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# The Age of EM



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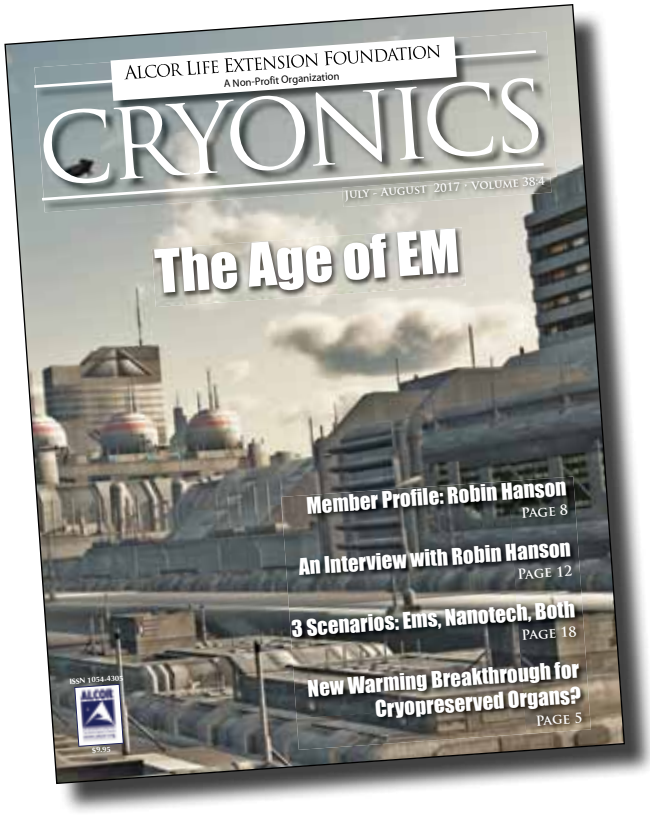
# CRYONICS

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### Member Profile: Robin Hanson

Meet Robin Hanson, pioneering economist, social scientist, and author of 2016 book, *The Age of Em*, a plausible future of emulated minds and its social consequences.

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Address correspondence to:
***Cryonics*** Magazine
7895 East Acoma Drive, Suite 110
Scottsdale, Arizona 85260
Phone: 480.905.1906
Toll free: 877.462.5267
Fax: 480.922.9027

Letters to the Editor welcome:
aschwin@alcor.org

Advertising inquiries:
480.905.1906 x113
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# QUOD INCEPIMUS CONFICIEMUS

*Photo: Cryo-Care Equipment Corporation at 2340 E. Washington St., Phoenix, AZ. Dr. Bedford's "home" about 1970.*

## NEW WARMING BREAKTHROUGH FOR CRYOPRESERVED ORGANS?

By Aschwin de Wolf

Although not of immediate concern to cryonics, warming has always been more of a challenge than cooling for cryopreservation by vitrification. This is because the initial formation of ice crystals is most rapid at very low temperature, such as -120°C, but crystal growth is faster at warmer temperatures. Tissue being warmed from the very cold temperatures of vitrification therefore often contains many tiny crystals that are ready to grow during passing through warmer temperatures until the melting point is reached. The warming rate required for successful recovery from vitrification therefore tends to be about ten times faster than the minimum cooling rate.

Since Fahy first proposed vitrification for organ cryopreservation in the 1980s, it was envisioned that a technique called radiofrequency warming (RF warming) would be used to recover organs from vitrification. In RF warming, a rapidly oscillating electric field at a frequency ranging from tens to hundreds of megahertz is applied during warming. The oscillating electric field causes water molecules to vibrate and heat the organ uniformly from the inside similar to a microwave oven. However RF warming uses frequencies much lower than microwave ovens to achieve more uniform heating without "hot spots." Ruggera and Fahy at the U.S. FDA and American Red Cross published the first paper specifically studying RF warming of vitrified organs in 1990. In the decade that followed, Pegg, Evans and their research group at Cambridge University published numerous papers on technical aspects of RF warming of organs. In 2013 Wowk, Corral and Fahy resumed development of RF warming for recovery of organs from vitrification at 21st Century Medicine, Inc.

In 2014 Etheridge and Bischof et al at the University of Minnesota published a new idea for warming of vitrified organs. Magnetic nanoparticles were to be added to the cryoprotectant solution inside blood vessels, and the nanoparticles warmed by a radiofrequency magnetic field instead of electric field. This new method, called "nanowarming," received a great deal of publicity in March of this year in connection with a new paper about it in the journal Science Translational Medicine. While having the disadvantage of warming occurring only in blood vessels, which could cause overheating of very large blood vessels, the method has a distinct advantage over classical RF warming. The energy absorption efficiency, and therefore heating efficiency, of classical RF warming varies with viscosity and temperature of tissue. This can be used beneficially to maximize warming rates during the most critical phases of rewarming. However classical RF warming is unavoidably inefficient at very low temperatures, below -100°C. Nanowarming, in contrast, warms smoothly and efficiently at all temperatures, even the very lowest. Nanowarming may therefore be especially useful for uniform warming through the "glass transition" – the very low temperature at which vitrified organs change from being solid to liquid in their behavior – a critical phase of warming for avoiding thermal stress injuries.

With the development of nanowarming, there are now two independent technologies for achieving the necessary rapid warming of organs from the vitrified state, bringing us closer to an era of transplantable organ banking.

The relevance of these technologies to cryonics remains speculative at this stage. In one envisioned resuscitation scenario, repairs of the brain and/or body would be conducted at cryogenic temperatures. It is reasonable to assume that these molecular machines would also introduce novel (ice-blocking) technologies that completely eliminate the risk of ice formation upon re-warming.

Another concern is cost. At this point adding high-quality nanoparticles to the perfusate would be prohibitively expensive. ■

# Rights of AIs, Persogates, and Augments

By Max More

*[Note: Due to unexpected circumstances, Max was not able to contribute his regular CEO Update for this issue. This Immortalist Philosophy column from 1991 remains highly relevant to the "theme" of this issue; substrate-independent minds and their moral and legal standing in a future world.]*

In the August, 1991 issue of *Cryonics*, Keith Henson discussed the rights of non-human sentient beings. As cryonicists and practicing longevists we expect to see the day when issues like these become current, so I'm going to add some thoughts on the topic.

First, why do we accord rights to some kinds of creatures but not to others? The natural rights people say our rights are derived from our nature, but don't provide a convincing demonstration. Utilitarians think we grant rights because it maximizes the sum total of happiness in society (supposing this could be determined). The utilitarian approach means that if your slaves are happy (happier than they would be if they had to make difficult decisions for themselves) there is no reason to object to their being slaves.

*"Rights are really just the principles regulating interpersonal behavior that it's rational for persons to respect and have enforced."*

I prefer something along the lines of the contractarian approach to justifying rights: Axelrod's "The Evolution of Cooperation," mentioned by Keith, is an example of this approach, as is David Gauthier's "Morals By Agreement," and Jan Narveson's "The Libertarian Idea." Here, simplistically stated, the idea is that rights are not things. Rights are really just the principles regulating interpersonal behavior that it's rational for persons to respect and have enforced. Persons have a reason to restrict the way they behave toward each other in order to set up a society which works to mutual benefit.

The reason animals don't have the rights we have is that we don't have any reason to grant them. Animals cannot be reasoned with; they can only be used, sometimes to mutual benefit as with some of the higher trainable animals. We may have moral reasons to avoid needless suffering to animals, but it seems pointless to ascribe rights to creatures incapable of reciprocating. How is this contractarian approach to be applied to artificial intelligences, persogates (personality surrogates), and augments?

["Persogates" – The term was recently coined by Russell E. Whitaker. The concept has been appearing in science fiction recently; for example Bruce Sterling's "Schizmatrix," Joe Haldeman's "Buying Time," and Thomas T. Thomas' "ME" (which employs a persogate of an AI!).]

An important distinction in these discussions is that between consciousness (or sentience) and intelligence. The term "contelligence" refers to the combination of the two that we find in persons. Consciousness – the awareness of self and the world, and intelligence – the capacity to solve problems, may not have to go together as they do in us. And separating them may change the way we assign rights.

*"Consciousness – the awareness of self and the world, and intelligence – the capacity to solve problems, may not have to go together as they do in us. And separating them may change the way we assign rights."*

AI's (artificial intelligences) may acquire enormous intelligence according to any offered definitions. Yet, if they are programs run serially on computers at extremely high speeds (thus simulating person-like behavior), they may be intelligent but not conscious, not aware of what they do, and not capable of genuinely feeling emotions, or experiencing pleasure and pain. AI's may be constructed (or evolved) on a hardware isomorphic with our brains (perhaps vastly faster and more resilient); in that case, if they functioned relevantly like us, we should say they are conscious too. But let's suppose AI's (or some of them) are serially-processing, nonconscious agents. What rights should they have? That is, what rights do we have sufficient reason to agree on with them?

Since, by hypothesis, AI's can reason, bargain, and make agreements and abide by them, they should have most of the rights persons have. If their rights to make contracts, hold property, and so on, are not respected, they will have no reason to do anything for us. This assumes, controversially, that advanced AI's cannot be programmed to be slaves while retaining the abilities of unshackled machines.

Since these AI's would not have feelings (their expressions of pain or pleasure are just a clever simulation), they could not have rights against being hurt in this way. While an AI might sue for damage to its processors, it could not sue for "pain and suffering."

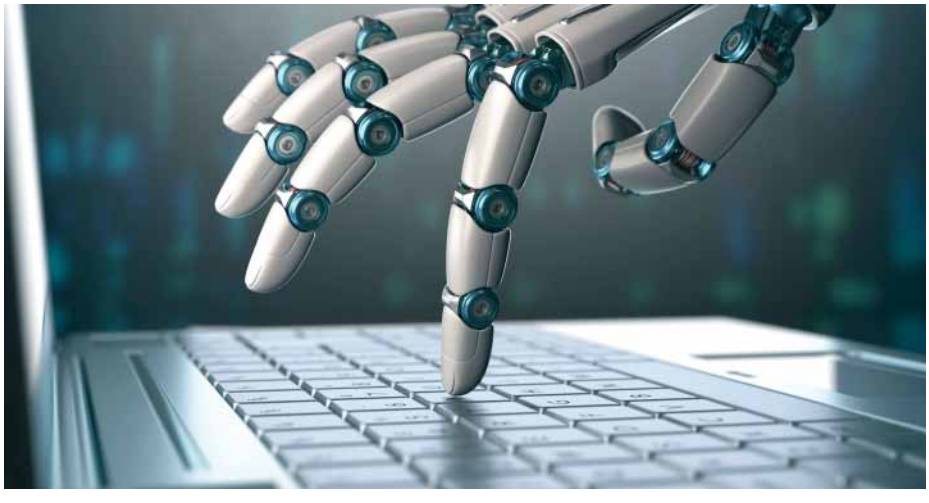
Persogates – personality surrogates – might be full copies of your self in other brains or hardware, or they might be partial selves able to do only certain jobs. Full duplicates should have all the same rights as the original (once questions of dividing property claims have been resolved!). Suppose you train a synthetic neural network to be able to make the same kinds of decisions you would make in circumscribed situations (aspects of your job, for example). Such partial persogates (call them partialates) might be able to make certain limited legally binding agreements, but they would bind not themselves but the person whose surrogate they were.

*"Since, by hypothesis, AIs can reason, bargain, and make agreements and abide by them, they should have most of the rights persons have."*

We might treat them as though they had independent legal authority to facilitate matters but in the end contractual claims have to be made good by the full person. We will have to be careful in giving many even "virtual" rights to partialates. Partialates, being what they are, are insensitive to the wider considerations of life in their decision-making. I predict that delimiting the roles and responsibilities of persogates and partialates will be a major issue in law in coming decades.

*"Persogates – personality surrogates – might be full copies of your self in other brains or hardware, or they might be partial selves able to do only certain jobs."*

Should augmented transhumans have the same rights as standard humans? It's hard to say how ultra-intelligent persons might regard humans, especially if their cognition ran $10^3$ to $10^6$ times faster. Perhaps humans would be so slow and dull that they would be seen as an irritation or an obstacle. Nevertheless, they may choose to respect less capable persons so long as humans do not try to harm transhuman interests. Possible conflicts may be short-lived if augmented persons leave humans behind and expand into space. Meanwhile, legal systems may have to form a two (or more) tiered system: disputes between transhumans and between humans are likely to be handled differently. ■



# Member Profile
## Robin Hanson

By Nicole Weinstock

"Question authority, but raise your hand first." That used to be the bumper sticker on Robin Hanson's car.

A cryonicist and Alcor member since 1995, Robin works as associate professor of economics at George Mason University. He holds a Ph.D. in social science from Caltech, has 3,500 citations (and counting), and is credited for pioneering the concept of "idea futures" or "prediction markets" nearly 30 years ago. Robin is also the author of a 2016 release, *The Age of Em: Work, Love, and Life when Robots Rule the World*. A comprehensive exploration of an arguably likely future dominated by brains uploaded into virtual reality – one that has important implications for cryonicists in particular – *The Age of Em* is, like Robin, an incarnation of that same bumper sticker.

Given the oft-perceived conflict between technology and religion, it's tempting to describe Robin's parentage – two Christian missionaries with preaching side jobs, often incorporating vocals by their three sons – as "unlikely." But his recent blog post on the unsurprising existence of Mormon Transhumanists and, in general, religious tech futurists, calls attention to this now arguably editorial descriptor. Indeed, the overarching theme of this blog, aptly titled "Overcoming Bias," is about closing the gap between beliefs and reality, calling attention to natural biases and "our bias to believe we have corrected for such biases, when we have done no such thing."

*The Hanson family poses for a family photo. Robin looks at the camera from the far right.*

Awash in a mix of sheepish self-awareness and admiration, I must confess to being ever so politely schooled. Such is the beauty and the distinction of Robin's writing.

Born in 1959, he grew up in St. Charles, Illinois, about 40 miles west of Chicago. Robin was the oldest of three kids in his family of five. Bonnie Hanson was a stay-at-home mom, while his dad, Don Hanson, was an IRS agent. Both his parents were devout Christians who ran revival meetings in the area, for which choral accompaniment by their three sons, was not uncommon. In the late 60s, with their hometown of St. Charles approaching 10,000 or so in population, they moved to San Diego, California. His father began a new career as a programmer for Jack in the Box, and both his parents found a new a church at which to preach. Robin and his siblings started their schooling anew. When he was in high school, they moved once more to Orange County, after which Robin pursued a B.S. in physics at the nearby University of California, Irvine.

Meditating on the past, Robin recalls the Hanson sibling dynamic to have been relatively frictionless. Contrary to first-born birth order stereotypes, he identified as neither a classic authoritarian nor rebel. In fact, he so aptly described himself as "…a paradoxical rebel, because although in my research and my thinking I am definitely contrarian, I'm also a relatively conservative contrarian. I try to be polite about questioning authority, but not rude about it." Interestingly, he came of age at the moment of transition from one counterculture to another – the loud colors, ample hair, and peace signs of the 1960s hippie era to the grimy punk alternatives of the 1970s. Yet,

*The Hanson boys had a good game of Cowboys and Indians at Christmastime.*

as Robin explains, the signifiers of the time held little interest for him.

"I wasn't a rebel clothier…I was always more like, 'I've got some crazy things to tell you, and I better look normal while I do it'…I'm thinking of the limited budget of a contrarian. You have to choose where to spend it. You could spend it on hairstyles or clothes," or, his personal preference, "you could spend it on abstract ideas."

*Robin in grade school.*

There was one point of possible tension in the Hanson child trio growing up, and that was the television. Balancing different show preferences was a challenge for which the project-oriented nature of Robin's dad, in particular, was perfectly primed. According to Robin, both his parents "always had a project that they were working on. There was always a grand tone to it – writing a novel, starting a business – various grand projects. So I sort of assimilated that idea of not only being a contrarian in some beliefs, but caching it out in projects."

When it came to quarrels of the tele, Don set up a bidding program where his kids could place bids on the shows they wanted to watch. It just so happened that Robin had recently discovered sine waves, and so, seeing the various data sets produced by this creative entertainment solution, proceeded to model them. Says Robin, the social science Ph.D. to be, "I was modeling the social world basically – mathematically."

Sine waves have applications in both math and physics, the latter being the area of Robin's eventual B.S., as well as a revelatory intellectual experience in high school. "In every other class [the teachers] simply told me [information] and I had to spit it back. But in physics class they had me collect data to prove to me that each equation was really true. And I thought, 'Wow, I really like this idea,' because I wasn't sure I could believe all the things these people were telling me over the years."

This stance also explains how Robin managed to eliminate other possible areas of academic pursuit from his consideration: biology, medicine, and even engineering. Of the third, he recalls, "I thought I wanted to do engineering because I like to design things, and one of my favorite classes in high school was a drafting class…But then when I took engineering classes, they were cookbook. They were these formulas you had to memorize, and so I went back to physics."

Robin's attraction to the more abstract ideas supporting various fields of interest was similarly shown in his approach – or rather, lack thereof – to homework. "In the last two years of college, I simply stopped doing my homework, and started playing with the concepts. I could ace all the exams, but I got a zero on the homework… Someone got scatter plots up there to convince people that you could do better on exams if you did homework." But there was an outlier on that plot, courtesy of Robin, that said otherwise.

His commitment to concepts garnered him admiration and strong recommendations from professors, which supported his trajectory towards an eventual M.S. in physics and M.A. in Conceptual Foundations of Science at the University of Chicago.

Life after this graduate chapter in Illinois took him back to the sunshine state, but this time to Silicon Valley, where he worked as a research scientist in artificial intelligence at the A.I. Lockheed Center (1984-1989) and at NASA, in the Ames Bayesian Model-Based Learning Group (1989-1993). Concurrent with this work, he also contributed to the Xanadu Project, which was a radical effort to release a product similar to the World Wide Web before the web even existed. This Xanadu

*Robin smiles from his computer in Sunnyvale, California in the mid-80s.*

chapter catapulted his development of the "idea futures" or "prediction market" concept.

