Prometheus, Vol. 24, No. 3, September 2006

Review Article: Resistance is Futile—The Future and Post-humanity

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Rebuilt—How Becoming Part Computer Made Me More Human

Michael Chorost

New York, Houghton Mifflin, 2005, 232 pp. US$24, ISBN 0-618-37829-4 hbk

More Than Human—Embracing the Promise of Biological Enhancement

Ramez Naam

New York, Random House, 2005, 277 pp. US$25, ISBN 0-7679-1843-6 hbk

What is to become of us *as a species*? Although there is debate about whether the processes of natural selection and evolution still operate on modern humans, there is no doubt that our ability to modify *ourselves* is rapidly increasing, and is already, by far, the dominant form of human change. Medicine has been skewing the survival stakes in our favour for a long time, but the newest forms of self modification go much further—involving wholesale implantation of hardware into our bodies and the re-writing of the genetic code that describes who we are and how our bodies function at the molecular and cellular levels. These two books offer complementary perspectives on a number of these forces of human change. The first book is the first-hand story of how Michael Chorost[1] regained his hearing by having a specialised computer implanted into his cochlea, and in his own words, became more human by becoming part machine. The second book presents an overview of the entire field of human biological enhancement, and points out just why these kinds of self modification seem inevitable, and not just in people who want relief from a disability.[2] Together these books present a convincing picture of a future for mankind that can only be described as post-human—that is, one which contains individuals who have significantly exceeded the limits and capacities of human beings.

The Cyborgs Among Us

Chorost's book unflinchingly tells the fascinating story of his own hearing loss and subsequent cochlear implantation. Born with a hearing defect, Chorost grew up

Prometheus ISSN 0810-9028 print/ISSN 1470-1030 online © 2006 Taylor & Francis
http://www.tandf.co.uk/journals
DOI: 10.1080/08109020600907779

wearing various kinds of hearing aids, and became an expert in extracting the most out of them in order to retain his, at times, fragile grip on the world of sound and speech. Conventional hearing aids work essentially by turning up the volume of the world so that those with poor hearing can make out enough to get by. But for this to work the wearer must retain at least some functional hair cells—the cells in the ear that detect sound waves and convert them into neural impulses for the brain. The book starts on the fateful day when Chorost's world fades into complete silence. Naturally he presumes it is due to some technical problem with his hearing aids, most likely the batteries, but nothing he tries restores his hearing. What has actually happened is that the last of Chorost's hair cells have stopped functioning, rendering all conventional hearing aids now useless to him. To get his hearing back Chorost must have a cochlear implant—a computerised device that will be surgically implanted into his brain and that artificially simulates the neural impulses that his hair cells once produced in response to everyday sounds. Unlike his old hearing aids, the implant becomes a permanent part of his body, recessed into his skull, beneath his scalp, and connected directly to his ear's nerve endings. A small, external magnetic disk adheres to the beneath-scalp implant and allows an external microphone and control box to communicate with it, through the skin by radio waves, at a rate of over one million bits of data per second. The external microphone constantly samples the world of sound and the control box passes this information on to the implant where it is analysed and converted into tiny electrical impulses that are fed into the brain to mimic the sensation of hearing. At first the implant delivers only unrecognisable noise, and does so until a lengthy calibration process is complete. This involves not only a long regime of hearing tests to find the optimal set of implant parameters for each individual, but also involves allowing the auditory cortex of the brain enough time to re-wire itself in order to make sense of the new, different signals coming from the electrodes of the implant. The results are new and augmented versions of reality, each one corresponding to a particular set of implant parameters. Even excluding extreme or unlikely settings, Chorost estimated that he had approximately 230,000 versions of reality to choose from. The version of the world of sound that he finally chose was different from the version he previously considered 'real' with his old hearing aids and is also probably different from the 'real world' of sound that most of us take for granted—but it allowed him to again participate in the important human world of sound and communication.

As you would expect, Chorost doesn't take his hearing for granted and because of this is able to share a number of fascinating insights throughout the book. For example, he points out that in some ways hearing is a more primary sense than vision—because hearing places you at the *centre* of the world, as sound continually occurs all around you in three dimensions and, under normal circumstances, can't be turned off. Vision, by contrast, places you as the *edge* of the world looking in, as our field of vision always remains just in front of us, and even this disappears when we close our eyes. After implantation Chorost has computer code running in a small machine beneath his skin—one functionally and physically connected to his brain. Chorost is now able to plug the audio output of a compact disc player directly into the external control box of his cochlear implant in order to listen to music, a feat that must represent the first time in human history when a digital recording has been directly converted into neural impulses and experienced as music without ever having existed as sound waves—the ultimate in private listening. For Chorost this is the essence of being a cybernetic organism, or cyborg—the computerised implant and his own brain have fused together in mutual co-operation to restore his hearing.

