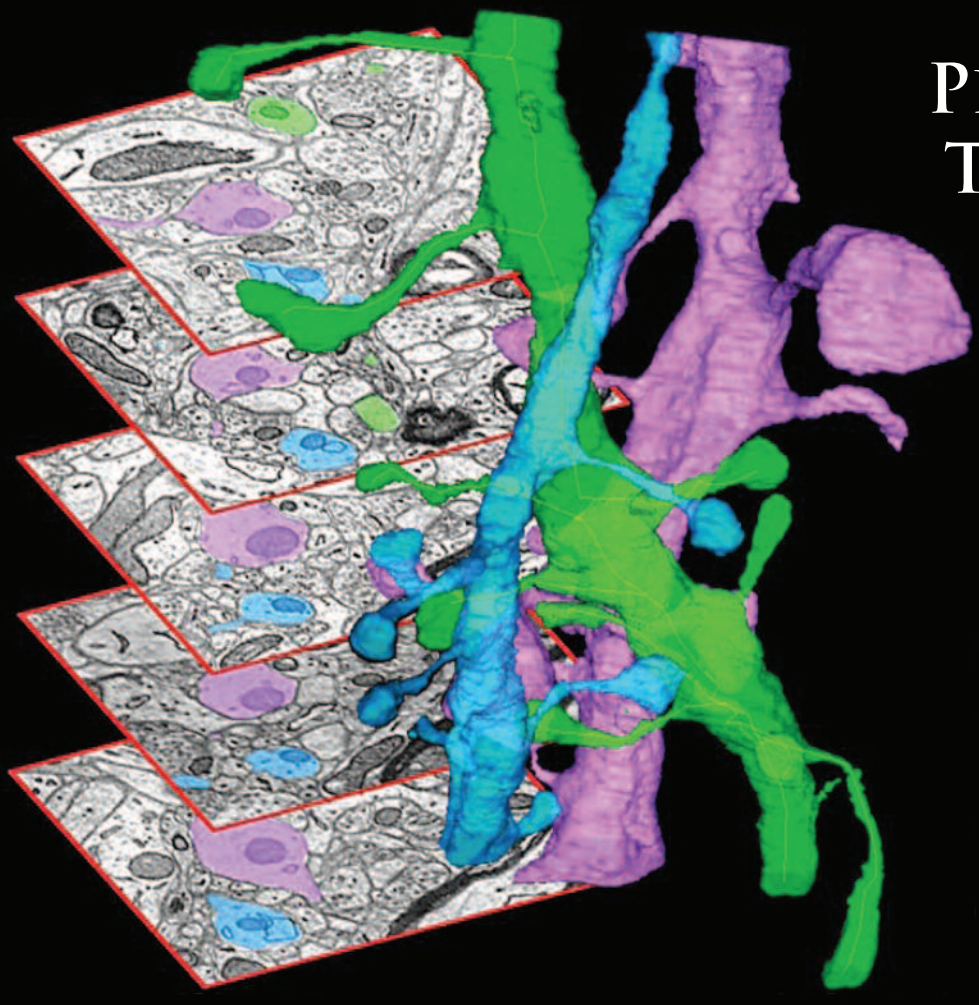
ALCOR LIFE EXTENSION FOUNDATION

CRYONICS

2ND QUARTER 2011 • VOLUME 32:2



Dendrites traced through a series of electron micrographs of a chemically fixed and plastic embedded piece of brain tissue.