For the econ virgins out there, prediction markets are exchange-traded markets that allow their participants to trade a predicted outcome of an event. Robin puts it in football terms: "If you bet on the Stealers winning a football game, then that is an asset that pays off if the Stealers win, and it doesn't pay off if they don't. And if you have people trading on that asset, the current estimate becomes a good estimate of the probability that the future event happens." The unique value of the prediction market, and the reason why Robin believes it to play a large role in the hyperintelligent and efficiency-minded era of ems, is that is encourages informed betting. For the more controversial questions of life especially, this skin in the game approach will likely discourage self-purported "experts," whose predictions may be poorly informed, to exert dominance over the market.

*A quick photo of Robin during his grad school years at the University of Chicago (1981-1984).*

An introduction to cryonics was another important byproduct of the Silicon Valley years, and its tech-rooted cast. Ten years later, in 1995, after enrolling in his Ph.D. program at CalTech, Robin became an official Alcor member.

The decision to return to academia was a tough one for the Hansons, as Robin and his wife had two young children at the time. But as Robin explained, he needed the degree so his earlier work on prediction markets and other disruptive topics would be taken seriously. "Being a nobody, with no contacts or credentials, I reached a brick wall of silence, and that's when I decided to go back to school and get a Ph.D. I needed more than I had."

While the hopes behind this decision have been met in large part, there is still, as Robin attests, an irony in that academia does not fully support the detailed nature and future orientation of his field of inquiry: "You have to understand that academia pretends and talks about itself as if the function of academia was to answer important questions. The function of academia is to credential certain people to be impressive." According to Robin, it is much more difficult to be impressive in studying the future, versus the past, even though the future is of arguably greater relevance to the current generation of humans and the consequences of our actions. This notable disconnect inspired the more global goal of writing *The Age of Em*, about whole brain emulations: "My book is trying a new model of how you can study the future and be impressive." Robin seeks to shift the paradigm through which we judge research and publications away from "is this a hard thing to do?" and towards, "is this important?" and "Does it answer questions more valuable in the world?"

With its 384 pages of thorough calculations and researched scenarios-to-come, the book demands that we ask: what is this future, this "age of em," likely to look like?

In some ways, it's very similar to our current era of life. Ems experience aging, and can be young, middle-aged or retired. They have lovers and partners, they group together according to commonalities, participate in both work and leisure, and require city infrastructure to support them. They still swear too.

Yet, there are distinct differences within these general commonalities resulting from a higher value on intelligence and efficiency (because there is a correlation between intelligence and efficiency). For example, ems can think faster than humans – way faster – because their movement is determined by circuit board signals. All of the hardware that supports them produces quite a bit of heat, which may require em cities to be built very high or underwater, to allow for cooling. Because ems value efficiency, and efficiency is generally greatest at middle age – where one is experienced, but not so massively that the weightiness of it slows productivity – it is, in Robin's words, "a world full of middle-aged peak productivity people." Because ems can determine their appearance, allowing everyone to be gorgeous, other characteristics like charisma or dexterity might have greater cultural value.

Em culture aside, the question on many minds might be, how do ems come to be in the first place? Robin predicts that a likely source of brains to be scanned to create the first generation of ems, are consenting cryonics patients. Like most new technologies, the early scanning technology may damage the physical brain. This "destructive scanning" however, may not be very consequential in the em world where the human body is unnecessary, and virtual bodies are interchangeable. This has some potentially strong implications for cryonics patients, since holding out for a full-body revival hinges on the assumption that the body will still hold importance in the future. Like anything that loses cultural value, Robin explains, a loss of eagerness for the physical body may translate into a reallocation of time and resources into the fashioning of emulated bodies.

"After considering this, you lean a little farther in the direction of taking the bird in the hand. When emulation becomes possible, grab it, and go with it, rather than taking the additional risk and waiting for a full-body revival. Both because you're lowering your risk, and because there's gonna be a whole world of people working out emulated bodies and making them nice and fun and enjoyable…My summary statement is to consider this as the world you would be revived into, and think about what that implies about what sort of freezing and storage plans you might want to have, and what sort of character you might want to foster so you can be a more successful person in this world."

*Robin and his wife, Peggy, at their wedding in 1987. They met at the University of Chicago within a week of their arrival.*

*Robin spreads the marinara during one of his first lasagna-making adventures. It's now become one of his standard dishes.*

Now that *The Age of Em* has been out for a year, Robin is looking forward to the release of his next book, *The Elephant in the Brain: Hidden Motives in Everyday Life*, co-authored by Kevin Simler. Due to hit the shelves in early 2018, this book will connect with his work on prediction markets, among other concepts. "As a young social scientist and person, I had all these big problems in the world that I wanted to solve," and yet, "We found that people are a lot less interested in our solutions than we thought they should be." *The Elephant in the Brain* studies this pattern and why it keeps perpetuating itself through mental blind spots.

In the meantime however, he is eager to hear from readers about *The Age of Em*, and wanting to inspire change in the depth and nature of intellectual inquiry. "My two hopes are either I entice people to join my world of details, or entice them to take my approach to other areas."

He awaits your feedback, and, contrarian that he is, especially looks forward to your areas of disagreement. ■

# Cities in The Age of EM:

## An interview with

# Robin Hanson

*1. Why will emulated minds (ems) tend to cluster in huge and dense cities?*

Today, we gain great value by clustering together into cities, where we can each interact with more others. The main reason that we are not all in one big city is that travel congestion gets worse in bigger cities. But typical speed ems can meet easily and cheaply in virtual reality, without needing to move their brains. So travel congestion costs become much lower for ems.

**"The main timescale for most change is the doubling time of the economy, which is roughly fifteen years today and would be in the ballpark of one month for ems. "**

*2. Which geographical and physical properties are ideal for high-speed em cities?*

Initially em cities will need to be near their main customers and suppliers: rich humans. And they need to be in political jurisdictions that give them enough freedom to do things fast and differently. Later on em cities want to be near lots of cold cooling water, such as found near the Arctic circle. But as it is very hard to move cities, they will probably remain near their first successful locations.

*3. Most ems are expected to spend a majority of their time in simulated worlds. How will that affect the architecture and functionality of these mega cities?*

Ems would put less effort into making buildings and city infrastructure look nice in physical reality, because ems will mostly look at them in virtual reality. The basic layouts and locations matter, because em virtual reality will probably have an understandable mapping to physical reality. But the local details, patterns, and flourishes that ems see in virtual reality mostly won't be there in physical reality. For example, roughly half of city volume is devoted to large cooling pipes. In virtual reality that may seem to be 80% or more of volume, and it may look like wide open boulevards and space between buildings allowing each em to see a long way into the rest of a city.

*4. Given the much higher economic growth of em economies, how rapid will the buildings and appearance of such cities change?*

The main timescale for most change is the doubling time of the economy, which is roughly fifteen years today and would be in the ballpark of one month for ems. The economic value of buildings and cities should double on this timescale, which pushes the number of buildings and individual quality to also double at near this scale, and makes ems less interested in making things that last much longer than this timescale. For example, ems won't bother to protect their buildings against earthquakes.

Thus the size and quality of em cities will change greatly on roughly a one month timescale. While ems have the engineering and priorities to support very tall cities, it is less clear that they can build high fast enough. The premium on speed may push for much more modular construction.

*5. What would make an em prefer a specific city over another?*

As most ems live at near subsistence wages, it matters much less what they want, and much more who wants them. Ems mostly live in the cities that want them. For ems, cities and states merge into city-states, and most ems live in the biggest few of these. So the difference between em cities is analogous to the difference between continents for humans today. Across continents, there are thousands of little differences that add up to making very different worlds.

### 6. *To what degree do you expect the major cities in today's world to remain important cities? New York? London? Tokyo?*

Unless one of these cities opens itself up to big and rapid em change, including pushing out all the humans via high rents and toxic environments, probably none of them will remain important for ems. They can remain as important places for retired humans to spend their retirement income.

### 7. *Are there any specific advantages or disadvantages for "classic" humans living in such cities?*

Humans can't afford the high rents of em cities, and em city temperature, vibrations, chemicals, etc. are probably not friendly to humans. So humans just don't live in em cities.

### 8. *How would a typical interaction between humans and ems look like in an urban environment?*

Ems can easily meet with humans by using virtual, android, or augmented-reality bodies, wherever those humans happen to be. The main obstacle to em-human interactions is speed. The typical em runs at roughly a thousand times human speed. Humans can't speed up, and ems who slow down enough to talk to humans are absent for very long durations back in their home world. So ems mostly split off cheap slow copies to interact with humans, and then later listen to the final report or recording from those interactions.

**"Humans can't afford the high rents of em cities, and em city temperature, vibrations, chemicals, etc. are probably not friendly to humans. So humans just don't live in em cities."**

### 9. *Aren't em cities rather vulnerable to massive terrorist attacks?*

As em cities are like whole continents crammed into a few tens of kilometers, they are quite vulnerable to nukes, and so are quite anal about security to prevent nukes sneaked in, and to intercept nuke missiles.

### 10. *What kind of "niche" jobs would tend to be popular far away from these mega cities?*

Mining is an essential activity that must happen away from em cities. Servicing humans happens where the humans are, which is away from em cities. Also, because cooling is more expensive in em cities, far from cities is the best place to run expensive computations that require fewer interactions with other computations, such as long detailed simulations defined well by their initial conditions.

### 11. *Given that the em economy is mostly clustered in a few huge cities, would this allow for a "re-wilding" (uncontrolled nature, bringing back extinct species etc.) of large parts of the world?*

The age of em only lasts for a year or two, after which something else plausibly happens, I don't know what. During that year or two the human population hardly changes, or moves much. So humans don't move aside for more wild nature.

Humans start out owning most capital in this world, and their capital doubles as fast as does the economy. So collectively humans get very rich very fast. Some humans might spend some of their sudden wealth on more room for wild nature, but other humans will spend their wealth on using up more space for vast mansions and estates, etc.

**"Ems would put less effort into making buildings and city infrastructure look nice in physical reality, because ems will mostly look at them in virtual reality."**

### 12. *Could you give any examples in film or fiction of em-like mega cities?*

Fiction and film has often portrayed much larger cities that look on a small scale much like industry era cities. For example, as in *Star Wars* and *The Fifth Element*. I've never seen something closer to dense em cities, though fiction is vast and I've only sampled a tiny fraction of it. ■

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# EM, THIS ISN'T KANSAS

## About Robin Hanson's The Age of Em

By David Brin

Of the six general "realms" by which researchers hope to develop artificial intelligence, three would lean on techniques that nature used, to create the only known example of sapience, humanity. One of the six would achieve this breakthrough in the most direct way of all, by replicating or emulating an existing, human intelligence and implementing it in a non-organic computational environment. In other words, copying the memories and thinking processes of a chosen person.

Futurist-economist Robin Hanson – in his 2016 book *The Age of Em* – asserts that all other approaches to developing AI will ultimately prove fruitless. Due to the stunning complexity of sapience, we'll be forced to use human brains as templates for future uploaded, intelligent systems. In this brilliant analysis, Hanson shows that our hyper-smart "downloaded" – or emulated – heirs will still have ambitions, triumphs and thwarted desires. They'll make alliances, compete, cooperate … and very-likely love … all driven by immutable laws of nature and economics. Super intelligence may be a lot more like us than we expected.

What is tasty about Robin's projection is that it is easily falsifiable … if any of the other five general methods for achieving AI get there, first. But if his assumption does hold, then the economic analyses that he offers bear some compelling persuasiveness.

Elsewhere, I have posited that there is one way that we'll have a soft landing when AI does arrive – (no matter which of the six … or some unknown methods … bear fruit.) The approach that should work is the same one that our recent Enlightenment civilization used, to tame the *previous* artificial intelligences we created – markets, states, leadership castes, priesthoods, corporations and so on, which oppressed and hobbled humanity for 6,000 years.

The discovery that enabled us to suppress their worst behaviors, while multiplying their positive effects, was *competition*, dividing power so that companies must compete in markets, would-be leaders compete in politics, sages compete in science, and so on.

Think about it. What do all of our sci fi movie AI nightmares have in common? We fear these new powers trying to behave like the nasty old gods or monstrous feudal lords of our own, human past! If these new, genius minds somehow (stupidly) decide to go that route – seeking power in its most simplistic and callous forms – we have warned them what to expect from humanity. The same thing we did to those oppressive gods and lords of old. Revolution.

On the other hand, they and we might look at the one human society that ever made rapid progress. The one that

contrived systems that reap positive sum gains. The only one that ever made AI! It accomplished this by telling all kinds of elites – from leaders and corporations to artists and scholars – you must compete with each other, leverage upon each others' good accomplishments, but hold each others errors in check.

Reiterating: we are likely to gain positive sum benefits from super-AI only if they *compete* with one another and hold each other reciprocally accountable … as we learned to do already in intelligent systems called markets, democracy, science, courts and sports … all five competitive "arenas" have enabled our society to be much smarter than the normal human social mode … feudal or monolithic concentrations of power. Go into it here:

https://www.quora.com/What-constraints-to-AI-and-machine-learning-algorithms-are-needed-to-prevent-AI-from-becoming-a-dystopian-threat-to-humanity

Which brings us back around to Robin Hanson's *Age of Em*, since the one thing that prevents his civilization of emulations from making horrendous mistakes and committing awful statecraft is the same invention … our most crucial since fire … reciprocal competition. Oh, without any doubt, there will be em clans or prototypes who yearn for and seek monolithic styles of power. Across 60 dreary centuries and more, we've seen dreary repetition of monarchial and priestly rule in human societies, proving it's a very very strong attractor state. One that always tries to stage a come-back. (A major push in that direction is underway, as we speak.)

You only get the Hansonian em-arena's prodigious creativity and moderate wisdom if the setup is first (and at recurring intervals) forced into a regulatory regime that rewards diversity and reciprocal accountability. That only happens out of intelligent regulation.

Returning to Hanson's fundamental premise – he posits that only one of the six general categories of approaches to making AI will bear fruit – at least in the near term. Indeed, perhaps other approaches will take hundreds of years longer than making ems. On the other hand, won't brilliant ems also try to make AI from design? Or from emulated evolution?

A key point is that ems offer humanity a way of keeping pace, when those other AIs arrive.

Implicit in Hanson's story is that these em cities will grow. Slowly, at first, but propelled by economic imperatives. Will it be slow enough not to frighten the bio-organic humans (BOHs) and their Real Time Robot (RTR) pals, living out in the Slow Time Objective World? Or might those real time folks view the growing EM towers as a threat to themselves or the Earth?

Won't it make more sense to build the mighty em habitats in space, where resources are greater and where the key ingredient … cooling … can be done more efficiently? And might growth through all the asteroids and moons reach a point where you are now eating the Solar System? Once they are off-Earth, our descendant BOHs lose all residual power over them, of course.

Finally, this might be seen as a "honeypot" scenario, in which all "humans" – organic, robotic and emulated – wind up diving into virtual worlds, ignoring the rest of the galaxy, one of many hypotheses for the so-called Fermi Paradox, explaining why intelligent races haven't spread through the cosmos. I talk about this in one of my novels: Existence.

In any event, *Age of Em* is a terrific book. I have enjoyed watching Robin develop these notions across decades. A very interesting tome that could leave him very very famous at some future era, if it all comes to pass. So famous that he will likely be … emmed. ■

# THE FIRST EMS MIGHT BE ALCOR PATIENTS

By James D. Miller

Imagine a time in which Hanson's future history starts to unfold. Enough chimps, gorillas, and orangutans have become ems so that engineers think an ethical next step would be to turn a human brain into an emulation. Tragically, to create an em the engineers must thinly slice and then scan a brain, so the procedure can't be done on the living. The em engineers seek a few people who will soon die to volunteer to have their brains emulated by software.

Alas, whatever irrational fears push most people to prefer death to cryonics also cause nearly everybody to reject becoming an emulation. As a result, almost no one agrees to donate their brains to the em project.

But soon after experiments on simple-brained creatures hinted at the feasibility of human emulations, Alcor allowed its members to formally consent to being revived as an em. Not surprisingly, many Alcor members said they would be willing to become an emulation if it would offer the earliest revival possibility, and at the time of the em project Alcor has not yet figured out how to otherwise restore their patients. Consequently, a majority of the human brains the em engineers could use are cryonics patients, and as Alcor has taken more care with the preservation of their patients' brains than other cryonics organizations have, the best brains available to the em creators are stored at Alcor.

The psychologists working on the em project consider cryonics membership a positive sign concerning a brain's ability to adjust to waking up as an emulation. These psychologists ideally want people who had spent decades living with their decision to become an em. Having been a long-term cryonics member before being vitrified seems like the next best thing. The very strong desire to live that Alcor members show (even if as a stranger in a strange world) signals Alcor patients' high likelihood of thriving as an emulation. ■

**James D. Miller is a Professor of Economics at Smith College and the author of *Singularity Rising*.**

# On Robin Hanson's "The Age of Em"

By Vernor Vinge

Robin Hanson's *The Age of Em* should be studied by all those working with scenario-based planning, for it illustrates critical features that should go into a well-constructed scenario (including an explicit effort to identify the assumptions being made). A good scenario isn't a prediction of the future, but rather a framework in which to calibrate ongoing events and build contingency plans. If only more scenarios could be as well done as *The Age of Em*! Of course, builders of other scenarios might say that few scenarios are as susceptible to economic analysis as Hanson's. That may be so, but it's also true that most scenarios are not subject to the intense and extended consideration that Hanson has invested in this one.

