World Business Academy SIGNPOSTS

Vol. 6, Issue 3 **REKINDLING THE HUMAN SPIRIT IN BUSINESS** **June 20, 2001**

Editor's Note: Genetically modified organisms (GMOs) are of paramount importance, not just to the world of agriculture, but in their potential impact to our biosphere. We understand that there are numerous legitimate competing concerns about GMOs' value to society. For example, the Green Revolution has definitely led to more people being fed because of the improvement of hybrid strains of corn, wheat, sorghum and soybeans. We recognize that GMOs can provide many benefits to humanity and commerce. Conversely, we are concerned as business people about the short time of testing before new products are released and their possible unintended consequences. Amory and Hunter Lovins appropriately point out that we ought to think long and hard before we move too quickly down this path. When we were dealing with hybridization of food crops using traditional Luther Burbank selective reproduction techniques, we had the luxury of ample time for analysis. The Lovins' article raises not only the question of whether or not we should have GMOs, but more importantly, how much time is required for analysis before we introduce these organisms into our food supply and biosphere. We invite commentary from the business community and other responsible parties on this very topical and critical issue.

A Tale of Two Botanies

Amory B. Lovins and L. Hunter Lovins

(An address to the World Botanical Congress, printed with permission)

We all owe a debt to the subject matter of the World Botanical Congress now meeting at the Missouri Botanical Garden. Plants, shaped into incredible diversity by **3.8 billion years of evolution,** make possible all life, underpin every ecosystem, 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's created 10,000 years of agriculture.

Now, however, in the name of feeding a growing human population, the process of biological evolution is being transformed. A St. Louis firm is practicing a completely different kind of botany which, in the Cartesian tradition of reducing complex wholes to simple parts, strives to alter isolated genes while **disregarding the interactive totality of ecosystems.** Seeking what Sir Francis Bacon called "the enlarging of the bounds of Human Empire, to the effecting of all things possible," 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.

As biophysicist Dr. Donella Meadows notes, the new botany aims to align the development of plants not with their evolutionary success but with their economic success: survival not of the fittest but of the fattest, those best able to profit from wide sales of monopolized products. (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 mainly 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 lifeforms aren't recallable.

In nature, all experiments are rigorously tested over eons. Single mutations venture into an unforgiving ecosystem and test their mettle. Whatever doesn't work gets recalled by the Manufacturer. 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 **(no government agency systematically tests for or certifies their long-term safety),** 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. Just during 1995–99, the non-Chinese farmland planted to such new crops expanded from zero to an eighth of a billion acres, about the size of Germany.

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, since **our government prohibits their labeling.** The official assumption is that they're different enough to patent but similar enough to make identical food, so 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 (Arctic flounder) rides a virus host to become part of a potato or 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,** extending like Africanized bees. 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 forbear, 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. **Shotgunning alien genes into the genome is thus like introducing exotic species into an ecosystem.** (Such invasives are among the top threats to global biodiversity today.) It's unwise to assume, as "genetic engineers" generally do, that 90+% 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—"a fit technology," said Nobel laureate Robert Sinsheimer, "for a wise, farseeing, and incorruptible people." 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. Both have failed to take their values from their customers and their discipline from the market. **The rise and fall of such technologies seems to go something like this:**

1. Promoters promise public benefits. Gifted scientists relish the "sweet" technology. Commercial enthusiasm and pride, bolstered by government promotion, draw huge investments. Advocates shield the promoters from political and market accountability, suppress dissent, and reject independent assessment. Rapid growth speeds industrial capture of the regulatory apparatus. (The combination of greedy firms, sleepy watchdogs, and sparse, disinterested scrutiny is a recipe for trouble, since systems without feedback are by definition stupid.)
2. Initial technical stumbles and troublesome questions elicit public concern, deflected by PR. Public concern increases because the more people find out about the innovation, the less they like it. The PR grows stronger but less persuasive. Emergent whistleblowers raise awkward questions. Many bad surprises dwarf the few benefits.
3. Operational disappointments abound as it becomes clear that the problems with the innovation are fundamental. Simultaneously, many people realize that the alternatives, often long known, actually work better and cost less.
4. Smart money and insurance coverage exit; practitioners stop having fun; some have nightmares without a safe place to discuss them. The product can be sold only by concealing its identity—a mockery of economic principles. Almost everyone realizes the business is dying of an incurable attack of market forces.

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5. With insubstantial benefits, mediocre performance, real risks, and unrewarding economics finally undeniable, the technology fades away, leaving behind socialized hazards, failed firms, disappointed investors, delegitimized institutions and a cynical public.

Where's the "You Are Here" sign for transgenic crops? Europe is already at stage 4. The U.S. is around stage 2, and moving rapidly in the same direction.

With transgenic crops as with nuclear fission, the key choices are not between unwelcome alternatives—nuclear warheads or subjugation, 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.** The botanists now being welcomed to St. Louis can help us see beyond molecules and genes to plants, and beyond plants to ecosystems. 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 smart-aleck, scientifically immature, but commercially hell-bent-for-leather enterprise, a billion times younger, that aims to replace it.

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