

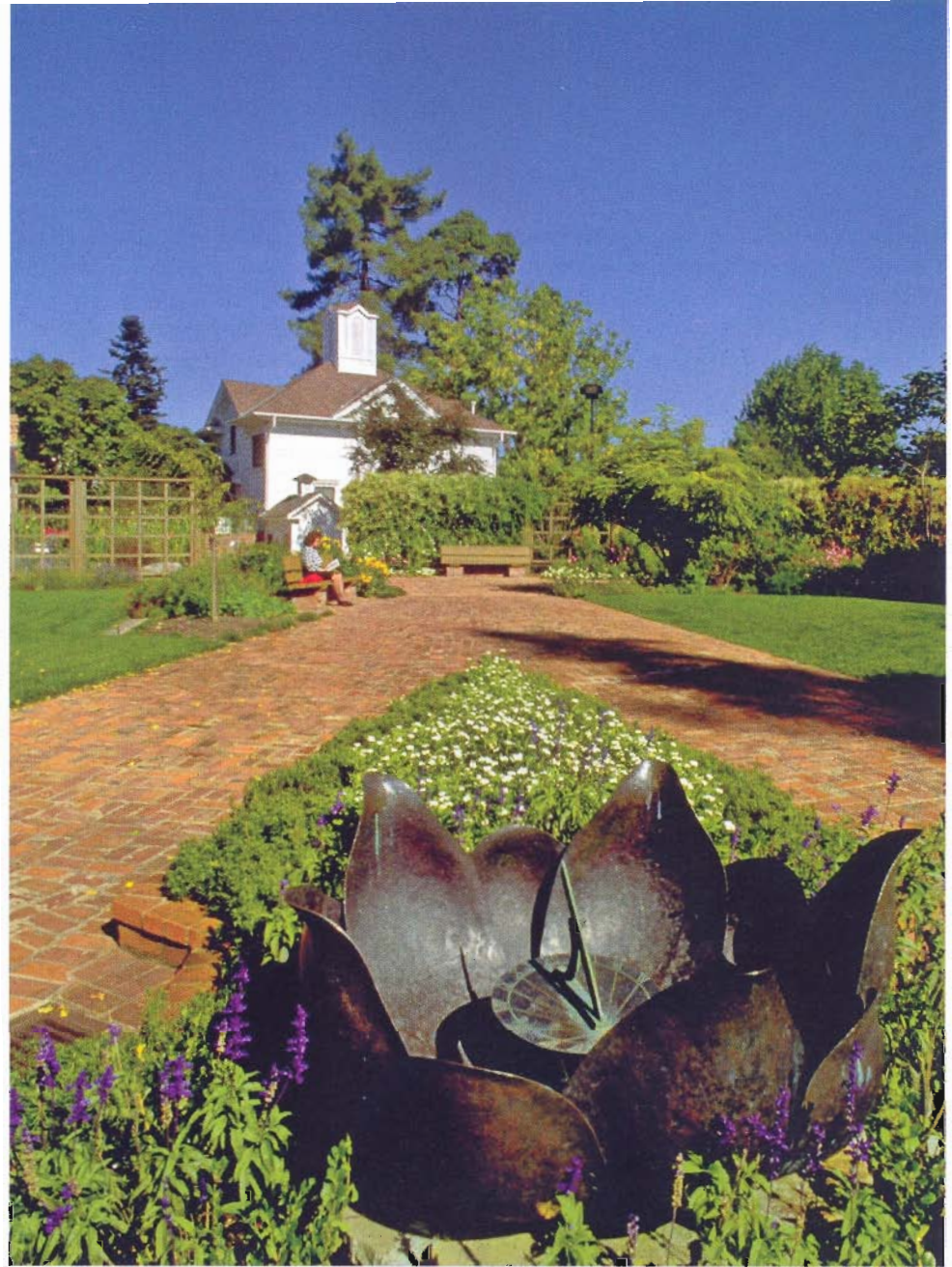
Well Bred

*The rise of transgenics or genetically modified food crops is at the root of heated debates around the world. Yet humans have been tinkering with plant makeup for thousands of years, as described in Noel Kingsbury's recently published book, *Hybrid: The History and Science of Plant Breeding*. In the first of our occasional "contrarian" columns, Mark Kane summarizes Kingsbury's book and poses a question: "Have we gone too far—or not far enough?" Dan Koeppel, author of *Banana: The Fate of the Fruit That Changed the World*, offers one response to that question on page 20.*

Here's plant breeding at its simplest: Grow 20 lettuce plants, reserve the most vigorous (or prettiest, or tastiest) plant, let it make seeds, plant the seeds the next year, and repeat. By using this technique, known as selection, over many generations, the people of prehistory turned a ragged, hard-seeded plant into corn and three wispy grasses into wheat.

But plant breeding also can be highly complicated, as it is for the corn, cotton, sugar beets, and soybeans grown by farmers today. With increasing frequency, field crops are the outcome of arranged marriages, bearing genes from bacteria poked into their cells to make them resist earworms, rootworms, or, in the case of so-called Roundup Ready crops, the widely used herbicide glyphosate.

How did we reach this point? In the late 19th and early 20th centuries, Luther Burbank, the best known of American plant breeders, performed selection on a vast scale. Burbank also made hybrids, the next step of simple breeding. His 'Alhambra' plum, for example, mingled the genes of seven plum species. Over a career of 50



years, he introduced 800 new selections and hybrids—but because he kept no records, scientists derided his work. Many plants grown today can be traced to Burbank's discoveries, including the 'Russet Burbank' potato, a natural variant of the original Burbank potato; and the Shasta daisy, a hybrid of confused parentage.

