

## WATER RESOURCES

## For Our Thirsty World, Efficiency or Else

Sandra L. Postel

By now we've all heard the prediction: Water will be the oil of the 21st century. As competition for water heats up, it will reshape national economies and geopolitical alliances, maybe even cause wars. But the prophetic phrase misses something big and fundamental. Unlike oil, fresh water has no substitutes. Although societies will transition away from oil (and hopefully soon), there is no transitioning away from water. And above all is the obvious: water is essential to life—not just to human life, but to the myriad species that make this world tick and hum to our great benefit.

In *When the Rivers Run Dry: Water—The Defining Crisis of the Twenty-First Century*, Fred Pearce provides a compelling compendium of place-based water stories that reveal just how ground-shifting the world's water predicament will be. A veteran science journalist, the author traveled to more than 30 countries during his research, unearthing dramas that put a human face on sobering facts and figures.

Many rivers around the globe are overtapped and no longer discharge much water to the sea. Make a list—Yellow, Indus, Ganges, Nile, Colorado—and the big question comes into focus: Where will the water needed for future food production come from? Pearce spends a good bit of time on various facets of this question—and for good reason. Irrigation accounts for the lion's share of the world's water consumption, 70 percent globally and 90 percent in many Asian countries, where nature doles out long dry seasons. One-fifth of China's wheat and one-seventh of its corn are produced, in good years, in the coastal province of Shandong, which is last in line to receive the flow of the Yellow River. Farmers have already abandoned millions of acres of cropland in the water-stressed Yellow River basin, and in the summer of 2000 a mini-water war broke out in Shandong as thousands of farmers tried to siphon water slated for cities from a reservoir. Likewise, at the lower end of the Indus River, impoverished

**When the Rivers Run Dry**  
Water—The Defining  
Crisis of the Twenty-First  
Century

**Fred Pearce**

Beacon Press, Boston, 2006.  
336 pp. \$26.95. ISBN 0-8070-  
8572-3.

Pakistani farmers are fleeing from their dry fields to the slums of Karachi, where unemployment and crime are rampant and al-Qaeda replenishes its ranks.

As major rivers dwindle to a trickle, farmers and cities alike pump more water from underground. Globally as much as one-tenth of the

world's food may be produced with water drawn from declining aquifers. In India, at least a quarter of the farmers are overtapping aquifers, withdrawing water faster than those underground sources are recharging, and setting the stage for a "colossal anarchy" as more wells and fields are abandoned.

With demands pressing against finite supplies, it matters how water gets divvied up. Typically rivers, lakes, and other freshwater ecosystems receive an ever-shrinking residual slice of the water pie, often too little to sustain fisheries, biodiversity, wetlands for water purification, and other vital services. The Aral Sea is now a well-known poster child of aquatic ruin—more salty desert than watery lake after decades of excessive river diversions. Although Pearce admits to having "a sneaking love of large dams," he concludes that China's decision to build a cascade of them on the upper Mekong River would be a catastrophe for "the entire ecological infrastructure on which much of Southeast Asian rural life is built."

Pearce devotes limited space to the complexities of hydrogeopolitics. But he pulls no punches in documenting the "hydrological apartheid" that now exists in the Jordan River basin. Today each Palestinian in the occupied West Bank uses less than a quarter as much water as a neighboring Israeli. Palestinian families around Nablus spend between 20 and 40 percent of their incomes to buy water, while Israeli settlers enjoy

green lawns and swimming pools. Pearce calls the 1967 Six Day War "the first modern water war," citing none other than Ariel Sharon, an Israeli commander in that war and later prime minister, who wrote: "The Six-Day War really started on the day Israel decided to act against the diversion of the Jordan." Before that war, less than a tenth of the Jordan River watershed was within Israel's borders; by the war's end, Israel controlled the vast majority of it, including Syria's Golan Heights and key aquifers under the West Bank.

Pearce generally is thin on prescriptions for solving the problems he lays out so persuasively, but his stories and numerous interviews offer tempting glimmers of a more productive way forward. In the Jordan basin, for example, a more equitable distribution of water might painlessly be



**Overtapped flow.** Due to the diversion of Colorado River water for agriculture and urban use, in most years the river no longer reaches the Gulf of California.

achieved if Israel chose to use its desalinated water to free up West Bank groundwater for the Palestinians. If that were to be combined with a sharp reduction of irrigated agriculture, which accounts for about two-thirds of Israel's water use but contributes two percent to its gross domestic product, hydrologic security for all is not out of reach.

