COVER

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Extropy Institute

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EXTROPY #10

Winter/Spring 1993 (vol.4, no.2)

EDITORIAL

This issue continues our inexorable advance on several fronts: #10 is larger than ever, with 48 densely packed pages (and would have been 56 pages if not for cuts forced by escalating costs). Color enlivens the cover for the first time. Distribution, both in the USA and internationally, has grown greatly since last issue: 2,500 copies are being printed and distributed all over the planet. This external growth accompanies an influx of new writers with a talent for intelligent, radical, and clear expression.

Rapidly growing circulation and production quality immediately increased costs unmatched by short-term income gains, forcing us to trim the issue down from the original monster. Two items postponed until next issue are economist Julian Simon's analysis of how environmentalist Cassandras falsely alarm people regarding population and resources, and my review of *Rational Readings on Environmental Concerns*.

In this issue, David Krieger conducts the first in a series of interviews with leading transhumanist thinkers and researchers. David's first subject is Mark Miller, a software developer working on the fabled Xanadu hypertext project. Mature hypertext will vastly increase the interconnectedness of information, allowing us to uncover knowledge and opinion with far greater selectivity, productivity, and ease.

Master roboticist Hans Moravec returns with a sweeping look at our future expansion into cyberspace and physical space. Hal Finney's excellent introduction to electronic cash and public key cryptography reveals a powerful means of protecting our privacy while facilitating remote market transactions. A "cypherpunks" group has formed in Northern California to discuss and develop these techniques.

"Technological self-transformation" continues my development of the Extropian philosophy. J. Storrs Hall, moderator of the Internet newsgroup sci.nanotech, provides an illuminating introduction to the design and potential of nanocomputers – molecular-scale computers orders of magnitude smaller and faster than our current computing devices. He also reviews Drexler's long-awaited technical tome *Nanosystems*.

In "Beyond the poor man's Extropianism," Mark Plus reviews two recent books on Ayn Rand's philosophy of Objectivism, examining the extent to which Rand's intellectual descendents have succeeded in building her ideas into a philosophy of life fit for today and tomorrow. Harry Shapiro reviews Gleick's book on the unconventional genius, Richard Feynman.

The spread of Extropian ideas is bursting beyond the confines of these pages: Apart from several e-mail lists spawned by Extropians, a growing number of reporters are calling ExI for our unique input on stories regarding advanced technologies and the future. On January 27 I will appear on *Breakthroughs: A TransCentury Update* – a public access cable-TV show in Los Angeles – explaining the Extropian worldview for thirty minutes to a potential audience of 120,000. We may also be mentioned soon in *Time*, and in a London newspaper. This exposure should attract new readers to *Extropy*, and bring new members into Extropy Institute, helping to ensure our sustained and expanded activity. If all goes well, *Extropy* may move to three or four issues per year in 1994.

Max More
Editor

MISSING CREDITS: In a grievous oversight, resulting from last-minute haste, I omitted to credit Extropy Institute director Tom Morrow for producing the new five-arrow spiral *Extropy* emblem gracing the cover of *Extropy* #9. Tom also designed the ExI logo. My thanks and apologies to Tom.

NEXT ISSUE: *Extropy* #11, is due to be mailed on July 15 1993. Likely features include:

- A memetic analysis of the spread of Extropian ideas.
- The construction and politics of ocean habitats for experimental living.
- Artificial languages and increased rationality.
- How to upload consciousness to a computer.
- Part II of the Mark Miller interview.
- Space colonization – future space launch and habitation systems.
- An article on "fuzzy logic" by its foremost proponent.
- Economist Julian Simon's "Bunkrapt: The Abstractions that Lead to Scares About Resources and Population Growth."
- Plus other possible articles, and the usual detailed reviews in *The Transhuman Taste*.

In the months before *Extropy* #11 is published, more Extropian reading will appear in issues 4, 5, and 6 of the Extropy Institute newsletter, *Exponent*. See p.38 for more information.

EXTROPY—a measure of intelligence, information, energy, life, experience, diversity, opportunity and growth. Extropianism is the philosophy that seeks to increase extropy. The Extropian Principles are: (1) Boundless Expansion; (2) Self-Transformation; (3) Intelligent Technology; (4) Spontaneous Order; (5) Dynamic Optimism. [See *Extropy* #9]

TRANSHUMANISM—Philosophies of life (such as Extropianism) that seek the continuation and acceleration of the evolution of intelligent life beyond its currently human form and human limitations by means of science and technology, guided by life-promoting principles and values, while rejecting dogma and religion. [See *Extropy* #6]

Pigs in cyberspace

Hans Moravec

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Exploration and colonization of the universe awaits, but earth-adapted biological humans are ill-equipped to respond to the challenge. Machines have gone farther and seen more, limited though they presently are by insect-like behavioral inflexibility. As they become smarter over the coming decades, space will be theirs. Organizations of robots of ever increasing intelligence and sensory and motor ability will expand and transform what they occupy, working with matter, space and time. As they grow, a smaller and smaller fraction of their territory will be undeveloped frontier. Competitive success will depend more and more on using already available matter and space in ever more refined and useful forms. The process, analogous to the miniaturization that makes today's computers a trillion times more powerful than the mechanical calculators of the past, will gradually transform all activity from grossly physical homesteading of raw nature, to minimum-energy quantum transactions of computation. The final frontier will be urbanized, ultimately into an arena where every bit of activity is a meaningful computation: the inhabited portion of the universe will transformed into a cyberspace.

Because it will use resources more efficiently, a mature cyberspace of the distant future will be effectively *much* bigger than the present physical universe. While only an infinitesimal fraction of existing matter and space is doing interesting work, in a well developed cyberspace every bit will be part of a relevant computation or storing a useful datum. Over time, more compact and faster ways of using space and matter will be invented, and used to restructure the cyberspace, effectively increasing the amount of computational spacetime per unit of physical spacetime.

Computational speedups will affect the subjective experience of entities in the cyberspace in a paradoxical way. At first glimpse, there is no subjective effect, because everything, inside and outside the individual, speeds up equally. But, more subtly, speedup produces an expansion of the cyber universe, because, as thought accelerates, more *subjective* time passes during the fixed (probably lightspeed) *physical* transit time of a message between a given pair of locations—so those fixed locations seem to grow farther apart. Also, as information storage is made continually more efficient through both denser utilization of matter and more efficient encodings, there will be increasingly more cyber-stuff between any two points. The effect may somewhat resemble the continuous-creation process in the old steady-state theory of the physical universe of Hoyle, Bondi and Gold, where hydrogen atoms appear just fast enough throughout the expanding cosmos to maintain a constant density.

A quantum-mechanical entropy calculation by Bekenstein suggests that the ultimate amount of information that can be stored given the mass and volume of a hydrogen atom is about a megabyte. But let's be conservative, and imagine that at some point in the future only "conventional" physics is in play, but every few atoms stores a useful bit. There are about 10^{56} atoms in the solar system. I estimate that a human brain-equivalent can be encoded in less than 10^{15} bits. If a body and surrounding environment takes a thousand times more storage in addition, a human, with immediate environment, might consume 10^{18} bits. An AI with equivalent intelligence could probably get by with less, since it does without the body-simulation "life support" needed to keep a body-oriented

human mind sane. So a city of a million human-scale inhabitants might be efficiently stored in 10^{24} bits. If the atoms of the solar system were cleverly rearranged so every 100 could represent a bit, then a single solar system could hold 10^{30} cities—far more than the number (10^{22}) of stars in the *visible universe*! Multiply that by 10^{11} stars in a galaxy, and one gets 10^{41} cities per galaxy. The visible universe, with 10^{11} galaxies, would then have room for 10^{51} cities—except that by the time intelligence has expanded that far, more efficient ways of using spacetime and encoding data would surely have been discovered, increasing the number much further.

Mind without body?

Start with the concepts of telepresence and virtual reality. You wear a harness that, with optical, acoustical, mechanical and chemical devices controls all that you sense, and measures all of your actions. Its machinery presents pictures to your eyes, sounds to your ears, pressures and temperatures to your skin, forces to your muscles and even smells and tastes for the remaining senses. Telepresence results when the inputs and outputs of this harness connect to a distant machine that looks like a humanoid robot. The images from the robot's two camera eyes appear on your "eyeglass" viewscreens, and you hear through its ears, feel through its skin and smell through its chemical sensors. When you move your head or body, the robot moves in exact synchrony. When you reach for an object seen in the viewscreens, the robot reaches for the object, and when it makes contact, your muscles and skin feel the resulting weight, shape, texture and temperature. For most practical purposes you inhabit the robot's body—your sense of consciousness has migrated to the robot's location, in a true "out of body" experience.

Virtual reality retains the harness, but replaces the remote robot with a computer simulation of a body and its surroundings. When connected to a virtual reality, the location you seem to inhabit does not exist in the usual physical sense, rather you are in a kind of computer-generated dream. If the computer has access to data from the outside world, the simulation may contain some "real" items, for instance representations of other people connected via their own harnesses, or even views of the outside world, perhaps through simulated windows.

One might imagine a hybrid system where a virtual "central station" is surrounded by portals that open on to views of multiple real locations. While in the station one inhabits a simulated body, but when one steps through a portal, the harness link is seamlessly switched from the simulation to a telepresence robot waiting at that location.

The technical challenges limit the availability, "fidelity" and affordability of telepresence and virtual reality systems today—in fact, they exist only in a few highly experimental demonstrations. But progress is being made, and its possible to anticipate a time, a few decades hence, when people spend more time in remote and virtual realities than in their immediate surroundings, just as today most of us spend more time in artificial indoor surroundings than in the great outdoors. The remote bodies we will inhabit can be stronger, faster and have better senses than our "home" body. In fact, as our home body ages and weakens, we might compensate by turning up some kind of "volume control." Eventually, we might wish to bypass our atrophied muscles and dimmed senses altogether, if neurobiology learns enough to connect our sensory and motor nerves directly to electronic interfaces. Then all the harness hardware could be discarded as obsolete, along with our sense organs and muscles, and indeed most of our body. There would be no "home" experiences to return to, but our remote and virtual existences would be better than ever.

The visible universe, with 10^{11} galaxies, would then have room for 10^{51} cities—except that by the time intelligence has expanded that far, more efficient ways of using spacetime and encoding data would surely have been discovered, increasing the number much further.

The picture is that we are now a "brain in a vat," sustained by life-support machinery, and connected by wonderful electronic links, at will, to a series of "rented" artificial bodies at remote locations, or to simulated bodies in artificial realities. But the brain is a biological machine not designed to function forever, even in an optimal physical environment. As it begins to malfunction, might we not choose to use the same advanced neurological electronics that make possible our links to the external world, to replace the gray matter as it begins to fail? Bit by bit our brain is replaced by electronic equivalents, which work at least as well, leaving our personality and thoughts clearer than ever. Eventually everything has been replaced by manufactured parts. No vestige of our original body remains, but our thoughts and awareness continue. We will call this process, and other approaches with the same end result, the *downloading* of a human mind into a machine. After downloading, our personality is a pattern impressed on electronic hardware, and we may then find ways to move our minds to other similar hardware, just as a computer program and its data can be copied from processor to processor. So not only can our sense of awareness shift from place to place at the speed of communication, but the very components of our minds may ride on the same data channels. We might find ourselves distributed over many locations, one piece of our mind here, another piece there, and our sense of awareness at yet another place. Time becomes more flexible—when our mind resides in very fast hardware, one second of real time may provide a subjective year of thinking time, while a thousand years of real time spent on a passive storage medium may seem like no time at all. Can we then consider ourselves to be a mind without a body? Not quite.

