# "A Post-Human Future?"

Imagine that you had power .... unprecedented, life-altering power to shape the course of human evolution. Imagine you could forever rid the world of disability and disease. Suppose you could extend the human life span by fifty or a hundred years. What if you could boost the mental power of the human mind by an order of magnitude, or give men and women bodies that in strength and agility could outstrip the greatest athletes of our time? As long as we're dreaming, imagine stumbling across the fountain of youth–the secret of eternal vitality. All of this may sound like farfetched science fiction, but if we can believe the promises of the bioengineers and nanotechnologists, all of it could soon be science fact.

Consider this: my December issue of *Discover* magazine featured the work of three researchers who shared in the honor of being named "Scientist of the Year," all of them on the cutting edge.

Svante Pääbo of the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, for instance, is at the forefront of mapping the Neanderthal genome, drawn from mitochondrial remnants found in fossilized bone. To determine exactly when and how our species leaped ahead of other early hominids, he's begun inserting strands of human DNA into the germ cells of mice to breed a rodent with superlative mental powers. Putting genes believed to control brain growth and speech into lab animals will help pinpoint exactly which sequences in the gene trigger an enhanced IQ–the ultimate aim being not to engineer a mousey master race, but to eventually breed a superior human or post-human personality, as far advanced beyond you or me as we are beyond the heavy browed cave dwellers that early *Homo sapiens* dispatched to extinction nearly 40,000 years ago.

Sharing in the "runner up" category for Scientist of the Year was the work of John Donaghue of Brown University's Brain Science program, co-founder of Cyberkinetics Neurotechnology Systems. Donaghue is the originator of Braingate, the world's most advanced cortical/computer interface, a tiny silicon chip implanted on the surface of the brain with micro-wires extending deep into the neural net. With Braingate installed, you can manipulate the cursor on a computer monitor using only the power of your thoughts: telekinesis without the ESP. This past summer, the device proved its potential when John Nagle, a quadriplegic paralyzed when a knife severed his spinal cord, was able to operate a robotic hand to open his email and change channels on his TV set, all without any physical contact on the part of the disabled man. Inventors envision a day not too far off when microchips inside your skull will let you solve complicated math problems in your head, boost your memory and even translate foreign languages with the aid of specialized cochlear implants.

Last but not least, John Keasling, a chemical engineer at Berkeley, is busy founding the field of synthetic biology–not simply putting genes from one species into another organism, but integrating DNA from several creatures to create whole living factories–microbes that take pictures like a camera, or bacteria that churn out fuel like a

petroleum refinery–melding living tissue into a machine/industrial complex, a process that *Forbes* with only slight hyperbole calls the “regenesis” of life.

Work like this is being hailed as a godsend by many. Imagine the pharmaceuticals. The Bill and Melinda Gates Foundation has given Keasling a major grant to develop a cheap, effective anti-malarial drug starting from nothing more complicated than a yeast. For people with disabilities, the prospect of artificial senses could literally make the lame to walk, the blind to see and the deaf to hear. Even now, genetic tests that enable doctors to screen for inherited conditions like Cystic Fibrosis and Tay-Sachs are dramatically cutting the incidence of those afflicted with such maladies. Instead of dosing cancer victims with generic chemo treatments, molecular medicine is tailoring therapy for fighting tumors to match each patient’s unique genetic fingerprint. Stem cells show potential of being teased into growing new heart valves and other desperately needed organs. Revenues from the biotech industry topped fifty billion dollars last year, and if investors are right, corporations with names like Genentech and Advanced Cell Technology are going to make us all rich as well as healthy, trim and incredibly sexy. Amid the applause that greets each new breakthrough, it’s hard to find a downside.

Of course there are soft-headed critics who cite the “yuck factor” involved in some of this. What about the day-glow bunny created by an avant-garde artiste named Eduardo Kac, a rabbit impregnated with genes from a phosphorescent jellyfish whose every cell glows green under black light? The creator claimed he needed a fresh medium for this new millennium, that aesthetes could no longer paint on cave walls in the manner of our primitive ancestors. Or what about the transgenic goat, crossed with an orb-weaving spider, whose milk produces fibers tough as an arachnid’s web? These hybrids do seem a bit creepy to me, and perhaps to you, like nothing produced in nature. But then fifty years ago, people felt organ transplants were creepy, too. Since then, they’ve become routine. The problem is that what strikes some people as gross or yucky draws an enthusiastic “gee whiz” from others. No previous generations have been able to control and manipulate life in quite this way, and we don’t necessarily have any inborn instincts or emotional responses that can guide us in this brave new world.