THE BRAIN PRESERVATION TECHNOLOGY PRIZE

PAGE 5

AUBREY DE GREY RESPONDS TO BEN BEST

PAGE 12

MEMBER PROFILE: HUGH HIXON

PAGE 14

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CRYONICS

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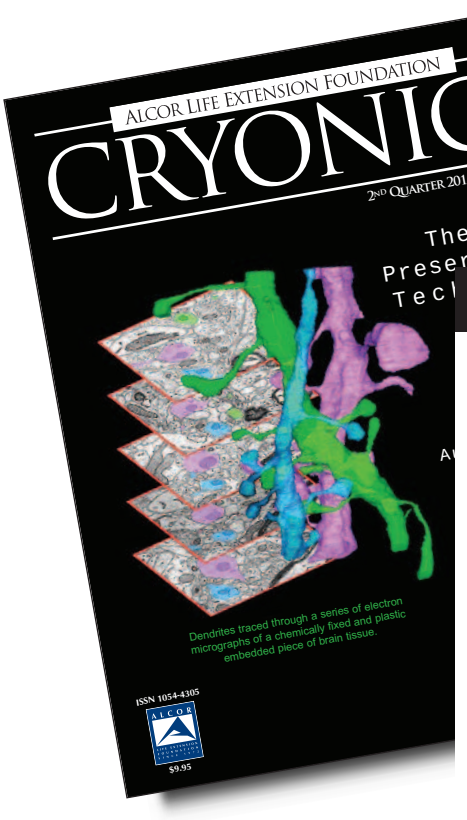

COVER STORY: PAGE 5

Alcor member Ken Hayworth introduces the reader to the Brain Preservation Foundation and the prize they have established to encourage state of the art preservation of the brain. The aim of this prize is to answer the question whether cryonics or any other preservation method preserves the precise pattern of synaptic connectivity in the brain. The author expects that an affirmative answer will produce greater acceptance of cryonics among scientists. Mike Perry responds and clarifies the position of the Editorial Board of the magazine.

CONTENTS

ALCOR LIFE EXTENSION FOUNDATION
CRYONICS

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FROM THE EDITOR

Human cryopreservation is the most mature technology to preserve identity-critical information in the brain but it is not the only feasible form of preservation. Brain structure can be preserved either through the use of cold temperatures or through the use of chemical fixation (or a combination of both). Although cryonics seems to have a number of distinct advantages over chemopreservation, such as its suitability for both non-ischemic and ischemic patients (see my article in Cryonics 4th Quarter 2009), one could argue that some of these advantages are simply the result of the fact that much more money and effort has been allocated to cryonics, as opposed to chemical preservation of the brain. What both approaches have in common is a reluctance to accept contemporary criteria concerning death. It is for this reason alone that advocates of cryonics have good reasons to be supportive of serious efforts in chemical brain preservation.

The cover article of this issue of *Cryonics* features a profile of the Brain Preservation Foundation written by Alcor member Ken Hayworth. Although Ken is somewhat partial to the use of chemical fixation as a means of brain preservation, the non-profit foundation that he and others have launched to promote brain preservation considers both approaches as serious candidates to preserve critical identity of the person. In his article for this magazine he will discuss the objectives of the organization, its relevance to cryonics, and the Brain Preservation Technology Prize that has been established to encourage researchers to perfect technologies that demonstrate detailed preservation of every neuronal process and every synaptic connection, as demonstrated by advanced electron microscopy technologies. Ken's article is followed by a comment from Mike Perry who outlines where Alcor agrees and disagrees with Ken's perspective.

The reader will have to wait for the next issue for a number of exciting updates on research and development in cryonics but this issue has solid technical content too. In addition to the article about the Brain Preservation Technology Prize, we are honored to publish Aubrey de Grey's response to Ben Best's critical assessment of SENS in our previous issue. I am very pleased to offer this exchange to our readers because the development of mature rejuvenation technologies is one of the conditions for cryonics to be meaningful for older people. Expect more focus on aging and rejuvenation in future issues of this magazine.

Following my desire to feature more staff members and board members in the magazine, in this issue you can read an extensive member profile of Hugh Hixon. Hugh Hixon's official title is Research Fellow but it is hard to imagine any (technical) aspect of cryonics that Hugh Hixon has not mastered. In particular, Hugh is the central person in the Alcor operating room to conduct and monitor cryoprotective perfusion. Hugh's knowledge and expertise in this area is of such importance that Alcor has increasingly recognized the urgent need to recruit and train more individuals to perform this crucial task. There are few people of whom it can be said that they have dedicated their life to cryonics and Hugh Hixon is one of them. I strongly encourage you to read the profile of this remarkable and gifted individual.