A human totally deprived of bodily senses does not do well. After twelve hours in a sensory deprivation tank (where one floats in a body-temperature saline solution that produces almost no skin sensation, in total darkness and silence, with taste and smell and the sensations of breathing minimized) a subject will begin to hallucinate, as the mind, somewhat like a television tuned to a nonexistent channel, turns up the amplification, desperately looking for a signal, becoming ever less discriminating in the theories it offers to make sense of the random sensory hiss it receives. Even the most extreme telepresence and virtual reality scenarios we have presented avoid complete bodylessness by always providing the mind with a consistent sensory (and motor) image, obtained from an actual remote robot body, or from a computer simulation. In those scenarios, a person may sometimes exist without a

physical body, but never without the illusion of having one.

But in our computers there are already many entities that resemble truly bodiless minds. A typical computer chess program knows nothing about physical chess pieces or chessboards, or about the staring eyes of its opponent or the bright lights of a tournament. Nor does it work with an internal simulation of those physical attributes. It reasons instead with a very efficient and compact mathematical representation of chess positions and moves. For the benefit of human players this internal representation is sometimes translated to a recognizable graphic on a computer screen, but such images mean nothing to the program that actually chooses the chess moves. For all practical purposes, the chess program's thoughts and sensations—its consciousness—is pure chess, with no taint of the physical, or any other, world. Much more than a human mind with a simulated body stored in a computer, a chess program is a mind without a body.

So now, imagine a future world where programs that do chess, mathematics, physics, engineering, art, business or whatever, have grown up to become at least as clever as the human mind. Imagine also the most of the inhabited universe has been converted to a computer network—a cyberspace—where such programs live, side by side with downloaded human minds and accompanying simulated human bodies. Suppose that all these entities make their living in something of a free market way, trading the products of their labor for the essentials of life—in this world memory space and computing cycles. Some entities do the equivalent of manual work, converting undeveloped parts of the universe into cyberspace, or improving the performance of existing patches, thus creating new wealth. Others work on physics or engineering problems whose solutions give the developers new and better ways to construct computing capacity. Some create programs that can become part of one's mental capacity. They trade their discoveries and inventions for more working space and time. There are entities that specialize as agents, collecting commissions in return for locating opportunities and negotiating deals for their clients. Others act as banks, storing and redistributing resources, buying and selling computing space, time and information. Some we might class as artists, creating structures that don't obviously result in physical resources, but which, for idiosyncratic reasons, are deemed valuable by some customers, and are traded at prices that fluctuate for subjective reasons. Some entities in the cyberworld will fail to produce enough value to support their requirements for existence—these eventually shrink and disappear, or merge with other ventures. Others will succeed and grow. The closest present day parallel is the growth, evolution, fragmentation and consolidation of corporations, whose options are shaped primarily by their economic performance.

A human would likely fare poorly in such a cyberspace. Unlike the streamlined artificial intelligences that zip about, making discoveries and deals, reconfiguring themselves to efficiently handle the data that constitutes their interactions, a human mind would lumber about in a massively inappropriate body simulation, analogous to someone in a deep diving suit plodding along among a troupe of acrobatic dolphins. Every interaction with the data world would first have to be analogized as some recognizable quasi-physical entity: other programs might be presented as animals, plants or demons, data items as books or treasure chests, accounting entries as coins or gold. Maintaining such fictions increases the cost of doing business, as does operating the mind machinery that reduces the physical simulations into mental abstractions in the downloaded human mind. Though a few humans may find a niche exploiting their baroque construction to produce human-flavored art, more may feel a great economic incentive to streamline their interface to the cyberspace.

We might then be tempted to replace some of our innermost mental processes with more cyberspace-appropriate programs purchased from the AIs, and so, bit by bit, transform ourselves into something much like them. Ultimately our thinking procedures could be totally liberated from any traces of our original body, indeed of any body.

The streamlining could begin with the elimination of the body-simulation along with the portions of the downloaded mind dedicated to interpreting sense-data. These would be and replaced with simpler integrated simpler programs that produced approximately the same net effect in one's consciousness. One would still view the cyber world in terms of location, color, smell, faces, and so on, but only those details we actually notice would be represented. We would still be at a disadvantage compared with the true artificial intelligences, who interact with the cyberspace in ways optimized for their tasks. We might then be tempted to replace some of our innermost mental processes with more cyberspace-appropriate programs purchased from the AIs, and so, bit by bit, transform ourselves into something much like them. Ultimately our thinking procedures could be totally liberated from any traces of our original body, indeed of any body. But the bodiless mind that results, wonderful though it may be in its clarity of thought and breadth of understanding, could in no sense be considered any longer human.

So, one way or another, the immensities of cyberspace will be teeming with very unhuman disembodied superminds, engaged in affairs of the future that are to human concerns as ours are to those of bacteria. But, once in a long while, humans do think of bacteria, even particular individual bacteria seen in particular microscopes. Similarly, a cyberbeing may occasionally bring to mind a human event of the distant past. If a sufficiently powerful mind makes a sufficiently large effort, such recall could occur with great detail—call it high fidelity. With enough fidelity, the situation of a remembered person, along with all the minutiae of her body, her thoughts, and feelings would be perfectly recreated in a kind of mental simulation: a cyberspace within a cyberspace where the person would be as alive there as anywhere. Sometimes the recall might be historically accurate, in other circumstances it could be artistically enhanced: it depends on the purposes of the cybermind. An evolving cyberspace becomes effectively ever more capacious and long lasting, and so can support ever more minds of ever greater power. If these minds spend only an infinitesimal fraction of their energy contemplating the human past, their sheer power should ensure that eventually our entire history is replayed many times in many places, and in many variations. The very moment we are now experiencing may actually be (almost certainly is) such a distributed

Protecting privacy with electronic cash

by Hal Finney

How can we defend our privacy in an era of increased computerization? Today, our lives are subject to monitoring in a host of different ways. Every credit card transaction goes into a database. Our phone calls are logged by the phone company and used for its own marketing purposes. Our checks are photocopied and archived by the banks. And new "matching" techniques combine information from multiple databases, revealing even more detail about our lives. As computer databases grow, as more transactions take place electronically, over phone systems and computer networks, the possible forms of monitoring will grow with them[1].

Predictably, most proposed solutions to this problem involve more government. One suggestion is to pass a set of laws designed to restrict information usage: "No information shall be used for a purpose different from that for which it was originally collected." Thus, income data collected by a bank through monitoring checking account activity could not be made available to mailing list companies; phone records could not be sold to telemarketing agencies, etc.

But this is a bad solution, for many reasons. The government is notoriously inefficient at enforcing existing laws, and the ease of collecting and using information suggests that it would be almost impossible to successfully enforce a law like this. The government also has a tendency to exempt itself from its own laws. It's unlikely that the IRS, for example, will happily give up the use of database matching, which it uses to track down tax evaders. And, of course, the very notion of trying to restrict the uses of information requires strict restrictions on the private actions of individuals which Extropians will find unacceptable.

But there is another solution, one advocated forcefully by computer scientist David Chaum of the Center for Mathematics and Computer Science in the Netherlands. While most people concerned with this problem have looked to paternalistic government solutions, Chaum has been quietly putting together the technical basis for a new way of organizing our financial and personal information. Rather than relying on new laws and more government, Chaum looks to technical solutions. And these solutions rely on the ancient science devoted to keeping information confidential: cryptography.

Cryptography, the art of secret writing, has undergone a revolution in the last two decades, a revolution sparked by the invention of "public-key" cryptography. Seizing on this new technology, computer scientists have branched out into dozens of directions, pushing the frontiers of secrecy and confidentiality into new territory. And it is these new applications for cryptography which offer such promise for avoiding the dangers described above.

Chaum's approach to the protection of privacy can be thought of as having three layers. The first layer is public-key cryptography, which protects the privacy of individual messages. The second layer is anonymous messaging, which allows people to communicate via electronic mail ("email") without revealing their true identities. And the third layer is electronic money, which allows people to not only communicate, but to transact business via a computer network, with the same kind of privacy you get when you use cash. If you go into a store today and make a purchase with cash, no records are left tying you personally to the transaction. With no records, there is nothing to go into a computer database. The goal of electronic cash is to allow these same kinds of private transactions to take place electronically.

(Be aware that there are other proposals for "electronic money" which are not nearly so protective of individuals' privacy. Chaum's proposals are intended to preserve the privacy attributes of cash, so the term "digital cash" is appropriate. But other electronic replacements for cash not only lack its privacy, but would actually facilitate computer monitoring by putting more detailed information into databases, and by discouraging the use of cash. If you see a proposal for an electronic money system, check to see whether it has the ability to preserve the privacy of financial transactions the way paper money does today. If not, realize that the proposal is designed to harm, not help, individual privacy.)

Public-Key Cryptography

The first of the three layers in the privacy-protecting electronic money system is public-key cryptography. The basic concept of public-key cryptography, invented in 1976 by Diffie and Hellman[2], is simple. Cryptographers have traditionally described an encryption system as being composed of two parts: an encryption method and a key. The encryption method is assumed to be publicly available, but the key is kept secret. If two people want to communicate, they agree on a secret key, and use that to encrypt and decrypt the message.

Public key cryptography introduced the idea that there could be two keys rather than one. One key, the public key, is known to everyone, and is used to encrypt messages. The other key, the secret key, is known only to you, and is used to decrypt messages. Public and secret keys are created in pairs, with each public key corresponding to one secret key, and vice versa.

So, to use a public-key system, you first create a public/secret key pair. You tell all your friends your public key, while keeping your secret key secret. When they want to send to you, they encrypt the message using your public key. The resulting encrypted message is readable only by using your secret key. This means that even the person who encrypted the message can't decrypt it! If he forgets what his original message

said, and he deleted it, he has no chance of reconstructing the original. Only you can do that. This is the paradox of public key cryptography - that a person can transform a message in such a way that they can't un-transform it, even though they know the exact formula used to make the transformation.

Figure 1 illustrates the steps involved in using a public-key system. (The keys and messages are based on actual output from Phillip Zimmermann's free public-key program, PGP.) Alice, on the left, first creates a public and secret key pair, the top two boxes on that side. The top box, the public key, she sends to her friend Bob, on the right. The second box is her secret key, which she keeps private. Bob, on the right, receives and saves Alice's public key. Then, when he wants to write to her, he composes a message, shown in the second box on that side. With a public-key encryption program like PGP, he encrypts the message using Alice's public key, producing output such as the third box on the right. This encrypted message is what he sends to Alice, as shown in the arrow leading back to the left side. Alice uses her saved secret key to decrypt the message from Bob, allowing her to reconstruct Bob's original message, shown as the last box on the left side.