Meanwhile, Burbank's peers at universities and nurseries were bringing science to plant breeding. Their inspiration was the rediscovered work of Gregor Mendel, an Austrian priest, who had shown in the mid-19th century that for pea plants, the choice of parents decided the traits of their progeny. By focusing on traits such as disease resistance and vigor, plant breeding developed rapidly. Wheat yields rose 40 percent. Barley and rice made similar gains. Today, selection and hybridization are called "classical breeding" to distinguish them from genetic modification (GM), which works not with parent plants but with their cells and genes.

One type of GM crop is based on a familiar organic insecticide. Only a generation ago, gardeners struggled with cole crops—kale, cabbage, and broccoli—often losing them to caterpillars that ate

A sundial marks the hours at the Luther Burbank Home and Gardens in Santa Rosa, California. The historic property is open to the public, and the gardens display some of Burbank's most famous hybrids.

holes in the leaves. Then came the discovery that a soil bacterium, *Bacillus thuringiensis* (BT), makes a protein toxic to the larvae of moths and butterflies. The protein soon became a product in the form of a powder to be dusted on plants. Caterpillars ate the leaves and the BT protein perforated their intestines. Toxic to the larvae and nothing else, BT was a boon to organic gardeners.

Seed companies soon found a way to insert the BT gene into corn grown by farmers. Now more than half of the corn grown in the United States comes from plants that protect themselves from caterpillars by making the BT protein in their cells. Government agencies have declared that BT corn is “substantially equivalent” to its parent and therefore needs no safety testing. Skeptics say that by eating BT corn we are all participating in a safety experiment without informed consent.

All this is the subject of *Hybrid: The History and Science of Plant Breeding* (The University of Chicago Press, 2009), an evenhanded history of plant breeding by the English horticulturist and garden historian Noel Kingsbury, Ph.D. On the phone from England, Kingsbury said that it’s important to look beyond the controversies of genetic science and recognize that “plant breeding is feeding the world.” The risks of altering cells must be understood,

but so must GM’s potential: stronger plants, resistance to pests and diseases, better taste and nutritional value, and higher yields.

Kingsbury has a tempered outlook about safety. “I support graduated testing,” he says. “There’s no reason to test a blight-resistant potato that derives its resistance from another potato.” If the new genes come from a different genus or even further afield—say, from a bacterium—then testing should be rigorous.

GM is currently a near-monopoly of corporations that are unlikely to focus on breeding vegetables, fruits, and flowers for organic growers and gardeners. But that can change. Apple cultivars ‘Liberty’ and ‘Freedom’ resist diseases thanks to genes from another apple species, a development that took more than 30 years of classical breeding at three universities. Such an advance can come quickly with GM. Kingsbury writes: “Organic growers have missed a trick in GM. Let’s use it to speed the introduction of cultivars that resist pests and diseases.” As he notes dryly, it is good to have carrots that do not get carrot fly.

Plant breeding is already turning to the wishes of organic growers, Kingsbury says. “The breeding of crops for organic growers is developing very rapidly, with the Netherlands in the forefront.” Could an organic Luther Burbank be next? —*Mark Kane*



Making a Case for Genetic Modification

The banana, probably the world’s most popular fruit, is so prone to disease that its very existence is threatened. Ironically, the banana’s inherent weakness emerges from a characteristic that helps make it so popular: Bananas are seedless. The fruits develop without the benefit of pollination, their “seeds” reduced to tiny dark specks.

Because cultivated bananas are sterile, they are propagated vegetatively through the daughter plants, or offsets, that can be divided from the mother plant. Vegetative reproduction results in consistent fruits—a benefit for fruit vendors—but the banana’s sterility makes conventional breeding nearly impossible. To save the banana, we need the laboratory.

The banana’s special biology makes it an ideal candidate for genetic modification (GM). Without pollen, without seeds, there’s no chance of contaminating nearby crops. Despite this argument, the future of the fruit isn’t promising. The variety we eat, ‘Cavendish’, is being pursued around the world by a virulent—and incurable by any current means—fungus. James Dale, an Australian biolo-

gist funded by the Gates Foundation, recently claimed to have developed a lab-bred variety of the fruit that resists the malady. But he’s been unable to launch the field trials needed to complete his research. “Fear,” he says, “is winning.”

“They’re wrong,” says Belgian scientist Rony Swennen, referring to a general public that sees GM food crops as something absolutely and universally evil. For the banana, Swennen says, there is no other way. He spent more than a decade working in Africa attempting to develop disease-resistant fruit using conventional hybridizing techniques. It didn’t work.

Swennen returned home and established a university laboratory that focused on genetically transforming the fruit; he also developed a cryogenic vault to preserve the banana’s biodiversity. (Across the planet, rare breeds of the fruit—including a handful of wild varieties, which are inedible but contain valuable genetic information—are vanishing, succumbing to both sickness and habitat loss.) Swennen’s first GM bananas were promising, shortcutting years of

traditional cultivation and testing. But field trials in regions where the fungus occurs are sometimes prevented. In Uganda, the world’s most banana-dependent country, officials and villagers expressed an interest in testing Swennen’s varieties. But the trials didn’t happen. There are those, Swennen explains, who oppose genetic engineering of bananas and by so doing, stand in the way of a development that would sustain the diet, economy, and way of life of millions.

It is easy to see genetic modification of our food as pure evil. But perspectives lacking nuance could lead to effects that are potentially even more ugly: starvation, market collapse, and the increased use of toxic chemicals that take a severe toll on the health of banana plantation workers. (Banana consumers are less at risk, as the fruit’s thick skin is nonabsorbent and much of the chemical residue is washed off in processing.) The development of a genetically modified banana should be one element of a global program to extend the fruit’s diversity and viability as a major food crop. —*Dan Koeppel*

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