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Playing God With The Genetic Code

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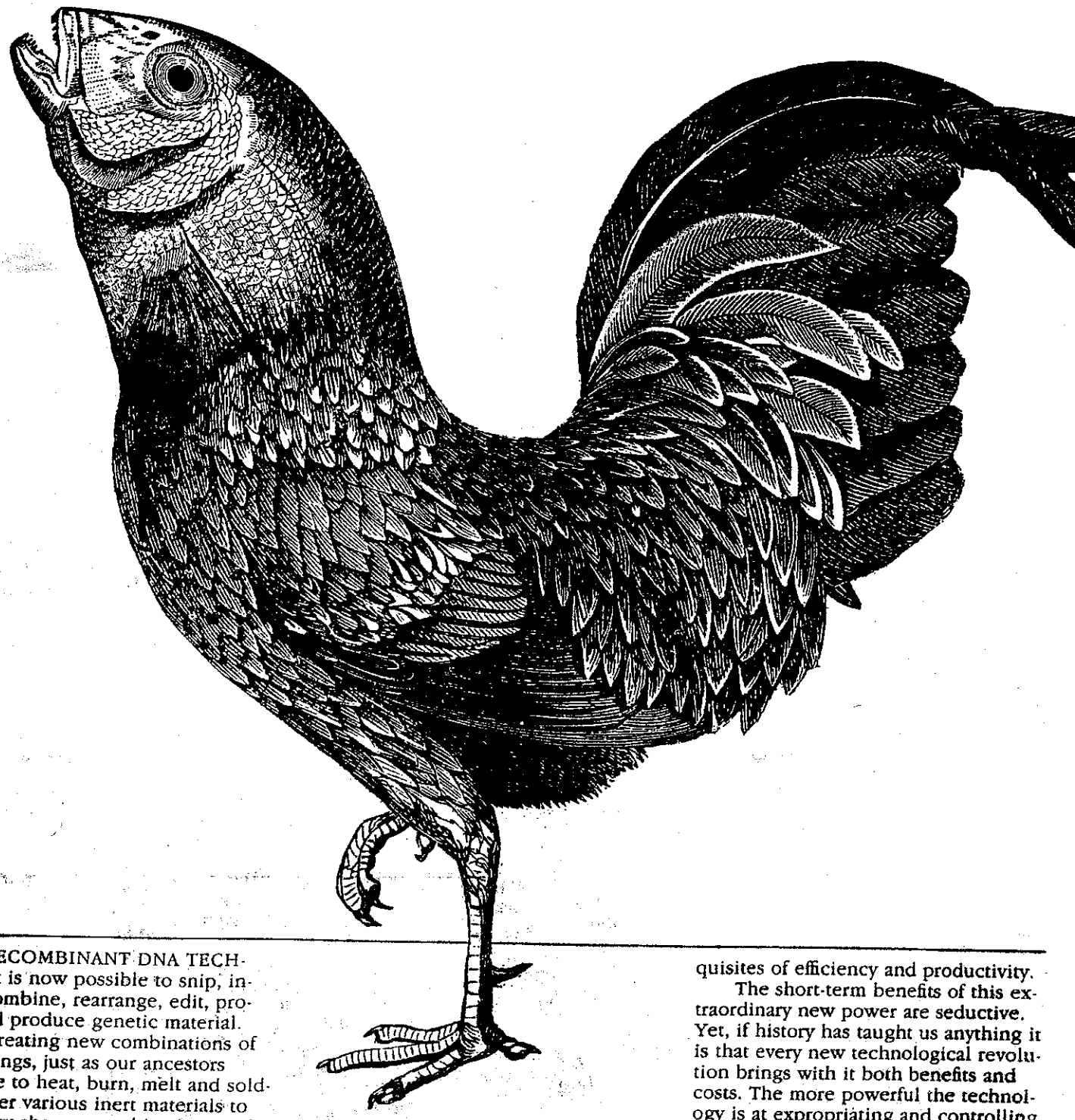

WITH RECOMBINANT DNA TECHnology it is now possible to snip, insert, recombine, rearrange, edit, program and produce genetic material. We are creating new combinations of living things, just as our ancestors were able to heat, burn, melt and solder together various inert materials to create new shapes, combinations and forms of inanimate matter.

The transition from the Age of Pyrotechnology to the Age of Biotechnology is the most important and disturbing technology change in recorded history. For with this newfound ability to manipulate the very blueprint of living organisms, we assume a new role in the natural scheme of things. For the first time in history, man becomes the architect of life itself, the creator and designer. As we begin to reprogram the genetic codes of living things to suit our own cultural and economic needs, we are taking on the task of creating a second genesis, a synthetic one geared to the requisites of efficiency and productivity.

The short-term benefits of this extraordinary new power are seductive. Yet, if history has taught us anything it is that every new technological revolution brings with it both benefits and costs. The more powerful the technology is at expropriating and controlling the forces of nature, the more exacting the price we will be forced to pay in terms of the disruption and destruction wreaked on the ecosystems that sustain life. Certainly, our recent experiences with the nuclear and petrochemical revolutions bear this out.

Genetic engineering represents the ultimate tool. It extends man's

reach over the forces of nature as no other technology in history, perhaps with the one exception of the nuclear bomb, the ultimate expression of the Age of Pyrotechnology. With genetic technology we assume control over the blueprints of life itself. Can any reasonable person believe for a moment that having such power is without risk?