There is no longer any need for public-key cryptography to be mysterious. There are now public-domain software packages which will let you experiment with public-key cryptography on your own computer, including Zimmermann's PGP and others. See the "Access" box for information on how to get them.

Anonymous Messages

Public-key cryptography allows people to communicate electronically with privacy and security. You can send messages safe from prying eyes using these techniques. But this is just a step towards the solution to the privacy problems we face. The next step provides the second layer of privacy: anonymous messages - messages whose source and destination can't be traced.

This is necessary because of the goal of providing in an electronic network the privacy of an ordinary cash transaction. Just as a merchant will accept cash from a customer without demanding proof of identity, we also want our electronic money system to allow similar transactions to take place, without the identity of the people involved being revealed to each other, or even to someone who is monitoring the network.

There are problems with providing anonymous messaging in current email systems. The national email networks are composed of thousands of machines, interconnected through a variety of gateways and message-passing systems. The fundamental necessity for a message to be delivered in such a system is that it be addressed appropriately. Typically an email address consists of a user's name, and the name of the computer system which is his electronic "home". As the message works its way through the network, routing information is added to it, to keep a record of where the message came from and what machines it passed through en route to its destination. In this system, all messages are prominently stamped with their source and destination. Providing anonymous messages in such a system at first appears impossible.

Chaum has proposed two separate systems for overcoming this problem[3]. I will focus here on what he calls a "Mix" as it is simpler and more appropriate for the application of anonymous electronic mail. The notion of a Mix is simple. It is basically a message forwarding service. An analogy with ordinary paper mail may be helpful. Imagine that you want to send a letter to a friend, but in such a way that even someone monitoring your outgoing mail would not know that you were doing this. One solution would be to put your letter into an envelope addressed to your friend, then to place this envelope inside a larger envelope which you would send to someone else, along with a note asking them to forward the letter to your friend. This would hide the true destination of your mail from someone who was watching your outgoing envelopes.

Chaum's Mixes use this basic idea, but applied to email and improved with public-key cryptography. A Mix is a computer program capable of receiving email. It receives messages which contain requests for remailing to another address, and basically just strips off these remailing instructions and forwards the messages as requested. Chaum adds security by having a different public key for each Mix. Now, instead of just sending the message with its forwarding request, the message plus forwarding info is encrypted with the Mix's public key before being sent to the Mix. The Mix simply decrypts the incoming message with its secret key, revealing the forwarding information, and sends the message on.

To protect the privacy of the sender, the Mix removes information about the original sender of the message before sending it. For even greater security, it's possible for the original sender to specify a "Cascade" of Mixes, a whole chain of Mixes that the message should go through before finally being sent to its destination. That way even if one of the Mixes is corrupt, it still can't determine who is sending to whom.

Using Mixes, then, the basic requirement for anonymous mail is met. A message en route in the network does not have to reveal its source and destination. It may be coming from a Mix, going to a Mix, or some combination of these.

Figure 2 shows an example of an anonymous message as it is forwarded through a Mix, using public-key cryptography to protect its privacy. As in Figure 1, Bob wants to send his encrypted message to Alice, but this time he wants to use a Mix to provide more confidentiality. Starting with the encrypted message from Figure 1, Bob (on the left, this time) first adds remailing instructions which will be interpreted by the Mix. These will include Alice's email address in some format specified by the Mix. (This example uses a simplified form of commands currently being used in experimental remailers.) Then he encrypts the whole message with the Mix's public key and sends it to the Mix.

Upon receipt, the Mix reverses the steps which Bob applied. It decrypts the message using its own secret key, then strips off the remailing instructions which Bob added. The resulting message (which the Mix can't read, being encrypted using Alice's secret key) is then forwarded to Alice as specified in the remailing instructions. As before, Alice receives and decrypts the message using her secret key. But this time, the message path has been protected by the Mix, and the fact that Alice and Bob are communicating is kept confidential.

Anonymous Return Addresses

We need something more advanced than message anonymity for truly private messaging, though. These anonymous messages are basically "one-way". I can send you a message, with the source and destination hidden, and when you receive the message you won't have any way of knowing who sent it. This means that you can't reply to me. We need the ability to have such replies.

Here, we have a seemingly paradoxical requirement: being able to reply to someone without knowing either who they are or what their email address is. Chaum shows how this can be solved using public-key cryptography and Mixes. The basic idea is what Chaum calls an Anonymous Return Address (ARA). In its simplest form, I create an ARA by taking my regular email address and encrypting it with the public key of a particular Mix - call it MixA for this example. I send this resulting block of encrypted text along with my message to you, through a Cascade of Mixes.

Now, when you receive the message, you see no return address, but you do see the block of text that is the ARA. You can reply to me without knowing who I am by sending your reply back to MixA, along with the ARA itself. MixA decrypts the ARA using its secret key, getting back my original email address that I encrypted. Using this email address, it is able to forward the mail to me. I was able to receive this message from you, although you have no knowledge of my true identity.

Figure 3 shows this process graphically. Bob, in the upper left, creates his ARA by encrypting a remailing command, similar to what was used in Figure 2, with the Mix's public key. He then includes this ARA in messages which he anonymously sends or publically posts. In the example, Alice sees Bob's ARA and wishes to respond to him, even though she doesn't know his email address. She composes her message, in the second box on the right, then combines her message with Bob's ARA. The combined message is sent to the Mix. The Mix now uses its secret key to decrypt the ARA portion of the message, revealing the remailing instructions which Bob encrypted to create the ARA. The remainder of the process is just as in Figure 3. The Mix strips off the remailing request and forwards the message to Bob's address, as shown.

These tools open many possibilities. With Mixes, Cascades, and ARAs, people can communicate without knowing other people's true identities. You can make an anonymous posting to a public message board, include your ARA, and receive replies from scores of people who don't know who you are. Some of them may reply anonymously and include their own ARAs. People can end up communicating with each other with none of them knowing the true identity of any of the others.

(Some "Chat" or "CB Simulator" systems today offer the illusion of such

anonymous communication, but in most cases the system operators can easily break through the cover of handles and pseudonyms and discover true identities. With a Cascade of Mixes, no single Mix can establish this relationship. As long as even one Mix of the Cascade remains uncorrupted, your identity is safe.)

Digital Pseudonyms

Anonymous messages bring forth the usefulness of "digital pseudonyms," another concept from Chaum. With no identification of the source of messages, there would seem to be no way of verifying that two messages came from the same person. There could be a problem with imposters pretending to be other people, resulting in utter confusion. To solve this problem, we need another concept from public-key cryptography: the "digital signature."

As described above, public-key cryptography allows messages encrypted with my public key to be decrypted with my secret key. However, it works the other way around as well. Messages can be encrypted with my *secret* key and then decrypted only with my *public* key. This property is what is used to implement the digital signature. If I encrypt a document with my secret key, anyone can decrypt it with my public key. And since my secret key is secret, only I can do this type of encryption. That means that if a document can be decrypted with my public key, then I, and only I, must have encrypted it with my secret key. This is considered a digital signature, in the sense that it is a proof that I was the one that "signed" (that is, encrypted) the document.

The digital signature concept can be used to solve the imposter problem by allowing for "digital pseudonyms." My digital pseudonym is simply a public/secret key pair, where, as usual, I let the public part be known. Typically, I'd publicize it along with my ARA. Now, to prove that a given message is from me and no one else, I sign the message using the secret key of my digital pseudonym. Any set of messages signed by that same digital pseudonym is therefore known to come from me, because only I know the secret key. People may not know who I am, but I can still maintain a stable public persona on the computer nets via my digital pseudonym. And there is no danger of anyone else successfully masquerading as me.

With public-key cryptography, Mixes, and digital pseudonyms, we have all we need for a network of people communicating privately and anonymously. Now, we need a way for them to transact business while maintaining these conditions.

Electronic Money

The next step, the third layer in our description, is digital cash - electronic money. Cash, ordinary folding paper money, is one of the last bastions of privacy in our financial lives. And many of the problems described above - the losses of privacy, the increase in computerized information - could be avoided if cash could be used more easily. But cash has many disadvantages. It can be lost, or stolen, and it's not safe to carry in large quantities. Also, it is useless for purchases made electronically, over the phone or (in the future) over computer networks. Digital cash is designed to combine the advantages of electronic payment systems - the safety and convenience - with the advantages of paper money - the privacy and anonymity.

Once again, we are faced with paradoxes in the notion of digital cash. Since digital cash may be sent by email and other electronic methods, it must basically be an information pattern - in concrete terms, some pattern of letters and numbers. How could such a string of characters have value, in the same sense that the dollar bill in your wallet does? What about counterfeiting? Couldn't another copy of the character string be created trivially? What prevents a person from "spending" the same money twice?

To answer these questions we turn again to public-key cryptography. Realize, though, that electronic money is an active area of research in cryptography. Many people have proposed different systems for electronic cash, each of which has its own advantages and disadvantages. I will present here a simplified concept to give a feel for the problems and solutions which exist[4].

One way to think of digital cash is by analogy to the early days of paper money. At one time, paper money was not the monopoly of governments that it is today. Instead, paper money was "bank notes", often given as receipts for the deposit of gold or similar "real money" in bank vaults. These notes would carry a description of what they were worth, such as, "Redeemable for one ounce of gold." A particular bank note could be redeemed at the issuing bank for its face value. People used these bank notes as we use paper money today. They were valuable because they were backed by materials of value in the bank vaults.

In a sense, then, a bank note can be viewed as a signed document, a promise to perform a redemption for the bearer who presents it at the bank. This suggests a way of thinking of digital money. Instead of a paper note with an engraved signature, we instead would use an electronic mail message with a digital signature.

An electronic bank could, like the banks of old, have valuable materials in its vaults. Today, these would likely be dollars or other government currency, but they could be gold or other commodities. Using these as backing, it would issue bank notes. These would be electronic messages, digitally signed by the bank's secret key, promising to transfer a specified sum to the account of whomever presented the note to the bank (or, if desired, to redeem the note in dollars or other valuables.)

Here is how it might work. You open an account with an electronic bank, depositing some money as in any bank. The bank then credits your account with your initial balance. Now, suppose you are going to want to make an electronic payment to me. Prior to any transactions, you would send a message to the bank, requesting one or more bank notes in specified denominations. (This is exactly analogous to withdrawing cash from your regular bank account.) The bank debits your account, creates new bank note messages, and sends them to you. They are sent to you as signed messages, encrypted with the bank's secret key. When decrypted with the bank's public key, which everyone knows, a one-dollar digital bank note would say, in effect, "This note is worth $1.00, payable on demand." It would also include a unique serial number, like the serial number on a dollar bill.

