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The Biotech Century

By Walter Isaacson

Ring farewell to the century of physics, the one in which we split the atom and turned silicon into computing power. It's time to ring in the century of biotechnology. Just as the discovery of the electron in 1897 was a seminal event for the 20th century, the seeds for the 21st century were spawned in 1953, when James Watson blurted out to Francis Crick how four nucleic acids could pair to form the self-copying code of a DNA molecule. Now we're just a few years away from one of the most important breakthroughs of all time: deciphering the human genome, the 100,000 genes encoded by 3 billion chemical pairs in our DNA.

Before this century, medicine consisted mainly of amputation saws, morphine and crude remedies that were about as effective as bloodletting. The flu epidemic of 1918 killed as many people (more than 20 million) in just a few months as were killed in four years of World War I. Since then, antibiotics and vaccines have allowed us to vanquish entire classes of diseases. As a result, life expectancy in the U.S. jumped from about 47 years at the beginning of the century to 76 now.

But 20th century medicine did little to increase the natural life-span of healthy humans. The next medical revolution will change that, because genetic engineering has the potential to conquer cancer, grow new blood vessels in the heart, block the growth of blood vessels in tumors, create new organs from stem cells and perhaps even reset the primeval genetic coding that causes cells to age.

Our children may be able (I hope, I fear) to choose their kids' traits: to select their gender and eye color; perhaps to tinker with their IQs, personalities and athletic abilities. They could clone themselves, or one of their kids, or a celebrity they admire, or maybe even us after we've died.

In the 5 million years since we hominids separated from apes, our DNA has evolved less than 2%. But in the next century we'll be able to alter our DNA radically, encoding our visions and vanities while concocting new life-forms. When Dr. Frankenstein made his monster, he wrestled with the moral issue of whether he should allow it to reproduce: "Had I the right, for my own benefit, to inflict the curse upon everlasting generations?" Will such questions require us to develop new moral philosophies?

Probably not. Instead, we'll reach again for a time-tested moral notion, one sometimes called the Golden Rule and which Immanuel Kant, the millennium's most meticulous moralist, gussied up into a categorical imperative: Do unto others as you would have them do unto you; treat each person as an individual rather than as a means to some end.

Under this moral precept we should recoil at human cloning, because it inevitably entails using humans as means to other humans' ends--valuing them as copies of others we loved or as collections of body parts, not as individuals in their own right. We should also draw a line, however fuzzy, that would permit using genetic engineering to cure diseases and disabilities (cystic fibrosis, muscular dystrophy) but not to change the personal attributes that make someone an individual (IQ, physical appearance, gender and sexuality).

The biotech age will also give us more reason to guard our personal privacy. Aldous Huxley, in *Brave New World*, got it wrong: rather than centralizing power in the hands of the state, DNA technology has empowered individuals and families. But the state will have an important role, making sure that no one, including insurance companies, can look at our genetic data without our permission or use it to discriminate against us.

Then we can get ready for the breakthrough that could come at the end of the next century and is comparable to mapping our genes: mapping the 10 billion or more neurons of our brain. With that information we might someday be able to create artificial intelligences that think and experience consciousness in ways that are indistinguishable from a human brain. Eventually we might be able to replicate our own minds in a machine, so that we could live on without the "wetware" of a biological brain and body. The 20th century's revolution in infotechnology will thereby merge with the 21st century's revolution in biotechnology.

But this is science fiction. Let's turn the page now and get back to real science.

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