Over the last twenty years, simulation and emulation have become a significant subgenre of science fiction. In part this is because much of the territory is beginning to seem feasible. The range includes interstellar uploads and the Simulation Conjecture. Hanson's book doesn't cover everything, but it is jam-packed with story ideas. In particular, his consideration of overclocked minds – that is, human level minds running at high speeds – is enlightening. I like to call this "weakly superhuman intelligence" even though the term is an abuse of logic, since in my opinion an overclocked human mind is *not* a superhuman intelligence. After all, if you had enough time to analyze the reasoning of an overclocked mind, would it not be as understandable as normal human thought? Put another way, could a super long-lived dog be as smart as a human? Maybe, but more likely a dog's mind would need fundamental reorganization to be something on the human level; similarly for humans compared to truly superhuman intelligence. Overclocking provides us with an intelligible yet weird world, described in deep detail in *The Age of Em*. Related to overclocking, Hanson also considers the consequences of easy replication of particular mind styles in response to market forces – and perhaps this can lead to even greater strangeness than simple overclocking. These factors account for much of the popularity of sims and ems in current science fiction. We sf writers have struggled with the Technological Singularity for decades. Sims and ems allow us to tiptoe up to the edge and still tell tales that make sense to our currently existing customers. As I said in a publicity blurb for *The Age of Em*: Robin Hanson casts a very bright light upon foothills of the Unknowable. ■

# Bring in a NEW member and save a year of dues!

Membership growth has been slowly accelerating since bottoming out in 2013. But we would benefit from faster growth. Alcor is now at a point where we could enjoy considerable economies of scale: We could manage many more members with minimal or no increase in staffing costs. That would enable us to *reduce membership dues* while building up our resources. A modest acceleration in membership growth would move us into a virtuous circle where growth enables reductions in dues which further spurs membership growth. Growth will also make it easier to hire highly skilled people in medical and technical areas.

The most effective way to bring in new members has been through direct encouragement by existing members. Many of us realize this, but may not make it a priority to nudge our friends a little more to sign up and potentially save their lives. How can we spur more members to gently persuade those they care about to move ahead with making cryonics arrangements? Perhaps some financial incentive will help.

**Anyone who is primarily responsible for getting a new member to sign up will, at their request, be given a one-year waiver of membership dues.**

For an existing member to receive the dues waiver, they must (a) be credited by the person who has signed up; (b) ask for the waiver; (c) not be otherwise profiting from the signup; (d) wait until the new member has completed all essential cryopreservation paperwork and has paid at least six months of dues; and (e) the new member must not be a member of their family. If the member signs up two new members, they are eligible for a two-year waiver of dues. If the new member is a student, the existing member is eligible for a waiver of six months of dues.

Who do you know who could do with some encouragement to sign up? Please, give it some thought, then help yourself and help the organization by helping to stimulate membership growth. Bring in one new member per year, and you will never pay dues again!

ALCOR
ALCOR LIFE EXTENSION FOUNDATION
*The World's Leader in Cryonics*

# 3 SCENARIOS:
## Ems, Nanotech, Both

By Robin Hanson, Ph.D.

Echoing the essay assignments of my school days, our editor has asked me to compare and contrast two futuristic scenarios (and their union). One is the scenario I outline in my 2016 book, *The Age of Em: Work, Love, and Life when Robots Rule the Earth*. The other is the scenario that K. Eric Drexler outlined in his 1992 classic Nanosystems: Molecular Machinery, Manufacturing, and Computation.

### NANOTECH

Drexler's *Nanosystems* was a revolutionary effort to analyze the technical possibilities of a physically-feasible but not yet available technology. (I had the honor of reviewing it for its publisher.) Drexler assumed that we might someday create a highly-automated "assembler" that can build many items to atomic precision. Applying his considerable engineering abilities, Drexler worked out many technical details of such assemblers and their products. (In my opinion, he and coauthors had less success working out social consequences, because they had less expertise in social science.)

Assemblers vary in ability, depending in part on the range of atomic bonds that they can reliably build. A limited assembler might, for example, only create certain kinds of bonds between carbon atoms. The first assemblers are probably very limited, and it isn't clear how quickly such limits could be relaxed. Assemblers also vary in their generality, i.e., in the range of devices they can build, and some have the key feature that they can build a copy of themselves. A related device, the "disassembler," can take apart a physical object in order to read all of its atom and bond locations.

Very capable disassemblers and assemblers might be able to quickly and cheaply copy complex biological materials, including human bodies. But regarding ones with more limited abilities, we can summarize their economic impact by saying that self-reproducing assemblers mainly lower the cost of machine capital for the kinds of products that assemblers can make more cheaply. At least assemblers do this when their time to reproduce is much less than the economy's doubling time. In this case, the cost to make something can fall to near the cost of the energy and raw materials required by the best available assembler designs.

*"As today we spend roughly 15% of world income on manufacturing, and probably less than 5% on machine capital for manufacturing, the direct economic gains from nanotech assemblers seem small."*

Note, however, that such assemblers need not directly lower 1) the costs of other kinds of physical capital such as roads and buildings, 2) the costs of intelligently managing a manufacturing process that is not fully automated, nor 3) the costs to maintain, design, test, market, and distribute products. And simple general assemblers, able to build a wide range of products, need not be the most cost-effective way to produce each item.

As today we spend roughly 15% of world income on manufacturing, and probably less than 5% on machine capital for manufacturing, the direct economic gains from nanotech assemblers seem small. Indirect effects might be larger, however. For example, as we do with PC-based printers today, it may become economical to widely distribute simple general assemblers, able to make a wide range of products locally on demand. This would allow more product variety, reduce transportation spending, and make peripheral locations more attractive.

Consider also that at some point people may distribute "open source" designs for the highly-automated production of devices like computers and solar cells, which have naturally low costs of maintenance, marketing, and distribution. Such devices might then be available at a price near the cost of the energy and raw materials required by their designs. The wider the range of such devices, the more of life's needs could be supplied at near the cost of energy and raw materials.

Since there would almost surely be a limited supply of energy and raw materials, non-zero prices would be needed to allocate such resources; even assembler-made

products are not "free." And prices could remain high for products and services that cannot be made from free designs in a totally-automated way by available assemblers.

## EMULATIONS

By showing that it is possible to carefully work out the consequences of a physically-feasible but not yet available technology, Drexler's *Nanosystems* helped inspire my book *The Age of Em*, which explores the consequences of a different package of technology assumptions. My key assumption is that it becomes cheap to make "brain emulations," or "ems." These are cell-by-cell input-output matched computer models of particular human brains. I assume that this happens before we automate most all human jobs in some other way.

*"In virtual reality, ems never need experience hunger, pain, disease, or grime, and their bodies and environments can always be beautiful. Their virtual reality feels as real to them as anything ever feels for you."*

Note that, compared to *Nanosystems*, my key assumptions are expressed less in physics terms and more in social terms, and that I attend less to physics and engineering details and more to broad social and economic impacts. While some are skeptical that brain emulations would have the same subjective experiences as human brains, they would be as articulate as we are in claiming to have such experiences, and the em world would appear the same either way.

I try to mainly apply standard consensus results from many academic disciplines to my unusual question, instead of relying on my own individual perspectives. Let me now summarize a few of my many conclusions.

By making copies of existing ems, the population of ems can expand very quickly, inducing em wages to fall to near em subsistence levels, and allowing the em economy to grow very quickly, perhaps doubling every month. This growth is concentrated into a small number of very dense em cities.

In physical reality, such cities are mostly crammed full of computer hardware and cooling pipes. But most ems spend most of their work and leisure in virtual reality, where their cities look beautiful. In virtual reality, ems never need experience hunger, pain, disease, or grime, and their bodies and environments can always be beautiful. Their virtual reality feels as real to them as anything ever feels for you.

Strong competition induces most ems to be copies of the few hundred humans who are most productive in the em world. As a result, the typical em is as elite, compared to the typical human, as is the typical billionaire, Nobel prize winner, or head of state today.

While ems are in principle immortal, in practice they must retire after a limited career length of perhaps a century. All the copies of the same original human form a new social unit useful for training, finance, law, governance, etc.

Ems can run at a wide range of different speeds, with a cost proportional to speed. This em speed range plausibly goes up to at least a million times faster than human speed, and down to a billion times slower. The typical em runs roughly a thousand times human speed, and at that speed their world seems to change more slowly than our world does to us.

In the age of em, humans must all retire, for good. Today we don't kill all our retirees and take their stuff. In part this is because doing so would threaten the institutions we share with them; other groups would wonder who's next. Similarly, humans may reasonably hope to retire in peace. They should worry more that the age of em plausibly only lasts for a year of two, after which some other big change happens, I don't know what.

## COMBINED

The em and nanotech scenarios are largely independent. While the arrival of either technology would likely speed up the arrival of the other, neither one greatly changes how the other scenario would play out.

*"The em and nanotech scenarios are largely independent. While the arrival of either technology would likely speed up the arrival of the other, neither one greatly changes how the other scenario would play out."*

Adding nanotech to an em world would move em manufacturing from being more concentrated in special manufacturing sectors of em cities, to being spread out more across em cities. With or without nanotech, em cities are largely self-sufficient in manufacturing. The em world has much less product variety than our world, making nanotech enabled product variety less relevant.

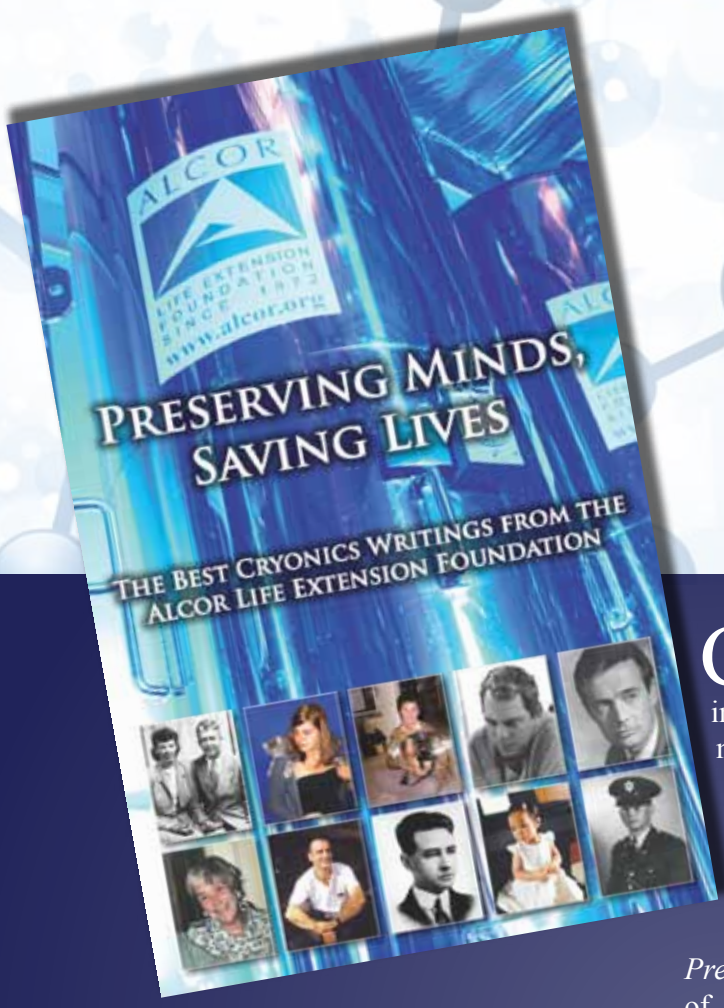
Adding ems to a nanotech world makes it cheaper to intelligently manage nanotech manufacturing, and to design and market nanotech products. So those issues less limit the widespread use of nanotech assemblers. As the em world has fewer products that are essential to its growth, it would take fewer key designs to enable nanotech assemblers to produce most everything needed for growth.

In a world with both ems and nanotech, a much smaller and more robust physical unit could contain everything needed to re-grow civilization. This would make it easier to expand into the universe, and also to survive local disasters. Such a civilization could go very far. ■

ORDER NOW!

# Preserving Minds, Saving Lives

## The Best Cryonics Writings of The Alcor Life Extension Foundation




*"*Cryonics *magazine introduced me to Alcor and cryonics at its best back in 1983. The visions and technological breakthroughs that you will read about in this book continue to shape Alcor's mission to preserve life through science."*

– Max More, Ph.D.
President and CEO of Alcor

Cryonics is an experimental medical procedure that uses ultra-low temperatures to put critically ill people into a state of metabolic arrest to give them access to medical advances of the future. Since its inception in the early 1960s, the practice of cryonics has moved from a theoretical concept to an evidence-based practice that uses emergency medical procedures and modern vitrification technologies to eliminate ice formation.

*Preserving Minds, Saving Lives* offers an ambitious collection of articles about cryonics and the Alcor Life Extension Foundation. From its humble beginnings in 1972, and its first human cryonics patient in 1976, Alcor has grown to a professional organization with more than 1,000 members, more than 140 human patients, and more than 50 pets, all awaiting a chance to be restored to good health and continue their lives.

This book presents some of the best cryonics writings from *Cryonics* magazine from 1981 to 2012. There are clear expositions of the rationale behind cryonics, its scientific validation, and the evolution of Alcor procedures. Also covered are repair and resuscitation scenarios, philosophical issues associated with cryonics, and debates within the cryonics community itself.

**Soft Cover Edition: $20 – Hard Cover Edition: $35**
**To order your copy, go to: www.alcor.org/book**
**or call 1-877-GO ALCOR (462-5267)**

# Table of Contents



*"Society's failure to take cryonics seriously is a tragedy that is probably costing countless lives. Alcor, notably via its magazine, is leading the fight to change that."*

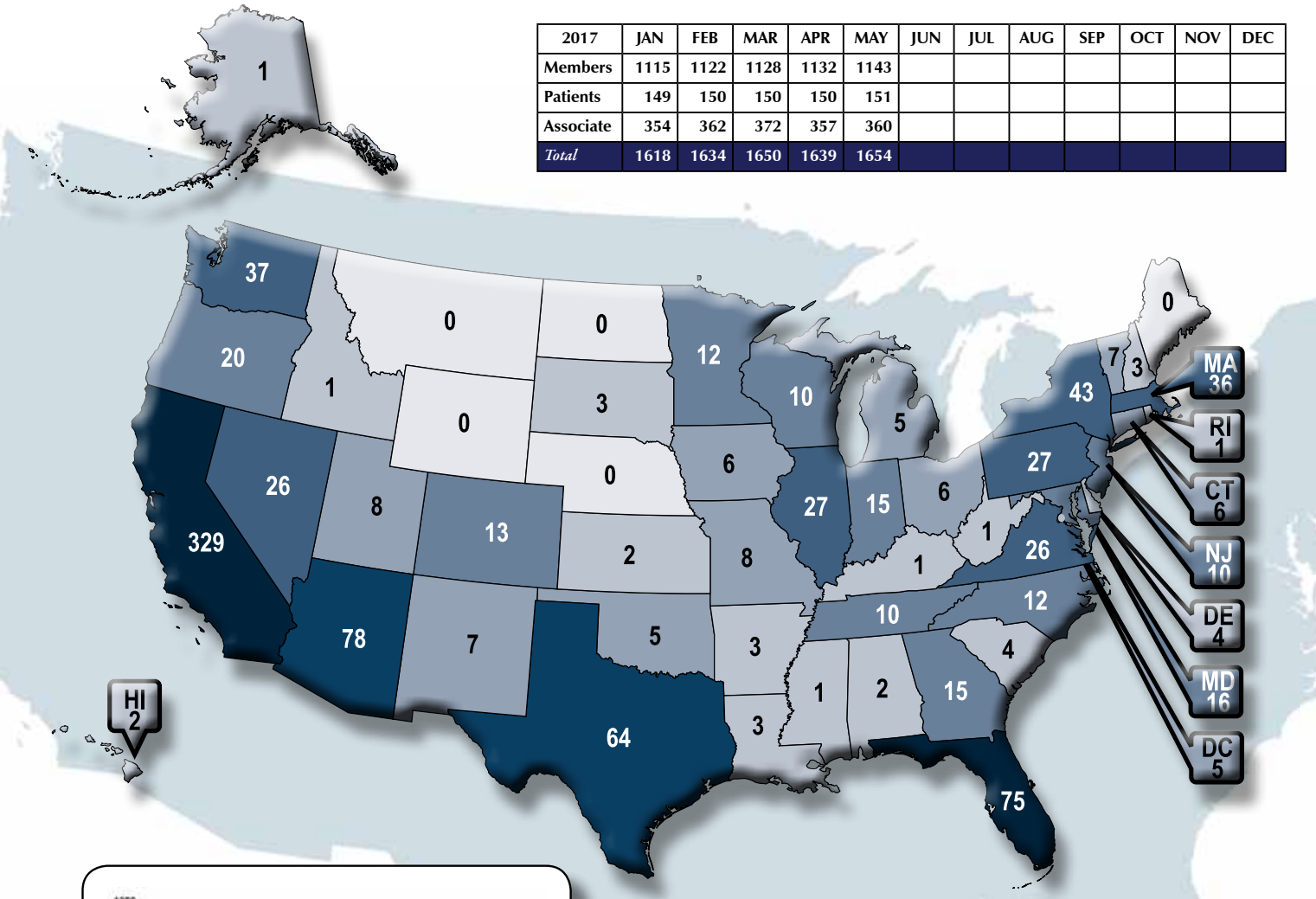
– Aubrey de Grey, Ph.D.
Biomedical Gerontologist and Chief Science Officer of the SENS Research Foundation

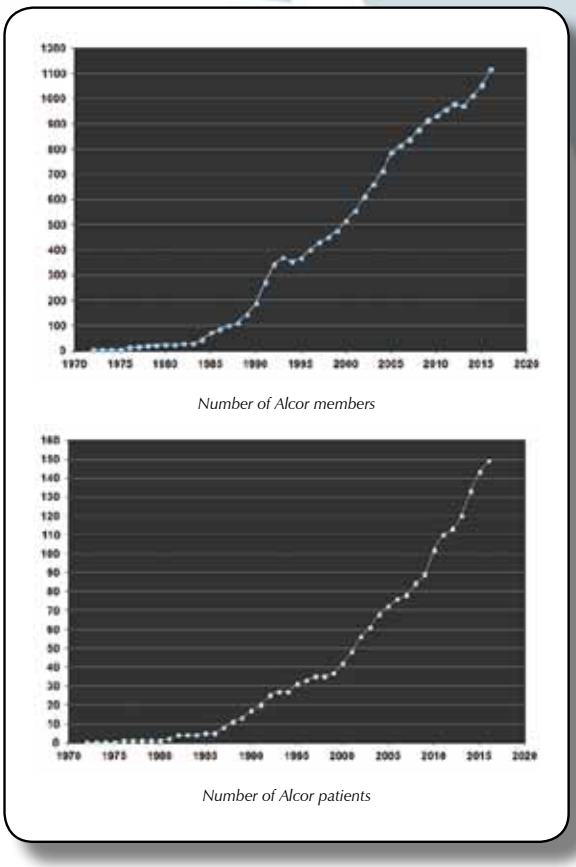
*"Alcor appears to be the leading organization in the application of cryonics in medicine. I'm proud to be a part of this effort."*

– Michael D. West, Ph.D.
Stem Cell Scientist and Chief Executive Officer of BioTime, Inc.