The serial number is important; as we will see below, it is used by the bank to make sure that a particular note is accepted for deposit only once. But putting serial numbers on the bank notes hurts anonymity; the bank can remember which account a bank note was withdrawn from, and then when it is deposited the bank will know that the depositer is doing business with the withdrawer. To avoid this, Chaum introduces a clever mathematical trick (too complex to describe here) which allows the serial number to be randomly changed as the note is withdrawn from the bank. The bank note still retains its proper form and value, but the serial number is different from the one the bank saw. This allows the bank to check that the same note isn't deposited more than once, while making it impossible for the bank to determine who withdrew any note that is deposited.

When you are ready to purchase something from me, you simply email me the appropriate bank note messages. I can check that they are legitimate bank notes by using the bank's public key to verify its signature. I then email the notes to the bank, which checks that the account numbers on the notes have not been deposited before this. If they are valid bank notes, the bank credits my account for the face value of the notes. Your account was decreased when you withdrew the bank notes,which you held like cash, and mine was increased when I sent them to the bank. The result is similar to how it would work if you with-

drew (paper) cash from the bank, mailed it to me, and I deposited the cash in my own account.

Figure 4 shows a similar transaction between Alice and Bob. The bank, in the upper left corner, creates a digital bank note by signing a message which specifies the serial number and value of the note, and sends it to Alice. Alice, as she withdraws it, uses Chaum's technique to alter the serial number so that the bank will not recognize the note as being from this withdrawal. She then pays Bob electronically by sending the bank note to him. Bob checks the note's validity by decrypting using the bank's public key to check its signature. He then sends the note to the bank, which checks the serial number to confirm that this bank note hasn't been spent used before. The serial number is different from that in Alice's withdrawal, preventing the bank from linking the two transactions.

With this simple picture in mind, we can begin to answer some of the objections listed above. Bank notes cannot be forged because only the bank knows the secret key that is used to issue them. Other people will therefore not be able to create bank notes of their own. Also, anyone can check that a bank note is not a forgery by verifying the bank's digital signature on the note. As for the copying issue, preventing a person from spending the same bank note more than once, this is handled by checking with the bank to see if the serial number on the note had been used before before accepting a bank note as payment. If it had been, the note would not be accepted. Any attempt to re-use a bank note will be detected because the serial number will be a duplicate of one used before. This means, too, that once you "spend" your digital cash by emailing it to someone, you should delete it from your computer, as it will be of no further value to you.

This simple scheme gives some of the flavor of electronic cash, but it still has awkward features. The need to check with the bank for each transaction may be inconvenient in many environments. And the fixed denominations of the bank notes described here, the inability to split them into smaller pieces, will also limit their usefulness. Chaum and others have proposed more complex systems which solve these problems in different ways.[5] With these more advanced systems, the anonymity, privacy, and convenience of cash transactions can be achieved even in a purely electronic environment.

Electronic Money in Practice

Having described the three layers of privacy protection, we can now see how electronic transactions can maintain individual privacy. Public-key cryptography protects the confidentiality of messages, as well as playing a key role in the other layers. Anonymous messaging further allows people to communicate without revealing more about themselves than they choose. And electronic money combines the anonymity of cash with the convenience of electronic payments. David Chaum has described variations of these techniques that can extend privacy protection to many other areas of our lives as well.[6]

Although my description of digital cash has been in terms of computer networks with email message transactions, it can be applied on a more local scale as well. With credit card sized computers, digital cash could just as easily be used to pay for groceries at the local supermarket as to order software from an anonymous supplier on the computer networks.

"Smart card" computers using digital cash could replace credit or debit cards for many purposes. The same types of messages would be used, with the interaction being between your smart card and the merchant's card reader.

On the nets themselves, any goods or services which are primarily information-based would be natural candidates for digital cash purchases. Today this might include such things as software, electronic magazines, even electronic books. In the future, with higher-bandwidth networks, it may be possible to purchase music and video recordings across the nets.

As another example, digital cash and anonymous remailers (such as Chaum's Mixes) have a synergistic relationship; that is, each directly benefits the other. Without anonymous remailers, digital cash would be pointless, as the desired confidentiality would be lost with each transaction, with message source and destination blatantly displayed in the electronic mail messages. And in the other direction, digital cash can be used to support anonymous remailing services. There could be a wide range of Mix services available on the nets; some would be free, and presumably offer relatively simple services, but others would charge, and would offer more service or more expensive security precautions. Such for-profit remailers could be paid for by digital cash.

What are the prospects for the eventual implementation of digital cash systems and the other technologies described here? Some experiments are already beginning. David Chaum has started a company, DigiCash, based in Amsterdam, which is attempting to set up an electronic money system on a small scale. As with any new business concept, though, especially in the conservative financial community, it will take time before a new system like this is widely used.

The many laws and regulations covering the banking and financial services industries in most Western nations will undoubtedly slow the acceptance of digital cash. Some have predicted that the initial success of electronic money may be in the form of a technically illegal "black market" where crypto-hackers buy and sell information, using cryptography to protect against government crackdowns.

In the nearer term, the tools are in place now for people to begin experimenting with the other concepts discussed here. Public-key cryptography is becoming a reality on the computer networks. And experimental remailers with integrated public-key cryptosystems are already in use on a small scale. Digital-pseudonym-based anonymous message posting should begin happening within the next year. The field is moving rapidly, as privacy advocates around the world hurry to bring these systems into existence before governments and other large institutions can react. See the "Access" box for information on how you can play a part in this quiet revolution.

We are on a path today which, if nothing changes, will lead to a world with the potential for greater government power, intrusion, and control. We can change this; these technologies can revolutionize the relationship between individuals and organizations, putting them both on an equal footing for the first time. Cryptography can make possible a world in which people have control over information about themselves, not because government has granted them that control, but because only they possess the cryptographic keys to reveal that information. This is the world we are working to create.

Notes

[1]For a review of the status of current monitoring technology, see [Clarke 88].

[2]See [Diffie 76].

Access

Public-Key Cryptography

Philip Zimmermann's free program PGP ("Pretty Good Privacy") is a widely available implementation of public key cryptography. It features high speed and has excellent key management, and operates on many systems, including PC compatibles, Macintoshes, and most Unix-based workstations. At publication time, version 2.1 was current. Readers with Internet access should be able to find PGP on such hosts as princeton.edu (/pub/pgp20) and pencil.cs.missouri.edu (/pub/crypt). Many of the larger bulletin-board systems carry PGP as well. Send email to Hugh Miller at <info-pgp-request@lucpul.it.luc.edu> for current information, or check the Usenet newsgroup alt.security.pgp.

Mark Riordan's free program RIPEM was in beta test at press time, with a release expected soon. Contact the author at <mrr@scss3.cl.msu.edu> for information about availability.

The Internet PEM ("Privacy Enhanced Mail") standard was due to be completed soon at press time. PEM uses a key-management hierarchy in which users register their public keys with a centralized organization. Free software implementing the basic public-key algorithms was expected to be available soon after the standard is finalized. Mail to <pem-dev@tis.com> for more information on availability.

Anonymous Remailers

An email discussion group exists which is devoted to the topics of encryption, remailers, digital cash, and other topics related to these. Experimental anonymous remailers are under development at press time and should be widely available soon. Contact <cypherpunks-request@toad.com> for information.

[3]The "Mix" is described in [Chaum 81]. Chaum's other solution, the "DC-Net", is described in [Chaum 88A].

[4]The electronic money scheme I describe is a simplification of Chaum's first proposal in [Chaum 88B].

[5]For more proposals about electronic cash, see: [Even 83], [Chaum 85], [Okamoto 89], [Okamoto 90], [Hayes 90], and [Chaum 90].

[6]See [Chaum 85] and [Chaum 92].

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Technological self-transformation

Expanding personal extropy

Max More
Extropy Institute

We, however, *want to be those who we are* – the new, the unique, the incomparable, those who give themselves their own law, those who create themselves!

[Friedrich Nietzsche, *The Gay Science*, p335]

'Will a self.' – Active, successful natures act, not according to the dictum 'know thyself', but as if there hovered before them the commandment: will a self and thou shalt become a self.

[Friedrich Nietzsche, *Assorted Opinions and Maxims*.]

Self-transformation and personal extropy

Self-transformation is a process that increases personal extropy. Extropy is a measure of a system's intelligence, information content, available energy, longevity, vitality, diversity, complexity, and capacity for growth. Clearly, I intend "self-transformation" to necessarily imply "*positive* self-transformation." The changes that I will discuss, rather than being value-neutral, all in some way *amplify* the extropy in your life and person: They make you more intelligent and wiser, physically healthier and more vigorous, increasingly psychologically effective, more creative, rational, and productive, and more effective at gathering and filtering information.

The Extropian philosophy of life sees self-transformation as a primary virtue. A virtue is a psychological characteristic, a moral excellence that propels us to live superbly in a particular manner. The virtue of *independence*, for example, is the characteristic exhibited by a person who makes their own decisions, using their own judgment, rather than allowing their decisions to be made by others by default. The virtue of *self-transformation* is a characteristic that reflects and empowers a person's drive for physical, intellectual, moral, and psychological excellence. A commitment to self-transformation means a refusal to acquiesce in mediocrity, a questioning of limits to one's potential, and a drive to perpetually overcome psychological, social, physiological, genetic, and neurological constraints.

Self-transformation is more than a mere preference. Ayn Rand identified the fundamental and ultimate choice perpetually confronting every organism: To live or to die. Without necessarily endorsing Rand's view that *all* values and virtues can strictly be derived from the ultimate choice to live, I do affirm the claim that a commitment to successful and fulfilling living – Aristotle's vision of human flourishing and Nietzsche's will to power – requires a conscious effort to overcome ourselves, to push past all limits to our growth. Self-transformation is a virtue because it promotes our survival, our efficacy, and our well-being. As a dynamic process of self-overcoming, an internally generated drive to grow and thrive, it is the very essence and highest expression of life.

The nature of self-transformation provides part of the reason why the Extropian philosophy has no place for notions of gods and the supernatural. As Feuerbach and Nietzsche realized, positing a divine realm of perfection undermines life since 'God' and 'spirit' are reactive concepts, being defined in terms of what physical life is not. In the major religions, the World is base and corrupt, our physical existence transitory and inferior. Allegiance to life consists in resolving to seek vitality within, not from an external deity or a supernatural realm. A conception of a perfect, infinite, eternal, and wholly good supernatural realm, contrasted with the world of experience, degrades and strips our world and our physical selves of worth and significance. Life is fundamentally a ceaseless process, whose quintessence is a self-overcoming, a progression, a self-transformation and self-augmentation. Life's purpose is not mere survival, for its energies remain once that basic goal is secured; nor is its purpose a drive to serve or glorify anything external, for then it would be self-alienating. The essence of life is what Nietzsche called the will to power – life's perpetual drive toward its own increase and excellence. Extropic life can thus never manifest self-sacrifice or worship of superior beings.

