was ready to roll and no one else was, Hoover suggested that the river be divided into two rivers: that way, the states owning and operating each river could figure out how to divide it up at their own leisure, but, meanwhile, the Bureau of Reclamation could get on with the job of controlling and developing it. The Hoover compromise was the sine qua non for Hoover Dam, which in turn was the sine qua non for the desert empire.

When Franklin Roosevelt dedicated this dam in 1935, he called it "Boulder Dam"—he didn't invent the name, but he gave it official sanction, and the injustice wasn't corrected until 1947, after Roosevelt's death. One can understand why he might have preferred that it not be known as Hoover Dam: with the exception of Grand Coulee Dam on the Columbia River, Hoover Dam was easily the biggest single-site public-works project undertaken in the Thirties—if not in size, certainly in impact; the Boulder Canyon Project had a mythic stature in the changing American consciousness, and its economic impact was immeasurable. By almost any of the standards of its day—revitalization of the economy, industrial recovery, reduction of unemployment, stimulation of investment and development—the Boulder Canyon Project looks like the prototype New Deal effort, but the army of men and machines was already gathering a year-and-a-half before Roosevelt was elected. And the project itself had been initiated in effect ten years before that.

It isn't my intention to nominate Hoover as a silent partner in the planning and construction of the New Deal so much as to ponder the degree to which the New Deal was mostly a repackaging (with some variations, most of which were eventually dropped) of what was already pretty well under way in America—at least in the West. Six Companies, the consortium of Western contractors who built Hoover Dam, realized that the public treasury had replaced private capital as the prime mover in America.

It is not difficult to disassemble the paradox of Hoover's eagerness to change the Colorado River, and his reluctance to put through other social programs: Hoover was first, and always at heart, an engineer. Before he went to work for the government in World War I he had been an engineer-errant all over the world. As President he wouldn't undertake to reform a society, but as an engineer he undertook the challenge of reforming a river.

And when one strips off the necrotic ideals and theories of the Thirties and takes a hard look at post-depression America, it is difficult to find a place where we have really worked for true social and economic reform if, instead, we were able to interpose another brilliant sequence of engineering miracles to postpone for a year or forever the social and economic confrontation with what some, in their hard-nosed unimaginative way, might call reality. In this no-longer-so-new age of technology, science, and rationalized economy, that is the story of the Lower Colorado River, water in the West, and America in general since Hoover Dam and the New Deal.

Facts and mysteries

Marching Songs

When we come to the engineering problems we meet the heart of the river dispute.... An engineering problem has a peculiar appeal to the Hoover type of mind—a type that is active, acute, logical, and constructive. And the Colorado River problem is primarily an engineering and economic problem.
—Wayne C. Williams
American Review of Reviews, June 1922

Take a method and try it. If it fails, try another. But above all, try something.
—Franklin D. Roosevelt, 1933

Thousands of complex operations were scheduled and carried out as an army of workmen, most of them craftsmen, swarmed about the canyon like ants but performing like a well-oiled machine.
—From a wall collage at Glen Canyon Dam

YOU CAN APPROVE or disapprove of dams on rivers in theory; you can even go so far as to learn to hate or advocate them as the theories become propaganda.

But confronting one of the great dams is an experience above and beyond all theory: it transcends the rationales offered up for taking on the challenge, and becomes a communion of sorts with the essential mystery of challenge itself. You stand down at the base of one of those monstrous featureless faces of concrete, and you don't even think of saying, "Well, that sure is beneficial," or "Man, what a sin against the environment"—or I don't know: maybe you do.

But to be such a sensible prude would be to be out of touch with one of the strongest and most compelling threads running through the whole human experience around the world: that tendency to evolve increasingly complex interdependent societies (usually based on intensive irrigated agriculture) whose only permanently discernible end seems to have been the erection of magnificent, mysterious, monolithically faceless incredibilities—the pyramids of Egypt and Central America, the cathedrals of Europe, the Great Wall of China, the temples of Angkor, Stonehenge, the heads of Easter Island—and the two great canyon dams on the Colorado River. " 'Come,' they said, 'let us build ourselves a city and a tower with its top in the heavens, and make a name for ourselves.' "

Of the two canyon dams, the sense of "communion" is much stronger at Hoover than at Glen Canyon. A piddling thirty years separate those two structures, but probably never in human history has so much happened in thirty years. When Six Companies and its army moved into the bottom of Boulder Canyon in 1931, America was effectively still trying to get organized to happen; by 1963, when they closed the gates at Glen Canyon, it seemed that too much of America had happened too quickly.

I am not just being mystical about this; I will swear that a different sense of America is empirically present at each of those dams. There is, for example, the water spouting from every bolt-hole in rock walls beside the dam at Glen Canyon—it's not ominous so much as insolent. And Glen Canyon Dam cracked not long after the river started putting its weight against it: not a serious crack, but "concrete evidence" that by then America was as divided as the Old Colorado. The imprecations from a million environmentalists are as much a part of that structure as its 5 million cubic yards of cement.

But there are no leaks in the darker andesite breccia at Boulder Canyon, and the dam is as solid as Roosevelt was in '36. This is where the Colorado River was really broken and put in harness, but there is a quality to the place that makes me, for one, feel that the river was not really demeaned by the act—that, once completed, the dam began a separate existence on a level of being with the river: whatever we use it for is irrelevant to the basic task it assumed, which is to teach the river to stand in and push rather than to cut and run.