Due to space limitations and increased caseload, Alcor cannot publish all of its case reports in the magazine. I would like to draw your attention to the recent David Hayes case report (http://www.alcor.org/Library/pdfs/casereportA1712DavidHayes.pdf). David Hayes has participated in a number of Alcor cases himself and was my colleague at Suspended Animation, Inc. As this report will show, Dave was not able to benefit from the very stabilization technologies that he was so familiar with. An inevitable autopsy and the holidays conspired to produce extensive delays which did not permit cryoprotective perfusion. Due to the legal efforts of Alcor, we were able to protect his brain from further injury. Mike Perry has written a short addendum about what members can do to minimize the risk of an (invasive) autopsy. If one needs only one reminder why we need to fight for improved legal status of cryonics patients, read this case report.

Aschwin de Wolf

CEO Update

By Max More

For the dullest among us, perfection may take the form of a simple vision: perhaps an other-worldly realm where there is no struggle, no suffering, no conflict, only immaculate submission to a perfect higher power. (In a variation of the same vision, this might include the provision of numerous virgins, apparently without will or rights of their own.) Or perhaps it takes the form of a different kind of higher power: a worldly power—whether an embodiment of the people's will (as classically exemplified in Hegel's and Marx's view of the State) or of the "pure race" or some other seductive fantasy. For the more intellectually sophisticated, it frequently takes the form of certainty in our own knowledge of what is right and correct and proper and rational, accompanied by a sure belief that everyone else is obviously a moron, or a dupe, or evil.

Perfectionist thinking of this kind entails rejecting tradeoffs. It involves fixating on a vision (sometimes arbitrary or ungrounded) of how things ideally ought to be while ignoring the costs of attempting to reach that ideal. Outside of pure mathematics and logic, perfection is not attainable in the real world. Even the flawless achievement of one goal means giving up another goal of inferior but substantial value (the economists' concept of "opportunity cost"). And achieving some aspects of a desired goal will mean giving up others. You may want a car that gets excellent gas mileage, but that will probably mean giving up the level of performance you hoped for. You may want to delay having children until you've accumulated more wealth and experience, but your fertility level may decline.

Tradeoffs clearly exist in cryonics, although you wouldn't know it by listening to most critics. We would all like cryonics to be perfect, but we know that gains come at a cost. We would like the costs of membership dues and cryopreservation charges to be lower. We would like the quality of cryopreservations to be higher. We would like everything to be run by medical professionals at low cost and with total commitment. We would like to be certain that a new employee of a cryonic organization will not lie and steal and betray us.

Think about cryonics for a little while and you will quickly compile a list of tradeoffs. For instance: better cryoprotectants such as M-22 cost more compared to cheaper glycerol; charter jets or air ambulances for fast transport of patients use up money that could be devoted to patient care or research or supporting operations; more money going into the patient care trust fund to strengthen it means less for continuing operations; rapid access to major blood vessels in transport causes damage but may reduce ischemic time.

Some particularly vicious critics use perfectionist thinking (either honestly-but-foolishly or dishonestly) to attack our fees while simultaneously blasting us for using imperfect equipment and for not being fully staffed with extremely expensive medical professionals. They pretend to want to perfect cryonics by adding more government regulation, when they know that the additional regulatory burdens could destroy cryonics organizations. We already comply with numerous regulations, including OSHA and workplace regulations, local regulations, shipping regulations, and so on.

The way these critics brandish perfectionism is similar to the way critics of technological progress and economic growth wield the "precautionary principle." The precautionary principle commands us, in essence, not to allow the introduction of any new technology or productive method unless you can prove that it is perfectly safe. This principle – unlike my alternative Proactionary Principle – turns a blind eye to tradeoffs while raising safety to the level of an absolute value.
[http://www.maxmore.com/perils.htm]

Critiquing the pernicious effects of perfectionism should not be an excuse to languish in current conditions. Every tradeoff should be probed in an effort to overcome its terms. Any particular tradeoff may be based on an assumption that no longer holds. Factors that were once fixed may become uncoupled due to new technologies, techniques, and organization. Institutions take on a life of their own. Assumptions based in current reality can get baked into the organizational culture. When conditions change, hardened assumptions may remain, the people in the organization being blind to how tradeoffs have shifted.

