

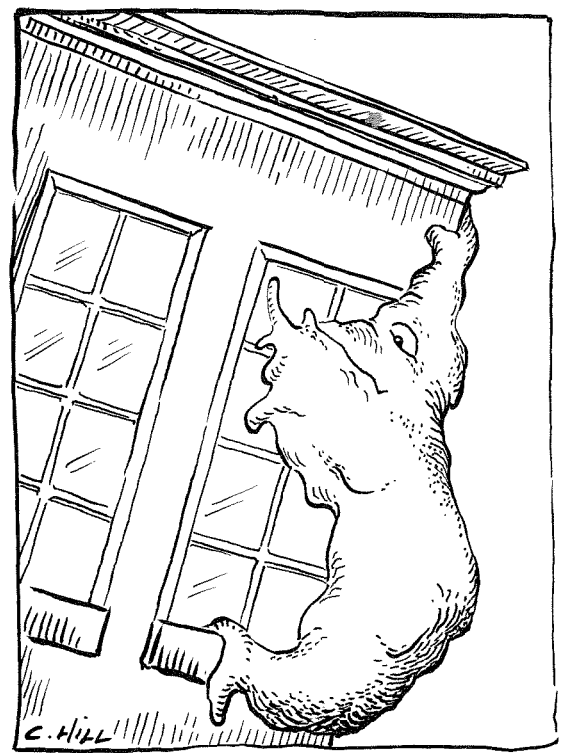
A Biological Century?

by Gregory Benford

Keeping in mind the theme of this session, I'm going to try to be fairly crazy. Perhaps unfairly crazy. The best way to contemplate the future, it seems to me, is not to think in categories of the present, but rather to learn from history, to the extent that it's possible, and extrapolate from that. It's tough to do. The hardest thing to realize about the future is that it can be qualitatively different from the present, just as our time is qualitatively different from the era of westward expansion through the Great Plains a century and a half ago.

I tend to believe that the 19th century was dominated mostly by the metaphors and technology of chemistry and mechanics. The 20th century has been dominated by electronics, and, of course, by physics, culminating in the incredible marriage of the atom and the rocket. Many of these developments can be traced back to the middle of the 19th century, when James Clerk Maxwell formulated electrodynamics, which ultimately gave us electronics. In the middle of this century, Watson and Crick discovered the structure of DNA, setting the stage for a 21st century that will be dominated by biology. And it will contain as many surprises, if not more, than we have seen in this century.

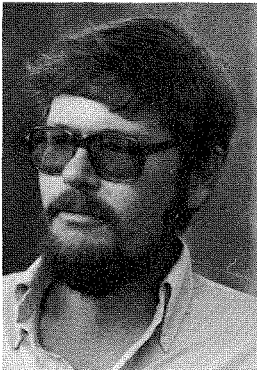
What would a biological century look like? If the 19th century was characterized by hardware and this century by information, that is, software, we might believe that the next century will be informed by liveware. Living technology. I think the first evidence we'll see of this phenomenon will be consumer products. Microbes residing in your teeth that fight plaque. A