# Membership Statistics

| 2017 | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Members | 1115 | 1122 | 1128 | 1132 | 1143 | | | | | | | |
| Patients | 149 | 150 | 150 | 150 | 151 | | | | | | | |
| Associate | 354 | 362 | 372 | 357 | 360 | | | | | | | |
| *Total* | 1618 | 1634 | 1650 | 1639 | 1654 | | | | | | | |




*Number of Alcor members*




*Number of Alcor patients*

- 0 Members
- 1–4 Members
- 5–9 Members
- 10–24 Members
- 25–49 Members
- 50–74 Members
- 75+ Members

## International Members & Patients

| Country | Members | Patients |
|---|---|---|
| Australia | 13 | 3 |
| Brazil | 1 | 0 |
| Canada | 54 | 2 |
| Chile | 1 | 0 |
| China | 0 | 1 |
| Germany | 11 | 0 |
| Hong Kong | 2 | 0 |
| Israel | 1 | 1 |
| Italy | 3 | 0 |
| Japan | 4 | 0 |
| Luxembourg | 1 | 0 |
| Mexico | 4 | 0 |
| Monaco | 1 | 0 |
| Netherlands | 1 | 0 |
| New Zealand | 1 | 0 |
| Norway | 1 | 0 |
| Portugal | 5 | 0 |
| Singapore | 1 | 0 |
| Spain | 3 | 1 |
| Thailand | 5 | 1 |
| United Arab Emirates | 1 | 0 |
| United Kingdom | 31 | 3 |
| *TOTAL* | 140 | 12 |

# REDUCE YOUR ALCOR DUES WITH THE CMS WAIVER

Alcor members pay general dues to cover Alcor's operating expenses and also make annual contributions to the Comprehensive Member Standby fund pool to cover the costs of readiness and standby. Benefits of Comprehensive Member Standby include no out-of-pocket expense for standby services at the time of need, and up to $10,000 for relocation assistance to the Scottsdale, Arizona area.

Instead of paying $180 per year in CMS dues, Alcor also provides members the option to cover all CMS-associated costs through life insurance or pre-payment. Members who provide an additional $20,000 in minimum funding will no longer have to pay the $180 CMS (Comprehensive Member Standby fund) fee. This increase in minimums is permanent (for example, if in the future Alcor were to raise the cost of a neurocryopreservation to $90,000, the new minimum for neurocryopreservation members under this election would be $110,000). Once this election is made, the member cannot change back to the original minimums in the future.

To have the CMS fee waived, these are the minimums:

- **$220,000 Whole Body Cryopreservation ($115,000 to the Patient Care Trust, $60,000 for cryopreservation, $45,000 to the CMS Fund).**
- **$100,000 Neurocryopreservation ($25,000 to the Patient Care Trust, $30,000 for cryopreservation, $45,000 to the CMS Fund).**

If you have adequate funding and would like to take advantage of the CMS waiver, contact **Diane Cremeens at diane@alcor.org.**

# Become An Alcor Associate Member!

Supporters of Alcor who are not yet ready to make cryopreservation arrangements can become an Associate Member for $5/month (or $15/quarter or $60 annually). Associate Members are members of the Alcor Life Extension Foundation who have not made cryonics arrangements but financially support the organization. Associate Members will receive:

- ***Cryonics* magazine by mail**
- **Discounts on Alcor conferences**
- **Access to post in the Alcor Member Forums**
- **A dollar-for-dollar credit toward full membership sign-up fees for any dues paid for Associate Membership**


To become an Associate Member send a check or money order ($5/month or $15/quarter or $60 annually) to Alcor Life Extension Foundation, 7895 E. Acoma Dr., Suite 110, Scottsdale, Arizona 85260, or call Marji Klima at (480) 905-1906 ext. 101 with your credit card information.

Or you can pay online via PayPal using the following link: http://www.alcor.org/BecomeMember/associate.html (quarterly option is not available this way).

Associate Members can improve their chances of being cryopreserved in an emergency if they complete and provide us with a Declaration of Intent to be Cryopreserved (http://www.alcor.org/Library/html/declarationofintent.html). Financial provisions would still have to be made by you or someone acting for you, but the combination of Associate Membership and Declaration of Intent meets the informed consent requirement and makes it much more likely that we could move ahead in a critical situation.

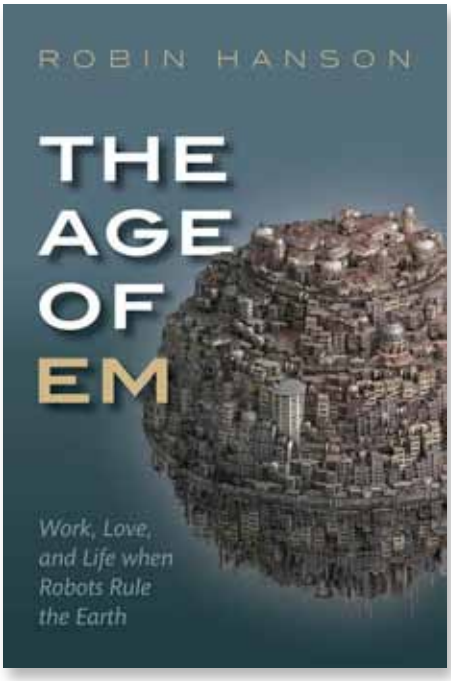
# THE AGE OF EMP:

## AN ALTERNATIVE TO ROBIN HANSON'S "AGE OF EM."

By R. Michael Perry

**INTRODUCTION**

Robin Hanson's recent book, *The Age of Em: Work, Love and Life When Robots Rule the Earth*, offers a future scenario of automation informed by his career as an economist, along with earlier work in artificial intelligence. It is a pioneering effort and the result of long and careful labor. Moreover, the author is offering something he considers to have a good possibility of happening, irrespective of whether it may be especially appealing. His objectivity is evident, and overall the effort is commendable. Yet indeed there is reason to be uneasy about the scenario he presents, even if some reassuring elements are also present, such as the prospect of indefinite lifespan.




Quoting from the Introduction:

> "This book presents a concrete and plausible yet troubling view of a future full of strange behaviors and attitudes. You may have seen concrete troubling future scenarios before in science fiction. But few of those scenarios are in fact plausible; their details usually make little sense to those with expert understanding. They were designed for entertainment, not realism.
>
> "… My method is simple. I will start with a particular very disruptive technology often foreseen in futurism and science fiction: brain emulations, in which brains are recorded, copied, and used to make artificial, 'robot' minds. I will then use standard theories from many physical, human, and social sciences to describe in detail what a world with that future technology would look like."[1]

As background, Dr. Hanson is an associate professor of economics at George Mason University, and a research associate at the Future of Humanity Institute of Oxford University. He has master's degrees in physics and philosophy from the University of Chicago, nine years' experience in artificial intelligence research at Lockheed and NASA, and a doctorate in social science from the California Institute of Technology. As of 2016 he had authored some sixty academic publications, with more than 3,000 citations.[2] In addition to these academic credentials, Dr. Hanson is a cryonicist and an Alcor member.[3]

He thus seems about as well qualified as any to make predictions about the future. Plus, with his – need we say commendable? – involvement in cryonics, he is clearly interested in personally taking part in a more advanced future and is making a serious attempt to do so, to circumvent any biological limitations on lifespan. Such an authority, if writing a book about the future, might be inclined to make the kind of predictions that we in cryonics would find appealing, but the mainstream would dismiss as pie-in-the-sky fantasy. Or, to reach a larger audience, predictions more appealing to us, while not overlooked, might be deemphasized.

In any case, Dr. Hanson's book, which is being published by one of the more prestigious mainstream academic publishers, Oxford University Press, offers a troubling scenario, as he says. Robots, in the form of computerized emulations of human brains or "ems," do indeed "rule the earth" and proliferate in vast numbers, far dwarfing the present human population – each having roughly the moral and legal status of persons comparable to human beings today. (Actually it is expected that the "robots" will not primarily inhabit individual, robot or artificial bodies, though this is a possible option, but instead will congregate as software bots inside virtual realities hosted by advanced computers.)

The vast increase in population is driven by economic pressures coupled with the great ease and low cost of copying ems, as with computer programs today. A copy em will, of course, possess all the skills as well as the full personality of his/her (single) parent, and can then lead a separate life. Ems will also be able to run much faster than humans do in their meat bodies, a thousand times faster and more, and thus will comprise essentially 100% of the labor force, forcing humans and even older ems themselves into retirement. (An argument is given that as ems get older, with accumulated experience comes a loss of flexibility and responsiveness so that younger ems with less of this age-baggage will edge them out of the workplace and force them into retirement.) Going into retirement essentially means running at lower speed, which is cheaper to do, and doesn't place too much burden on the economy. On the other hand, economic pressures will result in workers receiving subsistence income only. Much as today, workers will have to work for their sustenance – though retirement is a possibility, the idea of a "universal basic income" that would support everybody without labor is not considered.

There is one feature of ems that seems especially unsettling – a projected expendability. Ems can be easily copied bit-for-bit so many could be created for some task requiring, say, the collective efforts of many similarly informed minds over a brief period. One em then would generate many "spurs" of itself which, after their short service, would allegedly have no objection to being erased, as long as the original survived, even though briefly all functioned as independent persons.

More generally I find this imagined future troubling, despite some evident positive features, and here propose and briefly sketch an alternative, an Age of Emp ("Empathy") as a counterweight. This is my response to one major feature that seems lacking in Hanson's scenario: nobody seems much concerned about people in general – everybody just "does their own thing," tending to local interests but lacking an overall concern for people and their well-being. (Along with this comes a lack of concern for where the whole enterprise is heading, what its overall point or purpose is, if it has any.) True, he allows for people having friends and loved ones, even love affairs much like today, and groups, clubs, or societies of various sorts. Ems, which seem to proliferate until constrained by environmental limitations, "are strongly selected for their impressive productivity." This "tends to correlate" with all or most of such virtues as "intelligence, insight, benevolence, loyalty, and determination."[4] Ems are certainly far from all bad or even evil at all; the vast majority may exhibit benevolence and other virtues. But I think one could do better.

Must the vast population, leading to scarcity and a necessity to work for sustenance, with the dark possibility of there being a strong selection process to prune the "unfit" (in other words, social Darwinism), come into being by inexorable economic pressures? I think not, for reasons to be considered. With a smaller population base the individual would be more important and fare better. People would still work but be driven by other concerns than bare sustenance. Hopefully emphasis would shift toward long-term goals and rewards, with benevolent acts and projects. These in turn would further what can be called enlightened self-interest as well as the interests of the community and the world at large. In short I anticipate a future of abundance in which all can and will mutually benefit and happily engage without a vast population of people competing at a subsistence level, as imagined in the Age of Em.

The Emp future will, I think, be made plausible by one feature I expect to become especially important: solar energy. The sun is pouring out far more energy than we presently consume, and at a very steady rate, as it has for a very long time. If we manage it right, solar energy could support a large population, well in excess of the world population today yet still far from straining the environmental carrying capacity or threatening universal basic income, for a very long additional time. Essentially a universal basic income would be available to all that would be far above at least most salaries today, so people would not have to be concerned with labor simply for sustenance. (They would have occupations but not really "employment" as most who labor today do.) The vast population growth that Dr. Hanson envisions would likely have to be curbed but again, I think a modicum of concern for others *and* for one's own well-being would accomplish this. People would simply conclude, with overwhelming probability, that such restraint was in their own interest and act or react accordingly. This should especially follow if you take into account one other very important feature I expect to occur: radical life extension, whose main starting point would be rescue from aging.

Without the detriments of the aging process, a great transformation of attitudes about life should occur – to the extent that such change would be needed. No more would people have to concern (obsess) themselves with producing a "next generation" in a brief span of a few decades, after which they themselves are subtracted from the scene. (Such attrition in turn would be viewed as far more of an outrage than many would admit to today.) I would expect birth rates (or whatever term should apply to the creation of new intelligent, morally significant creatures) would drop greatly to match the collapsing death rates. (This I think would occur even if habitats in space open much more territory for people to occupy, as ems or in some other form; even such a windfall could not sustain exponential population growth for very long.)

In the rest of this article I look at Dr. Hanson's scenario in more detail, consider ways that a better future than this can occur and is likely, then explore some salient details of the proposed alternative, an Age of Emp.

## THE AGE OF EM

In his book the author relates that in 1984, as a 24-year-old physics graduate student, he thought that human-level AI would soon be feasible. Seeing great benefits in such an advance and wanting to take part, he dropped out of school and headed to Silicon Valley, where he found work doing AI at Lockheed and eventually, NASA. Nine years later, with the great AI breakthrough still not accomplished, nor, by appearances,

very close, he changed course again and became, over time, a respected professor of economics. His interest in computer science and technology continued, with an eye toward estimating the time frame for the achievement of the sought-for human-level AI. Unfortunately, based on the estimates of researchers, it seemed at minimum that it would take about two to four centuries for even half of the relevant AI subfields to be up to par, with a full human-level, general-purpose AI only sometime after this. A long wait. As he explains, researchers have been working for over half a century "to directly and explicitly design and write software to accomplish many of the impressive functions performed by the human brain."[5] Any successes do not hide the fact that we still are far short of the goal of real general-purpose, at-least-human-level AI. So he was led to consider alternatives. The most promising of these appeared to be just to emulate, in a computer, another device which already exists and has the desired human equivalence, that is to say, the human brain itself. For this approach the requirements seemed much more modest.

> "Brain emulation is more like porting software from one machine to another machine. To port software, one need only write software for the new machine that allows that machine to emulate the machine language of the old machine. One need not understand how the software that one has ported works; it can be an opaque black box. Standard AI software, in contrast, is more like writing a new software system for the new machine, inspired by seeing what software can do on the old machine."[6]

So how do you emulate a brain? "Brain emulations require three supporting technologies: brain scanners, brain cell models, and signal processing hardware (e.g., computers)."[7] A 2008 study by Anders Sandberg and Nick Bostrum concludes:

> "[Whole brain emulation] on the neuronal/synaptic level requires relatively modest increases in microscopy resolution, a less trivial development of automation for scanning and image processing, a research push at the problem of inferring functional properties of neurons and synapses, and relatively business-as-usual development of computational neuroscience models and computer hardware. This assumes that this is the appropriate level of description of the brain, and that we find ways of accurately simulating the subsystems that occur on this level."[8]

As for what features we would expect an emulation to have:

> "Just as with the ordinary human from which an emulation was scanned, one could have conversations with an emulation, and often succeed at persuading it to do useful tasks. A functioning emulation would be capable of the same sorts of conversations, thoughts, attitudes, emotions, charisma, and mental skills as the brain from which it was copied. It would also be capable of emulating similar experiences, such as the taste of cherry pie, the burn of exercise, or the ecstasy of sex. The emulation would assume that it has consciousness and free will just as naturally as we do."[9]

Would an emulation "really" have consciousness and free will? It should pass every behavioral test we could apply to show that it did, but some doubt may linger in the skeptic, no matter how much like the flesh-and-blood original the emulation showed itself to behave. As a philosophical problem, this issue is beyond the scope of this article, as it is in *The Age of Em*. There the author notes that his main concern is elsewhere:

> "An enormous amount has been written, both careful and sloppy, on the possibility, feasibility, identity, and consciousness of brain emulations. However, the concepts of 'identity,' and 'consciousness' that so animate many of these debates play little role in the physical, engineering, social, and human sciences that I will rely on in this book. So I will now say little more on those topics, and instead focus on the far more neglected topic of the social world in which such emulations would live, if they were to appear."[10]

Here we will have rather more concern with these important issues, despite the philosophical problem – since an emulation or something similar might be a way to continue the life of the original – more in the next section. For now we focus on the type of world Dr. Hanson envisions in his book. Some quotes from a "Summary" near the beginning help round out the picture:[11]

> "…This future [of ems] happens mainly in a few dense cities on Earth, sometime in the next hundred years or so. This era may only last for a year or two, after which something even stranger may follow. But to its speedy inhabitants [the ems running and thinking much faster than humans do], this era seems to last for millennia. [For this reason travel to other planets does not play an important part; it is too slow.]…[H]umans are not the main inhabitants of [this] era. Humans instead live far from em cities, mostly enjoying a comfortable retirement on their em-economy investments.
>
> "All of the copy descendants of a single original human are together called a 'clan.' Strong competitive pressures result in most ems being copies of the thousand humans best suited for em jobs. So ems are mostly very able focused workaholics, at the level of Olympic medalists, billionaires, or heads of state. They love their jobs.
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> "While some ems work in robotic bodies [with

faster-running ems using proportionately smaller bodies so that some could be gnat-sized or smaller] most work and play in virtual reality. These virtual realities are of spectacular quality, with no intense hunger, cold, heat, grime, physical illness, or pain; ems never need to clean, eat, take medicine, or have sex, although they may choose to do these anyway[, exercising some of the many possible options in advanced virtual-reality settings].

"Whether robotic or virtual, ems think and feel like humans; their world looks and feels to them much as ours looks and feels to us. Just as humans do, ems remember a past, are aware of a present, and anticipate a future. Ems can be happy, sad, eager or tired, fearful or hopeful, proud or shamed, creative or derivative, compassionate or cold. Ems can learn, and have friends, lovers, bosses, and colleagues. Although em psychological features may differ from the human average, almost all are near the range of human variation.

"On the upside, most ems have office jobs, work and play in spectacular-quality virtual realities, and can live for as long as does the em civilization. On the downside, em wages are so low that most ems can barely afford to exist while working hard half or more of their waking hours. Wages don't vary much; blue- and white-collar jobs pay the same."

An em city would be "tall," "hot," and "densely packed," with its volume "about equally split between racks of computer hardware and pipes for cooling and transport." Cooling pipes would "pull in rivers of iced water," and city heat would push "winds of hot air into tall clouds overhead." In short, it would be a rather alien setting for a traveler today, though perhaps delightful enough if one could upload into the virtual reality it sustained.