My only complaint about Hoover Dam is the intrusively noisy tour the Bureau of Reclamation and the Park Service put you through if you want to see the dam. The moment you start down into the dam—a 500-foot elevator drop that raises hell with your eardrums—a disembodied voice clicks on (the kind of voice that would make you grab for your wallet in a used-car lot): "Welcome to Hoover Dam... enough concrete to pave a standard highway sixteen feet wide from San Francisco to New York... power to run 500 electric toothbrushes to doomsday...."

This is a problem of sorts all the way along the Lower Colorado River: there is always a guide or recording to bury you with facts and figures. But Hoover Dam had its subtle ways of coming in around the edges of the guided tour, the fountain of statistics—as when I was down on the powerhouse deck, outside by the big step-up transformers, and the guide was rattling on about generators, transformers, and turbines big enough to mangle 500 cats a minute... but while he was talking, something was going *gronk*, an unhuman, omnidirectional *gronk*; the water between the wings of the powerhouse—a space big enough to hold the *Queen Mary*—was boiling and welling as if some prehistoric creature were about to surface; the very air seemed to hum in empathy with the huge wires taking the leaping power almost straight up out of the canyon. And behind us, curving up and away as smoothly as the

glass mountain of faith, was not a beneficial use but an elemental presence: the Immovable had been invoked to come put its back up against the Irresistible. There it sits, or squats, bland as a Buddha, Immovable, and the Irresistible is confounded.

The bureau's facts and figures—the irrelevant ones issued in situ, at any rate—merely insulate a person: they're there like the life rings around the deck, the illusion of something to hang onto in case you fall in.

But, given our bounden duty as good citizens to consider mundane function as well as divine form, it is necessary to make an effort to assess the impact of the imposition of the Immovable on the Irresistible. This means moving out into those facts and figures—the real ones, that is: not the general-issue irrelevancies passed out at the dams but the ones that either justify the effort—or don't.

And the important thing in such an inquiry is not to go in with a shovel to dig up the dirt, but to go in with a kind of Sherlockian "diffidence of scrutiny," to look not so much at the facts and the figures as at the spaces and spacing between them, the arrangement, the *religion* to them.

"Religion" is a slightly suspect concept we've tried to steer clear of in this age of technology, science, and rationalized economy; it smacks of irrational elements, vagaries, and illusions. But this seems to me to be a rather serious misconception of the basic idea of "religion."

Etymologically, "religion" is, perhaps appropriately, shrouded in some mystery, but one theory traces it back to the Latin *re*—for "back" or "again"—plus *ligare*—to bind together, connect. *Religion,* then: a connecting up again, a reassembly—of what? Well, whatever your world is made up of, whatever lies around in an unassembled form inviting assembly.

And in an age of technology, science, and rationalized economy, spiritual expression and art have gone beyond the limits of wood and stone for their higher expressions—after the cathedrals of Europe, what can you do with wood and stone, no matter how much "faith is the mortar"? As Spengler tells us, Europeans exhausted the "plastic" of stone and wood and color in those great structures; and artistic expression moved into the abstract regions of music, and then beyond even music, into mathematics. "Religious" art (if that isn't a tautology) became the connection and reconnection of abstract statistical elements into ever bigger and bigger assemblages. We ourselves have become correspondingly smaller and less significant as entities, being only atoms in the demography of "rationalized economy"; and we have only continued to play along, I think, because of our continuing fascination with the effort. All of our most costly expressions—the bomb, the extensions into space—can be seen to be the expressions of (and not necessarily the *point* of) the same Faustian imagination that had to invent the "higher mathematics" to go beyond even the expressions of Baroque music—Bach and Leibniz were contemporaries: the torch, so to speak, was passed. Leibniz with his monadic hierarchy, reaching to the infinite monad, God Itself.

But that's the river within us all—the purpose is to look for its reflection in the river we've made.... So on into the *real* Lower Colorado River, some of which I brought back in a suitcase.

Six Companies, Before and After

Henry, it sounds a little ambitious.
—W. A. ("Dad") Bechtel, to Henry J. Kaiser

But even if Kaiser becomes a much less active member of the group, the other Six Companies men will hardly lose the art, the desire, the excitement, and satisfaction of working together. The West, in its rightful hunger for the things they were able to bring, still needs them. They also look beyond the West. Henry Morrison talks of highways and railroads to be built in China. Steve Bechtel (son of W. A.) and the others see Europe and South America and Asia needing old factories rebuilt and new ones engineered. "We're not worried about any postwar letdown," says his younger brother. "For us the postwar is the period when we will really come into our own."
—Conclusion of a *Fortune* perspective piece, 1943

The same people who give us these water projects gave us Vietnam. (Hoots of laughter)
—Opinion offered as testimony,
Department of Interior water-project hearing,
Grand Junction, Colorado, March 1977

THE MEGALOPOLIS usually has no real overall social or political structure as it is forming other than its existence as an accumulation of people all going more or less the same way. This is not true for the Los Angeles–San Diego megalopolis, however: well before it was a true megalopolis, there was a tie between the two largest cities and all the towns and small cities around and in between; the tie was water, and the binder was the Metropolitan Water District.