I'm still quite new at the helm of Alcor, so I may be able to root out and challenge assumptions about tradeoffs that no longer apply. As time goes on, I may become increasingly vulnerable to "hardening of the orthodoxies." No perfect solution to this exists. However, as a pancritical rationalist in both philosophy and personality, I remain open to alternative views and outside inputs.

So, yes, it's important – no, *crucial* – to challenge assumptions behind tradeoffs. But neither can the real factors behind tradeoffs be ignored. That only leads to demoralization and even disaster. Relentless criticism of current cryonics practice, based in a standard of impossible perfectionism, is more likely to lead to despair than to improvement. The best alternative to perfectionism is continual improvement, or what the Japanese call kaizen. My commitment to all Alcor members for as long as I'm here, is *cryo-*

kaizen. We will never achieve perfection, but we will continually improve, learn from mistakes, improve our technology, our processes, and our organization.

Member privacy: We hope to see you at the Suspended Animation conference in May, in which Alcor will be participating. You should have received a brochure in the mail on the event. One member asked how she came to receive a brochure since she had not given SA her mailing address. In case anyone else is wondering the same, please note that Alcor *did not and will not give out member names and mailing addresses to other organizations*. SA sent us the brochures and we mailed them out (a mailing paid for by SA).

Upgrades: We continue to build up Alcor's capabilities. Top of my priority list for upgraded capabilities are standbys and personnel capable of carrying out cryoprotective perfusion. Our primary post-transport perfusionist, Hugh Hixon, has been the only person who fully understood the operation of our custom-built perfusion equipment. That has left us vulnerable in the event of his illness, absence (not a common occurrence), or – goodness forbid – his own cryopreservation. My thanks to Hugh for agreeing to train two people to bring up their existing knowledge and skills to the level needed to take over if necessary. Even if Hugh stays around for many years to come, it would be good to free him from some activities to preserve his time and energy for the numerous other projects only he is able to pursue.

I have also been dissatisfied with the number of people who we can reliably call on for remote standbys. While we have local teams with people of varying levels of training and experience, it has only been Aaron Drake and Steve Graber who have gone out from Alcor Central on standbys. We have already added two additional people to the Scottsdale-based standby team, and will continue to add to that number.

Earlier in this update, I emphasized the reality of tradeoffs. I also noted that, sometimes, existing tradeoffs can be overcome. Happily, we have recently improved our capabilities (or are about to) while also saving money. For instance: Thanks primarily to Steve Graber and Randal Fry we have a newly-designed portable ice bath that (unlike the previous one) is within both size and weight limits for commercial flights, saving us a substantial amount of money over time. We've also purchased a dozen drug pumps for use in the field at a 90% discount (thanks Aaron!), which make it easier to administer a couple of meds that cannot be given all at once.

Many of you will fondly remember previous major pieces of Alcor literature, such as *Reaching for Tomorrow*. Fine as those overview books were, they became outdated. The value of such comprehensive and clearly explained books remains. I'm supporting and will assist Mike Perry with his project to revise cryonics literature and make it available to those intrigued about cryonics.

Documentation: Another project I'm pushing is to improve the degree of documentation of crucial processes. This will make it easier to train additional people and to provide existing people with clear procedures to follow. Among the processes whose documentation are to be checked, improved, or created are: construction of tubing packs; supply inventory maintenance; procurement of chemicals, including custom-made chemicals; solution preparation; mixing perfusates; filling dewars; field blood washouts; cryoprotective perfusion; cryoprotectant perfusion equipment maintenance and troubleshooting; cryoprotectant perfusion equipment operation during cases; and cooldown and encapsulation operations.