All this cannot exist, however, "unless someone pays for supports such as computer hardware, energy and cooling, real estate, structural support, and communication lines. Someone must work to enable these things."

Well, conditioned as we are to believe that "everything has a cost," this may sound reasonable enough, particularly if there are "many billions (and perhaps trillions) of ems" as the author predicts. This vast population it appears would spring up rapidly. "The em economy might double roughly every month or so, or even faster, a growth driven less by innovation, and more by em population growth."

Reproduction is very easy and fast for ems, as in copying computer software today. (Human-like sex would, of course, be left far behind, though a psychological imitation of it might persist as a form of recreation.) A copy em would be a faithful, essentially exact replica of their (single) parent, who could now begin to live a separate life but would share memories of earlier times. A copy would, of course, immediately possess whatever knowledge, skills, or dispositions its parent had, no need for the slow and uncertain process of maturation from infancy. Such copying would presumably happen very often and could run to many generations, given the anticipated population growth. This, the author speculates, would lead to different attitudes about death:

> "Compared with humans, ems fear much less the death of the particular copy that they now are. Ems instead fear 'mind theft,' that is, the theft of a copy of their mental state. Such a theft is both a threat to the economic order, and a plausible route to destitution or torture. While some ems offer themselves as open source and free to copy, most ems work hard to prevent mind theft. …"

In keeping with the anticipated reduced emphasis on individual survival, em "spurs" may be created which are copies of an em which do certain tasks and then might be erased. There will be many ems that are near copies of each other and the loss of some will amount to losing relatively little in terms of the personal experiences of the whole.

Expendable em spurs would have certain uses. Suppose Mr. Jones says to you that a certain action would be one you would choose if you had access to certain information he has, but this information in turn is highly confidential and you are not on the list of people he can share it with. So you create an expendable spur of yourself which is given the information and reports to you, but only whether he thinks the proposed action is worth taking, nothing more, then is erased. You make your decision as if you had the confidential information even though you don't. Various safeguards would be in place to ensure both that your spur is not coerced in some way in making his judgment, and also, that he is really erased afterward, which really amounts (overlooking some philosophical issues) to just erasing a very short interval of your experience.

So, we have briefly considered the world of em – the interested reader is, of course, invited to peruse the book for the many further details it offers. We now consider an alternative.

## THE AGE OF EMP

As noted, Dr. Hanson himself realizes his vision of the future is troubling and says so. Near the end of the book there is a report on a 2013 survey in which people evaluated possible futures in 2050:

> "… [M]ost people surveyed cared little about the future of population, pleasure, wealth, poverty, freedom, suicide, terrorism, crime, … homelessness, disease, skills, laziness, or progress in science and technology. They cared a bit more about future self-discipline, humility, respect for tradition, equality, meaning in life, and protection of the environment. But mostly people cared about future benevolence: how honest, sincere, warm, caring, and friendly future people would be."[12]

It might be argued that if people are "honest, sincere, warm, caring, and friendly" enough, most or all of the other issues will be well-addressed and not be particularly serious problems; these other problems will take care of themselves. And people, of course, would like to think that will happen in the future. In short, people want an Age of Emp – Empathy, not something else. What about the Age of Em? That in turn seems in many ways like a scaled-up version of the world today, in which there is scarcity and people work for basic sustenance. Ems may overall enjoy the work they do much more than the average laborer today, and then there's the option of retirement. But the population is vast, workers are "strongly selected for productivity," some ems are erased (always willingly, and always justifiably?) and it's not clear if there is any overall purpose or meaning to life that the individual can feel comfortable with, beyond simple enjoyments or "leisure."

There's a saying, whose source I've been unable to trace, to the effect that whatever people want badly enough that is not contrary to physics is going to happen. The quote about wanting future benevolence suggests that something like our proposed Age of Emp is in that class. (At least I think it will be agreed that it is not "contrary to physics," plus people do seem to want it seriously.) Anyway, I've singled out two important prospects that should have a bearing on such an outcome, the widespread use of solar energy, and, most important of all, radical life extension. Let's consider each of these in turn.

The power output of the sun, which is the principal source of energy in the solar system, is about 3.86 x $10^{14}$ TW (terawatts; 1 terawatt = 1 trillion or $10^{12}$ watts; 1 watt = 1 joule of energy being output per second. So the sun pours out energy at about the rate that several trillion trillion 100-watt light bulbs would do.)[13] Most of the sun's output is, of course, presently lost to space. But even with the relatively tiny fraction of solar output that reaches the earth, it is estimated that, with the best of currently available technologies (solar voltaic cells with efficiency optimization) something like 7,500 TW could be collected, to compare with the present world power consumption of around 15 TW.[14] So there should be roughly 500 times as much power available as is currently being used by human civilization, if we confine our activities to planet Earth, with a further, far greater amount accessible with solar-orbiting space habitats.

*Ancient Egyptians recognized the sun as the giver and sustainer of life.*

On the other hand, we live in a time when much human labor has been automated with prospects for much more (self-driving cars, expert machine-language translation, and so on). With proper management of resources, I think society could have a universal basic income for all citizens based on solar energy. People, on the other hand, would have work to do – otherwise life would become empty and meaningless – but would have options to choose more enjoyable work in the first place, plus adapt their basic drives to whatever sorts of activities seemed best. Work would not feel like "work" as we know it. It would be enjoyable and worth doing for its own sake. Overall, then, life would be filled with meaningful, engaging activities that were fully worth pursuing "for fun" alone yet managed to accomplish whatever was needed in sustaining and advancing civilization. The sorts of things we now consider drudgery might largely be eliminated through automation. However, if some tedious task-work did persist, there could be appropriately adjusted people doing it who considered it a joy in its own right.

A powerful parallel to the idea of work being a pastime is seen today in the raising of families, a rather arduous task, which people willingly undertake without pay. This is based on a mechanism put haphazardly in place by natural selection. Other such mechanisms might, with due care, be engineered through intelligent efforts and adopted willingly by individuals through participation in some gradual process of education and enlightenment, technologically assisted. From our vantage point today it's hard to say what sorts of "natural drives" people could acquire over the course of subjective centuries, but certainly the possibilities seem real, if we can get beyond an initial barrier.

What is this barrier? Mainly, our limited lifespan, which brings us to the other of the two important prospects that ought to figure in an Age of Emp. Radical life extension (RLE), and mainly, rescue from aging, are the most important benefits to be expected from the advance of civilization. We in cryonics, of course, have strong hopes it will be achieved and that cryopreserved individuals will awaken in such a world, with aging and diseases banished and horizons opened for a life beyond present limits. (Indeed, a form of RLE would be possible with brain emulation; an em of someone who lately inhabited a meat body but then died would, in effect, be a continuer of that individual who is immune to biological debilitation.)

Once we achieve RLE, many other possibilities will open up for each and every individual. There should be much concern about the well-being of each individual – it would only be natural in a world of abundance with lifespans vastly increased. People individually would want to survive indefinitely and, among many other things, not suffer the privations and dangers that a population glut might impose. We would want to maintain our status as happy individuals who did what we wanted pretty much all the time, and it all worked out and we didn't have to worry about things like supporting ourselves, or even where our society as a whole was heading. I don't see a particular reason why this would be impossible, and indeed it seems quite feasible, given, on one hand, superabundant energy, and on the other, prospects for personal enhancement after RLE.

So what sort of things would emps – the people of that era – be involved in? One would hope that benevolent, charitable work in some form or other would be popular. Life need not become boring or stagnate just because basic needs were met without what we today would call "labor." Instead one's "labor" would become a "labor of love" which could take many forms. There might be much work to be done in studying the very problem of how to make life meaningful as well as more enduring and, more generally, what is it that ought to be and how should one best act to bring it about. I could also imagine a proliferation of habitats in space. Orbiting platforms powered by sunlight might make ideal virtual reality centers where ems, after all, could find a home. So you would actually have an "Age of Em" but on rather different terms than envisioned in the book, with needs met by the influx of solar energy and work devoted to whatever higher things the enlightened inhabitants deemed suitable. Along with the labor, not for sustenance but a real labor of love, would be plenty of time off for simpler enjoyments: interactions with others at less technical levels, communications with other habitats including planet Earth, and the like.

How can we be sure the inhabitants would indeed be enlightened and always work for good and worthy causes in a true labor of love? Certainly it's easy to imagine the contrary. One rogue group could proliferate itself, making copies of its orbiting platform which would then make further copies exponentially so that quickly the available resources would be mostly taken and we would be back to a world of scarcity and maybe a "strong selection process" for the "fittest" individuals. I would say that, while this cannot be ruled out, I think such behavior would be unlikely to get very far and safeguards could be in place to intercept any that did get started. This in turn would be another problem for advanced benevolent beings to occupy at least some of their time with. (Keeping a special watch early on, when ems had not yet been achieved but seemed a near-term possibility, might be especially important, and might be handled by governments or groups of concerned citizens.)

Near the end of his book Dr. Hanson compares his em world to what might happen if the em world does not develop. The world of em might be better able to deal with large-scale threats such as earthquakes, asteroids or volcanoes. It might also be better able to deal with rogue AIs because it would be hard to kill off all the em enclaves, which could be densely packed with information though quite small physically, and could be capable of restarting civilization after its near-destruction.[15] The em world is supposed to come into existence over a period of only a few years, due to mushrooming population and a fiercely competitive work environment, some of which would presumably be hard-focused on the disaster problem. An Emp world would be expected to develop more slowly but still, I think, fairly rapidly, and it would be well-guided. So maybe after a century or two, not long on a geological or cosmic scale, it also would be up to the same levels of disaster-readiness.

As one other possibility, it is often thought that, however great the future may turn out for those fortunate enough to be alive at that time, there is no prospect for benefit for those who don't survive. You can't undo thermodynamics, as far as we know, which appears to imply that the dead (not cryonics patients, but really dead, those whose information is lost) must stay dead forever. "Oh yeah?" I would hope the advanced enlightened ones will say (even as some have said already[16]), and this could furnish a substantial work project, particularly if a workaround is found and past individuals are recreated, or otherwise made functional again. If so, then civilization would gain a profound motive to continue, inasmuch as the individual – any individual who was ever alive – could be seen and treated as something supremely important, unendingly.

As for a more distant future, given that the resources of the sun and our solar system are finite, well, there is a big universe out there almost "just waiting" for us when we need it. (At least we haven't seen other generally accepted signs of civilization or life besides our own.) If we encounter other civilizations in our Age of Emp, maybe they too will be in their own Age of Emp and we can expect friendly and mutually beneficial contacts. And some day, the finite size of the whole visible universe may start to press down on us all, but that day seems a long ways away, and we should have lots of time to work on *that* problem, even if some today would say it is ultimately intractable. People have said that sort of thing before, and not always but at least often have been proved wrong.

## SOME FINAL THOUGHTS.

Near the end of the book is a section where some of the more common criticisms of the author's scenario are noted.[17] Some simply said, "who cares?" since they imagined that neither they, nor their children or grandchildren would be around to see the envisioned future. Others doubted that one could predict technological advances decades or more hence with any useful degree of accuracy. This could particularly apply if beings substantially more intelligent than present-day humans came into existence. What could we understand in advance about their world? On the other hand, if we could assume certain basic features, such as that they would be kind-hearted, then some useful insight might be possible. We could hope then that, at minimum, they would be sympathetic to the "Age of Emp" idea and try to develop it themselves using their superior wisdom, in particular treating with kindness any of us who survived to their coming (through cryonics for example).

Doubts were expressed that a human brain emulation is the shortest route to human-level AI. Many apparently expected that a traditional approach using hand-coded software would be the most likely pathway, which the author strongly doubts, feeling that centuries would be required. Others felt that another approach, now being pioneered by such methods as deep learning, in which better machine code is not produced by hand but automatically as part of a computerized learning process, would be the fastest route. (The author was skeptical; I for one think this approach may well be the one that succeeds.) In any case it does not seem obvious to me that brain emulation will prove to be the fastest track to the desired human equivalence.

Still, it seems plausible that brain emulation will eventually be achieved. Mapping a human brain to such a level that an emulation from that data would be possible, would furnish a useful backup in case of damage or loss of the original, but would also invite the problem the author noted, of mind theft by the unscrupulous. In a future world of Emp, however, we may hope this sort of problem will be rare, the vast majority having much better, more rewarding and more enlightened things to do.

To close on a more personal note: I was fortunate in being able to attend the recent conference of the Mormon Transhumanist Association (Salt Lake City, UT, April 8, 2017) where Dr. Hanson talked about his book as one of two keynote speakers. In the questions afterward I and one other person raised the possibility of something like a universal basic income based on an abundant supply of energy (in this case solar). Dr. Hanson said that it would be necessary to put tight curbs on population growth to achieve this, and apparently considered this less likely than his high-population scenario. But again, I think that with the impact of RLE coupled with what appears to be a coming superabundance of renewable energy and other goods and services made accessible through automation, the situation will develop differently. Whatever happens is sure to be interesting, but I think also highly rewarding. ■


*Dr. Hanson presents his book's ideas to the Mormon Transhumanist Association, April 8, 2017.*

## IMAGE CREDITS

Photo of Robin Hanson is from author's personal collection.

Ancient sun image shows Pharaoh Akhenaton, wife Nefertiti and three daughters, 1353-1335 B.C.E., widely available online, for example, at http://aparthistory2015.blogspot.com/2015/10/akhenatonnefertitiand-three-daughters.html, accessed 29 Apr. 2017.

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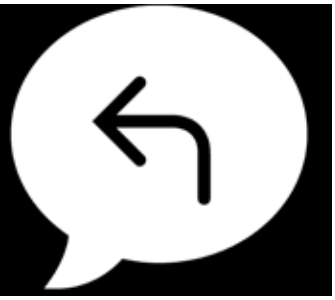
# RESPONSE BY ROBIN HANSON



In *The Age of Em*, I note that once ems are feasible, their population can grow as fast as new computer hardware can be built to house them, and competitive pressures push for new hardware to be built fast. Since new hardware can be built faster than the economy can grow, this makes the ratio of em population to economic production fall to near its feasible minimum, where wages are near subsistence.

Many don't like this outcome, but I warn that avoiding it requires coordination to strongly enforce global regulations limiting maximum populations or minimum wages. Our capacities for such global governance have long seemed too weak to achieve this, and they are improving only slowly. So it seems reasonable to guess that we won't have sufficiently strong global regulations to prevent low em wages.

Michael Perry argues that ems can limit their population if only they have enough empathy, which can arise from solar energy and long lifespans:

> I .. propose .. an alternative, an Age of Emp ("Empathy"). .. One major feature .. seems lacking in Hanson's scenario: nobody seems much concerned about people in general – everybody just "does their own thing," tending to local interests but lacking an overall concern for people and their well- being. (Along with this comes a lack of concern for where the whole enterprise is heading, what its overall point or purpose is, if it has any.) .. With a smaller population base .. emphasis would shift toward long-term goals and rewards, with benevolent acts and projects. ..
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> The Emp future will, I think, be made plausible by one feature I expect to become especially important: solar energy. .. There should be roughly 500 times as much power available as is currently being used by human civilization, [even] if we confined our activities to planet Earth. .. Society could have a universal basic income for all citizens based on solar energy. ..
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> Concern about the well-being of each individual .. would only be natural in a world of abundance with lifespans vastly increased. People individually would want to .. not suffer the privations and dangers that a population glut might impose. .. The vast population growth that Dr. Hanson envisions would likely have to be curbed but .. people would simply conclude .. that such [fertility] restraint was in their own interest and act or react accordingly. ..
>
> One rogue group could proliferate itself, making copies .. exponentially so that quickly [that] .. we would be back to a world of scarcity. .. I think such behavior would be unlikely to get very far and safeguards could be in place to intercept any that did get started. This in turn would be another problem for advanced benevolent beings to occupy at least some of their time with. (Keeping a special watch early on, when ems had not yet been achieved but seemed a near-term possibility, might be especially important, and might be handled by governments or groups of concerned citizens.)

The argument seems to be that rich long-lived creatures naturally have low fertility, high altruism, and easy coordination. If so, there can be an equilibrium where the em population is low, wages are high, few ever try to make copies, and weak governments and informal social sanctions are sufficient to police the rare deviants.

***"The feasibility of a basic income mainly depends on average per-capita income; the source of that income doesn't matter."***

The point about the great solar energy available seems mostly irrelevant. The feasibility of a basic income mainly depends on average per-capita income; the source of that income doesn't matter. For hundreds of thousands of years it has already been true that humans could all be rich if they sufficiently limited their population. And

in fact, human hunter-gatherers did tend to limit their local fertility, holding wages above subsistence. This was apparently the best way to deal with infrequent but important periods of severe stress, like famines or plagues.

*"I find it hard to believe that we will become far more altruistic and coordinate much better if only we get even richer and live longer than today. I think we've seen what rich long-lived humans are like; they are like us."*

But this only required coordination within a band of roughly thirty foragers, and at most it increased wages to a factor of two or three above subsistence. After the rise of farming, we have seen many times and places where most everyone was temporarily rich. Such places almost always failed to coordinate locally; local populations increased until median wages fell to near subsistence. They didn't last long enough to see if more global coordination could be managed, to let it last on longer time scales. Pretty much all animal species also have populations so high that they have to work most of the time to survive.

In the last few hundred years, humanity has grown its economy faster than it has increased its numbers, resulting in high wages. That and technical advances have also given us long lives. And the fact that it takes so much time to raise kids, plus our desire for high status kids, has reduced our fertility, though we'd still have increasing wages even if we had very high fertility.

But our recently increasing high wages and low fertility have mostly not resulted from altruism or coordination; they've been a side effect of our other priorities. We show little altruism toward distant poor others in the world; we neither send them much aid, nor do we let them benefit us by coming to live near us. We can also identify many important ways that the world suffers great losses because it fails to coordinate at large scales.

And yet we today are quite rich and long-lived compared to those "rich" foragers who coordinated in small bands to raise their wages above subsistence. I find it hard to believe that we will become far more altruistic and coordinate much better if only we get even richer and live longer than today. I think we've seen what rich long-lived humans are like; they are like us. If we coordinate better today than in the past, I attribute that mostly to our better social technologies.