The Metropolitan Water District is a "supplemental supplier"—in effect, a wholesaler of water to local water districts which need to supplement local supplies in order to meet their demands. In its 4,900-square-mile service area along the West Coast south of Ventura, the MWD supplies well over half of the domestic and industrial water.

It is no coincidence that the MWD was formed by the California state legislature in 1928, the same year the Boulder Canyon Project Act was passed by Congress. Los Angeles had already "acquired" some "outside" water via the Los Angeles Aqueduct—"Mulholland's Ditch"—from the Owens Valley in the Sierras. But that project was hardly completed before it was apparent that it wasn't going to meet the growing city's needs—or, rather, its demands—forever. The closest potential supplier of water was the Colorado River—250 miles away over desert and mountain. If the Bureau of Reclamation could organize the installation of a plug big enough to store the Colorado River, Southern Californians would find a way to get the water to their cities. No one doubted this.

Accordingly, the MWD was formed, and a $220 million bond issue floated; and in 1930, before the Boulder Canyon diversion tunnels had even been begun, the Department of the Interior had negotiated

contracts with the MWD for 1.1 million acre-feet of water, once the dam was completed and the MWD had a means of delivery.

This 1.1 million acre-feet is an interesting figure in the "religion of the age." Arizona's concern that California would be able to appropriate all the water in the Lower River, before Arizona could get underway to use a share of it, had led to the California Limitations Act of 1929, in which California statutorily promised to limit its appropriations to senior rights on 4.4 million acre-feet a year. The 1930 contracts divided this water into 3.85 million acre-feet for agricultural irrigation and 0.55 million acre-feet for the MWD.

But there was all that other water in the river, reasoned California, that Arizona and the Upper River states weren't able to use yet—why couldn't California "borrow" a little of that "surplus water" for the time being? So the Department of the Interior went along, and wrote contracts for a total of 5.362 million acre-feet—almost 1 million acre-feet of "surplus water" that California would eventually have to relinquish. The MWD allocation was doubled, and another 112,000 acre-feet was thrown in for San Diego —then still a moderately sleepy little burg. The desert empire was going to grow on borrowed water.

In 1934, with Hoover Dam just a little over half done, the bureau's engineers took the MWD's money and began work on Parker Dam (about 150 miles south of Hoover Dam) and the Colorado Aqueduct. In its own way, the Aqueduct was every bit the engineering marvel that Hoover Dam was: designed to move up to 1 billion gallons a day from Lake Havasu behind Parker Dam up over a total pumped lift of 1,617 vertical feet, through the San Jacinto Mountains in tunnels, and into Matthews Reservoir near Riverside, a total trip of 242 miles through pipe and canal.

That same year, another 150 miles down the river, construction began on the Imperial Dam and the All-American Canal, both of which were actually part of the Boulder Canyon Act. This was a sophisticated irrigation project, consisting originally of a diversion dam with desilting facilities and eighty miles of "all-American" concrete-lined canal to replace the old cobbled-up Alamo Canal, which lay mostly in Mexico. The canal was designed to deliver more than 3 million acre-feet a year into existing works in the Imperial Valley, with extensions into the Coachella Valley north of the Salton Sea, eastward into the Gila Valley in Arizona, and south to the Yuma Valley and Mesa (then served by the old Laguna weir dam, a low-overflow diversion dam built by the bureau between 1907 and 1911). Imperial Dam was not designed for storage; irrigation water is "ordered" from Parker Dam—a three-day trip down to the diversion works, and a seven-day trip to the farthest reaches of the Coachella Valley.

Both of these projects—the water for the cities, and the water for the food for the cities—were put into operation in 1941. Just in time for the war boom in Los Angeles and San Diego.

In 1941 it must have looked beautiful. In a single decade the Colorado River had been put in harness and the desert empire sketched in. The old unpredictable and shifty river was dead; a new controlled and efficient river with most of its dials and gauges and faucets in place was providing a steady supply of food and water for growing cities on the edge of the most inhospitable desert in America. And en route to the homes and fields, it was spinning the great turbines that were, in a classic bit of bureau tractor-poetry, "humming the endless tunes of untold wealth": in the prewar years the first four generators on line at Hoover Dam were supplying Los Angeles with 98 percent of its electricity.

All that remained were some finishing touches—a couple more smaller diversion dams for irrigation (Palo Verde in 1957 and Headgate Rock in 1967), and then the big dam at Glen Canyon that would make the compact division a matter of fact, and would stack up in combination with Lake Mead the inconceivable storage of more than three years' total flow of a great river.

Supply and demand

Voice Crying in the Wilderness

This is the dead land
This is cactus land...

Between the idea
And the reality...

Between the conception
And the creation...

Between the potency
And the existence...
—T.S. Eliot, "The Hollow Men"

IN THE HARE-AND-TORTOISE race between the idea and the reality, plodding reality is catching up. There has been a lot of water through the dam, but has it been enough for the empire? We could look first at those "endless tunes of untold wealth" that were to have been hummed in chorus by the banks of mighty hydroelectric generators up and down the river. When the bureau was trying to sell the idea of a single huge and costly dam to control the Colorado (the contract was the biggest ever let by the nation), the sale of electrical power was to repay the construction cost—and it will: the fifty-year repayment plan is right on schedule.

Critics doubted, however, that such a "huge" power demand could be generated in the desert. So the bureau was in the position of having to promote and peddle its product: the promise of lots and lots of cheap, clean power for the empire.