The practice of self-transformation interacts synergistically with the other Extropian principles, as they are embodied in an individual's actions.[1] *Dynamic optimism* serves to motivate

continuous personal transformation, and to sustain transformative efforts, conquering barriers and overwhelming discouragement during times of difficulty or weariness. *Boundless expansion* as a society provides the context required for us to sustain truly long-term personal progress, to provide energy, space, and the framework for the diversity implicit in individual self-transformation. *Intelligent technology* in this context means directing science and technology toward the transcendence of our hitherto inherently limited abilities. *Spontaneous order* is an enabling condition, allowing each individual to pursue his or her *self*-transformation with minimal interference from others and to maximum mutual benefit from the resulting diversity.

ST and extreme longevity

The extropian commitment to self-transformation coheres naturally with the extropian desire for extreme longevity and the quest for physical immortality. Practically immortal transhumans will need both to modify themselves continually to keep up with the world, and to ensure fulfillment over the long term. Completion of the ancient alchemists' quest for the key to abolishing aging is in sight. After crawling along for years with only minor successes (such as dietary restriction and Co-enzyme Q10 experiments), over the last five years interventive gerontology has begun to employ the tools of molecular biology. Progress in both theory and practice is accelerating, and will make another leap forward once the analytical and interventive tools of nanomedicine are brought to bear, probably by the end of the first quarter of the 21st century. It is no longer so radical to claim that we can expect enormous extension of the human lifespan by the middle of the 21st Century (and *perhaps* much sooner).[2]

Many of those who think superficially about the possibilities and consequences of indefinite lifespans paint a picture of stagnant persons grown bored with life. They picture those advanced in age to be psychologically decrepit. They equate deep maturity with boredom and ennui. This is a false image, except for those who (at *any* age) choose a passive life of stagnation despite the pressures of change. We need not look into the next century to see how this projection obscures rather than illuminates. Even now, with estimated lifespans approaching 80 years (ignoring future gerontological advances), the conditions of life relevant to personal transformation have undergone drastic changes as compared to the historically recent past. When most people died in their thirties or forties, or younger, and technology, culture, and social organization changed at a glacial rate, personal transformation was neither necessary nor lauded. A man working on the land in 16th century Europe felt no need to challenge his limits in favor of an innovative life. His job would likely remain unchanged throughout his entire life. He would probably be married for life, and the organization of his family would be set – no troubling alternative lifestyle to upset his equanimity. He would rarely, if ever, have to rise to the challenge of new technologies, important new ideas, or significant political change.

Now, in 1993, few people can get through life without undergoing major change, and almost no one (the Amish may be exceptions) can avoid some changes to their lifestyle. Increasingly absurd in a young person is the belief that they can train for a career and stay in that career indefinitely. Workers in manufacturing have had to learn service skills; business executives have had to become proficient at using computers; and doctors have had to adapt to new diagnostic and treatment modalities. Family structure is no longer a given, to be entered into unconsciously, and by which to be bound for life. The male provider and head of the household is being challenged, as is the need for a large family, a partner of the other sex, and lifelong commitments. We have a growing choice of ideas, gadgets, cultures, sports, and games to choose from, and the choices grow at an accelerating rate due to population growth and economic pressures.

So, even now, self-transformation – learning new skills, modifying habits, selecting new interests and behaviors – is necessary if we are to stay involved in our protean world. Whereas the Old World smothered personal innovation in a sea of stasis, the contemporary world repeatedly electrifies us with the charge of change. The 21st Century – the era of the transition from the human to the transhuman – can only boost this current. While some conservatives will always seek to stagnate as far as possible, the pressures will all favor personal transformation. Biotechnology, nanotechnology, neural networks, synthetic intelligence, expansion into space, intelligence intensification, and neurochemical modification (plus innovations as yet unforeseen) will ensure the flow of change and the widening field of choice. We are used to associating 'advanced age' (as we now think of it) with lack of vigor, ill health, and senility. But the centenarians of next century will appear youthful and exude energy. Not only will physical illness become practically unknown, we will fully understand the basis of depression and lack of enthusiasm, allowing us to choose to maintain ourselves in a perpetually high energy condition. With the termination of aging, chronic illness, and depression, advanced age will cease to imply weariness, retirement, or resignation.

Apart from transforming ourselves in order to keep up, we would-be immortals will find self-transformation necessary for a fulfilling, meaningful life. Whereas old views held that a meaningful life required a strong and stable bond to a particular community, a particular social role, and a particular god, the Extropian view sees meaning and fulfillment partly in the bonds one *chooses* to form, and in the *process* of growth, renewal, and the dissolving of old bonds and the forming of new ones.[3] A stimulating, challenging, and fulfilling life will require periodic, though not continual, metamorphosis. Rather than permanently retiring after six decades, the long-lived will take periodic temporary retirements in order to reflect on their current life, to slow the pace for a time, or to learn new skills. No matter how long we live, we can always find new interests, new fields of study, new friends, new cultures and subcultures, and new sports and games. By avoiding stasis, we can forever elude the existential boredom typified in tales such as Capek's *The Makropulos Case*. Some may eventually choose to end their otherwise limitless lives, as does Elina Makropulos, but only those who do not challenge themselves to transform.

A long-lived and deeply mature person will be quite different from the humans of today (even ignoring the technological augmentations sketched below). In comparison, all of us today are callow, undeveloped infants. We make our decisions based on a narrow perspective arrived at after a small number of years, like the view of a dark auditorium illuminated by a solitary spotlight. Our senior selves will have come to understand their own and others' motivations, desires, and behavior far more deeply; they will have experimented with many more ideas, cultures, and relationships. These senior selves will look back on their first century of life, and see their early selves as immature and impulsive, ignorant and ignoble, making decisions largely in ignorance of the world and of their own selves. Up until the 20th Century, all the experience and wisdom accumulated by the oldest persons has been degraded by old age, and annihi-

lated by death. The elders of the future will be able to build on their learning, evolving a level of sophistication and maturity that we mere neonates are incapable of fully comprehending.

Immortalism and self-transformation belong together in another way: Some of us now living will not remain alive until the abolition of aging. In light of this, longevists with sufficient foresight, independence, and determination, are making arrangements to have themselves placed into biostasis (currently in the unperfected form of cryonic suspension) in the event of cessation of life functions resulting from disease, accident, or old age. Opting for biostasis is a probable life-saver, but brings with it the possibility of true future shock. Patients remaining in biostasis for more than a few years will be greeted by a joltingly different world. The prospect of such a rude jolt shooting them from a familiar to a strange world has been enough to frighten people away from the idea of biostasis. The prospect unseats those people so much that they choose risking becoming food for worms over facing an alien future. The more committed we are to self-transformation, the less fear we will have of a sudden jump into the future. We will be familiar with the unfamiliar. We will be experienced in adapting, learning, and innovating. We may even reflect on this prospect more with excitement than trepidation.

Self-definition

> One thing is needed – 'To give style' to one's character – a great and rare art! He exercises it who surveys all that his nature presents in strength and weakness and then molds it to an artistic plan until everything appears as art and reason, and even the weaknesses delight the eye.
>
> [Friedrich Nietzsche, *The Gay Science*, p.290]

The history of humanity has been a history of the growth of our ability to define ourselves as individuals. Our future will see the continuation and deepening of this evolutionary process. The primitive lifeforms from which we evolved were completely defined by forces external to choice, such as genetic and environmental determinants. The continued importance of these factors manifests itself in the tired "nature vs. nurture," or genetic heritage vs. environment, debate. Yet we, more than any previous organisms or earlier humans, have the power to define our selves, to choose who and how to be. As Richard Dawkins argued in *The Selfish Gene*, as conscious beings we can understand and thus allow for the imperatives of our genes. We can rebel against the tyranny of the selfish replicators. This capacity for rebellion against our genetic programming is what allows us to control our reproduction, to redirect our sexual energies, and to rethink and reorganize gender roles and family structures. As our environments have grown more diverse, so our range of choices has grown. Many humans may continue to be programmed by aspects of their environment (incoming information, family upbringing, geographical location, political ideology, predominant morality, religion, etc.), but now they must usually choose between competing programming forces. Here lies the budding of autonomy. The existence of diverse options facilitates – but does not guarantee – that any individual will make *conscious* choices.

The continuing increase in our behavioral, morphological, neurological, and genetic freedom can be seen in examples ranging from the superficial to the profound. Our choice of clothing can be used both to express something about ourselves ("I'm an efficient executive,"

DEFINITIONS

Biological fundamentalism: A new conservatism that resists asexual reproduction, genetic engineering, altering human anatomy, overcoming death. A resistance to the evolution from the human to the posthuman.

Ideal identity: A internal model of our personality as we wish it to be; the person we seek to become.

Immortalist: A person who believes in the possibility of, and who seeks to attain, physical immortality.

Longevist: A person who seeks to extend their life beyond current norms (but who may not wish to live forever).

Morphological freedom: The ability to alter bodily form at will through technologies such as surgery, genetic engineering, nanotechnology, uploading.

Nanomedicine: The use of molecular-scale devices to repair damage and boost the immune system.

The Net: The interlinked collection of computer networks, including the Internet, allowing remote conversation, data processing, and information retrieval.

Optimal Persona: A personally constructed and sustained model of the person into whom you intend to develop.

Smart drugs/nootropics: Substances that, without negative side-effects, can enhance retention, recall, and concentration.

Transhuman: Someone in the transition stage from human to biologically, neurologically, and genetically posthuman. One who orients his/her thinking towards the future to prepare for coming changes and who seeks out and takes advantage of opportunities for self-advancement.

Transbiomorphosis: The transformation of the human body from a natural, biological organism into a superior, consciously designed vehicle of personality.

Uploading: The transferance of personality patterns embodied in the brain to an appropriately configured supercomputer, allowing the same person to live in more powerful hardware.

"I'm a Grateful Dead fan") and to help us attain an appropriate mood. Adopting a more formal attire for certain times of the day may help us to focus on the task at hand. Dressing in sporting gear may generate a mood favoring exercise. Advertising provides crude role models and may help us to feel like a certain kind of person by using the product.

The partial personas we find in books and in film – more encompassing and profound than those in advertising – act as templates guiding us in sculpting ourselves into the self we want to become. Many males try, at least partially, to emulate tough characters portrayed by Arnold Schwarzenegger, Clint Eastwood, Harrison Ford, and Jean-Claude van Damme. Lately women, too, have had the choice of personas portrayed in Sigourney Weaver's Ripley, and Linda Hamilton's Sarah Connor. Many readers of this journal have, to varying degrees, sought to emulate qualities found in the characters of writers Ayn Rand and Robert Heinlein. By focusing on the paradigm personalities in these didactic stories, we can home in our desired self without having to deduce the requisite behavior from abstract rules. An image of our intended result is more effective at promoting change than is an abstract set of prescriptions. In times of intellectual opposition and isolation, for instance, recalling an image of Rand's Howard Roark will stiffen our resolve and independence more than advising oneself to "be independent!"