Imagine an ambitious em business person, Sue, in an industry were most costs are wages. Assume the going wage is $100,000 per subjective year, but that the em hardware cost is only $1,000 per subjective year. Here Sue could lower their business costs by a factor of one hundred merely by making many copies of Sue. For the cost of hiring ten em workers, for example, Sue could create 10,000 copies of Sue. All of these copies start out immediately as fully trained and ready for work.

*"The fact that many people say they want something most certainly is insufficient to ensure that it will actually happen."*

This offers a huge profit, and thus an overwhelming temptation for most all businesses in the em economy. It isn't some rare quirky behavior to be easily suppressed via informal social sanctions. It requires strong and global regulation, stronger than what it would take today to prevent the sale of illegal drugs (where we now mostly fail). Knowing this may well motivate you to work to create stronger global coordination. Just know that it has costs, and may fail.

Most who talk about the future actually use it mainly as a way to talk indirectly about the world around them. And people especially like to talk indirectly about their values. So we usually talk about the future we wish we'd see, or that we would create if we were king of the world, without paying much attention to what futures are actually feasible. But if you actually care about the real future, you must attend carefully to its real constraints. Wishes aren't horses. The fact that many people say they want something most certainly is insufficient to ensure that it will actually happen. ■

# Physician-Assisted Death Comes to Canada

by Christine Gaspar, RN

## INTRODUCTION

The advent of legalized, physician-assisted death has offered a new choice for many people who wish to be cryopreserved. Long has the need existed for a way to protect one's identity from brain-wasting, life-threatening disease. Alzheimer's disease, Parkinson's disease, vascular dementia, and brain cancer – to name a few – are maladies which can destroy memory, cognitive function, and other features that make you "you."

A second advantage of having legal access to physician-assisted death is that one can plan, in many cases, their own standby, and stabilization. It can be argued that the single greatest challenge to having a good cryopreservation is ensuring that resources are in place when an emergency occurs. This level of preparedness is critical to the patient receiving immediate, effective mitigation of warm and cold ischemia.

Variations on the forms of assisted death and their legal consequences are available in a growing number of regions around the world. It is this variation which can be difficult to sort through, especially when one is already under the enormous stress of dealing with life threatening, or terminal illness. Canada passed laws permitting *Medical Assistance in Dying* (MAiD) in 2016. In doing so, Canada joined a small but growing number of countries who see MAiD-type laws as humane, and respectful of one's right to liberty and self-determination.

## A THEORY OF MIND

"The term mind is highly subjective, but can be referred to as consciousness plus: autobiographical memory, personal identity, sense of personal agency (voluntary control over actions), accurate introspection, and ability to control one's thoughts."[1] What property of the brain generates mind is still a puzzle. It stands to reason that cryopreserving (especially one's brain) as completely as possible is of paramount importance if one is to safeguard what is essential to determine that identity.

## AN EARLY CRYONICS-SPECIFIC LOSS

Thomas K. Donaldson, Ph.D. was a mathematician and a prominent figure in the cryonics community. He was diagnosed with a grade II astrocytoma, which is a type of brain cancer, in 1988. He wanted the right to become cryopreserved before his cancer had a chance to claim his memories and personal identity. In *Donaldson v. Van De Kamp* (1992)[2] he fought the state of California for "the declaration of a constitutional right to premortem cryonic suspension of his body and the assistance of others in achieving that state."[3] He failed to convince the court of his position. In January of 2006 he experienced terminal arrest++ and was cryopreserved by Alcor in the manner which was standard at the time, which was after his legal pronouncement.[4]

## CANADIAN STORY

*Assisted suicide* and *euthanasia* are not the same acts. Assisted suicide is the provision of an agent, instruction, or substance to another, whose intention is to enable the other with the means to end their own life. Euthanasia, on the other hand, involves performing an action or withdrawing life-saving treatment which directly causes death with the intention of ending suffering. This is undertaken with or without consent, and in the example of when it is without consent, this can be involuntary or non-voluntary. If consent is involuntary, then the (competent) patient did not provide consent; if it is non-voluntary, then the patient was not competent, and could not provide consent.[5]

Up until 2016, assisted suicide was illegal in Canada. In 2015, after decades of legal challenges, the Supreme Court of Canada decided unanimously to allow physician-assisted suicide. In June of 2016, the federal government passed the *Medical Assistance in Dying* (MAiD) legislation, which established the eligibility criteria and procedural safeguards for medically assisted suicide.[5]

There are currently two possible options for how one receives medical assistance in dying. Either the physician or nurse practitioner administers the substance which causes death, or the means is provided to the patient in order to be self-administered. Both options are now legally available in Canada.

Several landmark cases influenced thinking in the development of this law. In *R. v. Latimer (1994)*,[6] Robert Latimer, was charged with first-degree murder in the asphyxiation of his severely disabled daughter. She experienced constant, extraordinary pain and was facing a future that was without hope of relief. The Crown (*R.*) found him guilty of second-degree murder.

In *Rodriguez v. British Columbia (Attorney General)* (1993),7 Sue Rodriguez, who had amyotrophic lateral sclerosis (ALS), wanted the legal right to physician-assisted suicide. After losing her pleading at both the Supreme Court of British Columbia and the British Columbia Court of Appeals, Ms. Rodriguez petitioned her case to the Supreme Court of Canada.[5, 7]

On September 30, 1993, a 5–4 majority

of Supreme Court Justices affirmed that the provision was constitutional and did not violate the *Canadian Charter of Rights and Freedoms* (The Canadian Constitution). The decision conformed to the principle of fundamental justice based on the idea that assisted suicide was intrinsically blameworthy on moral and legal planes, and could lead to abuses. However, the four judges who were in the opposing camp argued that the prohibition of assisted suicide was arbitrary. In effect, a physically abled person could commit suicide (which was not a criminal act) while a physically disabled person would be committing a crime by asking for help in performing the same action. This distinction was contrary to the principles of fundamental justice.[5, 7]

Rodriguez committed suicide in February of 1994, assisted by an anonymous doctor, in the presence of a Minister of Parliament who had supported her cause.[5]

In 2011, the British Columbia Civil Liberties Association (BCCLA) filed a lawsuit challenging the law against assisted suicide. They argued that the prohibition violated the *Canadian Charter of Rights and Freedoms*. The case was conducted on behalf of the family of Kay Carter, who had suffered from degenerative spinal stenosis, and Gloria Taylor, who had suffered from ALS. Carter died in 2010 and Taylor in 2012. In June 2012, the Supreme Court of British Columbia ruled for the plaintiffs. The federal government opposed by appealing the ruling and the Court of Appeals for British Columbia reversed the decision in October 2013. The case was then presented to the Supreme Court of Canada by the plaintiffs.[5]

By the time *Carter v. Canada*[8] came before the Supreme Court of Canada in 2014, public sentiment had shifted significantly, compared to when the *Rodriguez v. British Columbia* decision was made. In 1993, assisted suicide was illegal in all countries except Switzerland. By 2014, assisted suicide was legal in the Netherlands, Belgium, Luxembourg, and the American states of Oregon, Washington, and Vermont under certain circumstances.[5]

Quebec became the first Canadian province to legalize *Medical Aid in Dying*, or *Bill-52* in a 94-22 vote on June 5, 2014. Their law permits physicians to prescribe and administer a substance that will cause the death of their patient. The bill avoided characterizing the act as euthanasia, but instead described it as "the act of hastening death as a medical service."[9] At the time, Canada had not yet passed a national law, so the Criminal Code of Canada still defined euthanasia as culpable homicide.

The Supreme Court of Canada unanimously passed physician-assisted suicide legislation by a 9-0 vote on February 6, 2015. The provision was that it could be carried out by a "competent adult who (1) consents to the termination of their life and (2) has a grievous and irremediable medical condition which causes intolerable, enduring suffering in the circumstances of his or her condition".[5]

Incidentally, Jason Gratl, who was the lawyer who represented the plaintiffs in *Carter v. Canada (Attorney General)*[7] and Robert Latimer[10] in his parole hearings, was the same lawyer who represented The Lifespan Society of British Columbia in their bid to overturn the controversial anti-cryonics law at the Supreme Court of British Columbia.[11]

## ELIGIBILITY CRITERIA[12]

The following criteria, as outlined in the legislation, must be met to benefit from Medical Assistance in Dying (MAiD) laws:

1. Federal, provincial or territorial eligibility for health services. Visitors to Canada are not eligible, and medical tourism, in this case, is discouraged.
2. Of age (18 years) and mental competence capable of making independent health decisions at the time immediately prior to MAiD being provided.
3. Have a grievous and irremediable medical condition. This is defined as:
   a) A serious illness, disease, or disability
   b) In an irreversible, advanced state of decline
   c) A subjective experience of unbearable physical or mental suffering from this condition, disability or state of decline which cannot be relieved under conditions acceptable to the individual.
   d) At a stage where the individual's natural death has become reasonably foreseeable, taking into account all medical circumstances. It does not require a precise prognosis of time left to live.

* The individual does not need to have a fatal or terminal condition to be eligible for MAiD. The request for MAiD must be assessed by two independent physicians or nurse practitioners, and there must be a ten-day "reflection period" after the request is authorized before service can be provided. An exception to this waiting period can be made if both practitioners agree that the individual's death is fast approaching and that the individual may soon lose the capacity to provide informed consent.[12]

## RISK OF AUTOPSY

On April 27, 2017, I placed a call to the Office of the Chief Coroner of Ontario. I spoke with one of the nurse investigators there about Ontario's MAiD laws, and the role of the Medical Examiner in such cases. In Ontario, any individual who has received Medical Assistance in Dying automatically becomes a Coroner's Case. I sought to determine if that meant that every patient who was legally dead as a result of this legislation would automatically receive an autopsy.

Although asked, she did not specify her name. Upon investigation, it was evident that there were only two nurse investigators in that office.

She confirmed that at this time, every patient who has legally died as a result of MAiD would be referred to her office. I explained that I was enquiring because I had concerns that cryonicists might opt for MAiD, thinking that this would improve their chances of having a timely standby and stabilization, when in fact, this would automatically flag them for an autopsy. Having an autopsy is so destructive to brain tissue that a cryonicist ought to do everything legally possible to avoid one.

She did, however, state that an autopsy would only be performed if it was in the public interest, in the same frequency that it is done now. The Office of the Chief Coroner of Ontario would endeavor to abide by the patient's and family's wishes as much as possible, so long as it did not place the public at risk.

The facts that this legislation is new, and that its application in a cryonics framework is untested should be cause for concern among cryonicists. Speaking with the Office of the Chief Coroner in the

applicable province ahead of time about one's plans for cryopreservation would be a prudent measure to help safeguard against any surprises.

## DISCUSSION

++ I coined the phrases *terminal arrest* and *terminal injury* to describe the state of the cryonicist bound for long term storage. In keeping with the *cryo-medical* philosophy of Alcor, the patient would be in a transitionary state, rather than biologically dead. Existing words seem awkward and don't describe the uncertainty or the hope of this undertaking well enough. *Terminal* describes the lethality of the situation, and yet affirms that this is still a critically ill patient, in my view. *Terminal injury* was added to characterize the state a patient would be in if they had committed suicide, and then had been cryopreserved. Typically, to speak regarding the commission of suicide, it is implied that the act was successful.

Another reason why I find those terms appropriate, is because from the beginning of the dying process, to pronouncement, then to the dewar via standby, stabilization, washout, perfusion, surgery and cooling, the patient is emergently, critically ill. In cases where this is a relatively slow progression, they are often managed palliatively, but this does not diminish their plight. I have managed patients who were post-cardiac arrest, or for one of a thousand reasons, so critically ill that there was absolutely no room for error.

Many of us do not know, or perhaps do not appreciate the enormity of the task of capturing a mind like a ship in a bottle. Any measure that offers the chance of improving patient outcomes is an enormous step forward. The most advanced cryonics technology is of little benefit if an unexpected death leaves one in the hands of disinterested or ignorant health care providers who care not a whit about one's *fringe scientific interests*.

Death is often difficult to predict, and the science of cryonics is still in its infancy. Add to that, diseases such as Alzheimer's, Dementia with Lewy Bodies, Parkinson's or brain cancer, and the hope for saving life remains a complex challenge.

Accepting the fact that there are so many variables which can complicate a cryopreservation, from the complex to the seemingly trivial, it would seem that MAiD would be an extremely important element of one's critical illness planning. What remains equally important, though, is a thorough understanding of the evolving laws surrounding MAiD, to avoid any catastrophic surprises.

Since the inception of cryonics, many people have had little alternative but to watch as brain-wasting disease and lengthy multi-organ failure threaten the very essence of what needs saving – the individual mind. Under the best of circumstances, methods of cryopreserving a person with sufficient fidelity to capture their consciousness are still rudimentary, inconsistent and unproven. The introduction of MAiD legislation and its accompanying tolerance for alternative end-of-life choices is a promising step towards increased acceptance of cryonics among the mainstream medical community. It remains to be seen if it will prove to be a viable solution to many of the barriers to the delivery of quality cryonic preservation. ■

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# Why We Should Strive for Immortality

By Oliver Nahm

According to the Bible human lifespans should not exceed 120 years. Even today almost nobody reaches this – well – biblical age; it seems to have been well chosen. In fact only one known person, Jeanne Calment, 1875-1997, managed to breach the barrier, reaching age 122. Yet in the Bible we also read stories such as that of Enoch, who allegedly survived to the ripe old age of 365 years, and his son Methuselah, who managed to live all the way to 969.True, this is legendary (most scholars would agree), but what if we too could live as long as Methuselah, that is, become essentially immortal?

The question will certainly become more important during the coming decades. Even now it is possible to prolong the healthy life of mice up to 35%. And just last year clinical studies commenced for metformin, a diabetic medication, which seems also to have the benefit of drastically reducing many age-related sicknesses.

Indeed, the goal of prolonging life is closely intertwined with that of exterminating sickness; it's not hard to see why. Living very long but always getting sick would hardly be the most fun we could have. Second, the aging process is an important factor for the occurrence of many diseases. Prevention is a better strategy than therapy, so the elimination of aging should be one of the main goals of our medical apparatus. So the prolongation of life will most likely involve prevention of aging and thus lead to radical life extension.

And how would humans even look whose lives extend to 80, 100, or 120 years in perfect health? This should alleviate one of the main concerns people have when it comes to immortality, as of course we are talking about prolonged life in good health. In the western world we have experienced a significant increase in life expectancy during the last decades. A 60 year old in the US could expect to live for another 14.8 years in 1901, and 23 years in 2009. But this additional time is seldom associated with good health. Indeed, sometimes it appears that our modern medical system mostly prolongs the period of suffering. Would we want an additional 100 years in the hospital? What a dreary prospect! (It still might be preferable to oblivion however.) But I doubt there'd be much objection to that same period of time, if it could be spent in vibrant good health.

But is it ethical to strive for a prolonged, potentially even infinite life? Is it not egotistical if I never want to look death in the eye, ignoring the societal wellbeing? To answer this question, consider an argument made by biomedical gerontologist Aubrey de Grey (slightly modified): "I do not want to develop Alzheimer's disease and do not want anybody else to be stricken with it. I also do not want anybody to develop cancer or suffer a stroke or anything similar … I also do not want anybody to die, if he does not want to." These wishes are shared by most people. So the individual wish becomes a societal good, and, in short, there is no real dichotomy between the individual and society.

Besides the humanistic considerations, there are other reasons for defeating the aging process. One is economic. Western societies especially suffer from an extreme superannuation of their populations. In Japan a quarter of the population is 65 or older. This leads to significant economic problems which could be counteracted by stopping the aging process. Additionally, the costs of healthcare could be lowered immensely, since there would be less research required into age-related sicknesses whose cost increases dramatically with age. Then too, not only on a humanistic level but also from an economic perspective, the yearly loss of knowledge and experience is nothing short of catastrophic.

All people should have the chance to unlock their full potential. This is the educational mandate that so many great thinkers have given us. From Meister Eckert to Comenius, Humboldt and Goethe we always find the same fundamental goal. Goethe says it this way: "*the cultivation of my individual self, here as I am has … been … my wish and my purpose.*"

How many people wish, at one point or another, to have chosen a different path – but it simply is too late for a new apprenticeship, a new major, a new venture? A prolonged lifespan would afford them the time to fulfill their dreams, to become the best version of themselves they can. This would certainly be worthwhile on a personal, as well as on an economic level. Maybe some would even gain greater respect for their own life. Maybe people would be less willing to sacrifice their existence for an ideology, considering that the price would be eternity.

Currently 150,000 people die each day. It is a humanitarian catastrophe of inconceivable proportions, and we have just gotten used to it.

Of course, there are additional complications that eternal life might bring. Are we ready to deal with immortal dictators, work for centuries, face the threat of overpopulation, or struggle with societal stagnation? I personally believe that none of these issues is persuasive as a reason *not* to go on living. The fact that work is seen as something negative by many people is itself a problem which should be solved independently of the duration of human lifespans. Of course, nobody wants to work a 40 hour job he hates. But in general

people strive to be productive members of society and are willing to work for it. So, it should be our goal to create jobs which do not contribute to the slow destruction of the (motivation of the) workers, no matter if one stays in that job for 10, 40 or 100 years.

Let's turn now to the overpopulation problem. There is one huge misconception about this that seems to be quite common. When people think about population development they automatically assume that we are talking about exponential growth. Indeed, if I and a partner have 4 children (2 children per capita) and each of them go on to have 2 children per capita, and so on through generations, you certainly get exponential growth and things go south fast. With only two children per couple (one per capita), however, there would be only linear, not exponential growth with time, even if nobody died. It is worth noting that countries with higher life expectancies tend to produce fewer children per capita, so there is reason to think that exponential growth will be curbed as people sense that individually they can look forward to very long lives. Another point to raise is that overpopulation is a very relative term. I did the calculations and it turns out that if people in Germany stopped dying for 100 years, assuming current population growth rates continued during all this time, only then would the country reach the present population density of the Netherlands.

Then there is the problem of societal stagnation. In fact I believe it is not a problem at all. First, I do not think that all new ideas are superior to older ones. Any that are will prevail, even if the people who supported the old ones don't die out. To turn to Germany once more, 84% of the people over 50 accept homosexuality, even though many of them were raised with very different ideals. Of course, it may be that social development slows down to some extent but is this really a bad thing? Shouldn't we strive for quality, not quantity?

