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problem of world food production because irrigation along with heavy fertilization is counted on to increase land productivity in pace with population growth.

To add large amounts of fertilizer to the soil, it must also be flushed with large quantities of water to create the desired effect. This technique of using large amounts of fertilizer and water to grow all variety of edible grains, fruits and vegetables can multiply a field's production many fold. Land that would otherwise be marginal cropland, or worse, can be productively cultivated through irrigation, either by diversion of water through dams and canals or ground water (aquifer) pumping. Irrigated fields can be anywhere from three to ten times more productive than rain-fed. Huge crops have been harvested in areas that were historically little more than desert. Presently 36% of all crops and 50% of all grain production in the world are generated on irrigated land. Seventy percent of all world water abstraction is for irrigation. When it comes to increasing cropland productivity worldwide in years to come, efficient water capture and usage will be an overriding necessity. Both dam building and ground water pumping, however, which will be called on for the needed irrigation, offer an array of environmental trade-offs — again complicating increased food production.

When a river is engineered to do work, whether for a hydroelectric dam, flood control or the facilitation of irrigation, it is at the expense of the health of that river.There is a corruption of the natural flow. Its path is changed from one of least resistance to one of maximized resistance. With that comes a cost beyond that of dam or canal construction. It is the cost of entropy added to the system, witnessed as environmental degradation. Fish habitats are disrupted. Temperature gradients in the water are altered. The flow of river sediments is obstructed. The long-term ecological stability of the of the drainage field is radically stressed.

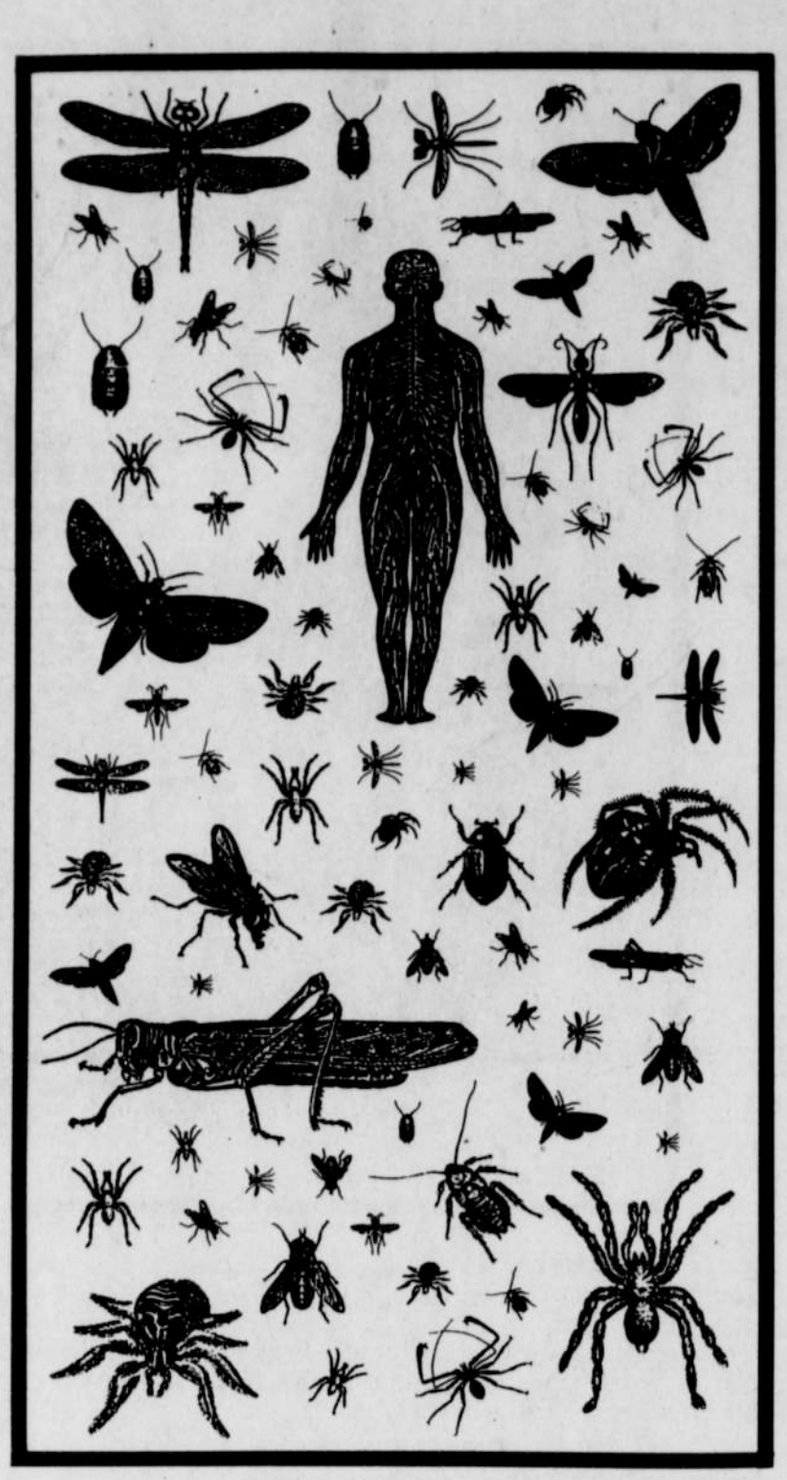
The roundly hailed economic success of damming the Columbia and Colorado Rivers in the 1930s are now potential disasters. In the case of the Columbia, the salmon stocks, once a major fishing industry, have steadily dwindled by 95% to the point that the industry is all but gone. The Colorado is so heavily diverted by dams and irrigation canals it runs dry before reaching the sea. Dan Beard, while Commissioner of the U.S. Bureau of Reclamation in the early 1990s, stated "It is a serious mistake for any region in the world to use what we did on the Colorado and Columbia Rivers as examples to be duplicated." And yet building dams is exactly how many developing countries will seek to meet their agricultural and energy needs.

