



WORLD CHANGING

A USER'S GUIDE FOR THE 21ST CENTURY

EDITED BY ALEX STEFFEN | FOREWORD BY AL GORE

DESIGN BY SAGMEISTER INC. | ABRAMS, NEW YORK

which can be a major problem in heavily urbanized areas. The Germans are proving to us all that easy rainwater harvesting is facilitated by good design. PF

Q-Drum

In Africa, a simple plastic cylinder has improved the lives of thousands of women and children. The Q-Drum greatly simplifies the task of fetching water—an activity that usually requires several trips, several hours, and a lot of backbreaking work carrying cumbersome containers. Rather than requiring heavy lifting, the Q-Drum rolls easily along the ground, and can hold up to 13 gallons (50 liters) of water (previous containers held 1.3 gallons [5 liters] of water at best). It's also durable: it's pulled along by a rope—instead of handles or other breakable parts—which can easily be replaced or repaired anywhere on the continent. A screw-on lid greatly improves sanitation by preventing contaminants from entering the water. A similar product is the Hippo Water Roller. Though less sturdy, it has a larger capacity, and comes with a kit for a drip-irrigation attachment. JF

Worldchanging Water Pumps

It's one thing to improve water-carrying techniques, it's quite another to build water pumps that function without infrastructure—without being connected to a public water system or electricity, both of which are out of reach for many rural poor people. Two new devices do just that.



KickStart's MoneyMaker

KickStart is a nonprofit organization founded by American engineers to create a middle class in Africa. KickStart's Super-MoneyMaker has become their best-selling product; the device allows users to pump water for irrigation using their feet, which facilitates a higher yield for farmers, who can increase tillable area, and sell surplus goods for a small profit. The pumps cost ninety dollars, which is a sizable investment, but the paybacks are huge. One woman was able to radically transform her horticulture business in one year—from a subsistence farm bringing in \$93 a season to a five-person operation bringing in \$3,200 a season. She was thus able to send her children to school, instead of into the fields.

PlayPump

South Africa's Roundabout PlayPump is powered by a very unusual source: a merry-go-round. As kids play on the merry-go-round, the rotation pushes a reciprocating pump that pulls water from a well up into a small water tower, for storage. Villagers can then get water at their convenience from a faucet. Billboards on the water towers providing public health messages and commercial advertisements pay for the system's maintenance and repair. JF

Fog Catching

Fog collection is a beautifully low-tech way to supply fresh water in areas with negligible rainfall. Chile, Nepal, and southern Africa have successfully installed fog-catching arrays, fine nets that are stretched vertically between poles, with



a gutter at the bottom. As fog blows through the nets, it condenses and runs down the nets into the gutter; the water is then channeled into reservoirs. Depending on the amount of water collected, the reservoirs can supply homes, irrigation systems, or whole villages with water. The systems require minimal maintenance—they're inexpensive devices with no moving parts and no need for power. The water needs no treatment to be potable; in fact, it is usually much cleaner than all but the best well or river water.

FogQuest, a Canadian nonprofit, is the first organization to successfully deploy fog collectors. According to the organization, its first installation, in the Chilean village of Chungungo, accumulated an average of 3,963–26,417 gallons (15,000–100,000 liters) of water per day throughout its first year in operation. The village was able to stop importing water by truck, and to begin growing gardens and fruit trees; its population subsequently doubled, reversing the migration to cities that had kept it low.

A new and improved fog catcher from UK-based QinetiQ uses biomimicry [see Biomimicry, p. 99] to increase the effectiveness of the nets. A material that has a microtexture like that of a Namibian desert beetle's back composes QinetiQ's nets. The Namib Desert is an incredibly hot, dry environment where occasional morning fog is the only source of water. The beetles that live there have evolved a shell that has a combination of hydrophilic bumps on hydrophobic furrows, which strain moisture from the air and concentrate it. JF & DD



Water Purification

Silver Pot

In Latin America, the group Potters for Peace has designed a low-tech, low-cost water purifier that can be manufactured by local potters; it has been used by the Red Cross and Doctors Without Borders. The Filtrón is a pot made from clay infused with sawdust and colloidal silver. Water poured into the pot filters through its walls into a second, outside pot; in the process most bacteria get trapped, since they're too large to travel through the porous clay; the silver in the clay kills any bacteria that are small enough to pass through. The pots cost about nine dollars apiece and last for three years. Their manufacture also helps boost local economies; a Filtrón factory can be set up for just three thousand dollars.

Solar Watercones

The best-yet solar water purifier is the Watercone, a solar still that uses the sun's heat to evaporate water, which then condenses on the inside of its cone—flip the funnel-like cone over and you can pour the water right into a container. This cheap, rugged system can purify about 1.6 quarts (1.5 liters) of water per day, not only killing all waterborne pathogens but also removing particulates, many chemicals, and heavy metals. Better yet, it can also desalinate seawater—an important function for the world's sizable coastal populations. JF

Opposite: The Q-Drum (left), a rollable water container, makes it easier to bring water home, while the Super-MoneyMaker Pump (right) makes it easier to irrigate the land at low cost.

Left: Fog catchers strain moisture from the air for collection, Fralda Verde, Chile.

TreePeople

TreePeople is an organization pursuing an ambitious effort to retrofit Los Angeles with “green infrastructure” and reconnect the hydrologic cycle. The work for which they are best known involves just what their name implies—planting trees throughout the city where greenery is minimal, air pollution severe, and water poorly managed. Another TreePeople project, T.R.E.E.S., will mimic the “sponge and filter” mechanism of trees and apply it on a large scale by installing a system of cisterns and infiltrators within a small urban watershed. The system is designed to help capture water—which is at times a virtual godsend in Southern California—and recharge the aquifer, instead of letting the water run off and dissipate.