Changes of name have long been a method for redefining and committing oneself to specific values. Traditionally, woman who marry have given up their surname for that of their husband. This action was a way of supporting the belief that men were primary and women were subservient. Adoption of a new name may reflect rejection of one's native culture, religion, or nationality, and identification with new communities. Assumed names are common on the computer networks, the new names frequently differing wildly from standard names. A number of Extropians have adopted new names, to project what *they value*, rather than retaining a label connecting them to an unchosen background.

The computer networks are now a major locus of self-definition, at least with respect to the ability to choose how we appear to others. Apart from use of assumed names on the Net, some like to present a virtual image different from their physical image. Some women use a normally male name and carefully maintain this pretense in order to see how differently they will be treated. Since what you can know about someone regardless of their wishes across the Net is severely limited by the medium, it is easy to present personal characteristics selectively, or even misleadingly. Those who want to interact with others free of sexist, racist or nationalist prejudice may withhold or conceal these facts about themselves. The precocious but acne-ridden adolescent can contribute to discussions without fear that others will discount his or her contributions due to age or appearance.

What will happen as network speeds increase, allowing affordable video and voice transmission? Will this force virtual images to conform to physical images? At first perhaps, but further computational advances will allow real-time modification or synthesis of our virtual appearance. An amusing and plausible example of this is found in Bruce Sterling's SF novel *Schismatrix*, where video images are processed to remove stubble and skin blemishes, and to enhance attractiveness in the absence of make-up. Morphing techniques and digital image processing are already moving us in this direction. Just as netters now use adopted names, many in the future will create synthetic faces and voices as vehicles of expression. Their bodies will largely cease to constrain their mode of expression; they will be able to choose a form mildly or drastically different from their actual form. Further in the future, if we upload ourselves and exist primarily in the computational world (downloading ourselves into a range of bodies as it suits us), the range of possible forms and their ease of adoption will become practically unlimited. The distinction between virtual image or identity and actual image will increasingly weaken over the coming years, and will dissolve entirely if we upload. Our synthetic images will have become our actual images.

Attention to posture and bodily motion is another path to achieving a desired psychological state. More physically drastic modifications, such as cosmetic surgery and implants, are becoming increasingly common. As costs fall and expertise climbs, more people will choose more radical surgical and physical modifications, especially once nanomedicine has superseded crude surgical alteration. We may yet see physiognomic choices as bizarre as those of the Urban Surgery youth group portrayed by SF writer Walter Jon Williams.

In the 21st Century, the depth and significance of self-transformation and augmentation will far exceed our current experience. Within a decade biologists will have decoded the human genetic program, and we will then accelerate our ability to understand and correct genetically-related physical (and psychological and intellectual) deficits, and to enhance normal abilities to transhuman levels. Today's gene therapy is a magnificent achievement, but will seem minor once nanomedicine is able to alter any of the DNA of a developed, adult human. Each of us can then choose to alter mildly or massively our physical constitution. We can boost our immune systems, alter our facial features, become taller or shorter, stronger or more delicate, and sharpen our senses.

These capabilities will leave us still human, merely giving us a choice of the peaks of humanity. But genetic changes could be radical enough to make the appellation 'human' inaccurate. If some people's genetic coding is different enough from that of humans, they will be a distinct species. If the changes are *positive* changes, these new peaks in the evolutionary landscape will be *transhuman*. Genetic enhancement will be used alongside neurochemical modification, and other cognitive enhancements such as neural-computer integration (as described below). We who prize moving forward, thrusting past old limits, and seeking new abilities, will no longer be confined by our genetic, biological, and neurological heritage. We will ignore the biological fundamentalists who will invoke "God's plan," or "the natural order of things," in an effort to imprison us at the human level. We will move through the transhuman stage into posthumanity, where our physical and intellectual capacities will exceed a human's as a human's capacities exceed an ape's. To fully flower, self-transformation requires a rebellion against humanity. As Nietzsche put it:

> I teach you the superman. Man is something that should be overcome. What have you done to overcome him?
> [*Thus spake Zarathustra*, I prologue, p.3]

Emerging and future technologies of transformation will be resisted by some religious and humanist groups precisely because of their powerful abilities to change our human constitution. Some opposition will result from fears about purported dangers of these technologies. Granted, caution is warranted, but such fears typically are vastly overinflated – as the hysteria over genetic engineering research illustrated. Opposition will also be motivated by a vaguer notion that humans should not 'interfere' with 'God's plan,' or 'the natural order.'

This notion should only amuse us who believe in no god and who understand that transformation of self and environment is perfectly natural for humans.

Ideal self/Optimal Persona

In pursuing self-transformation we face a plethora of options of both ends and means. Questions about ends may include: Which skills shall I concentrate on developing? Do I want to become more or less judgmental? More or less giving to others? What kind of occupation do I desire? Is physical cultivation important to me? With regard to means, we may ask: Should I stay in/return to formal education longer? Should I work for others or work for myself? Should I use the current generation of smart drugs? Should I sign up for cryonic suspension? Proceeding effectively in our self-sculpting will require a clearly defined goal. Knowing our destination will allow us to set priorities, and to choose among methods and means, picking those we find most desirable and believe most effective.

We will ignore the biological fundamentalists who will invoke "God's plan," or "the natural order of things," in an effort to imprison us at the human level. We will move through the transhuman stage into posthumanity, where our physical and intellectual capacities will exceed a human's as a human's capacities exceed an ape's.

Setting a goal for self-transformation is best implemented by creating for ourselves a paradigm, an idealized model of the person we want to become. Comparing our present condition to our paradigm will allow us to steer a course through distractions and temptations more effectively than trying to reason our way along soley by using abstract rules, principles, and guidelines. Cybernetic control systems work on this principle. They have some map or representation of their destination, and continually compare their present state or location to the map, then make adjustments to keep on track. Our paradigm – which I will call the *ideal self*, or the *Optimal Persona*[4] – differs from the map of many cybernetic systems in that it is dynamic, not static. *We* decide who we want to become, and there is nothing to prevent us from changing our minds (though we should realize that constancy and tenacity are generally more productive than frequent changes of direction). Our ideal self should evolve as we revise the ranking of our values, as we see come to recognize new goals as worthwhile, and as we learn new behaviors that contribute more effectively to our ideal. The Optimal Persona is Nietzsche's *Ubermensch*, the higher being existing within us as potential waiting to be actualized.

Constructing and periodically revising an Optimal Persona requires a high degree of self-awareness, an understanding of what we are motivated to do and what are the causes of these motivations. We need to have an idea of what we can reasonably expect to change in any given timeframe. Before setting out to change some of our personality characteristics so as to cohere with and support other characteristics, we should think critically about which parts of our current selves we have freely chosen and which we adopted unconsciously, absorbing them from the familial and cultural environment. For instance, someone might have been raised to be unfailingly polite, never speaking out directly against something they regard as mistaken or despicable. This person may have adopted this pattern of behavior, feeling it to be a part of them, yet critical reflection may lead them to decide that this behavior frustrates their more considered values and goals – those that are more truly personal because they were formed consciously in the light of their broader view of themselves and of the world. Beliefs, values, or behaviors adopted largely unreflectively (i.e., most of those personal qualities acquired early in life) may nevertheless form part of one's ideal self, but only after examining and reaffirming their worth and their coherence with other desired qualities. [See sidebar for a practical exercise based on the ideal self.]

Danger lurks in any desire to be different from our current self. Holding a conception of an Optimal Persona, and the critical self-examination necessary to actualize it, introduces the possibility of denying the worth of one's current self. Self-disgust and self-denigration, whether in recurring but transient episodes or as an enduring characteristic, is common among persons of high standards. Such people often treat themselves far more harshly for their shortcomings than they would another person. On making an error, on discovering their ignorance of something, or on failing their own standards, these individuals curse themselves, insult themselves, and in extreme cases may physically punish themselves. To avoid this, we need to be aware of the difference between dissatisfaction on the one hand, and disgust, anger, and hatred on the other. You can respect and esteem yourself for what you can do, for what you get right, and for what you achieve, while simultaneously being dissatisfied with yourself. Dissatisfaction means you believe you can (and perhaps should) do better. Self-disgust means that you believe you *must* do better, that you are worthless unless you are perfect. Even if perfection is measured by your own standards, this kind of perfectionism is both painful and self-defeating.

Hatred of self brings depression and paralysis. A better response to mistakes, slips, and backsliding is to praise yourself for your current and past achievements and successes, while acknowledging the faulty behavior and focusing on ways to prevent a recurrence and to minimize the negative consequences. Similar remarks apply to the temptation to repress feelings that you believe to be inconsistent with your ideal.[5] One might, for example, feel fear when confronted with some threat or uncertainty. Repressing the emotion, rather than experiencing it and acting appropriately in response, will bury important information about yourself and your situation. A better response is to acknowledge the unwelcome feeling of fear, anxiety, anger, or weakness, and to investigate the possible ways of changing yourself or your situation so that these emotional responses will not occur. In the case of fear, this might mean working out or arming yourself for more physical confidence, or learning the skills needed to cope with a difficult situation. Or the best strategy might be to learn to live with the unpleasant emotion, reducing its severity by critically challenging the basis of the feeling, such as by thinking of a frustration as an inconvenience rather than as a disaster.

Continuity and self-direction

Before describing some possible cognitive, physical, and psychological transformations possible today or in the future, I wish to stress the importance of

TECHNOLOGIES OF TRANSFORMATION

- **Nootropics (smart drugs):** Drugs that enhance retention, recall, and concentration.
- **Electronic networks:** Online databases, virtual fora discussions on numerous topics.
- **Hypertext:** Massively interconnected database; references can be tracked in both directions.
- **Genetic engineering**
- **Neurochemical modification:** Personal control of emotional and cognitive states.
- **Nanocomputer implants:** Molecular computer integrated with the brain, providing additional memory, processing power, and running decision-making programs.
- **Internal nanotech:** Nanoengineered immune system, strengthened bones, reinforced skull, backup organs, muscular augmentation.

the *self* in "self-transformation." Discussions of actual and hypothetical instances of radical transformation usually provoke the question, "But is the person after the change really the same person as the person before the change?" This is too complex an issue to explore adequately here.[6] I will limit myself to claiming that an important consideration determining whether a person undergoing dramatic change remains logically the same is the extent to which that person selects and directs the changes.

The sense in which the pre- and post-transformation individuals are the same is the logical, not the qualitative sense. Clearly, by hypothesis, they are significantly different qualitatively. They are the same – they are logically identical – if they can reasonably be considered as two temporal stages of one persisting entity. If a person suffers a massive brain injury, causing loss of all rational capacities, major changes in emotional response, an inability to recognize close friends, and erasure of memory, the psychological connections between the earlier and the later individual are too tenuous for them to count as the same person (though we can say the same *body* persists). Loss of continuity need not (at least in principle) require a *loss* to occur. If the entire psychology of someone changes instantaneously and these are changes for the better (even according to their pre-change standards), personal continuity will have been destroyed, leaving behind a new person. Obviously, a spectrum exists between cases of total discontinuity and total absence of change; personal continuity may be disrupted to varying degrees.