Thus, the question of whether we *should* embark on a long journey in which we become the architects of life is, along with the nuclear issue, the most important ever to face the human family. We have heard much of late about the benefits of this great revolution in technology, but we are long past due for a discussion of the costs. The full-scale use of biotechnology in military research, agriculture and industry, and in human reproduction and health, raises environmental, economic and ethical concerns that are without parallel.

Environmental Risks

The biotechnology industry is preparing to release scores of genetically engineered viruses, bacteria, plant strains and transgenic animals into the environment in the next few years. So in coming decades, hundreds, even thousands, of genetically engineered life forms may enter the world's ecosystems in massive commercial volumes. A central question that must be answered prior to any such large-scale releases of biotechnology organisms into the environment is therefore what risks such products pose to human health and to the earth's ecology.

Because they are alive, genetically engineered products are inherently more unpredictable than chemical products. Genetically engineered products can reproduce, mutate and migrate. Once released, it is virtually impossible to recall these living products back to the laboratory. A survey of a hundred top U.S. scientists acknowledges the potential benefits of genetic engineering but warns that "its imprudent or careless use . . . could lead to irreversible, devastating damage to the ecology."

Moreover, environmental scientists have compared the risk of releasing biotechnology products to those we have encountered in introducing exotic organisms to North American habitats. While most of these organisms have adapted to our ecosystems, several–including Chestnut Blight, Kudzu vine, Dutch Elm Disease and the Gypsy moth–have wreaked havoc on the environment.

The long-term cumulative environmental impact of the deliberate release of thousands of genetically engineered organisms could be devastating. The sensible approach now being undertaken in Japan and in several European countries is to impose a moratorium on the deliberate release of any and all genetically engineered organisms until such time as a "predictive ecology" can be developed which will be capable of adequately assessing the effect that these organisms will have on the environment.

The use of biotechnology also creates the potential for considerable social and economic dislocation, especially in the world's farming communities. Even a single biotechnological product can have significant adverse impacts. A timely illustration is the recent research and development of bovine growth hormone (BGH). When injected into cattle on a daily basis, this hormone, cloned through genetic engineering, can increase milk production by at least 30 percent per dairy cow. Because of an already flooded milk market, BGH therefore poses a serious threat to dairy farmers. It has been estimated that milk prices may fall 10 to 15 percent within the first three years of the introduction of BGH. It is further estimated that the number of dairy farmers may have to be reduced by 25 to 30 percent to restore market equilibrium.

Additionally, a U.S. Congressional report has concluded that the use of BGH could cause a historic shift in U.S. milk production from the traditional, smaller dairy farms in the Northeast to larger dairy farms in the West. These dislocations, and the problems resulting from similar biotechnology products, will have dramatic social, economic and cultural effects unless the dissemination of genetically engineered products is strictly controlled around the world.

Ethical Considerations

The use of biotechnology creates profound and difficult ethical questions. Its use in reproduction and genetic screening raises unique questions of discrimination, the exploitation of women and the prospect of a commercial eugenics. Moreover, genetic engineering is being used to revolutionize biological warfare through the creation of "novel" viruses and bacteria that could have catastrophic effects and initiate a genetic arms race.

Most worrisome is that scientists are crossing species boundaries at an ever-increasing rate, inserting human genes into animals and animal genes into other animals and plants. Many recent achievements sound more like science fiction than science fact. For example, scientists have taken the gene that emits light in a firefly and inserted it into the permanent genetic makeup of a tobacco plant; the tobacco leaves light up 24 hours a day. Researchers have inserted human growth hormone genes into the genetic code of rats and pigs; the rats grow twice as fast and twice as big as normal. Scientists have fused sheep and goat cells, creating the geep, a half-sheep, half-goat chimera.

Should biotechnologists be allowed to play God, crossing human genes into animals and animal genes into plants? These techniques in fact go far beyond any traditional breeding of animal or plant species. Cross-species genetic transfers may in fact be the ultimate offense to the dignity and integrity of the biotic community. And the prolonged and expanded use of these cross-species engineering feats could mean the end of the natural world as we know it.

Recently, the U.S. Patent and Trademark Office granted the first patent on a genetically engineered animal. This regulatory edict, the first-ever commercial patent on animals, reduced genetically engineered animals to the status of manufactured products. It is a decision that bodes ill. Will succeding generations grow up in a world in which the genetic codes of plants, animals and humans are interchangeable and living things are programmed as engineered products, with no greater intrinsic value than automobiles or toasters?

Before we allow the biotechnology industry and the scientific community to push society headlong into the biotechnology revolution, the world needs to thoroughly scrutinize the long-term environmental, economic and ethical issues raised by this powerful new technology. It is now clear that when society commercialized the nuclear and petrochemical revolutions, it did so without first resolving the "hard" questions about the ultimate impacts of those technologies. As a result, we are now confronted with a huge environmental and societal bill, including undisposable nuclear waste, toxic waste dumps, acid rain, the "greenhouse" effect and ozone depletion.

Let us hope that the world's leaders have learned from these mistakes and this time, with biotechnology, will raise the important questions *before*, rather than after, the damage is done. For it is only through this kind of foresight that we can assure that human choices will dictate the growth of technology rather than technology controlling the future of humans. ●

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