If implemented citywide, TreePeople believes, the project would drastically cut the use of imported water, reduce flooding and toxic runoff, and provide a host of other benefits. Because Southern California, which relies heavily on water piped from the Colorado River, may lose access to some of that water supply, reducing LA’s need for imported water looks like a pretty compelling proposition. PF

Permeable Pavement

When it rains in the city, impervious surfaces such as asphalt and concrete repel water and send it directly into storm drains. The flooding that occurs on curbs and corners comes from overloaded drains, and causes problems far more serious than the inadvertent splashing and hy-

droplaning of passing cars. Among other things, plants and trees in urban environments miss out on the rainwater that should be their most obvious source of moisture. Paving compromises the health of the botanical life that keeps our cities beautiful, shaded, and cool; it also contributes to the wasting of water, since the trees must be irrigated by other means.

Pavement does have its upsides, however: it’s stable, even, and firm—ideal for cars, bikes, and pedestrians. A new material called permeable pavement preserves all the functionality of regular pavement but eliminates the downsides. Permeable pavement can be laid anywhere concrete and asphalt usually go; it creates the same hard surface but allows rainwater to filter through into the ground. This prevents street flooding and keeps urban greenery healthier, with less work and less water.

Permeable pavement hasn’t found its way into many areas yet, but Vancouver embraced its benefits early. To test the effectiveness of new pavement technologies, the city incorporated the material into its Country Lanes project, a demonstration area in which the city redesigned a series of streets to be only partially asphalt—and partially covered by permeable surfaces, which provide a solid, durable surface, but allow grass and plants to grow through. The permeable surfaces reduced storm runoff and improved air and water quality; they also enhanced the appearance of the streets, adding greenery to stretches of formerly bare concrete.

Another kind of permeable pavement commonly used in parks and other urban public spaces is Biopaver, a system of interlocking concrete blocks that have compost built into the

middle. You can lay these blocks in your driveway or on a sidewalk in place of cement. Over time, the compost biodegrades and seeds sprout from within the concrete square; the structure remains intact, but becomes partially obscured by grass. The roots of the plants actually take in pollutants from the ground beneath the pavement and clean up the soil. They also take in contaminants as they absorb storm runoff, both cleaning the water that goes into the ground and controlling flooding. And just like that, the solution to the problem of pavement turns out to make urban areas even more beautiful. SR

Beyond Living Machines

If we want to make a city run like nature, we need to create systems that can handle our waste in natural ways. Back in the 1960s, biologist John Todd began designing systems that used healthy, thriving ecosystems to clean sewage—gracefully coordinated tools he called Living Machines.

Living Machines are hothouses and artificial marshes in which sewage runs through a series of small faux ecosystems—tanks of bacteria, algae, plants, crustaceans, and fish. The plants and animals break down, filter out, or absorb some part of the sewage and turn it into living matter. What comes out the other end, after it is fed on by all these living components, is water (sometimes cleaner than the water in our taps) and biomass (living matter that can be composted for soil, fed to livestock, or otherwise returned to nature). And Living Machines themselves can be quite beautiful: the

tanks often resemble well-groomed gardens of water plants.

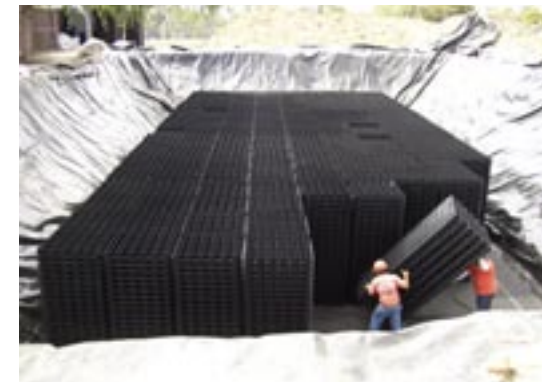
Living Machines were a great—arguably revolutionary—invention in principle, but in practice they often proved too finicky to build and maintain on a scale that would make them practical for cities. Some of the flora and fauna in the Living Machines could not handle the toxic witches’ brew that runs through sewers. As William McDonough and Michael Braungart put it in *Cradle to Cradle* [see *Knowing What’s Green*, p. 115], “In addition to biological wastes, people began to pour all kinds of things down the drain: cans of paint, harsh chemicals used to unclog pipes, bleach, paint thinners, nail-polish removers. And the waste itself now carried antibiotics and even estrogens from birth control pills. Add the various industrial wastes, cleaners, chemicals and other substances that will join household wastes, and you have highly complex mixtures of chemical and biological substances that still go by the name of sewage” (2002).

But some industrial microbes find sewage totally yummy. Researchers are trying to breed microbes and algae that eat sewage and secrete hydrogen [see *Neobiological Industry*, p. 111]. Other researchers have identified bacterial membranes that can filter most organic matter from inorganic matter. And certain scientists believe we may be able to tame particular kinds of fungi to extract heavy metals in concentrations sufficient to be reclaimed.

Living machines and industrial microbes could, of course, work together, with microbes cooking off hydrogen in vats linked to tanks of marsh plants and hungry snails—producing energy and cleaning water at the same time. (For one



The Watercone uses sunshine to distill water, Aden, Yemen.



This cistern, developed through the Open Charter Elementary School Stormwater Project, holds 110,000 gallons of rainwater, decreasing LA’s need to import water, Los Angeles, California.