The Edge of the Future

Naam's book presents a wide-ranging overview of the types of human enhancement that are currently under development in the world's laboratories and universities. These nascent technologies include new kinds of drugs to make you smarter, genetic modification to make you live longer and look more youthful, and cybernetic implants to overcome various human disabilities and to allow even the non-disabled to interface directly with computers and even each other. Naam argues that these latest technologies should not be feared and are actually outcomes of the same kinds of technological development that the world has been enjoying for many decades. For example, it was once thought that in vitro fertilisation (IVF) would psychologically traumatise the child produced by such artificial means and that the technique was an abhorrent intrusion of technology into the natural process of reproduction. Since 1978 more than a million babies have been produced by IVF and longitudinal studies suggest no psychological harm has come to the parents or the children—in fact, previously infertile couples are generally extremely happy and grateful with the outcome. The safety of IVF has now been improved with the introduction of a process called pre-implantation genetic diagnosis (PGD) where doctors are able to pick the healthiest embryos for implantation and avoid ones that may be predisposed to particular genetic disorders. But here's the rub: what if non-IVF parents want similar kinds of pre-birth screening? What if parents would like to optimise the genes of their children, as part of such screening, to raise their IQ, make them longer-lived, or more physically attractive? PGD is currently legal for IVF procedures, but other kinds of reproductive genetic manipulation are not, even though much of the technology is already available.

The Genie has always Been Out of the Bottle

The technologically possible always runs several steps ahead of what most people consider morally acceptable, and it seems likely that this gap is set to increase with the ever-quickening pace of technological development. Such issues of morality and the appropriate use of technology are central to our notions of human identity because the degree to which we sanction human enhancement will determine the speed with which we humans turn into post-humans. However, even given moral and legal prohibition of certain human enhancements, it seems inevitable that someone somewhere will start offering such procedures to those who are willing to pay a great deal for them. For example, having your child genetically enhanced in order to boost his IQ by 30 points could convey huge advantages in terms of scholastic achievement, employment prospects and future wealth. Such enhancement may carry risks, but the potential rewards are so great that it is certain that many parents will consider the risk worth it. In addition, Naam points out that people in different countries have different attitudes towards genetic enhancement—people in the US and Europe are generally against it, but people in much of Asia are more accepting. This makes the issue of human enhancement more complex—not only is the issue socio-economic, but also political. Thus, genetically enhanced individuals may form new powerful socio-economic elites, and the appearance of such elites may sway many more people towards human enhancement. In addition, countries that have large populations of enhanced individuals may also be at considerable economic, and therefore political, advantage over those countries without enhanced elites. This could further promote human enhancement through the possibility of the removal of prohibitions against it purely on the grounds of economic efficiency.

Viewed within the wider context of economics and work, the latest human enhancements can be seen as part of a long-term process of lifestyle change which started before the industrial revolution—only now, the forefront of technological change is no longer the field, the factory, or office, but our bodies themselves. In addition, throughout this process, technological advancement has been closely linked to increases in the standard of living. One of the first sources of mass-produced technology was the United States, where assembly lines, mass-produced consumer goods, greater consumer choice and greater consumption were seen as overt evidence of a superior standard of living.[3] Such technological development was also intimately connected with the 'American dream', that is, that anyone could be wealthy and could enjoy such a standard of living if they worked hard enough. This technologically intensive consumerist 'dream' has now been exported to much of the rest of the world.

However, in 1964 Herbert Marcuse pointed out that one of the most significant outcomes of modern industrialised society is the obliteration of the opposition between private and public existence and between individual and social needs.[4] Thus the advanced society dictates the needs, attitudes and aspirations of its inhabitants so that it can more efficiently, and more pleasantly, satisfy such needs and aspirations. The individual is absorbed into a kind of symbiotic relationship with the advanced society in which he or she lives, such that it would be inconceivable or impossible for the individual to exist outside it. In such circumstances it also becomes more difficult for the individual to resist the inertia of the advanced society, for example, in terms of directives to work longer hours or to consume more goods. Perhaps one of the most extreme examples of the logical endpoint of this process can be seen in the 1971 film *THX-1138*, in which citizens of a highly technological society are continually sedated to make them more manageable and are told to 'buy now, buy more'.[5] However, the process of production and consumption in their society has reached such a level of 'efficiency' that the only items for sale are small, coloured geometric objects with no apparent use, which citizens immediately drop into the waste disposal upon bringing them home.

