Attack of the Mustard Plants!

"Here Come the Hyper-Accumulators!" by Niall Kirkwood, in *Harvard Design Magazine* (Fall 2002–Winter 2003), 48 Quincy Street, Cambridge, Mass. 02138.

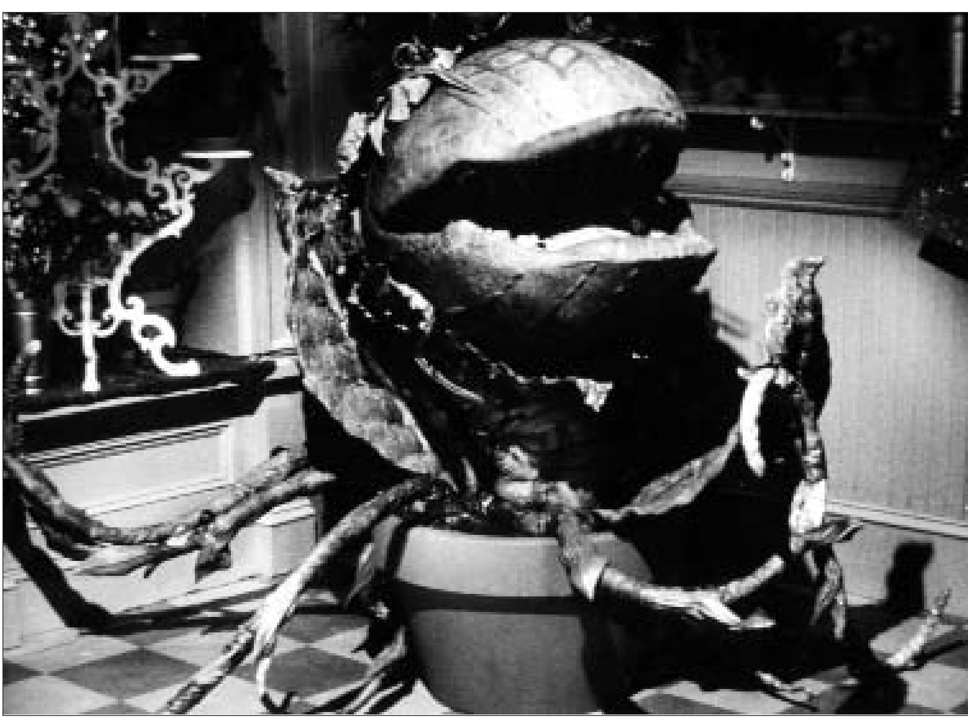
Aficionados of 1950s horror flicks who think they know everything there is to know about voracious plants might be surprised to learn that scientists are now enlisting certain strains of feisty flora in the fight against artificial toxins. This budding field is known as *phytoremediation*.

Kirkwood, director of the Harvard Design School's Center for Technology and Environment, says there are three main branches of natural environment-scrubbers. First are the plants known collectively as *phyto-accumulators*, such as the Indian mustard plant, whose leaves and shoots can absorb toxic substances from soil; the leaves can then be harvested and disposed of several times during the growing season. This process has been used to extract lead from the grounds of a former battery factory, and was also used after the 1986 Chernobyl nuclear accident to remove radioactive cesium and strontium from the soil.

A second, much slower process, called *phytodegradation*, utilizes the enzymes secreted by certain toxin-resistant plants to break down harmful chemicals in the soil around their roots.

The final group of cleaners, represented by willow and poplar trees, uses hydraulic control to pump contaminated water up from their deep root systems to transpire it through their leaves.

Why turn to plants when there is a billion-dollar cleanup industry already in place? Because plants can be just as effective in dealing with some toxins, and at a fraction of the cost. Kirkwood cites a 1998 Environmental Protection Agency study demonstrating that mustard plants could reduce lead levels from 1,200 parts per million to below 400 parts per million (an acceptable level) at a projected cost of $60,000 to $100,000 per acre. Cleaning an acre this way requires the disposal of just 500 tons of mustard plants. The conventional approach would require hauling away 20,000 tons of contaminated soil, at a cost of $600,000. Small



Little Shop of Horrors' ***Audrey II was a people muncher, but now scientists are discovering a number of real-life plants that can help clean up the toxic messes that people leave behind.***

wonder that the domestic market for phytoremediation is expected to grow from well under $100 million in 2000 to between $235 million and $400 million by 2005.

The downside to phytoremediation is that it takes time for the plants to do their work. Such techniques, says Kirkwood, "will make sense only if there are appropriate growing conditions, contaminant densities, and aeration of the soil." But phytoremediation can also allow contaminated sites to be partially inhabited even while the cleanup is going on.

The Daughterless Gene

"The Plot to Kill the Carp" by Todd Woody, in *Wired* (Oct. 2002), 520 Third St., 3rd Fl., San Francisco, Calif. 94107–1815.

Eight years ago, Australian wildlife officials were alarmed to discover environmentally destructive European carp—which are already dominant in mainland Australia's waterways—swimming among the rare native fish in Tasmania's Lake Crescent. Carp, writes Woody, a Sydney-based journalist, are "the Borg of the fish world." Uprooting aquatic vegetation, they turn clear-running water muddy, depriving native fish of food, light, and oxygen.

Authorities held the rapidly multiplying Lake Crescent invaders in check by lowering the lake's water levels and denying them space to spawn. But Australian scientists now believe they have a better solution: "daughterless" genes.

"Biologists have long known that female fish develop when an enzyme called aromatase transforms androgen into estrogen," notes Woody. If aromatase were chemically blocked, fish could be made to produce only males. Biologist Ron Thresher and his colleagues developed a gene to do exactly that. As carp injected with daughterless genes produce single-sex offspring, "the population of each targeted river or lake will eventually drive itself to extinction."

That's the idea, at least. The scientists have already proved they can develop a daughterless gene for the zebra fish, a two-inch cousin of the carp. Next comes the destructive, fast-breeding mosquito fish. If that effort is successful, work on the daughterless carp will begin.

Skeptics such as Bob Phelps, director of the Australian Gene Ethics Network, worry about the unknowable consequences of releasing "millions of genetically engineered fish into complex ecological systems." Woody describes "the nightmare scenario: Daughterless carp somehow escape to other parts of the world and breed with dozens of closely related species. Or they evolve in unforeseen ways into superpests." Thresher, however, says the daughterless carp would be introduced to a target population only gradually over many years, so there would be plenty of time to halt the process if something went awry.

With the continuing spread of destructive alien species around the world, defensive genetic technologies are also likely to spread, says Woody. Scientists and regulators who are dealing with the influx of alien species in North America's Great Lakes, for example, are interested in the new technologies as a way of dealing with invaders such as the big head carp, a 50-pound monster from China.

Arts & Letters

How Blue Can You Get?

"A Distinctly Bluesy Condition" by Carlo Rotella, in *The American Scholar* (Autumn 2002), 1785 Massachusetts Ave., N.W., 4th Fl., Washington, D.C. 20036.

Buddy Guy's blues guitar playing, "as instantly recognizable as his voice, can be shrewdly pent up, but when he lets himself go—which is most of the time—it soars wildly over the top in a torrent of fast, loud, often distorted notes that regain their purity when sustained on a bent string pinned to the fingerboard." That's one of the characteristics