There are two reasons why self-direction of one's transformation is important in maintaining continuity. The more obvious reason is that another person is less likely to make the changes in you that you would choose, either because they don't know what those are, or because the modifications they choose to make will be influenced by their own interests. The second reason is that continuity requires that later stages of an individual *develop* out of earlier stages, rather than simply usurping their place. Thus replacing 90% of a person's brain with neural matter of a different configuration would not preserve continuity, because in no way is the resulting person a development out of the earlier. Changing ourselves is more likely to result in continuous development rather than disruption of self since the outcome will better reflect our values and goals. In choosing which changes to make and when to make them, we will be better able to integrate the new or modified characteristics into our overall character. Control over our own transformations will grow in importance as more powerful technologies (some described below) are introduced, e.g., genetic engineering, neurochemical modulation of mood and cognition, neural-computer integration.

Cognitive self transformation

This category of self-transformation encompasses intellectual virtues that foster personal growth, non-technological methods of enhancing intelligence and rationality, and technologies capable of augmenting our intellectual powers to a superhuman level.

The intellectual virtues are those enduring qualities of character that reveal themselves in our methods and habits of thinking. Rationality – the unlimited application of critical thinking – should be regarded as the primary intellectual virtue. Rational thinking means not believing assertions casually; it requires a habit of asking questions such as: "What is your evidence for that?" "According to whom?" Rationality means questioning, examining, assessing your own beliefs for their coherence and grounding, and an avoidance of belief in a proposition simply because it is easy or comforting.

Rationality does not allow room for accepting ideas on faith. 'Faith,' in the sense used here, means believing in something in the absence of or contrary to the evidence; I do not use the term to include trust in what someone says where that trust is justified on the basis of past experience. Faith in a method of personal transformation leads to stagnation, since the continuing failure of the method to produce results will be ignored or rationalized. Critical rationality play an essential role in effectively assessing competing means to our goals. For instance, we should be open to evidence showing the ineffectiveness of current nootropics (smart drugs), so as not to waste our resources and to free us to pursue other methods.

Determining where to draw the line between persistence and faith can be

difficult. Some methods of self-improvement may only take effect after considerable and repeated effort; abandoning them too soon will as surely lead to stultification as will clinging to failed methods. Knowing when to abandon one avenue of exploration in favor of a fresh one will partly depend on knowledge about our own propensities either to give up prematurely or to persist irrationally. Critical rationality therefore requires a balance; it is not simply a matter of being constantly and supremely critical. A propensity constantly to criticize all attempts at self-improvement may reflect, not a reasonable caution, but an evasion of the responsibility to choose a method and implement it.

Achieving this balance between persistence and critical analysis requires an ability to tolerate uncertainty and ambiguity. Authoritarian personalities, like authoritarian governments, cannot bear disagreement, uncertainty, or alternatives. They demand allegiance to a single goal, a single method, a single agency. Living extropically calls on us to develop and sustain the contrary ability to welcome alternatives, to encourage diversity of opinion, and to thrive on uncertainty. Only the ability to remain open to new information and evidence will be effective in our pursuit of self-transformation. We will heed R.A. Wilson's dictum: "Convictions make convicts," and will think in terms of working hypotheses rather than certain beliefs, and use the probabilistic categories of "fuzzy logic" rather than the black and white knife of classical logic. We can learn to enjoy the progress represented by being corrected more than the comfort of feeling certain. Not only will this be more personally effective, thriving on uncertainty and correction will reduce interpersonal conflict, allowing us to accept the merits of another's argument without needing to reject their entire argument or to attack the argument's proponent.

Cognitive self-transformation requires us to search for and employ the most effective methods of increasing our intelligence. Effective reasoning is possible only if we study the process of reasoning itself, in order to allow for weaknesses in typical ways of thinking, and to seek ways of augmenting our analytical and creative capacities. Metareasoning (reasoning about reasoning) will obviously include studying the fundamentals of logic, statistics, and some areas of mathematics. It may include the newer field of fuzzy logic, as implemented in the new generation of electronic goods to handle continuously varying quantities. We can further sharpen our reasoning in regard to decision-making by studying the fields of game theory and strategy, applying iterated Prisoners' Dilemma reasoning (as illustrated in Axelrod's enlightening work), and more controversially, Hofstadter-style superrationality. These fields, added to an understanding of human psychology, will increase our effectiveness in personal interactions, enhancing our ability to achieve our goals while leaving others feeling satisfied rather than frustrated.

Cognitive psychologists have demonstrated biases in human reasoning about the probability of an uncertain event, or the value of an uncertain quantity. They have shown that we "rely on a limited number of heuristic principles which reduce the complex tasks of assessing probabilities and predicting values to simpler judgmental operations. In general, these heuristics are quite useful, but sometimes they lead to severe and systematic errors."[7] An example is the representativeness heuristic, in which probabilities are estimated according to the degree to which A is representative of B (the degree to which A resembles B). For example, if given a description of an individual who is shy, helpful, uninterested in the real world, but tidy and possessing a passion for organization, most people will guess out of a list of jobs that he is a librarian. This estimation will usually be made in disregard of prior probabilities; even if there are far more farmers than librarians, for instance, the individual will be assumed to be a librarian because of the closeness of his description to a stereotype of librarians. Avoiding the inappropriate use of heuristics such as this is tremendously difficult. Measuring probabilities by closeness to a stereotype appears to be a natural result of the functioning of our brains. Our neural networks form paradigms or exemplars, to which we compare incoming information.[8] The more we familiarize ourselves with these biases, the more frequently we will notice and correct them.

Other typical heuristics and biases include the availability heuristic, in which we overestimate the probability of an event because we easily recall a similar event. So, I might forego buying a Dell computer because I remember the problems my friend had with a Dell, even if there is no reason to believe this to be statistically significant. The Gambler's Fallacy, involving fallacious assumptions about probability and causation, is well known. Other errors arise from mistaken beliefs regarding statistical regression, from anchoring our estimates to previous estimates (a type of cognitive conformism), and from conflation of correlation and causation.

Many other methods of cognitive augmentation are available, even without employing technology. General semantics[9] warns of intellectual traps such as wholly identifying one thing with another ("John *is* a Republican"), and even offers a revision to English – E-prime[10] – which attempts to avoid use of forms of the verb *to be*. Artificial languages such as Loglan/Lojban might repay our study by providing a linguistic medium specifically designed to prevent unintentional ambiguity. Philosophy of science can improve our understanding of experimental procedure and scientific warrant[11]. Speedreading techniques enable us to boost the efficiency of our information gathering, while numerous memory techniques allow us to retain more of the information acquired. These are just some of the non-technological means available for our project of cognitive enhancement, each of which deserves an article, at least, in itself.

Present and future technologies will further expand our intellectual capacities, in conjunction with the foregoing means. The current generation of nootropics (smart drugs) appear to be mildly effective for relatively young, healthy persons, but improved understanding of neurochemistry, synthesis of more powerful compounds, and more precise delivery mechanisms, should allow us to push back our biological and neurological limitations. Our capacities for organizing and presenting information are vastly expanded by use of personal computers, and the Net provides a practically endless source of documents, discussions, and expertise. The appearance, in 1993, of the first generation of personal digital assistants (PDAs) heralds an era of increasingly portable personal computing power and communications flexibility. Soon you will be able to contact most people, and access remote databases, no matter where you happen to be. Software agents and 'knowbots' will help us to gather the information that interests us, relieving us of tedious work hunting down and managing information. Recent experiments linking a biological neuron to a field effect transistor point to the day when our computerized assistants will be inside our heads. Eventually our computers will be tightly integrated with our brains, becoming part of us, and abolishing barriers to the attainment of transhuman intelligence.[12] We may also genetically engineer our brains to expand their capacities, and even upload our consciousness to superior hardware, thereby endowing ourselves with

the unlimited potential of posthuman intelligence.[13]

Physical self-transformation

Superior cognitive performance will not persist for long if our bodies are deteriorating, aging, and dying. Elevating personal extropy will therefore include physical self-transformation. As with cognitive enhancement, many physical improvements can be made without employing current or future technologies. Living extropically will involve a concern for maximizing our health through diet and exercise, from widespread practices such as high-fiber, low-fat foods, weight-training and aerobic exercise, to well-established but lesser known practices such as the very low calorie, very high nutrition Walford (High/Low) Diet[14], which has consistently reduced the incidence of many diseases and extended both mean and maximum lifespan in widely varying species.

Even given an extropian commitment to physical transformation, we face conflicting choices. Physical transformation refers to a collection of goals, including health, longevity, strength, resilience, speed, stamina, suppleness, and beauty. Some of these goals may be, to a degree, mutually inconsistent. For instance, the Walford Diet is tremendously effective at promoting health and longevity, but will preclude extensive muscle-building. If we choose primarily to pursue the peaks of performance, whether strength, stamina speed, or suppleness, we will likely have to sacrifice some health, longevity, or possible beauty (depending on your standards). Aerobic exercise exceeding about 30 minutes, three to four times weekly, will increase stamina but produce no further cardiovascular protection, while producing more free radical activity and injuries, and (temporarily) suppressing immune function. Injecting anabolic steroids will reliably increase muscle mass and strength, but sustained use brings several deleterious health effects. So, while all Extropians ought to challenge themselves with exercise and a careful diet, the particular mix of performance vs. health and longevity will be a personal choice.

The decades that lie ahead will bring technologies of transformation enabling us to modify, augment, and replace our human, biological bodies with superior vehicles worthy of our evolving intelligence. Increasingly, those of us desiring bodies beyond those evolved by natural processes, will engage in a process of what I call *transbiomorphosis* – the engineering of improved bodies by intervening in biological processes, and by incrementally replacing our biological forms with synthetic life-sustaining bodies. As Nietzsche realized in the late Nineteenth century, humanity is not the end of the story of evolution:

> ...Man is a rope, fastened between animal and superman - a rope over an abyss...what is great in man is that he is a bridge and not a goal.
>
> [Friedrich Nietzsche, *Thus Spake Zarathustra*, Pt.1, p.3]

Already we can enhance our health and longevity with a multitude of nutritional supplements and drugs. The 1990s have seen the beginning of gene therapy; we can expect genetic engineering to progress from restoring defective systems (today's medical paradigm) to pushing back natural limits (tomorrow's medical paradigm). Much discussed artificial organs will be a temporary measure, merely a stand-in until the arrival of nanotechnological medicine which, without cutting or poisoning will cure disease, regenerate limbs, reverse aging, and will allow us to reinforce our bones, massively strengthen our immune systems, and re-engineer our bodily structure as we please.[15] Apart from structural enhancement, we can anticipate unprecedented control over our appearance, including the possibility of complete and reversible change of gender.

VISUALIZE YOUR OPTIMAL PERSONA

Reprogram your behaviors and habits by regularly practicing this exercise.

(1) Develop in detail an image of your ideal self. Write down your desired characteristics. Then select two or three behaviors to change or goals to achieve.