To further compound the matter, irrigation in itself is hard on the soil. Not only does the flush of water accelerate erosion, but, as evaporating water percolates through saturated ground, it leaches salts from the fertilizers to the surface, eventually leading to a sterilizing salinization of the topsoil. Current estimates say 20% of the world's irrigated land suffers from high levels of salinization, waterlogging, excessive erosion and infertility. When increased fertilizer and pesticide concentrations are factored into the equation, the water draining back to the river is polluted with chemical toxins, further altering the river habitat.

Downstream, where the river empties into the ocean, increased nitrogen levels rob waters of oxygen. "The North, Baltic, Arabian and Black Seas, the Chesapeake Bay, the Bay of Bengal and the Pacific coasts of North and South America all suffer from periodic fish kills or complete collapse of fisheries caused by nutrient overload," Michael Renner wrote in *State of the World 1997*. Agricultural runoff from the Mississippi Delta has created a "dead zone" in the Gulf of Mexico the size of New Jersey that has virtually killed all bottom-dwelling marine organisms. Intensified techniques can bring productive farming to otherwise unusable land, but there are huge trade-offs that gradually come to bear as we confront real biological limits.

As damming rivers is invariably a compromise to the natural cycle, the pumping of ancient aquifers or ground water to irrigate dry land for agricultural use also stresses the biosphere's delicate hydrological balance. These vast underground reserves are the sources of our purest water. In an effort to increase farming yield *now*, however, this ground water is often pumped faster than it can be naturally replenished — a borrowing from the future to meet today's needs. This is happening at dangerous rates in the United States, China, India, Mexico and the Middle East. In fact, water tables are falling on every continent in the world.

In the United States, ground water is presently being drawn out 25% faster than it can be replenished. The Oglala aquifer beneath the American Great Plains that supplies water for some 20% of all irrigated land in the U.S. is now showing signs of depletion. It is all but empty at its shallow end in the Texas panhandle where pumping and irrigation has been forced to a halt. Ultimately, this depletion of ground water leads to a variety of other environmental losses. Land subsidence, intrusion of salt water into coastal areas, ground water contamination and desiccation of nearby lakes are all further debits of unsustainable water use. In the overall scheme for feeding future generations, the cost of water will be a sure measure of the severity of the situation.



FOOD & WATER INC.

Seeds:

With irrigation limited by water availability, and arable land already near maximum, many horticulturists point to new seed varieties as an answer to cropland productivity. Seeds have been attuned to climate, soil conditions and farming techniques through hybridization since the middle of the 19th century and the work of Gregor Mendel. Today genetic engineering is seen as an accelerated alternative to traditional seed breeding. Considerable work is being done in this field right now, but "after 25 years of research, biotechnologists have not produced a single high-yielding variety of wheat, rice or corn," Lester Brown wrote in *The Agricultural Link* (Worldwatch Institute, 1997). The reason for this is that 100 years of traditional techniques have "largely exploited the genetic potential for increasing the share of photosynthate that goes into the seed." This is not to say there is no reason to believe new seeds will not be "created" in the lab, it is just that we cannot count on biotechnical advances until they are made. And unfortunately the way we manage our natural genetic resources is not going to help.

Consider what is happening to the world's tropical rainforests, the home for some of the most diverse and rare flora and fauna. When rain forests are cut down and turned into commercial property, monoculture cropland or grazing land, more than just the water and air-cleansing properties of these critical areas are eliminated. Genetic seed pools, plant and animal, are diminished or lost. The same is true when an old-growth temperate forest is harvested or a western prairie is turned into grain land. A vast and complex ecosystem of plants and animals is destroyed. When forests are replanted, it's not with the array of species that were eliminated. They are turned into tree plantations, replanted with one, maybe two, varieties of trees. Then they are harvested in 30 or 40 years. Superficially, the forest returns, but the diversity of life with all its ecological value does not. The same is true with cropland. Though thousands of edible plants exist in the library of biota, only ten species of plants make up 95% of world agriculture! Our agricultural methods are not only narrowing species and seed variety, but they are equally narrowing the variety of things we eat — all to our detriment.