But a problem with power generation out of a dam whose primary purpose is storage is that, once you run the water through your turbines, it isn't stored anymore; and the supply of hydroelectric power along the Colorado has been a function not of the demand for power but of the growing demand for water and the correspondingly shrinking supply. As a result, one usually strains in vain to hear the generators on the

Colorado dams humming in chorus: in forty years of generation at Hoover Dam, only once have the generators worked up to 60 percent of their "nameplate" potential—in 1952, the year of near-record runoff—and the average for forty years is under 40 percent of potential.

What supplies the enormous power demand today in Southern California, of course, is not-so-cheap, not-so-clean, and not-so-endlessly abundant steam power generated by gas-fired plants along the oceanfront—such as Scatterloud, El Segundo, Redondo, south of the Venice beaches—and the huge desert plants, such as the Navajo Generating Station on the shore of Lake Powell, one-third-owned and -operated by the city of Los Angeles. The promise of hydropower helped build the empire—but good old consumptive, pollutive, and dependable steam power operates and maintains it.

A variation on this situation is the currently out-of-control California dream of lots and lots of water for the cities. Knowing from the start that they were growing on borrowed water, Southern California and the MWD began looking even further afield—not for water *in addition* to what they had, but for water to *replace* part of what they had.

The search for new water—not just in Southern California but in the rest of the state, too—led to the State Water Project, probably the largest "rationalization of nature" ever yet undertaken anywhere. This is strictly a State of California (Department of Water Resources) project, which, when finished, will deliver more than 4 million acre-feet a year around the state at a total construction cost in excess of $3 billion. The annual power bill, just to move the water around, will be 7.1 billion kilowatt-hours (net, after subtracting the system's own hydro-generation). The project is currently about 75 percent done, with a few reservoirs to go yet. The main canal, the California Aqueduct, with 600 miles of concrete ditch, is completed.

The MWD has contracted for 2.0115 million acre-feet of State Project water when the system is completed; now, the MWD's entitlement is in the neighborhood of .7 million acre-feet a year. As the amount received from the state has increased in recent years, the district's use of borrowed Colorado River water has decreased accordingly—until this year.

The second year of drought in the Sierras has so drained the incomplete storage facilities of the State Water Project that it was necessary to entirely cut off the allotment to Southern California this spring. This left the MWD no choice but to turn on the Colorado Aqueduct full bore: a billion gallons a day, forty-five thirty-year-old pumps going around the clock with no backup capacity in case of breakdown. Northern California is paying the extra electric bill, about a third of something just under 2 billion kilowatt-hours—in a power-short year, remember.

But even with no maintenance problems and a brimful canal every day of the year, the MWD cannot pump enough water through the aqueduct to fulfill last year's demand of 1.4 million acre-feet; they can only move a little over 1.2 million acre-feet. Accordingly, the MWD has asked its "retailers" to enforce a 10 percent "mandatory conservation" program in order to maintain reservoir reserves in the city.

In short, there is simply not lots and lots of water; there is barely enough water—but what seems to be missing in Los Angeles is a general sense of appreciation for the magnitude of the precarious miracle that manages to supply even barely enough water.

Of the three necessities for the modern industrial city—food, water, and power in huge quantities—the supply of the last two is seen to depend on systems that are operating at, or beyond, their reasonable limits, and the supply of the first is increasingly threatened by salt in the fields. The Colorado was a hard-water river with a high salinity even before men started using it. But for water stored in reservoirs, nature exacts a storage charge through evaporation—evaporation losses along the two rivers total close to a tenth of the average annual flow (just under 14 million acre-feet). This concentrates the salts and minerals in the remaining water, and every time we run the water over the fields, more salts are dissolved and carried back into the river. Then water that evaporates out of the furrows in fields down the line leaves a white "bathtub ring" of salt that ultimately destroys the productivity of the fields.

In 1974 the Colorado River Basin Salinity Control Act was passed to get remedial measures underway for this growing problem. But desalination is a terribly expensive and power-consumptive process, and the remedial practices in irrigation (such as "pressure irrigating" from pipes) are equally expensive. And this damned maintenance work does not move the imagination the way building the dam did. We tend to think of our cities, especially Los Angeles, as profanely secular places. I hope I have helped illustrate what an act of naive faith it is to turn on a faucet in Los Angeles.

WE CAN TRACE some of our present problems along the two rivers to "the river's joke." When the seven states sat down in 1921 to divide the river, measurements at the time indicated an average annual flow of just under 17 million acre-feet. So they divided 15 million acre-feet equally, 7.5 million acre-feet to each river. That's not being unduly piggish. But in 1929, the year after the compact was signed, the river went into a forty-year "dry cycle," over which it averaged an annual flow of only 13.1 million acre-feet.

The long-term average is now around 13.9 million acre-feet—and with "entitlements" of 7.5 for the Upper River, 7.5 for the Lower, 1.5 for Mexico, and another 1.5 for "nature's storage charge" and other systems losses, a problem of supply can be seen to exist that isn't *entirely* our fault.

But the truth is, we would eventually have come up against this problem, even if the river ran an average of 20 million acre-feet, due to the nature of our religion—which we of course denied as being a "religion" at all, and thereby never examined for flaws of faith. But our faith in technology, science, and rationalized economy has a profane and tragic flaw: we have assumed an infinity of supply, capable of fulfilling an infinity of demand, if we can come up with the technology of production.