Building Improvements: Visitors to Alcor cannot help but notice changes. One of the less obvious but important ones is that OR cleanliness has been improved by the addition of tacky mats by the door and skirts and weather-stripping around both doors. More obvious improvements include a much quieter kitchen fan; painting of chipped base boards (underway); painting walls in the conference room (completed), entrance area (underway), and some offices (planned); moving Steve Graber to a renovated office nearer the workshop, freeing his current office for the new MCD position (done); and removal of some front cubicles and the creation of a better reception area (planned). We are also replacing the large number of framed pictures of patients in the conference room with a dynamic electronic display using LCD frames. This not only looks much better but is a scalable solution as our patient population grows.

Alcor 104th patient: As you will have read elsewhere, On Friday March 25, after a field washout by Suspended Animation, Alcor member A-2478 was transported by charter flight to Scottsdale (most of the cost of which had previously been covered by a relative), arriving shortly after midnight on Saturday March 26. Surgery and perfusion were performed without major incident. The patient has been transferred to long-term storage at liquid nitrogen temperature. This was my first time overseeing a cryopreservation. As a result of the experience, I have added to the Emergency Checklist, created a more comprehensive Emergency Contact list, and developed a better understanding of the indications and contra-indications for field washout. We are also developing more and better options for mortuaries and charter flights.

Talks: As part of a renewed effort to inform and inspire new audiences about cryonics, I will be giving a talk at the May 14-15 Humanity+ @ Parsons conference, titled "Designing Death: Reframing and Refusing the End of Life." [http://humanityplus.org/conferences/parsons/] The conference—organized by today's leading transhumanist organization and a leading design school—features a rich roster of speakers and, we hope, an audience open to exploring the possibilities for changing "death" from an unchosen end into a new beginning with a fresh body and open future. As previously mentioned, the following weekend I will be representing Alcor at the Suspended Animation conference. Then, in August/September, I'll be speaking on cryonics at Aubrey de Grey's fifth SENS conference in Cambridge, England.

Boosting growth through communication: Alcor membership has been growing slowly in recent years (despite an uptick in April). It's time to focus on boosting growth so that we can maintain and improve our technical capabilities. I am starting to do this through two measures. The first of these, already underway, is to give more talks on cryonics and Alcor to potentially interested and open groups. In addition to the three conference talks already arranged for this year, we will be looking to secure the services of a speaker's agent or bureau. The second initiative is to make use of Web video by posting short (no more than 5-minute) videos on YouTube and/or Vimeo, answering common questions, refuting common objections, and addressing misconceptions. We will also look into other forms of targeted social media.

Visitors: On a Saturday in late February, we had some eminent and influential visitors. Many of the staff came in to join in the tour. Many penetrating questions were asked, and it seems very likely that we will have new members as a result. (I hope we will be able to reveal their identities at that point.) ■

The Brain Preservation Technology Prize:

A challenge to cryonicists, a challenge to scientists

By Kenneth J. Hayworth, PhD

My name is Kenneth Hayworth and I am a PhD neuroscientist working in a university laboratory developing automated electron imaging techniques. The primary focus of my research is tracing synaptic connections in brain tissue at the ultrastructure level. I am also a long-time, albeit quite skeptical, member of Alcor.

Like many of my fellow materialist scientists I have no problem viewing the idea of cryonics as merely a technical challenge: "Can a dying person be placed in a long-term static state to await future technology that can revive and cure them?" As a neuroscientist I have no problem stating the minimum conditions that such a static state needs to meet for it to allow possible future revival of the individual with memories and personality intact – the precise connectivity of the brain's hundred billion neurons must remain intact. I have discussed the idea of cryonics with dozens of my fellow neuroscientists over the years and this is the central question that comes up again and again:

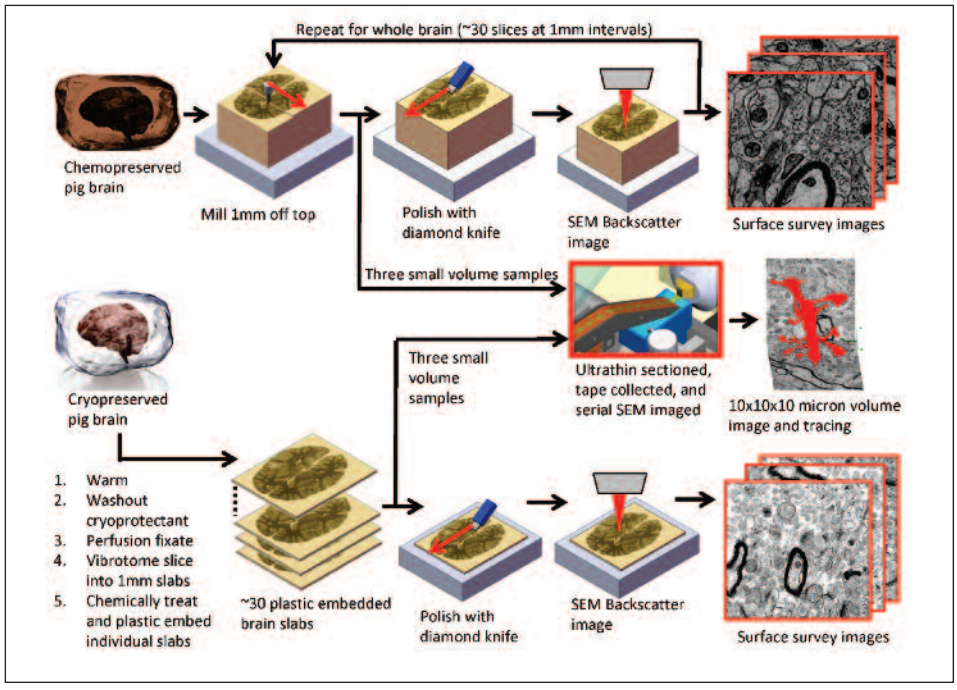
"Do current cryonic suspension techniques preserve the precise wiring of the brain's neurons?"

The prevailing assumption among my colleagues is that current techniques do not. It is for this reason my colleagues reject cryonics as a legitimate medical practice. Their assumption is based mostly upon media hearsay from a few vocal cryobiologists with an axe to grind against cryonics. To try to get a real answer to this question I searched the available literature and interviewed cryonics researchers and practitioners. What I found was a few papers showing selected electron micrographs of distorted but recognizable neural tissue (for example, Darwin et al. 1995, Lemler et al. 2004). Although these reports are far more promising than most scientists would expect, they are still far from convincing to me and my colleagues in neuroscience.

It is often assumed that the only evidence that will persuade large numbers of mainstream scientists to embrace cryonics is a demonstrated revival of a whole mammal after being cooled to a temperature sufficient for long-term storage (an extremely difficult technical goal which is likely still decades off). Such a demonstration of revival might be the only acceptable criterion for the small cryobiology community (who is used to thinking of the brain as a 'black box' which either survives or does not), but this is not necessarily a criterion neuro and cognitive scientists have. For these brain science specialists, who probably outnumber cryobiologists a hundred to one, the key criterion is a demonstration that the precise connectivity of the brain's 100 billion neurons is preserved by cryonic procedures.

To reemphasize, I believe that thousands of neuro and cognitive scientists are ready and willing to embrace cryopreservation as a legitimate medical procedure if it can be shown that cryonic procedures preserve the precise pattern of connectivity between neurons across the entire brain. What's more, according to the top cryonics researchers I have interviewed, the current techniques may be up to this task (e.g. Lemler et al. 2004).

The action item to the cryonics community should be clear: Today's best available imaging technology should be used



Evaluation procedures for the Brain Preservation Technology Prize

The prize calls for a comprehensive statistical survey of the entire preserved brain at electron microscope resolution (~5 nanometers) to verify that the neuronal connectivity of the brain is preserved throughout. Because imaging an entire brain at such high resolution would be extremely costly and time consuming the prize only calls for imaging the brain at 1mm intervals and only calls for these slices to be statically surveyed at medium and high resolution looking for damage. The prize also calls for the extraction of three small sub volumes of the brain to be sectioned at 50nm thickness and serially imaged to produce a 3D volume image. Such 3D volume images are the only way to verify that synaptic connectivity is truly preserved by a given technique.