Although *When the Rivers Run Dry* offers little fresh analysis (and, much to my chagrin, no list of references), its collection of anecdotes and examples point away from big

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dams, massive diversions, and other large-scale supply solutions and toward more demand-focused, local-level, working-with-nature approaches. In India, a vibrant grass-roots movement to capture rainwater is replenishing aquifers. “Water tables have risen so much in Rajasthan,” Pearce writes, “that five ancient desert rivers ... have returned to the map.” Drip irrigation, which delivers water directly to the roots of plants, holds vast potential to increase “crop per drop,” but is the technology of choice on only about 1 percent of the world’s irrigated land. Overall, eliminating the enormous waste of water, especially in agriculture, could return flows to rivers and replenish aquifers, but the heavy subsidies that discourage efficiency and productivity remain stubbornly in place.

The ideas that Pearce puts forth have in common a deep respect for, and understanding of, the water cycle and the myriad services that nature provides through it. If scientific and technological ingenuity focused more on working productively with that cycle rather than on further manipulating it, perhaps human needs for water can be harmonized with those of the ecosystems that sustain us.

10.1126/science.1132334

## PHILOSOPHY OF SCIENCE

# Science Undermined by Our Limited Imagination?

Tim Lewens

Kyle Stanford’s admirably clear and engaging *Exceeding Our Grasp* addresses the most basic question in the philosophy of science: Should we believe what scientific theories tell us about the world? Stanford is not asking the trivial question of whether our theories are correct in every detail. Everyone will agree that many of the fine-grained claims in molecular genetics, quantum physics, and biological anthropology, for example, are likely to need substantial revision in the future. The question is instead whether we should think our best theories—in chemistry, physics, biology, and elsewhere—are even close to

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## BROWSINGS

### Rivers of America.

Tim Palmer. Abrams, New York, 2006. 224 pp. \$40, C\$50, £24.95. ISBN 0-8109-5485-0.

Photographers have long been captivated by flowing water. Here Palmer, the author of several previous books on river conservation and specific rivers, offers a selection of scenes of unspoiled waterways from around the United States. Short essays sketch the impact rivers have had on his life, their importance to ecosystems, the threats they face (from dams and pollution to exotic species and riverside development), and steps being taken on their behalf. But the book is primarily a celebration of the visual aesthetics of rivers (right, the Tuolumne in the Sierra Nevada foothills).

### Ogallala Blue.

Water and Life on the High Plains. William Ashworth. Norton, New York, 2006. 344 pp. \$26.95, C\$35.50. ISBN 0-393-05842-5.

To 19th-century explorers and surveyors, the High Plains, west of the 100th meridian, seemed the Great American Desert. Despite sufficient rainfall to make the region semiarid, they believed the shortgrass prairie worthless for farming. Today, the land accounts for over 20% of the U.S. agricultural output. Most of the water that fuels this harvest comes from the Ogallala Aquifer. Ashworth tells the story of this groundwater and the people it sustains. He discusses the origins of the fossil water and the sheet of erosional debris that contains it, extraction technologies (such as centrifugal pumps and center-pivot sprinklers), and the range of approaches to allocating, managing, and conserving the resource. Five trillion gallons are being withdrawn from the aquifer each year. Although draconian predictions of the Ogallala’s fate have gone unrealized, Ashworth argues that the reprieve is likely only to be temporary.

### Bird Coloration.

Geoffrey E. Hill and Kevin J. McGraw, Eds. Harvard University Press, Cambridge, MA, 2006. Volume 1, Mechanisms and Measurements. 631 pp. \$95, £59.95, €87.50. ISBN 0-674-01893-1. Volume 2, Function and Evolution. 519 pp. \$95, £59.95, €87.50. ISBN 0-674-02176-2.

These two volumes offer students and researchers a wide-ranging account of how and why birds often display bold and brilliant colors. An initial section covers perception and measurement. Subsequent chapters discuss the pigments (e.g., melanins and carotenoids) and feather structures that produce colors. Next, contributors consider how genes, the environment, and hormones control color expression. In the second volume, the authors examine avian uses of color, including concealment, mate choice, and signaling. Two contributors review the selective pressures driving the evolution of avian colors and patterns. A final chapter describes an approach to reconstructing the coloration of ancestral avian lineages.

the truth. So-called scientific realists say yes. Stanford says no.

In defense of this striking claim, Stanford’s book develops what he calls “the problem of unconceived alternatives.” His argument is a close relative of an older philosophical argument known as the “pessimistic induction,” which begins by claiming that the history of science is predominantly a history of failure. Time and again, theories that enjoyed impressive predictive and practical successes, and that were regarded as beyond doubt, have later been rejected as fundamentally mistaken. The argument concludes that

the theories we now hold to be true will eventually go the same way.

Stanford (a philosopher of science at the University of California, Irvine) diverges from a simple defense of the pessimistic induction by shifting the argumentative focus from scientific theories to scientists. He tries to show that past scientists have typically failed to consider (let alone evaluate) important alternatives to the theories they have ended up espousing. The central chapters of the book consist of a series of case studies in neglect, all in the domain of 19th-century theories of development and inheritance.