Where we came up with such a notion, God only knows; everyone else in the world is not so deluded. Perhaps it, too, like the ideal of individualism, is rooted most deeply in the fertile soil and humid climate of the North Atlantic world where no one has ever known what it is to want for water.

Spengler seems to make that kind of connection between the Jeffersonian man and the illusions of infinity when he talks about "infinite solitude" as the prime symbol and "home of the Faustian soul." And so does Faust, our cultural prototype—remember Faust's last effort, which was to be the "masterpiece of the human spirit": "the people's land reclaimed from sea." When Goethe lived, America had not even discovered that the Anglo-European consciousness was in possession of one of the world's great deserts, or he might have put Faust in Arizona—a shorter trip home for Mephistopheles. Had he lived today, he might have written the story of water in the West—a far bigger story, but much the same one.

Well, at least, we say, there's hope. We seem to be waking up to reality in this country. There is Environmental Awareness. To be sure, we are waking up to the realities of finitude. The significance of something like the Water Quality Act, which aims for "fishable and swimmable" waters in all streams by 1983, goes far beyond the recreational and hygienic values—provided the spirit of the law is followed, and it doesn't just become another bonanza for lawyers to pick apart in the letter.

But up against that we have to contend with the evidence that the profane faith is still strong in us—or, at any rate, among us. Take a look at central Arizona, at Phoenix, named for the mythic bird that is surely the sign and symbol for our desert empire.

The priest's solution

Voice Crying in the Wilderness

Civilized means citified, trained, faithful to some regimen deliberately instituted. Civilization might be taken as a purely descriptive term, like Kultur, *rather than a eulogistic one; it might simply indicate the possession of instruments, material and social, for accomplishing all sorts of things, whether those things were worth accomplishing or not.*

—George Santayana
"Marginal Notes on Civilization in the U.S."

THEY HAVE A PROBLEM in Phoenix and Tucson: there isn't enough water there to maintain civilization as we know it in Pennsylvania and Illinois.

The only major source of water in that central Arizona desert is huge aquifers underground, at depths from 200 to 1,200 feet, that have been collecting small yearly deposits of water for eons.

The two cities, and the agricultural lands around them, have been pumping these aquifers for nearly all their water; they are pumping it much faster than it is being replenished—overall, more than twice as fast. The water table is dropping as much as thirteen feet a year in places. The Arizona Water Commission is aware of this, and has its engineers working on the problem. But when you turn a problem over to engineers, you are going to get an engineer's solution—just as a priest would give you a priest's kind of solution; and as the spaces between the figures increase proportionally to the decrease in raw water available for manipulation with figures, the priest's and the engineer's answers draw closer together: have faith.

The fundamental problem, and the nature of the solution, are brought out in the State Water Plan (Phase I):

> *Obviously, we cannot keep up our profligate ways forever. Actions to balance supply and use must be taken. Fortunately, a major step forward is well underway. The Central Arizona Project, a federal reclamation project currently under construction, will bring an average of 1.2 maf [million acre-feet] per year into Central Arizona.*

Does this call to mind the moment from the movies when, just in time, the U.S. Cavalry rides over the ridge?

If you were to stand a mirror along the Arizona-California border in Lake Havasu, the reflection of the Colorado Aqueduct would be the Central Arizona Project: 300 miles of the usual pipes, pumps, and canals to carry Colorado River water to the Phoenix-Tucson corridor.

That figure, "an average of 1.2 maf" ("an average of" is a modifier in bureau church Latin), is one of the more interesting figures for demonstrating the state of the faith today; it would take care of roughly two-thirds of the present "overdraft" of ground water in central Arizona. But it turns out that the figure is an average of fifty years of deliveries from the Central Arizona Project ranging from 1.5 million acre-feet to 0.98 million acre-feet—and during those fifty years (1985-2035), a period when the most conservative estimates see the population of Phoenix alone more than doubling from its present million-plus, *the deliveries will decrease from 1.5 million acre-feet to 0.98 million acre-feet.*

The reason the figures will decrease is "probable increased use of Upper Basin allotments." So what "an average of 1.2 maf" means is that central Arizona, like California before her, is going to grow on borrowed water from the Colorado River. This isn't history now; this is the future we're talking about. Last spring in Phoenix, I attended an open work session of the Arizona Water Commission at which the commission sat to hear its engineers' recommendations for the distribution of the Central Arizona Project municipal waters. The job was not easy: it had 500,000 acre-feet to meet requests for over 2 million. The way it resolved the problems was by giving everybody a little bit—allotments ranging from 3 percent to 100 percent of the requests, with the average around 25 to 30 percent. The engineers were candid about saying that some of the developments would probably outgrow their issue of Central Arizona Project water, and rather quickly. One

development in particular was discussed at some length; the developers have already sold 6,000 of their 12,000 lots; they have their streets and utilities in, but they will be given only enough water for 7,000 lots in 2035.

Even assuming that the realtors are pipe-dreaming about their eventual developments (as they probably are to a degree), the engineers calculate that the central Arizona corridor can only hope to balance its projected demand with the dependable supply (Central Arizona Project water plus groundwater replenishment) if nearly all the agricultural land in the central Arizona area is retired. But who's going to bell *that* cat? (If we ask them nicely, will the farmers just go away? Should we buy up their land for a "brown belt"?)*

The discussion of the "fundamental problem" in the State Water Plan continues:

> *Additional actions will be necessary (in the future)... to meet municipal and industrial growth requirements without increasing overdrafts.*

Or, to translate: find more water somewhere and bring it in.