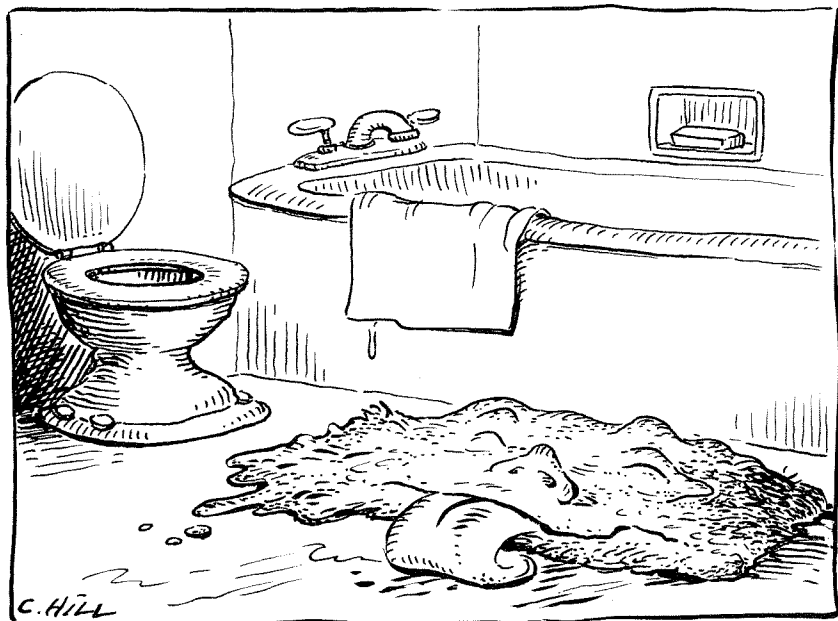


kitchen or bathroom mat that is alive and cleans the room because it lives off what it eats. Or a service that does windows because it's in fact a green fungus that crawls around the outside of a large building and lives there permanently, again living off what it eats. Another possibility is a grow-your-own-home. Why grow trees, chop them into pieces, and then reassemble them? In the long run, it might be much smarter to simply engineer the genes of the trees and grow your own house. We can imagine lots of these kinds of things that will change the landscape of personal life.

Now, what about the larger picture? As we heard from Professor Hood, the human genome project proves again something we learned in grade school: Learn to read a book and there arises in some of us, regrettably perhaps, a temptation to write a book. I believe we will one day do that. But that will come further downstream.

A biological century also raises the possibility of brave new approaches to preserving threatened tropical ecosystems. Suppose you're in the library in Alexandria after it's caught fire, and you can only save as many books as you can carry in one basket. Do you rummage through the shelves saying, "This is by Aristotle, but this is just Alexander the Great's laundry list, so I'll take the Aristotle?" Not if you're trying to work fast. You would probably just grab everything you could carry. Perhaps one of the things we ought to discuss right now is a crash program to preserve everything we can salvage out of the tropical biospheres. Flora and fauna, sampled widely and





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stored long term, perhaps in liquid nitrogen, with the expectation of restoring them to nature at a later date. We can't effectively use that information now, but that's the point about the future—it will be different. A biological century may well be able to recover information from anything that we save, analyze genomes, do exotic restorations, perhaps revive whole systems—and the more we save, the better. Contemplate how much effort we're currently spending to recover everything we possibly can from a fellow frozen near a Swiss glacier 5,000 years ago.

Such capabilities will bring into focus a choice we may eventually have to make. Remember that awful sentence from the Vietnam War: To save the village we had to destroy it. Perhaps to save the biosphere, we will have, not to destroy it, but to substantially modify it. That may mean, for example, changing the nature of many major species, so that they are more amenable to living with us. I know some people may feel that this is immoral and maybe it is, but we've been doing it for millennia in agriculture and animal husbandry. Consider the acacia tree, which has an ant that lives in a symbiotic relationship with it. The ant polices the weeds around the tree and drives off other insects that like its bark. In return, the ant gets to eat some of tree's blossoms. Imagine adapting that mechanism to trees that bear fruit for us, like orange trees. You set up a new symbiotic relationship, tuning the insect's response and tuning the plant. I don't think that's crazy on a scale of a century.

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dark side that we must think about very seriously. One of the great concerns we're going to have will be a huge wedge of population in the tropical regions. This demographic explosion could produce billions more people than Earth can support, given our current habits. (Our current habits, I often think, are expressed aptly by simply noting that the average person thinks he isn't.) I believe there's a fair chance that someone will notice that on the one hand we have enormous biological technology, and on the other we have an enormous excess of humans. Some maniac may attempt to kill billions of people in one shot with a plague, maybe a super-influenza conveyed from mouth to mouth. The last time a lunatic did something so vast, he wasn't a research biologist. He was an Austrian and, incidentally, a vegetarian. You can't predict where your enemies will come from. There will be a dark side, and we must remember this.

The most extraordinary challenge ahead of us, however, will come from a brand-new field, which I will call humanistics. It will involve specialists in artificial intelligence, evolution, and computer languages, as well as brain scientists, biotechnicians—yes, even humanists—in the combined study of what it is to be human. We're going to have to hack out a definition of what human actually is, because the ability to produce things that look the same and walk the same—although maybe they won't talk the same as we—may occur within a century. That will be the greatest challenge to our species, and I hope we don't have to face it before we can save the biosphere. Knowing, however, that God has not only a sense of humor, but also, obviously, a sense of irony, I expect we'll have to deal with both issues simultaneously. □

Award-winning science-fiction writer Gregory Benford is professor of physics at UC Irvine and has served as an adviser to the Department of Energy, NASA, and the White House Council on Space Policy.