Tale of Two Botanies

By Amory B. and L. Hunter Lovins

Plants, shaped into incredible diversity by 3.8 billion years of evolution, make possible all life and are resilient against almost any threat–except human destructiveness. From botany came the genetics of Mendel and Lamarck, formalizing the patient plant-breeding that created 10,000 years of agriculture.

Now, however, in the name of feeding a growing human population, a completely different kind of botany, in the Cartesian tradition of reducing complex wholes to simple parts, strives to alter isolated genes while disregarding the interactive totality of ecosystems. Its ambition is to replace nature's wisdom with people's cleverness; to treat nature not as model and mentor but as a set of limits to be evaded when inconvenient; not to study nature but to restructure it.

The new botany aligns the development of plants with their economic, not evolutionary, success: survival not of the fittest but of the fattest. High-yield, open-pollinated seeds abound; the new crops were created not because they're productive but because they're patentable. Their economic value is oriented not toward helping subsistence farmers to feed themselves, but toward feeding more livestock for the already overfed rich. Most worryingly, the transformation of plant genetics is being accelerated from the measured pace of biological evolution to the speed of next quarter's earnings report. Such haste makes it impossible to foresee and forestall: Unintended consequences appear only later, when they may not be fixable, because novel life forms aren't recallable.

In nature, all experiments are rigorously tested over eons. Single mutations venture into an unforgiving ecosystem and test their mettle. What's alive today is what worked; only successes yield progeny. But in the brave new world of artifice, organisms are briefly tested by their creators in laboratory and field, then mass-marketed worldwide. The USDA has already approved about 50 genetically engineered crops for unlimited release; U.S. researchers have tested about 4,500 more.

Over half the world's soybeans and a third of the corn now contain genes spliced in from other forms of life. You've probably eaten some lately–unwittingly. The official assumption is that they're different enough to patent but similar enough to make identical food; Europe's insistence on labeling, to let people choose what they're eating, is considered an irrational barrier to free trade.

Traditional agronomy transfers genes between plants whose kinship lets them interbreed. The new botany mechanically transfers genes between organisms that can never mate naturally: An antifreeze gene from a fish becomes part of a strawberry. Such patchwork, done by people who've seldom studied evolutionary biology and ecology, uses so-called "genetic engineering"–a double misnomer. It moves genes but is not about genetics. "Engineering" implies understanding of the causal mechanisms that link actions to effects, but nobody understands the mechanisms by which genes, interacting with each other and the environment, express traits. Transgenic manipulation inserts foreign genes into random locations in a plant's DNA to see what happens. That's not engineering; it's the industrialization of life by people with a narrow understanding of it.

The results, too, are more worrisome than those of mere mechanical tinkering, because unlike mechanical contrivances, genetically modified organisms reproduce, genes spread, and mistakes literally take on a life of their own. Herbicide-resistance genes may escape to make "superweeds." Insecticide-making genes may kill beyond their intended targets. Both these problems have already occurred; their ecological effects are not yet known. Among other recent unpleasant surprises, spliced genes seem unusually likely to spread to other organisms. Canola pollen can waft spliced genes more than a mile, and common crops can hybridize with completely unrelated weeds.

Gene-spliced Bt insecticide in corn pollen kills Monarch butterflies; that insecticide, unlike its natural forebear, can build up in soil; and corn borers' resistance to it is apparently a dominant trait, so planned anti-resistance procedures won't work.

It could get worse. Division into species seems to be nature's way of keeping pathogens in a box where they behave properly (they learn that it's a bad strategy to kill your host). Transgenics may let pathogens vault the species barrier and enter new realms where they have no idea how to behave. It's so hard to eradicate an unwanted wild gene that we've intentionally done it only once–with the smallpox virus.

Since evolution is a fundamental process, it must occur at every scale at which it's physically possible, down to and including the nanoecosystem of the genome. It's unwise to assume, as "genetic engineers" generally do, that 90-plus percent of the genome is "garbage" or "junk" because they don't know its function. That mysterious, messy, ancient stuff is the context that influences how genes express traits. It's the genetic version of biodiversity, which in larger ecosystems is the source of resilience and endurance.

Transgenics is showing disturbing historical parallels to another problematic invention, nuclear fission. In both enterprises, technical ability has evolved faster than social institutions; skill has outrun wisdom. Both have overlooked fundamentals, often from other disciplines wrongly deemed irrelevant. Both have overreached–too far, too fast, too uncritical.

Our key choices now are not between unwelcome alternatives–nuclear power or freezing in the dark, transgenic crops or starvation–but between those bad choices and attractive ones outside the orthodoxy.

For crops, the best choice would be fairer distribution of food grown by a respectful and biologically informed agriculture that stops treating soil like dirt. But sound choices tend to emerge and get adopted in time only if we take seriously the discipline of mindful markets and the wisdom of informed democracy. Botanists have a professional duty to help us all understand the vital differences between biology and biotechnology–between the foundations of their traditional science and the scientifically immature but commercially hell-for-leather enterprise, a billion times younger, that aims to replace it.

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