In 2035, instead of gratitude that the Central Arizona Project ditch is still half full—if it is—there is likely to be concern that it is half empty. The same will be true of the Colorado Aqueduct to Los Angeles. There will always be a little more land that could be irrigated out of the All-American and Gila Canals. In short, we have the facilities; if only we had a little more water. And, not including small municipal plants, there are ten major "technological extensions" carrying water *away* from the Lower Colorado River: why not one or two to carry water *into* it?

An abortive Central Arizona Project bill in 1967 (the one that also included two Grand Canyon dams) suggested just that, in the form of a proposed study to divert water from the Columbia River. The people in the Northwest protested so vigorously that, for the Central Arizona Project bill to get through in 1968, it was necessary to write in a ten-year moratorium on even mentioning the subject. But also included in the 1968 bill was the creation of the National Water Commission under the Secretary of the Interior to study the national water situation, and a vague section about the U.S. relieving the two Colorado Rivers of responsibility for the international obligation to Mexico as the first allocation from a 2.5-million-acre-foot augmentation to the Colorado Basin—just in the event that such a thing should ever happen, that is.

Diversion from the Columbia River is not the only augmentation idea being pursued. For the past decade, the Bureau of Reclamation has been experimenting with cloud-seeding as a means of snowpack augmentation in the San Juan Mountains of Colorado—over the vociferous complaints of San Juan residents, it might be added, who don't want to shovel any more snow than they now get. The results of cloud-seeding have been, unfortunately for the faithful, inconclusive —but the bureau blames this on excessive and unrealistic controls insisted on by San Juan residents.

The possible consequences of this kind of augmentation go far beyond the political. It is one thing to move water around on the ground from river to river, something else again to try to manipulate weather patterns. Nobody really knows what might happen—although the general lack of success indicates that these attempts might be on a par with the old "rain follows the plow" assumption and the explosives tests of 100 years ago. It does seem inevitable at this point that there will be more talk about diversion from the Columbia River, when the moratorium is off next year.

And then there is that persisting pipe dream of the infinitely faithful—NAWAPA, not an ancient Indian god, but the acronym for North American Water and Power Alliance, a $200 billion project to bring 160 million acre-feet of water a year from Alaska and northern Canada through canals 700 feet wide to reservoirs 500 miles long, to supplement the water supply of thirty-two states. It will... I beg your pardon. It *would* at least double the total flow in the two Colorado Rivers.

They will wait in Phoenix for the water to come from wherever the water will come. And if it doesn't come, if the water dances of the Udalls and Goldwaters in the halls and committee rooms of Washington come to nothing, then Phoenix and Tucson will pump from the Pleistocene aquifers until the pumps go dry: then, like the Hohokam Indians before them (some of whose ancient irrigating ditches were dug out for Phoenix use), the faithful in Phoenix will fold their developments and silently steal away.

The phoenix, remember, never did intend to live forever.

Marching Song

I think most Arizonans would agree that the Tucson area I represent is a major center of environmental concern in our state.... Asked [in a poll] if they believed we could maintain both a strong economy and strong environmental laws, 88 percent said yes. —Sen. Morris Udall, March 1977

HEADING SOUTH from Yuma toward Mexico, I passed the turnoff to the site of the future Yuma Desalting Plant. This will be the first major effort to do something about the international problem of saline water from the Colorado Basin to Mexico. This is getting into what you might call the "second-order problems" of the river: if you would call the Lower Colorado River the solution to a problem, then the eventual string of desalination plants along the river would be "solutions to the problems caused by solutions." And when you look into the power requirements for any of the desalination processes, it becomes obvious that the solutions to the second-order problems will eventually become problems requiring solutions in the third order... et

* Recently, the Carter Administration announced that further funding for the Central Arizona Project will depend in some measure on the state's ability to come up with a workable groundwater management plan. The Administration's evolving "water policy review" is still in a more or less embryonic stage, but will eventually deserve much more than a footnote—if only to describe the battles.

cetera. What we are beginning to learn about this business of technology as a cure-all could probably be formalized into a law: technological problems increase in exact proportion to technological solutions.

All precipitation is the result of a desalination process. Water running through any land picks up a certain amount of minerals, alkalis, and salts. These are carried to the sea by rivers, and there the sun removes part of the water from the salts: that's why the rain is pure and the sea grows saltier all the time.

But the sun, in spite of its resources, doesn't work fast enough for the empire's demands. So we are going to spend $100 million over the next several years for a border plant to take part of the salts out of 167,000 acre-feet of very saline return flow from some Gila Valley projects. That doesn't sound like a great deal of water for a $100,000 plant, but desalination is not a very rewarding process: you pay a lot for a little. More than a fourth of that 167,000 acre-feet will be lost, too, used to carry the salts off to the sea in a concrete ditch.

This is an indication of how desperately valuable water is getting to be down in the Lower River Service Area—it is literally worth more than gold, or at any rate the paper stuff that used to be backed by gold. And an even more extreme example is our readiness to invest $16 million in pumps to be installed at the border: their function will be to pump water out of the ground into the river channel for credit toward our Mexican obligation. The reason we have decided to install pumps is that the Mexicans installed some pumps close to *their* side of the border and were pumping *our* groundwater (water, you remember, having no concept of borders). The official term for our response is "protective pumping."