(2) Sit up straight. Breathe in deeply, hold the breath while tensing all your muscles. After a few seconds, blow out the breath while releasing the muscular tension. Repeat. Then start and maintain regular deep breathing (try breathing in for two seconds, holding it for eight seconds, and breathing out for four seconds).

(3) Bring into focus a picture of your Optimal Persona, seeing yourself behaving as you want, achieving your goals. Practice until you can use all sensory modalities: Make your internal image clear and moving, and hear what is being said, even imagining the smells and sensations of the situation.

Continue for 15-20 minutes. Use this exercise at least once a day, focusing on just a few characteristics in each session.

For more details on a variety of visualization techniques, see Tony Robbins, *Unlimited Power*, Adelaide Bry, *Visualization: Directing the Movies of Your Mind*, Jose Silva, *The Silva Mind Control Method*.

Transbiomorphosis will involve the merging of our machines and technologies with the human body. Earlier, I said that computers will continue to shrink, while their power grows, and the degree of interconnectivity with our brains increases until they become part of our brains. We can also expect our senses to be sharpened and new senses to be added through interfaces with mechanical sensors.

Most people feel alarmed or horrified by the prospect of human-machine integration or merging. They fear, understandably, a loss of humanity in becoming "mechanized." This fear is fed by popular images, whether it is the collectivist monstrosity of the Borg in *Star Trek: The Next Generation*, the programmed behavior of *Robocop*, or the rigidly robotic imagery in the pioneering techno music of *Kraftwerk*. Mechanization of this kind is indeed to be shunned, for it extracts the vitality of life, simplifying thought and behavior, subjecting the agent to programming and external control. This is the very antithesis of the Extropian drive for self-actualization, personal growth, and individual freedom. These undesirable and misleading connotations of the term 'mechanization' explain why I prefer to talk of transbiomorphosis. Our future integration with the products of technology will not be a mechanizing, constraining, subtracting process, but the very opposite.

Recent years have revealed a clear trend toward making our artifacts organic (in the abstract sense), fluid, responsive, and living. While rigidly programmed computers will probably always be used for some purposes (due to their blinding speed at logical computations), we are witnessing the emergence of connectionist machines – neural networks that learn from experience, adapt, and solve problems without a human determining the algorithms. Such artificial neural networks are modeled (more or less abstractly) on brain function. The new field of artificial life (A-Life)[16] attempts to evolve computational and robot organisms that share the characteristics of our familiar carbon-based life. Software designers are developing knowbots and other software agents that respond to our needs and desires, learning from us and helping us. Fuzzy logic is being implemented in electronic devices, obviating the need for rigid on-off responses. These and other examples illustrate ways in which some technologies are diverging from traditional rigid machine behavior, and evolving towards an organic, flexible, complex function suitable for supplementing our limited brains.

Psychological transformation

In this section I will comment on self-transformation as applied to personality and behavior. This will include what would normally be called morality – questions of what behaviors and dispositions are *good* and *bad*. However, standard notions of good and bad are deeply stained by the religious metaphysics that I have already rejected. In place of moral concepts we might evaluate our psychological characteristics as healthy and unhealthy or sick. As Norton says, expressing Nietzsche's view: "Health denotes all that contributes to ascendent vitality, while sickness characterizes whatever contributes to life's degeneration and demise..." (Norton, p.82.)

If we are to actualize our ideal selves, we must first choose that self. The self we encounter when we first look within may not be a self we have chosen. Before we can realize ourselves, we need to discover and choose ourselves. This requires a thorough, unrelenting self-examination in order to uncover the sources of our current psychology. We will expose the contribution of our family, our teachers, and our culture to our development, and will see that we absorbed many of those influences largely unconsciously and uncritically. Choosing an ideal self asks of us that we "revaluate all values," that we look at our person as a fascinating stranger, and determine whether we wish to affirm, modify, or relinquish each of our important beliefs, habits, associations, relationships, and dispositions. Since self-transformation is a dynamic process and the ideal self an ever-evolving paradigm, the initial period of revaluation must be followed by recurrent self-examination and course correction. A range of psychological techniques can facilitate self-understanding (such as the sentence-completion exercise frequently employed by Nathaniel Branden[17]), as can meditation techniques. Some internal explorers report breakthroughs facilitated by drugs such as the empathetic MDMA ("Ecstasy") and the psychedelic LSD.

Once a self has been affirmed and an ideal self or Optimal Persona created, we need to take responsibility for our own lives, and we will demand the right of self-determination. In our quest for self-realization and transformation we will want to experiment with alternative methods of growth, including those discussed earlier. This requires that others not interfere with our free and responsible choices. Unfortunately, the government of the U.S.A., in common with every other state in the world, arrogates to itself the power to circumscribe our experimentation. In our pursuit of health, longevity, and cognitive enhancement, our greatest enemy in the U.S.A. is the Food and Drug Administration, with its monopolistic approval process.[18] The barriers to self-development raised by agencies such as this show that political awareness and action should form part of our plans for transformation. Only in a truly free community can we fully realize our potential.

External obstacles should never be used as an excuse for failing to explore our potentials in the many ways left to us. We can try out new careers and projects, developing new skills and aspects of ourselves; we can mix with different types of people; experiment with new types of relationship; and visit new locations, learning about diverse cultures. A commitment to experimentation, flexibility, and personal evolution will protect us against our own dogmatism, stagnation, and the thoughtless comfort of conformity.

A core feature of successful psychological transformation is self-discipline. Without the ability to control our impulses and to maintain our carefully planned course, we will fritter away our energies in every direction. Lack of self-control will leave us vulnerable to those who would use us as tools for their own ends: "He who cannot obey himself is commanded." Self-discipline and the conscious self-guidance of our lives will allow us to achieve ever higher goals, as we raise our sights with each triumph. Effective self-rule will free us of the desire to control others. Contrary to popular interpretation, the *Ubermensch* are *not* the Blond Beast, the conqueror and plunderer. They are those who neither rule others nor tolerate others' attempts to rule them. The developed, self-chosen self will exude benevolence, emanating its excess of health and self-confidence. As a well crafted and integrated individual, the self-transforming person will have the strength to be honest and sincere, to reveal and express him/herself. One who has long practiced self-transformation will present an appearance of depth, stability, discipline, and of being at ease.[19]

Changing aspects of our personality and determining our mental state can be tremendously difficult. Joining the non-technological tools already at our disposal soon will be powerful means of cognitive and emotional modulation.

Modification of our DNA and resulting brain structure may be able to alter the ancient evolved drives over which we currently have minimal control. For instance, we may be able to reliably control our drives for sex, for territory, and for violence. If we come to understand the relation between our brain structure and endemic desires for intellectual comfort and certainty, we might be able to modify ourselves (with a cautious eye on the consequences) to reduce our need to be proven 'correct,' and raise our tolerance for seriously considering alternative interpretations of the world.

Since our cognition and our emotions are deeply interwoven, future abilities to edit genes, modify the hormonal output of the neuroendocrine system, and to affect the levels of the numerous neurotransmitters, should grant us far greater choice of how we typically think and feel. We may develop chemical-releasing implants, controlled by a computer interfaced with our brains, that allow us to rapidly alter our state of mind, for instance to dramatically increase alertness, or to disconnect sexual impulses when they are distracting, or to gear us up for a major intellectual challenge.[20] These possibilities may alarm some people, but they are merely extensions of everyday, much cruder methods of neurological and emotional control, such as the use of exercise, sex, food, drugs, and television.

I have attempted to demonstrate the centrality of self-transformation to an extropic life, and to explore several aspects of and means toward self-transformation. We face an open-ended future looming large with potential for defining and transforming ourselves to an extent unthinkable in all past human history. As is to be expected in regard to this topic, I have focused on selves as individuals, since we each have to take charge of our own destiny, and accept responsibility for who we are and who we can become. This stress on the individual should not be taken to denigrate the extensive contribution to self-development afforded by suitable groups and cultures. We need not be isolated, totally self-sustaining achievers. Support and encouragement by fellow extropic-minded persons is enormously valuable. Extropian friendships, cultural groups, and activities provide a stimulus for us to move onward, upward, outward. Let us encourage each other by setting examples of what can be achieved, let us share our discoveries, and accelerate ourselves toward the attainment of individual and cultural excellence.

NOTES

[1] I have developed other Extropian principles in previous issues of *Extropy*: Spontaneous Order in "Order Without Orderers," *Extropy* #7 (vol.3, no.1), and "Dynamic Optimism," *Extropy* #8 (vol.3, no.2), and summarized all five principles in "The Extropian Principles 2.0," *Extropy* #9 (vol.4, no.1).

[2] A survey of the increasingly optimistic views of professional gerontologists appeared in *Life*, October 1992.

[3] See "Transhumanism: A Futurist Philosophy." *Extropy* #6 (Summer 1990).

[4] I borrow the term "Optimal Persona" from Bruce Sterling's excellent near-future novel, *Islands in the Net*, though in *Islands* the Optimal Persona is a common hallucination rather than a consciously constructed model.

[5] A good discussion of this can be found in books by Nathaniel Branden, especially *The Disowned Self*, and *Honoring the Self*.

[6] I analyze this issue in detail in Chapter 6 of my Ph.D. dissertation (in progress), *The Diachronic Self: Identity, Continuity, Transformation*. Contact me at the Extropy Institute address if you would like a copy.

[7] Amos Tversky and Daniel Kahneman, p.3 of Kahneman, Slovic, Tversky, 1982. See also, Nisbet and Ross, 1980.

[8] See Paul M. Churchland, 1989.

[9] The classic reference is Alfred Korzybski, *Science and Sanity*, 1933.)

[10] On E-Prime, see D. David Bourland, Jr. and Paul Dennisthorne Johnstone, eds., 1991, and the Summer 1992 issue of *ETC. A Review of General Semantics*.

[11] A good place to start would be Klemke, Hollinger, Kline, eds. 1980, and Lambert and Brittan, Jr., 1970, 1979.

[12] See E.A. Wan, et al, 190, and J.D. Foley, October 1987.

[13] Hans Moravec, 1988.

[14] Roy L. Walford, *The 120 Year Diet*, 1986

[15] Nanotechnological medicine is described in Drexler, 1986, and Drexler, Peterson, Pergamit, 1991.

[16] For an introduction to A-Life, see Simon! D. Levy's "Neurocomputing 5: Artificial Life," in *Extropy* #8 (vol.3, no.2), Winter 1991-92.

[17] His first book illustrating this often startling technique is *The Disowned Self*.

[18] I critique the deadly policies of the FDA in my talk, "Recreational Drugs and Smart Drugs: Paternalism and Responsibility," available on audio tape.

[19] An effective portrait of the developed, self-transformed person is presented in Wayne Dyer's books, *Your Erroneous Zones*, *Pulling Your Own Strings*, and especially *The Sky's the Limit*. Unfortunately I cannot recommend later books by Dyer, who appears to have abandoned useful insights for New Age vagueness and platitudes.

[20] A recent SF novel by Greg Egan, *Quarantine*, contains the best portrayal to date of these possibilities and their effects on our self-conception and sense of identity.

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