Clearly we owe it to ourselves to avoid such a dystopic future. However, the relationship between individuals and the technological society in which we live seems certain to become more intimate, will go beyond the conventional consumerism we know today and is likely to encourage many new kinds of human enhancement. Already common are the use of many mind-altering prescription and recreational drugs, and cosmetic enhancements, such as plastic surgery. It seems inevitable that new kinds of functional and cosmetic enhancements will become common in the future, and Naam's book provides a host of possibilities of what these might be. For example, Naam describes brain interface systems that involve the surgical implantation of electrodes into the surface of the brain, and which can already allow a monkey to manipulate a robot arm at will, as naturally as if it were their own fifth limb. Such control can even happen at great distances because the information read out of the brain by the interface can easily be sent through computer networks. Similar brain interface systems are already available for human quadriplegics, allowing them to manipulate a cursor on a computer screen in order to communicate with others or to send emails, just by thinking about it. The possible applications for such brain interface technology are wide, significant and potentially concerning. The US Defense Advanced Research Project Agency (DARPA) has funded animal research to further develop such brain interface systems to allow direct brain-to-brain communication. Such systems are tantamount to a kind of technologically augmented telepathy, but a kind of telepathy in which the information stream could be read, recorded and even edited by others. The advantages of this kind of technology might include fantastically improved communication between military troops in the field, powerful new kinds of computer interfaces, and even diagnostic aids and clinical therapies for mental disorders. The disadvantages are Orwellian to say the least and might include new types of mind control or the possibility of computer users effectively becoming plug-in components.

Curing Death

For many, one of the most appealing human enhancements covered in Naam's book will be that of not just looking younger, but looking younger *and living much longer*. When genetic research on life extension began it was thought that aging was such a complex process that hundreds, if not thousands of genes would be involved—thus making remote the task of successfully re-writing these genes to extend life. However, in the 1980s, contrary to these expectations, it was shown that the lifespan of nematode worms could be doubled by a mutation in a single gene. Importantly, there is also considerable evidence to suggest that this is not just good news for nematode worms, but that we share enough of the underlying cellular mechanics with these tiny creatures to expect significant human life extension to arise from such work. More genes associated with life extension have now been found and therapies based on this technology may be available soon.

Success in this and related areas have led some enthusiasts of life extension to go to the extremes of believing that death itself can be cured. Perhaps one of the most prominent of these would-be immortals is Ray Kurzweil, who said in a recent interview, when asked how long he planned to live, 'Let's just say I'm not planning on dying'.[6] Employing what he calls his bridge-to-bridge approach, Kurzweil uses the very best technology at any point in his life to allow him to live long enough to employ the next wave of technology in order to live even longer. His optimism for this approach comes from the accelerating returns he sees in all kinds of technologies from computer chip design to genomics research. The number of components that it is possible to cram onto a computer chip has been doubling every two years since the 1970s—a widely known regularity called Moore's Law. Similar exponential gains have been seen in gene research. Kurzweil claims that, thanks to new technologies, humans too are now obeying a kind of Moore's Law with respect to enhancement and longevity. Employing step one of his bridge-to-bridge technique, Kurzweil currently takes 250 dietary supplements a day and has weekly intravenous infusions of a substance intended to rejuvenate his cell membranes. His next planned 'bridge' involves using genetic and gene-therapy techniques to diagnose disease and extend his life. The third bridge he foresees involves using swarms of tiny nanotechnology robots to replace the functions of his failing organs. Eventually Kurzweil believes he can leave his decaying body behind entirely and replicate his mind inside a computer—thus achieving eternal life as a virtual being.[7] Kurzweil at age 56, believes all of this will be possible before he dies because the rate of technological advancement is accelerating so quickly that we constantly underestimate its speed and impact on our lives.

The Exquisite Complexity of Organic Systems

It seems ironic to me that Kurzweil expects us to accept his immortality claims on a scientific basis while taking so many scientifically unproven dietary supplements in the hope that they will make him live longer. He may be doing himself good, but he could also be doing himself harm—we currently don't know. Furthermore, the longevity extremists, like Kurzweil, seem to grossly underestimate the complexity and difficulty of the tasks involved in wholesale genetic enhancement and organ replacement. For example, very recently, artificial bladders have been successfully grown in the laboratory from patients' own tissue—a result hailed as a landmark in tissue engineering.[8] However, the replacement bladders do not yet function as well as the real thing and even these are the result of a 16-year programme of work. The scientists involved also point out that more complex organs, such as kidneys and hearts, present even greater challenges of tissue engineering. Thus, it would be easy to dismiss Kurzweil's hyperbole as the wishful thinking of an aging, wealthy, American technocrat—however, much of the underlying science of life extension should be taken seriously. Thankfully, Naam presents a more reasoned view of the often overblown field of longevity research in his book, including Kurzweil, and argues convincingly that we *will* see significant increases in human life spans in our lifetimes because of it—although 'curing' death isn't likely to happen anytime soon.