Unquestionably, the empire is experiencing dog days when the major projects along its river are in that category—Boulder Canyon to "protective pumping" can only be called a decline. And without substantial "augmentation"—which would of course only defer the problems for a generation at best—such problems are going to increase in number and complexity as use of the two rivers increases. At present, you could say the river is about 120 percent committed and 85 percent used; and the empire builders in the Upper River states will not be content until the river is 120 percent used.

The apparent success of the Lower Colorado River reclamation projects can be seen to rest almost entirely on the vast storage of water possible behind the two great canyon dams: the annual flood is contained and distributed according to a regular schedule (the river only comes when called), and there has been enough left over above demands to cover three to five bad years, maybe more.

But what is not so immediately obvious is the degree to which the actual storage in those two reservoirs has been the direct result of a "time lag" in the full development and use of the two rivers' waters. At present, the total use of Upper and Lower River water is around 12.2 million acre-feet a year (Upper River, 3.8; Lower River, 6.1; Mexico, 1.7; Lower River system losses, 0.6). By 1990, with the Central Arizona Project completed and delivering, and the coal-oil shale-mineral development in the Upper River area booming to fill empire demands, the total use is expected to increase to around 14.2 million acre-feet in just over the long-term average annual flow.

A U.S. Geological Survey study predicted that the Upper River states would never be able to use more than 5.8 million acre-feet a year—a much-debated and disputed point—but even assuming that this is accurate, the development of mineral resources and related municipal uses in the Upper River will probably push the total use to more than 15 million acre-feet a year during the first quarter of the twenty-first century.

This means that either we had better head into a wet cycle damn soon, or we will be approaching the day when there is nothing left in Lakes Powell and Mead but a gurgle. California learned this year that all the reservoir capacity in the world is worthless if you empty it one year and not enough comes in for the next year; and it seems at this point that it is only a matter of time until the desert empire of the Lower Colorado River learns the same lesson. And even now, with the real demand substantially under the theoretical supply, the quality of the water is seriously diminished by overuse; what will this problem look like when use is 120 percent of dependable replenishment?

So, with the precedent set by California and central Arizona, it's time for the whole river to borrow some water. As the faithful tend to put it, the Colorado Rivers just don't have enough water to handle their commitments. The arrogance of such a statement is subconscious and naively "American": aside from the testimony of John Wesley Powell, there isn't much evidence in the entire history of the Anglo-American settlement of the Colorado River to indicate that anyone ever seriously considered that the Colorado might not have enough water to make seven states bloom like the Emerald Isle.

Now, if we become such slaves to good sense in the next decade as to refuse to permit any augmentation, the whole design is going to look a little silly—the Lower Colorado River will be comparable to the cathedral at Chartres, where ambition o'erleaped capability, and the money ran out with one tower undone, leaving the magnificent thing with an unfinished look, a little out of balance, looking a little funny even . . . but it won't be all that *funny* down in the desert empire. Billion-gallon, billion-dollar aqueducts consigned to running half-empty; reservoirs with their tub rings from the early-Seventies high 200 feet above the diminishing water level; fields turning a dazzling white as the sun carries the overworked water off to the heavens, leaving behind the cruel burden of salt; desalination plants gulping great quantities of power to eke out a thin stream of marginal water . . . and the cities. Oh, the cities, not cities of the desert but the desert-negated: dry pools popping up out of the ground, the bleaching unusable deck chairs on the brown grass under the leafless orange tree, the tedious count of gallons to see whether one more shower this month will cost 4 cents or go over the limit for $4 . . . the pleasant climate will not be so pleasant when water can't be taken for granted: it will be a great deal like—well, like living in the desert.

The desert. I am reminded of a strange moment on the Hoover Dam tour. I've made that out to be a canned spiel, and for the most part it was; but our guide was moved to a moment of philosophy. We had walked back through tunnels into the walls of Boulder Canyon beside the dam, and were standing with our guide in a strange little glass-walled room built right on top of one of the thirty-foot-diameter penstock tubes, inside one of the fifty-foot-high diversion tunnels used to get the river out of the way for building the dam . . . a shadowy place, incongruous as a dream.

The guide said what he was supposed to say there —but then he began to digress, in the half-halting, half-defensive manner we affect for personal confessions in this impersonal age. He started talking about the desert, and "the bones buried in the desert," the ranchers, miners, forty-niners the desert had claimed. What was he saying? That the desert is death? And to bring water into the desert is to conquer death?

I am, as I've said, no lover of the desert; but I think I know the desert a little, and I haven't the faith of a grain of mustard seed that all the rivers of the West, or Western civilization, could overcome the salts and the silt and keep it blooming. We have diverted a whole river to run into the desert, and it isn't nearly enough. "All the rivers run into the sea," said the Preacher, "yet the sea is not full"—but I don't think we will have begun to understand the concept of emptiness until we try to run all the rivers into the desert.

It may be our ironic destiny that out in the "infinite solitude" of the vast Southwestern deserts we will learn that finitude is our lot, that there are limits we can't transcend or transgress—technology, science, and rationalized economy notwithstanding. Or then again . . . well, it is true, finally, that to back off from the game at this point would not conclusively prove the "Faustian soul" wrong; it would only mean that we had decided to try to learn a new game, a new soul. Or, as the Faustian soul would say: we lost the faith. Went shopping for a new one.