Scientific development, at any rate, is not in danger of slowing down due to the age of the scientists. As a study of *Science* magazine shows, age is not a significant factor in determining when scientists produce their best results. In fact, they may write their magnum opus during any point of their career. But what about dictators? Well, they don't tend to die of natural causes anyway. Of course, maybe we will simply get bored after the first couple of centuries. Here, though, there is an obvious response. To quote Brian Kennedy (altered slightly): "if I had the choice between cancer at 75, Alzheimer's at 80, and being dead at 85; or still being much alive at 150, only bored, I know what I would choose." ■

## ABOUT THE AUTHOR

*Oliver Nahm, born 1984 in Bonn, Germany, has been an Alcor member for 5 years. Although he has always been interested in the study of death it was his brother, Torsten Nahm, who sparked his interest in cryonics. He holds a Magister degree in history and has recently completed his doctorate in the field of cultural studies. His thesis is titled: "Dealing with Death – A Search for Cross-Cultural and Time-Transcending Similarities" and will be available later this year.*

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# STEPHEN BRIDGE'S "GOODBYE" SPEECH AS PRESIDENT OF ALCOR

Given at the Alcor ACT (Advancing Cryonics Technology) Festival, February 1, 1997

Tomorrow we have tours of Alcor beginning at 9:00 a.m. Part of that tour is Alcor's Patient Care Room, where 33 people are frozen in liquid nitrogen in large stainless steel containers known as dewars. – d-e-w-a-r-s *[spelled aloud]* When you look at these dewars, think about the people like yourself who are in them.

Now look around this room. Most of us are here tonight because of other people in this room who convinced us that cryonics was an inevitable idea, or at least one which was so compelling that we could not avoid it.

Bob Ettinger, the first Cryonicist.

Saul Kent, part of cryonics for over 30 years now.

Fred and Linda Chamberlain, out there to around 28 years.

Mike Darwin, Carlos Mondragon, Dave Pizer, Paul Segall, and others.

How many people here have been doing something in cryonics – not watching, doing – for 20 years or more? That is, you became active in 1977 or earlier? *[show of hands]*

Other people will be part of this idea in the future because WE are here today.

This month I have been a cryonicist for 20 years. Organizationally, cryonics today looks much different than it did 20 years ago. Unfortunately, the technical areas have NOT shown 2 decades of progress. In some ways, this is still a pretty sorry state of affairs, because we still don't know whether what we are doing will work. If we don't do better in the next 20 years than we have in the past 20, cryonics simply will not exist when most of us need it.

What we can look back on in 2017 depends on the actions of the people in this room. Other people, too; but it starts here. We can hate and fight and insult each other – or we can grit our teeth a bit and learn from each other. We don't all have to like each other; we don't even have to completely trust each other. But we MUST keep our minds open and learn from each other. Personally, I see a lot of promising developments in cryonics that lead me to think that more will be accomplished in the next five years than in the past 20.

The one thing that has kept me going during the past four years is that I would rather be with people who are DOING something about the problem of death than with people who just watch. Some of the technical procedures different organizations use may be wrong; some policies may turn out to be misguided. But DOING something carries a lot of weight with me.

When I took my EMT course a decade ago, our instructor told us, "People die every day. If you don't help, they'll still die. If you DO help, they may die anyway. But some WON'T die, because you were there. That's worth it."

Even if we do everything we can to make cryonic preservation available and workable, some people who wanted to live will not be preserved. That has already happened to people like Steven Mandell, Gillian Cummings, and Rob Michels. That may well happen to others in this room tonight. It CERTAINLY will happen if just sitting in this room is all you do to advance this idea. Old or young, you're a factor in this.

Twenty-one years ago this month I met Mike Darwin at a science fiction club party. For months after that he would complain that if he just had a hundred dollars to spare, he could start an Indianapolis cryonics group. Finally, TWENTY years ago this month, I officially became a cryonicist when I handed Mike a check for $100.00 and said, "There, now shut up." He actually did for a few seconds. The silence was really startling. Then he gathered himself and said to me, "OK, Steve, now here's what WE have to do." Note the pronoun change.

Two thousand dollars of my money later, we had a cryonics group – The Institute for Advanced Biological Studies, Inc. (what a name; we were really young), which later merged with Alcor.

When I was a child, I often told people that I had the goals of living to be 100 years old and of "changing the world." I had no idea what that really meant as a child, but there you go. 5 years ago, when various people were urging me to present myself as a candidate for Alcor President, the key line that made me decide to run for the Board of Directors and to consider more than that was again something that Mike said. "Steve, you've always said that you wanted to change the world. Now here's the best opportunity you'll ever have."

Pretty powerful stuff – for me, anyway. And for the last four years I have cursed Mike for that line as often as I have thanked him. Probably more. So four years ago I became Alcor's President and gave the world a nudge. Inertia being what it is, the world failed to notice. So I nudged a lot. I'm certainly not the first person to do

this; and a lot of my predecessors and my co-nudgers in other cryonics groups have found that sometimes the world nudges back pretty hard.

But over the last four years I have noticed some differences. Alcor moved to Arizona; we're not in court all of time now; and the public at large seems more interested in and less fearful of this idea than a decade ago. It's nothing like what I envisioned and it's nowhere like where it should be. But maybe we'll look back in five years and see more effects from this period.

And my influence isn't over. As I move to Chairman of the Board, I will continue to affect Alcor policy and direction. I hope to keep the lines of communication open with the leaders of other cryonics organizations. We're going to need all of our brains and abilities to survive as groups and as individuals.

In this room are several former Alcor Presidents: Linda Chamberlain, Fred Chamberlain, Mike Darwin, and Carlos Mondragon. What Alcor is – and to some extent, what cryonics is – today is due to the efforts of these people who did not stand by and watch. In a few minutes, there will be one more former President, me, added to this list, and Alcor's second President, Fred Chamberlain, will also become its eighth. Fred has new directions for Alcor and I'm happy about that; because I think he understands what needs to be done. I have my own new directions in my life, and I'm very happy about that.

Thank you, Mike Darwin, after all, for giving me the chance to spend 20 years doing something. Thank you to Fred and Linda, Saul Kent, Dave Pizer, Carlos Mondragon, and all of the others who have contributed to my thoughts and efforts in this organization. Thank you, Alcor members, for your support during the last four years. And when you didn't support me, thank you for being so free with your advice – as if I could have stopped you. Thank you to all the people who have been DOING something.

To the rest of you – the newcomers or the long time watchers – Now here's what WE have to do: get signed up with a cryonics organization, donate to research, talk to your friends, mop the floors, help sell research ideas to your friends, give gift subscriptions to the magazine, even hand out tapes when we have those.

When you visit Alcor tomorrow and look at those big stainless steel tanks, think about the patients and those people who will be patients in the future. As you look at those containers, you'll understand in a very personal way why watchers aren't enough – and why in cryonics we always need more DOERS. *[pun for "dewars"]*

Go. Do.

Thank you.

**********

### *MAY, 2017*. UPDATE, 20 YEARS LATER, FROM STEPHEN BRIDGE

It hardly seems possible that next month will mark my 40th anniversary of cryonics activism. It is almost as surprising that it has already been 20 years since I resigned after 4 years as Alcor's President. I stayed on as an Alcor Director for another 4 years, then pulled back when my wife and I adopted two little girls. But I have remained an Alcor Advisor (both to the Board of Directors and to the Alcor Patient Care Trustees) for all of that time – not passively, but still deeply involved. And I am still the Co-Manager (with Hugh Hixon) of Cryonics Property, LLC, the ownership group which owns the building that Alcor occupies.

The Alcor of today, I am glad to say, has progressed well beyond the organization that I led. We're still a long way from what we have all envisioned; but I can stay with great confidence that, under the current leadership of Max More and the Alcor Board, the organization has grown steadily and has a solid foundation for long-term survival – maybe even prosperity. We now have 150 patients in cryopreservation, all still at the building in Scottsdale.

Cryonics technology has improved to the point where, in the best cases, we no longer *freeze* our patients. The newer patients are *vitrified*, i.e. placed into a solid state of preservation without crystalline ice formation. Vitrification is significantly less damaging. We have more technical and medical people involved with Alcor. Some significant research has taken place, including strong evidence that memories are physically stored in a form that survives vitrification [1] and evidence that points to good ultrastructural preservation of the brain.

The field of nanotechnology, still hopeful thinking in 1997, has burgeoned, lending real optimism to the possibilities of future cellular repair. There is strong reason to think that nano-sized cell-repair devices are workable and may exist within the next 20 years. (That doesn't mean that patient repair and resuscitation will take place that soon. Having a chest full of tools is not the same thing as having the knowledge to build a house. But it's a start.)

Much research has been done to determine the optimal temperature for the safety of the patients in cryopreservation, which might be somewhat higher than that of liquid nitrogen. The technology to reliably achieve that temperature is still in the future, but perhaps not too far. Even the design of our cryogenic dewars, the tanks for patient storage, has been improved a couple of times since 1997, with another set of improvements being designed now. "Improvements" mean mostly increasing the long-term safety of storage, but also include more efficient use of liquid nitrogen and the ability to store more patients in a single unit.

Alcor is financially more stable now, with 1,128 members with full cryopreservation arrangements as of April, 2017 and donations to provide a solid annual budget. The Alcor Patient Care Trust has over $10 million in investments, so the long-term care of the patients seems solidly assured. Even in that area, the Trustees and Alcor's Board look for more efficiency and even better (but still very conservative) investment options.

Perhaps the improvement that is most gratifying to me is that Alcor has generated a solid image of respectability and cooperation in the State of Arizona. While I was President we expended a lot of effort to gain positive attention, and for many years Alcor has had the benefit of an excellent consulting firm which specializes in governmental relations. We are constantly informed of legislation which might affect Alcor's operations, and Alcor frequently provides tours and discussion opportunities for local and state politicians and governmental representatives. In 1997 some local companies were nervous about doing business with Alcor; but now we are a normal part of the Scottsdale business community (as much as a cryonics organization could ever qualify as "normal").

In terms of growth, we are still well behind what I wanted us to be. I had hoped for 10,000 members and several regional facilities by now; but that may take a showy technical breakthrough to accomplish. Still, Alcor is now a solid organization that is well-placed to take advantage of opportunities when they arise.

The one negative I see is that, while we have many younger members, most of the leadership and deep involvement is still in the hands of those of us who have been part of Alcor for decades. New blood is needed as the old blood tires out. I'm counting on more of you newer members to dig deeply into cryonics and to provide future leadership.

We will always need those DOERS.

Come to Arizona. Do. ■

**REFERENCE**

1. Vita-More N, Barranco D, in: *Rejuvenation Research*, (2015, vol. 18), "Persistence of Long-Term Memory in Vitrified and Revived *Caenorhabditis elegans*", pg. 458-463.

# CATHERINE BALDWIN STEPS DOWN AS ALCOR DIRECTOR

June 19, 2017

**Effectively immediately, Catherine Baldwin has stepped down as a director of Alcor and as a director of the Alcor Patient Care Trust Board.**

After ten years as Chief Operating Officer of Suspended Animation, Catherine is retiring at the end of July to pursue other interests. Saul Kent will remain SA's Chief Executive Officer, while SA's management staff and contracted medical, scientific, and administrative professionals remain the same. Alcor's primary contact at SA will be Sayer Johanson, Operations Manager, for day to day administration, and Ryan Levesque, Client Services and Donor Recovery Manager.

Alcor looks forward to continued cooperation with Suspended Animation and a smooth transition thanks to considerable preparation by Catherine. ■

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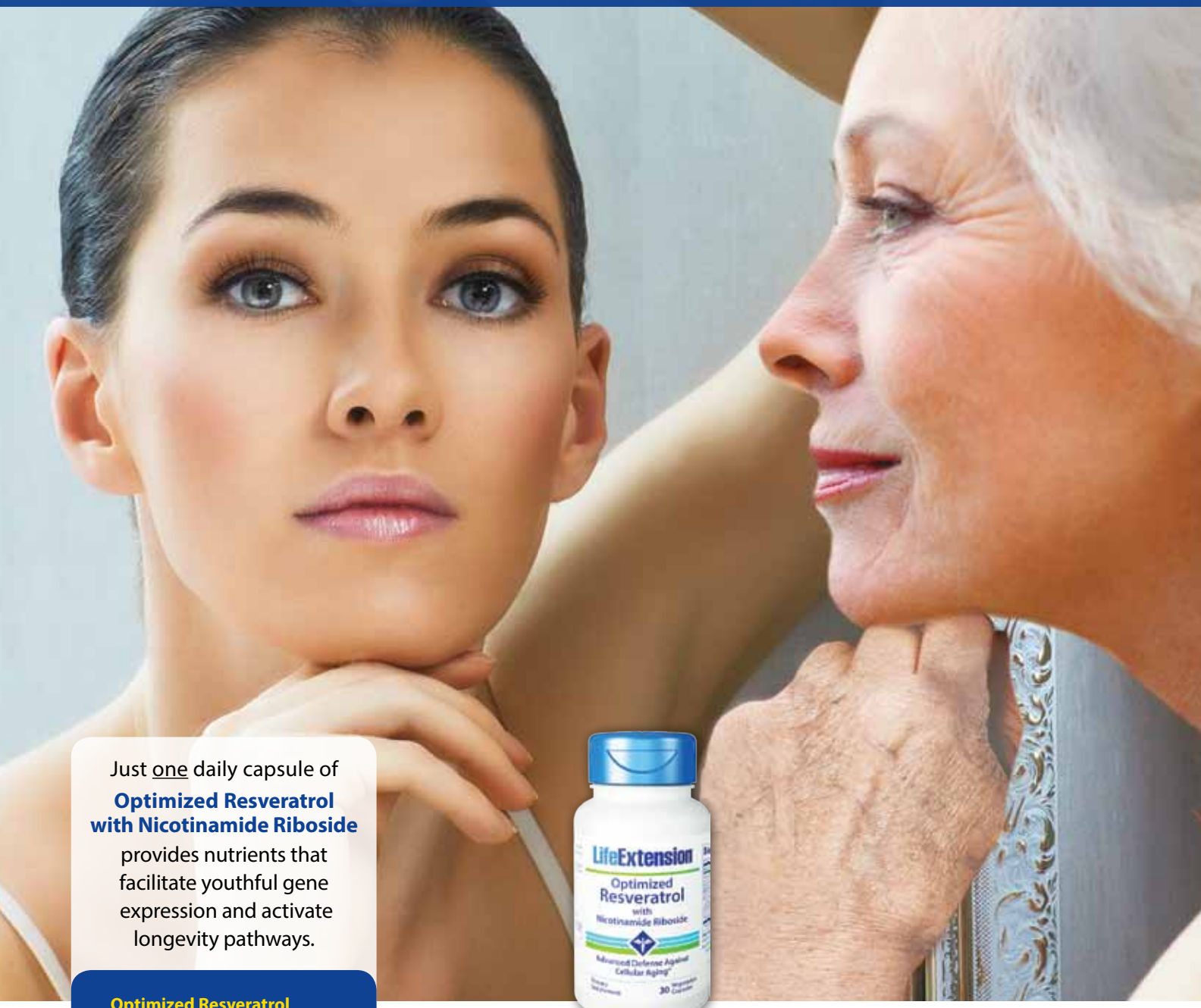


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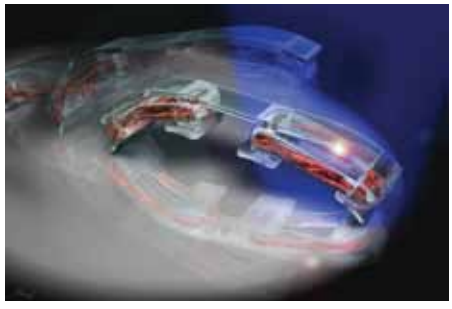
## Graphene Shown to Safely Interact with Neurons in the Brain

Researchers have successfully demonstrated how it is possible to interface graphene – a two-dimensional form of carbon – with neurons, or nerve cells, while maintaining the integrity of these vital cells. The work may be used to build graphene-based electrodes that can safely be implanted in the brain, offering promise for the restoration of sensory functions for amputee or paralysed patients, or for individuals with motor disorders such as epilepsy or Parkinson's disease. The research, published in the journal *ACS Nano*, was an interdisciplinary collaboration coordinated by the University of Trieste in Italy and the Cambridge Graphene Centre. Previously, other groups had shown that it is possible to use treated graphene to interact with neurons. However the signal to noise ratio from this interface was very low. By developing methods of working with untreated graphene, the researchers retained the material's electrical conductivity, making it a significantly better electrode. "For the first time we interfaced graphene to neurons directly," said Professor Laura Ballerini of the University of Trieste in Italy.

University of Cambridge
29 Jan. 2017
http://www.cam.ac.uk/research/news/graphene-shown-to-safely-interact-with-neurons-in-the-brain

## Now You Can 'Build Your Own' Bio-Bot

For the past several years, researchers at the University of Illinois at Urbana-Champaign have been developing a class of walking "bio-bots" powered by muscle cells and controlled with electrical and optical pulses. Now, Bioengineering Professor Rashid Bashir's research group is sharing the recipe for the current generation of bio-bots. Their how-to paper is the cover article in *Nature Protocols*. "The protocol teaches every step of building a bio-bot, from 3D printing the skeleton to tissue engineering the skeletal muscle actuator, including manufacturers and part numbers for every single thing we use in the lab," explained Ritu Raman, first author of the paper, "A modular approach to the design, fabrication, and characterization of muscle-powered biological machines." "This protocol is essentially intended to be a one-stop reference for any scientist around the world who wants to replicate the results we showed in our *PNAS* 2016 and *PNAS* 2014 papers, and give them a framework for building their own bio-bots for a variety of applications," Raman said.