Variety is the essence of earth's sustained existence and our own health. "More than half of all (medical) prescriptions filled worldwide contain active ingredients originating from wild species — particularly wild plants," Cheri Sugal wrote ("Forest Loss Continues") in *Vital Signs 1997*. The chances for a breakthrough in biotechnology or traditional plant breeding are directly related to the depth and breadth of Earth's genetic treasure trove. The cornucopia is abundance sustained through diversity. Once a forest is eliminated the potential for new medicines or genetic material from rare insects or plants is virtually lost forever. And this is happening at a frightful pace.

Habitat loss and contamination of river drainage fields is literally decimating plant, insect and animal life. Of 4,400 catalogued mammal species, 11% are endangered, another 14% are becoming vulnerable — that means a quarter of all mammals are threatened.Half of all primates, our nearest animal cousins, are threatened. A third of all fish. Eleven percent of all birds. A fifth of all reptiles. A quarter of all amphibians. And unknown quantities of insects and plants are threatened. We are eliminating the foundation of life on the planet. In the full extension of the complex relationships of life on this planet, these living things are really us. We may as well be cutting off our fingers and toes one at a time. In the words of Harvard social biologist E.O.Wilson, "The process now going on that will take millions of years to correct is the loss of genetic and species diversity by the destruction of natural habitats. This is the folly our descendants are least likely to forgive us."

There is a genetic integrity underlying all life on this planet. It is a fine and sacred thing.Yes, we have the technology to do the miraculous, splice genes and clone sheep, but the story of Frankenstein still rings true. Our tampering with the threads of life can not be too cautious. Biotechnology is offered as one candle in the building wind of food demand, but as in irrigation, fertilization and pesticide use, moderation of industrial impact is essential to sustainability. Whatever we do, no matter what immediate pressures we face, we now operate within delicate limits. And the uncertainty of the effects of global warming doubles this jeopardy.

Weather:

Earth is a vastly adaptive and resilient living environment. With time, it is likely the planet can mend from any human insult, short of knocking it off its orbit. The point is, however, that wherever human populations concentrate, whenever and wherever there is expansive civilization — the Han Dynasty in China, the Sumerians in the Mesopotamian valley, the Mayans in Central America, the Greco/Roman cultures of the Mediterranean basin — wherever there has been expanded agriculture necessitated by high population densities, the Earth has been scarred and desertified.

Gas powered and electrified modern society has greater and further-reaching impact than any of the ancient civilizations. Western industrialization and the steady capitalization of the Third World have created a global system. Its effect on the Earth is not limited, as in ancient history, to isolated spots. This is most evident in the heavy agricultural debts we are incurring against the planet to feed the mass of humans that currently exist. Over the last five to ten years, all the critical trends regarding arable land, the depletion of aquifers, loss of soil and narrowing biodiversity[3] have begun to top out. When we look to feed future, larger populations we must wonder how large a debt upon the land we can incur and still repay without disastrous reprisals.

Of all our environmental problems the production of carbon dioxide through tropical deforestation, automobile exhaust and industrial emissions looms as our presiding usurer. Despite 40 years of warnings from the scientific community about greenhouse effects and global warming, concentrations of carbon dioxide in the atmosphere annually climb at alarming rates. While sulfur and nitrogen emissions have started to level off, while chlorofleurocarbons and other ozone depleting emissions have been significantly reduced, we cannot seem to curb our production of carbon dioxide.

Sadly, the United States is the worst abuser, alone generating 23% of the world's carbon emissions in 1995. "The International Energy Agency projects global emissions of carbon from fossil fuels will exceed 1990 levels by 17% in (the year) 2000 and 49% by 2010, reaching nearly 9 billion tons annually." (Christopher Flavin, *State of the World 1997*, Worldwatch Institute) Clearly, in this case, we are out of control and the richest societies are issuing the loudest denials.

STOP CLEARCUTTING

There is no evidence that clearcutting can be repeated more than four or five times before the soil gives out. There is plentiful evidence, however, of how bad the end can be.

Think of landscapes that used to be forested — those of China and India for example.

Some argue that we cannot afford to stop clearcutting. But are we really so poverty stricken that we cannot afford to leave to our descendants more than a wasteland?

Clearcutting is a lethal addiction. Voting for Measure 64 begins recovery.

It makes self-respect possible, and the respect of our children.

~ROBERT ADAMS

Robert Adams lives in Astoria. He is a photographer and the author of many books, including *West From the Columbia*, *Los Angeles Spring* and *To Make It Home: Photographs of the American West*. His articles and photographs have appeared in the NCTE.