I have to confess to a certain confusion myself, at that level. I'm fine up there on the rational facts-and-figures level: I can scrape out the mortar and show how the bureau is trying to build a cathedral with not enough stone for an outhouse. But down on the powerhouse deck at Hoover, among the laid-off generators and transformers, looking up at the Immovable so underworked by the Irresistible these days, I say in spite of myself, "What a beginning!" Shall man ever live by good sense alone? Putting the facts and figures together with the assembled parts, I sense the mixture of genius, passion, madness, and method that are the major parts of what we call art.

But the aesthetic flaw is, of course, the absence of control—this "masterwork of the human mind" has no final design, no completeness: I think it would always need just one more river. Lacking that kind of controlling design, it remains just a mixture of genius, passion, madness, and method; and feeling that, I can start to let go of part of the old will-dominant heritage. But no matter what we know about how much it will cost us to keep adding on and augmenting, we don't know what it will cost us to try to stop—what will we *do* with ourselves? We will probably maintain, is what we'll do, fight the silt and the salts until the whole operation implodes quietly from a big buildup of boredom; then we'll disperse, and archaeologists will ponder the mystery in the future. Babylon, Persepolis, Gomorrah, Phoenix: "Come let us build ourselves a city and a tower with its top in the heavens, and make a name for ourselves." Inevitable though I see it is, I'll miss us when we're gone sensible. □

THE EFFECTS OF DROUGHT

America has long tried to compensate for nature's aquatic irregularities. Since 1900 at least twenty special Presidential and Congressional commissions have scrutinized the nation's water resources. The federal government has hammered at the hydrological cycle with nearly $90 billion of water-development money. And that is still less than half of what state and local governments and private entrepreneurs have spent for irrigation systems, flood control, hydroelectric power plants, navigation, and recreation.

Still, the drought this year has done its damage. Portions of twenty-nine states became eligible for disaster-assistance loans from the federal government. Florida, Georgia, and Alabama have suffered agricultural losses of more than $1 billion. California, supplier of 25 percent of the nation's food, expects to lose the same amount. Most rivers were running below normal in July—the Mississippi, Saint Lawrence, Missouri, Columbia, and Ohio Rivers 30 percent wer. "It will take two months of normal infall," said Malcolm Reid of the Commerce Department Environmental Data Service, "to alleviate the effects of the drought in the least affected areas. . . at least sixteen months in the worst affected."

Hundreds of farmers from southern Nebraska to the Texas Panhandle have been affected by the diminution of a once bountiful underground water source. The Ogallala aquifer irrigates 6 million acres in Texas and 6.5 million in Nebraska, and since 1930 its water table has dropped steadily. In some places heavy pumping has lowered it as much as 700 feet. Farms have been abandoned as some of the 70,000 wells around Lubbock—the area which produces 25 percent of the nation's cotton—have gone dry.

In California, where drought has been the order of the day in some areas for over two years, some 8,000 new wells have been drilled in the past year alone, sending water tables in some areas dropping at a rate of six feet a month. Los Angeles has had to double its pumping from local wells, normally the source of 17 percent of its total water supply.

At present, a full third of the continental United States is susceptible to drought and water shortages, and some experts predict that by the year 2000 only three of the eighteen mainland water regions—New England, the Ohio Basin, and the South Atlantic Gulf areas—will find their water supplies adequate. (Though "adequate" is a vague term, it might be safe to say that the average resident of Phoenix, now using 160 gallons of water a day, could barely countenance the .8 gallon that an inhabitant of the semi-arid lands of Africa uses.)

The Water Resources Commission in its 1973 report listed some of the variables affecting demand for water—population, energy consumption, governmental programs such as farm price supports or environmental-protection goals, technological changes, personal and national income, and the price of water. Though usable supply depends ultimately on the quirks of precipitation, it seems that in the future there will be few parts of the country so blessed that human intervention in the hydrological cycle will not leave a large mark.

Harper's

OCTOBER 1977 FOUNDED IN 1850/VOL. 255, NO. 1529

Cover painting by Dickran Palulian

Published monthly by Harper's Magazine Company, Two Park Avenue, New York, N.Y. 10016, a division of the Minneapolis Star and Tribune Company, Inc. John Cowles, Jr., Chairman; Otto A. Silha, President; Donald R. Dwight, Vice President; Charles W. Arnason, Secretary; William R. Beattie, Treasurer. Subscriptions: $8.97 one year. Foreign except Canada and Pan America: $1.50 per year additional.
For advertising information contact Harper-Atlantic Sales, 420 Lexington Avenue, New York, N.Y. 10017. Other offices in Boston, Chicago, Detroit, Los Angeles, Philadelphia, and San Francisco.

Printed in the U.S.A. Second-class postage paid at New York, N.Y., and additional mailing offices.
POSTMASTER: Please send Form 3579 to Harper's Magazine, 1225 Portland Place, Boulder, Colo. 80323.

SUBSCRIPTION CORRESPONDENCE: Harper's Magazine, 1255 Portland Place, Boulder, Colorado 80323. For changes of address, provide both old address (use address label from latest issue) and new address, including zip code. Allow six weeks advance notice.