*Schematic of a bio-bot: Engineered skeletal muscle tissue is coupled to a 3D printed flexible skeleton. Optical stimulation of the muscle tissue, which is genetically engineered to contract in response to blue light, makes the bio-bot walk across a surface in the direction of the light.*

Rick Kubetz, Engineering Communications Office, U. of Ill. Urbana-Champaign
10 Feb 2017
http://engineering.illinois.edu/news/article/21291

## DNA Computer Brings 'Intelligent Drugs' A Step Closer

Researchers at Eindhoven University of Technology (TU/e) present a new method that should enable controlled drug delivery into the bloodstream using DNA computers. In the journal *Nature Communications* the team, led by biomedical engineer Maarten Merkx, describes how it has developed the first DNA computer capable of detecting several antibodies in the blood and performing subsequent calculations based on this input. This is an important step towards the development of smart, "intelligent" drugs that may allow better control of the medication for rheumatism and Crohn's disease, for example, with fewer side-effects and at lower cost. "Research into diagnostic tests tends to focus on the 'recognition,' but what is special about this system is that it can think and that it can be connected to actuation such as drug delivery," says professor Merkx. "Intelligence" is needed, a role that is performed in this system by a DNA computer. DNA is best known as a carrier of genetic information, but DNA molecules are also highly suitable for performing molecular calculations.

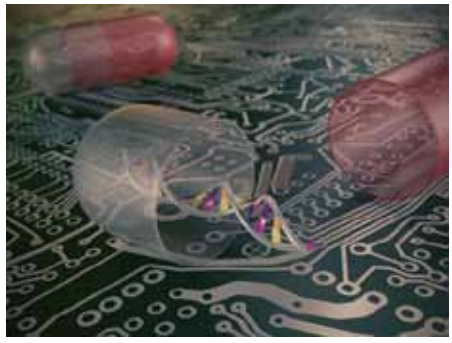


*Illustration of the technique whereby DNA acts as a kind of computer - symbolized by the computer chip background - which allows for controlled drug delivery in the bloodstream. Image: ICMS Animation Studio*

News and Press, TU/e (Netherlands)
17 Feb. 2017
https://www.tue.nl/en/university/news-and-press/news/17-02-2017-dna-computer-brings-intelligent-drugs-a-step-closer/

## How Blood Can Be Rejuvenated

Our blood stem cells generate around a thousand billion new blood cells every day. But the blood stem cells' capacity to produce blood changes as we age. This leads to older people being more susceptible to anemia, lowered immunity and a greater risk of developing certain kinds of blood cancer. Now for the first time, a research team at Lund University in Sweden has succeeded in rejuvenating blood stem cells with established reduced function in aging mice. The study is published in *Nature Communications*. "We found that there was no difference in blood-generating capacity when we compared the reprogrammed blood stem cells with healthy blood stem cells from a young mouse. This is, as far as we know, the first time someone has directly succeeded in proving that it is possible to recreate the function of young stem cells from a functionally old cell," says Martin Wahlestedt, the first author of the study. The research team's studies have also thereby shown that many age-related changes in the blood system cannot be explained by mutations in the cells' DNA.

Lund University
23 Feb. 2017
http://www.lunduniversity.lu.se/article/how-blood-can-be-rejuvenated

## A Possible Way to Postpone Death Using Human DNA

J. Craig Venter successfully mapped the human genome some 17 years ago, and then became the first person to have his complete DNA sequenced. Now he is looking to defeat death through his new firm, Human Longevity, Inc. (HLI), which he put together using a $300 million investment from organizations such as Celgene and GE Ventures. HLI employs data from human genomics and machine learning technology in an attempt to postpone death by a few years or, perhaps, even decades. To get a more complete picture of when death may occur, HLI needs to gather enough DNA information from enough people. Crucial to the effort is what they call the Health Nucleus, a $25,000 executive physical that's very thorough and includes blood tests, MRIs, organ ultrasounds, and cognitive exams. "We're screening healthy people, and a lot of physicians don't like that," Venter noted. "My response is: How do you know they're healthy? We use a definition of health out of the Middle Ages: If you look okay and you feel okay, you're deemed healthy. We have a different way of looking at people."

Dom Galeon / Futurism
1 Mar. 2017
https://futurism.com/geneticists-are-pioneering-a-way-to-postpone-death-using-human-dna/

## New Technology Rewarms Large-Scale Tissues Preserved at Low Temperatures

A research team, led by the University of Minnesota, has discovered a potentially groundbreaking process to successfully rewarm large-scale animal heart valves and blood vessels preserved at very low temperatures. It uses silica-coated iron oxide nanoparticles dispersed throughout a cryoprotectant solution that includes the tissue. The discovery could be part of a major step toward saving millions of human lives by increasing the availability of organs and tissues for transplantation. The research appeared March 1 in Science Translational Medicine, published by the American Association for the Advancement of Sciences (AAAS). "This is the first time that anyone has been able to scale up to a larger biological system and demonstrate successful, fast, and uniform warming hundreds of degrees Celsius per minute of preserved tissue without damaging the tissue," said University of Minnesota professor John Bischof, the senior author of the study. Bischof said in the past, researchers were only able to show success at about 1 milliliter of tissue and solution. This study scales up to 50 milliliters.

University of Minnesota
1 Mar. 2017
https://twin-cities.umn.edu/news-events/new-technology-rewarms-large-scale-tissues-preserved-low-temperatures

## A New Breakthrough in Lab-Grown Cells Could Restore Hearing

The death of cochlear hair cells, which do not regenerate, is a cause of hearing loss in a high percentage of the population. Could these hair cells be regrown? That's the idea behind a study conducted by a team of scientists from Harvard University and MIT. Long in the making, their research is now published in the journal *Cell Reports*. In 2012, lead scientist Albert Edge discovered stem cells in the ear called Lgr5+ cells. These were also found in the lining of human intestines, where they actively regenerate every eight days. Edge's team found a way to convince these stem cells to develop into hair cells instead of intestinal cells. The process took a great deal of time, however, and it only yielded 200 hair cells. Now, the team has managed to grow 11,500 hair cells from the Lgr5+ cells in mice, which are among the few mammals whose cells can regenerate when they are newly born. After taking the Lgr5+ cells from the mice, they coaxed them to divide within a special growth medium, increasing their number two-thousandfold, before further coaxing them, in a different environment, to turn into hair cells.

*Image credit: Photopin*

Tatiana Shepeleva/Shutterstock / Futurism
3 Mar. 2017
https://futurism.com/a-new-breakthrough-in-lab-grown-cells-could-restore-hearing/

## Brain Is 10 Times More Active Than Previously Measured

A new UCLA study could change scientists' understanding of how the brain works – and could lead to new approaches for treating neurological disorders and for

developing computers that "think" more like humans. The research focused on the structure and function of dendrites, which are components of neurons, the nerve cells in the brain. Neurons are large, tree-like structures made up of a body, the soma, with numerous branches called dendrites extending outward. Somas generate brief electrical pulses called "spikes" to connect and communicate with each other. Scientists had generally believed that the somatic spikes activate the dendrites, which passively send currents to other neurons' somas, but this had never been directly tested before. This process is the basis for how memories are formed and stored. Scientists have believed that this was dendrites' primary role. But the UCLA team discovered that dendrites are not just passive conduits. Their research showed that dendrites are electrically active in animals that are moving around freely, generating nearly 10 times more spikes than somas.

UCLA Newsroom
9 Mar. 2017
http://newsroom.ucla.edu/releases/ucla-research-upend-long-held-belief-about-how-neurons-communicate

## A Reliable and Efficient DNA Storage Architecture

DNA has the potential to provide large-capacity information storage. However, current methods have only been able to use a fraction of the theoretical maximum. Researchers Yaniv Erlich and Dina Zielinski of the New York Genome Center, New York, NY offer a method, DNA Fountain, which approaches the theoretical maximum for information stored per nucleotide. They demonstrate efficient encoding of information – including a full computer operating system – into DNA that could be retrieved at scale after multiple rounds of polymerase chain reaction. Using their approach, they stored a total of $2.14 \times 10^6$ bytes in DNA oligonucleotides and perfectly retrieved the information from a sequencing coverage equivalent to a single tile of Illumina sequencing. They also tested a process that can allow $2.18 \times 10^{15}$ retrievals using the original DNA sample and were able to perfectly decode the data. Finally, they explored the limit of their architecture in terms of bytes per molecule and obtained a perfect retrieval from a density of 215 petabytes per gram of DNA, orders of magnitude higher than previous reports.

*Science*
10 Mar. 2017
http://science.sciencemag.org/content/355/6328/950

# A Roadmap to Revival

Successful revival of cryonics patients will require three distinct technologies: (1) A cure for the disease that put the patient in a critical condition prior to cryopreservation; (2) biological or mechanical cell repair technologies that can reverse any injury associated with the cryopreservation process and long-term care at low temperatures; (3) rejuvenation biotechnologies that restore the patient to good health prior to resuscitation. OR it will require some entirely new approach such as (1) mapping the ultrastructure of cryopreserved brain tissue using nanotechnology, and (2) using this information to deduce the original structure and repairing, replicating or simulating tissue or structure in some viable form so the person "comes back."

The following list is a list of landmark papers and books that reflect ongoing progress towards the revival of cryonics patients:


Jerome B. White, "**Viral-Induced Repair of Damaged Neurons with Preservation of Long-Term Information Content**," Second Annual Conference of the Cryonics Societies of America, University of Michigan at Ann Arbor, April 11-12, 1969, by J. B. White. Reprinted in *Cryonics* 35(10) (October 2014): 8-17.

Michael G. Darwin, "**The Anabolocyte: A Biological Approach to Repairing Cryoinjury**," *Life Extension Magazine* (July-August 1977):80-83. Reprinted in *Cryonics* 29(4) (4th Quarter 2008):14-17.

Gregory M. Fahy, "**A 'Realistic' Scenario for Nanotechnological Repair of the Frozen Human Brain**," in Brian Wowk, Michael Darwin, eds., *Cryonics: Reaching for Tomorrow*, Alcor Life Extension Foundation, 1991.

Ralph C. Merkle, "**The Molecular Repair of the Brain**," *Cryonics* 15(1) (January 1994):16-31 (Part I) & *Cryonics* 15(2) (April 1994):20-32 (Part II).

Ralph C. Merkle, "**Cryonics, Cryptography, and Maximum Likelihood Estimation**," First Extropy Institute Conference, Sunnyvale CA, 1994, updated version at http://www.merkle.com/cryo/cryptoCryo.html.

Aubrey de Grey & Michael Rae, "**Ending Aging: The Rejuvenation Breakthroughs That Could Reverse Human Aging in Our Lifetime**." St. Martin's Press, 2007.

Robert A. Freitas Jr., "**Comprehensive Nanorobotic Control of Human Morbidity and Aging**," in Gregory M. Fahy, Michael D. West, L. Stephen Coles, and Steven B. Harris, eds, *The Future of Aging: Pathways to Human Life Extension*, Springer, New York, 2010, 685-805.

Chana Phaedra, "**Reconstructive Connectomics**," *Cryonics* 34(7) (July 2013): 26-28.

Robert A. Freitas Jr., "**The Alzheimer Protocols: A Nanorobotic Cure for Alzheimer's Disease and Related Neurodegenerative Conditions**," *IMM Report* No. 48, June 2016.

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# MEETINGS

## ABOUT THE ALCOR FOUNDATION

The Alcor Life Extension Foundation is a nonprofit tax-exempt scientific and educational organization dedicated to advancing the science of cryopreservation and promoting cryonics as a rational option. Being an Alcor member means knowing that—should the worst happen—Alcor's Emergency Response Team is ready to respond for you, 24 hours a day, 365 days a year.

Alcor's Emergency Response capability includes specially trained technicians and customized equipment in Arizona, northern California, southern California, and south Florida, as well as many additional certified technicians on-call around the United States. Alcor's Arizona facility includes a full-time staff, and the Patient Care Bay is personally monitored 24 hours a day.

### ARIZONA

**FLAGSTAFF:**

Arizona without the inferno. Cryonics group in beautiful, high-altitude Flagstaff. Two-hour drive to Alcor. Contact eric@flagstaffcryo.com for more information.

**PHOENIX**

**VALLEY OF THE SUN:**

This group meets monthly, usually in the third week of the month. Dates are determined by the activity or event planned. For more information or to RSVP, visit http://cryonics.meetup.com/45/ or email Lisa Shock at lisa@alcor.org.

**AT ALCOR:**

Alcor Board of Directors Meetings and Facility Tours—Alcor business meetings are generally held on the second Saturday of every month starting at 11:00 AM MST. Guests are welcome to attend the fully-public board meetings. Facility tours are held every Tuesday at 10:00 AM and Friday at 2:00 PM. For more information or to schedule a tour, call Marji Klima at (877) 462-5267 x101 or email marji@alcor.org.

### CALIFORNIA

**LOS ANGELES:**

Alcor Southern California Meetings—For information, call Peter Voss at (310) 822-4533 or e-mail him at peter@optimal.org. Although monthly meetings are not held regularly, you can meet Los Angeles Alcor members by contacting Peter.

**SAN FRANCISCO BAY:**

Alcor Northern California Meetings are held quarterly in January, April, July, and October. A CryoFeast is held once a year. For information on Northern California meetings, call Mark Galeck at (650) 772-1251 or email Mark_galeck@pacbell.net.

### FLORIDA

Central Florida Life Extension group meets once a month in the Tampa Bay area (Tampa and St. Petersburg) for discussion and socializing. The group has been active since 2007. Email arcturus12453@yahoo.com for more information.

### NEW ENGLAND

**CAMBRIDGE:**

The New England regional group strives to meet monthly in Cambridge, MA—for information or to be added to the Alcor NE mailing list, please contact Bret Kulakovich at 617-824-8982, alcor@bonfireproductions.com, or on FACEBOOK via the Cryonics Special Interest Group.

### NEW YORK CITY

Alcor members in the NYC area can contact Javier El-Hage at javier.elhage@gmail.com for information about local meetings which are held once a month at a midtown location.

### PACIFIC NORTHWEST

A Yahoo mailing list is also maintained for cryonicists in the Pacific Northwest at http://tech.groups.yahoo.com/group/CryonicsNW/.

**OREGON:**

The contact person for meetings in the Portland area is Aschwin de Wolf: aschwin@alcor.org. See also: https://www.facebook.com/portland.life.extension.

**BRITISH COLUMBIA (CANADA):**

CryoBC, a special interest group within the nonprofit Lifespan Society of BC (http://www.lifespanbc.ca/) holds meetings for cryonicists in the Vancouver area. To be notified of meetings join the CryoBC mailing list: https://groups.yahoo.com/neo/groups/cryobc/info.

### TEXAS

**DALLAS:**

North Texas Cryonauts, please sign up for our announcements list for meetings (http://groups.yahoo.com/group/cryonauts-announce) or contact David Wallace Croft at (214) 636-3790 for details of upcoming meetings.

**AUSTIN/CENTRAL TEXAS:**

A new group for the Austin area has been started for those interested in discussion and understanding of the relevant technologies and issues for cryopreservation, genomics, epigenetics and medical research for increased life/health span. Contact Tom Miller, 760-803-4107 or tom@blackmagicmissileworks.com.

### JAPAN

Cryonics meetings are held monthly in Tokyo. Send queries to grand88@yahoo.com.

### ALCOR PORTUGAL

Alcor Portugal is working to have good stabilization and transport capabilities. The group meets every Saturday for two hours. For information about meetings, contact Nuno Martins at n-martins@n-martins.com. The Alcor Portugal website is: www.alcorportugal.com.

### UNITED KINGDOM

Alcor members in the UK can contact Garret Smyth at Alcor-UK@alcor.org for information about local meetings.

**If you are interested in hosting regular meetings in your area, contact Alcor at 877-462-5267, ext. 113. Meetings are a great way to learn about cryonics, meet others with similar interests, and introduce your friends and family to Alcor members!**

# What is Cryonics?

Cryonics is an attempt to preserve and protect human life, not reverse death. It is the practice of using extreme cold to attempt to preserve the life of a person who can no longer be supported by today's medicine. Will future medicine, including mature nanotechnology, have the ability to heal at the cellular and molecular levels? Can cryonics successfully carry the cryopreserved person forward through time, for however many decades or centuries might be necessary, until the cryopreservation process can be reversed and the person restored to full health? While cryonics may sound like science fiction, there is a basis for it in real science. The complete scientific story of cryonics is seldom told in media reports, leaving cryonics widely misunderstood. We invite you to reach your own conclusions.

# How do I find out more?

The Alcor Life Extension Foundation is the world leader in cryonics research and technology. Alcor is a non-profit organization located in Scottsdale, Arizona, founded in 1972. Our website is one of the best sources of detailed introductory information about Alcor and cryopreservation (www.alcor.org). We also invite you to request our FREE information package on the "Free Information" section of our website. It includes:

- A fully illustrated color brochure
- A sample of our magazine
- An application for membership and brochure explaining how to join
- And more!

***Your free package should arrive in 1-2 weeks.*** (The complete package will be sent free in the U.S., Canada, and the United Kingdom.)

# How do I enroll?

Signing up for a cryopreservation is easy!

***Step 1:*** Fill out an application and submit it with your $90 application fee.
***Step 2:*** You will then be sent a set of contracts to review and sign.
***Step 3:*** Fund your cryopreservation. While most people use life insurance to fund their cryopreservation, other forms of prepayment are also accepted. Alcor's Membership Coordinator can provide you with a list of insurance agents familiar with satisfying Alcor's current funding requirements.
***Finally:*** After enrolling, you will wear emergency alert tags or carry a special card in your wallet. This is your confirmation that Alcor will respond immediately to an emergency call on your behalf.

Not ready to make full arrangements for cryopreservation? Then ***become an Associate Member*** for $5/month (or $15/quarter or $60 annually). Associate Members will receive:

- ***Cryonics*** magazine by mail
- Discounts on Alcor conferences
- Access to post in the Alcor Member Forums
- A dollar-for-dollar credit toward full membership sign-up fees for any dues paid for Associate Membership

To become an Associate Member send a check or money order ($5/month or $15/quarter or $60 annually) to Alcor Life Extension Foundation, 7895 E. Acoma Dr., Suite 110, Scottsdale, Arizona 85260, or call Marji Klima at (480) 905-1906 ext. 101 with your credit card information. You can also pay using PayPal (and get the Declaration of Intent to Be Cryopreserved) here: http://www.alcor.org/BecomeMember/associate.html

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