Which seems to me a reason to go slowly down this road, not at the breakneck speed technology is currently driving us. There are no reliable maps, no well-established signposts or “proceed with caution” markers such as the ones that might have helped our parents or grandparents navigate when they faced uncertain terrain. Consider how fast the territory is changing. When I was in college thirty years ago, scientists at Harvard were just beginning to experiment with recombinant DNA. Today most of the food we eat has been genetically modified: ninety percent of the U.S. soybean crop is GM, half the corn, along with three quarters of the cotton grown in this country. If biotech is indeed the highway to the future, it’s one we’re traveling at white-knuckle velocity without too much public discussion about what our ultimate destination might be or of any unseen dangers along the way. But you don’t need a “mapquest” implanted in your frontal lobes to foresee more than a few slippery slopes and blind alleys ahead.

One of those slippery inclines is the lack of any hard, fast line between using genetic

engineering to treat disease and overcome disability and using it to create designer children through manipulation of the germ line. If it's okay to splice a gene into a human embryo that will prevent the child from being born "sub-average," whatever that means, why not give our sons and daughters a juiced-up genome to make them taller, smarter, faster, more musical and funny, less shy, more outgoing, with leaner abs and a sunny disposition and no male pattern baldness? Of course, the rich are more likely to invest in gestating these baby Einsteins, because they can afford to, just as they can currently afford to send their kiddies to exclusive preschools and prep academies. The middle class will be pressured to follow suit, lest their otherwise normal youngsters be stigmatized as fatsos or dummies. Eighth graders will sort themselves into the cool kids and the nerds, based not on what brand of blue jeans they wear but on what brand of genes they carry in their chromosomes. The poor, who can't pay for embryonic enhancements or digital gizmos in their brains, will eventually become a breed apart, left behind in a manner that gives a whole new sinister meaning to the term "disinherited," their biological hardware as outmoded as a Commodore 64 competing against the latest machine from Dell.

And this is precisely the future that many proponents of biotech are hoping for: replacing the human race with a model that has faster circuits and a bigger hard drive. As James Watson, who unraveled the double helix, puts it, our aim now should be "going for perfection." That's what those transgenic mice in Leipzig are all about–the proposed next step in our evolutionary trajectory.

At that point, the difference between "nature" and "nurture" will effectively disappear, because there will be no "nature" left. As the human signature has touched and transformed every square inch of the planet, from melting tundra in the Arctic to mercury in the oceans, the last remnants of the internal wilderness will have vanished too. Our genetic make-up, the living link that ties us to our own hunting-and-gathering forbears as well as to every other creature on the planet, that gives us the same anatomy and psychic resonance as Christ and Plato, will have been forever altered. Our descendants will inhabit an environment which has become totally engineered, subject to the forces of a market economy, inside and out.

For some, that's a prospect that evokes an elated "wow." But for me, it signals a big "uh-oh." On the one hand, I'm not sure that the human race wise enough to design its own destiny. And on the other, I care for human nature and trust in it too much to call for its permanent abolition. When I think about my own children, for example, I'm confounded. I'd never purposely make a child as moody or dreamy as my daughter, or one with such a short temper or casual attitude toward money as my son. Were I in charge of their biochemistry, I'd inevitably try to fix their flaws, tinker to make them more like me, or less like me, and probably be as dissatisfied with the results as I am with most of my own creations. I know the enterprise would end in frustration for all, as it does now whenever I try too hard to control my kids rather than simply cheering them on. They remain stubbornly independent, resistant to my influences. Yet as it is, I couldn't love them more, and if the aim is "going for perfection" I as a parent would say that both are nearly perfect just the way they are.

In this season, as we celebrate the birth of a child long ago, it occurs to me that hope for the future lies less in improving the human race than in learning to love and accept one another. Love doesn't require a higher I.Q. or a body built by Fischer. It's the dearest expression of our humanity, most like the divine, and it's readily available to all. Those are the glad tidings I rejoice in, and this is where I find the good news. Not in the latest headline about splicing rat neurons with a silicon wafer, but in the much, much more subtle splicing of hearts.