Chorost also emphasises the exquisite complexity of organic systems—pointing out that despite the technological sophistication of his cochlear implant, it is able to provide him with only 16 channels of auditory information, whereas a normal human ear delivers the equivalent of thousands. Although he is very grateful to be able to hear again, and admires the skill and science behind his implant, he still considers it a repair job equivalent to 'fixing a spider web with yarn'. Again, the central issue is that despite all the impressive advances in our technology, we are still nowhere near being able to match the subtlety and complexity of Nature's designs, let alone improve on them.[9] Although there is no reason why improvement on the organic should not be possible in the long term, our current best efforts fall far short of the real thing. Those who believe humans are now progressing down an exponential returns curve, similar to Moore's Law, will argue that these shortfalls, albeit large at present, will quickly be closed by the exponential advances in technology. However, despite decades of modern scientific study, so little is known about many organic systems, particularly the human brain, that it seems to me impossible to estimate with any accuracy when our technology will reach the same level of sophistication—that is, we simply don't know enough about the difficulty of the problem to estimate when we might be able to solve it.

The Failures of Successful Technology

Another factor that should temper our enthusiasm for new technologies, but that often doesn't, is the fact that all technologies are double-edged swords in some respect, and that things can often turn out quite differently to how they were imaged. Computerisation in the 1970s was widely perceived as the harbinger of greater leisure time. Unfortunately, the opposite has happened—we now work longer hours than ever before[10] and this is largely due to computers having fostered a faster-paced, always-available, global, commercial environment. The subsequent arrival of wireless computer technology came with the same hopeful claims of greater convenience and leisure—'now you can work anywhere'. However, for many computer users 'now you *can* work *anywhere*' has quickly turned into 'now you *will* work *everywhere*'. The relatively short history of technology is littered with grand prognostications which have come to nothing and then been more or less forgotten.[11] Even Chorost's cochlear implant, which seems entirely advantageous for him, comes with a down side for some. Some members of the signing deaf community consider such technology as tantamount to instruments of genocide for their unique culture, as more parents of deaf children now choose a cochlear implant rather than teaching their deaf children sign language. Sign language comes with all the complexity, syntax and subtleties of a spoken language, but is entirely different from it. To signers, hearing people seem stiff and expressionless because all their communication is done with their lips, hence signers often derisively call hearing people 'robots'.

In Conclusion

Our progress towards a post-human future has begun. Already there are some cyborgs among us, and already many of us make use of mind-altering drugs both medically and recreationally. Many more drugs and prostheses will become available in the near future to ease human disabilities. In addition, an increasing number of designer drugs and gene therapies, initially developed for medical purposes, will begin to be used to enhance the abilities of fully able individuals, for example to increase memory capacity, raise IQ, or simply for fun. While most of us will also make use of increasingly sophisticated technological tools in the future, it will be much longer before such tools begin to be implanted into the bodies of fully able individuals. This is simply because such implants will have to do better than our natural faculties before there will be any advantage for them to be adopted, to say nothing of the long-term safety considerations. Currently, even our best technology falls far short of the complexity and sophistication of organic systems. Although the rate of technological advance is increasing and there is no logical reason why our technology cannot approach the complexity of Nature, and indeed improve on it, how long this might take remains unclear. However, despite the technical hurdles and potential risks, it seems inevitable that humans will increasingly enhance themselves, as the desire to enhance is closely tied to our desire to do better for ourselves and to get ahead. The critical issue is how to maintain choice and freedom in an increasingly post-human world. We have failed to do better for ourselves if we become slaves to our technology, or if self-enhancement simply becomes a new kind of mindless consumerism. Naam and Chorost's books allow significant insight into the issues of human enhancement, both in terms of an overview of the current state of the field, and in terms of the human side of the potential benefits of effective enhancement. Resistance to human enhancement probably is futile in the sense that technological development isn't going to stop. However, whether enhancement is to the detriment or betterment of humanity represents a crossroads that needs to be addressed before our post-human futures are set in stone. Two of the possible paths that lie ahead for humanity are either assimilated components in a vast machine, or free agents with powerful human-integrated technology at our disposal. We should consider the issues now and choose well.

Notes and References

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