Evaluation of a chemopreserved brain embedded in a plastic block for long-term storage is straightforward - the block is milled down at 1mm intervals and the resulting surfaces are polished flat with a diamond knife and scanned by electron microscope. Evaluation of a cryopreserved brain is more challenging. One approach shown here is to warm the brain, wash out the cryoprotectant solutions, and then reperfuse the brain with fixative. The soft brain can then be sliced at 1mm intervals with a vibrating knife and each resulting slab put through a staining and plastic embedding procedure and SEM imaged. This warm-fix-embed approach has been used to evaluate the quality of cryopreserved brains previously. Another approach (which is technically more challenging) would involve leaving the cryopreserved brain in a vitrified state and electron imaging milled and polished surfaces directly.

to rigorously determine the quality of neuronal circuit preservation within a cryopreserved brain, and the results should be widely publicized so that every mainstream scientist has an opportunity to see the true current state of cryopreservation for him or herself.

Brain Preservation Technology Prize

After considerable thought I came to the conclusion that the best way to bring about such a wide-reaching 'scientific reevaluation of cryonics' is to put forward a challenge prize modeled after the inspirational Ansari X Prize (for commercial space travel) and the skeptical Paranormal Challenge Prize offered by the James Randi Educational Foundation. A prize has the crucial advantage of precisely defining the criteria for success – a fact all cryonics skeptics should eagerly embrace. Simultaneously a prize has the ability to explain to a wide audience why the particular milestone chosen (in this case demonstration of brain preservation at the electron microscope level) is on the critical path to a truly inspirational future goal (reanimation of a preserved individual). Put simply, a challenge prize will bring skeptics, advocates, scientists, and interested laypeople to the same table for an impartial evaluation of cryopreservation and a thoughtful conversation about what we can reasonably expect to achieve over the next few years.

As a neuroscientist whose day job is to map neural circuits, I know exactly what type of evidence is needed to convince the scientific community that cryonics preserves the neural circuits encoding our unique memories and personality. What is required is a systematic whole-brain survey with an electron microscope. Recently I, along with my colleagues John Smart and Jacob DiMare, formed the Brain Preservation Foundation (BPF) to promote new scientific research in the field of whole brain preservation for long-term static storage. The BPF has announced the Brain Preservation Technology Prize (purse currently at $106,000) for the first team to demonstrate that an entire large mammalian brain can be preserved for long-term storage such that the connectivity between neurons remains intact and traceable using today's electron microscopic imaging techniques. A complete set of rules for the prize can be found on our BPF website www.brainpreservation.org.

A challenge to cryonicists – demonstrate the quality of your product

This prize is being presented as a challenge to cryonics providers like Alcor and their research partners: "Demonstrate the quality of your product in a rigorous, independent, and open way to the scientific community and to your customers." The BPF is hard at work raising funds to promote this prize and to help perform the electron microscopic evaluation required, and we are recruiting a board of scientific advisors and judges that will give the prize credibility. This prize should be viewed as a tremendous opportunity for the cryonics community as a whole to publicly refute the prevailing negative stereotype of frostbitten and destroyed brain tissue. Even if the current cryonic techniques are unable to meet the rigorous requirements for winning the prize, a 'good showing' should serve to reinvigorate interest in cryonics in the mainstream scientific community and in the general public as well. It is my fervent hope that Alcor and its research partners will rise to this challenge. As a long-time dues paying member of Alcor, I believe it is Alcor's responsibility to do so to counter the continual claims in the press that their service is inadequate.

A challenge to scientists – develop alternatives to cryonics

The Brain Preservation Technology Prize is also a challenge to the wider scientific community. It has been almost 50 years since the professional cryobiology community briefly considered the possibility of putting a person into indefinite suspended animation for medical applications and then quickly dismissed the possibility as impossible with the technology of the day. Incredible advances have been made in all areas of science and technology in the intervening decades. Is it still impossible to preserve a person in a long-term static state? If so, why? The Brain Preservation Technology Prize is a challenge to this generation of scientists to reevaluate what is possible, to move beyond the expectations of their parents and grandparents and look at the problem with a fresh perspective.

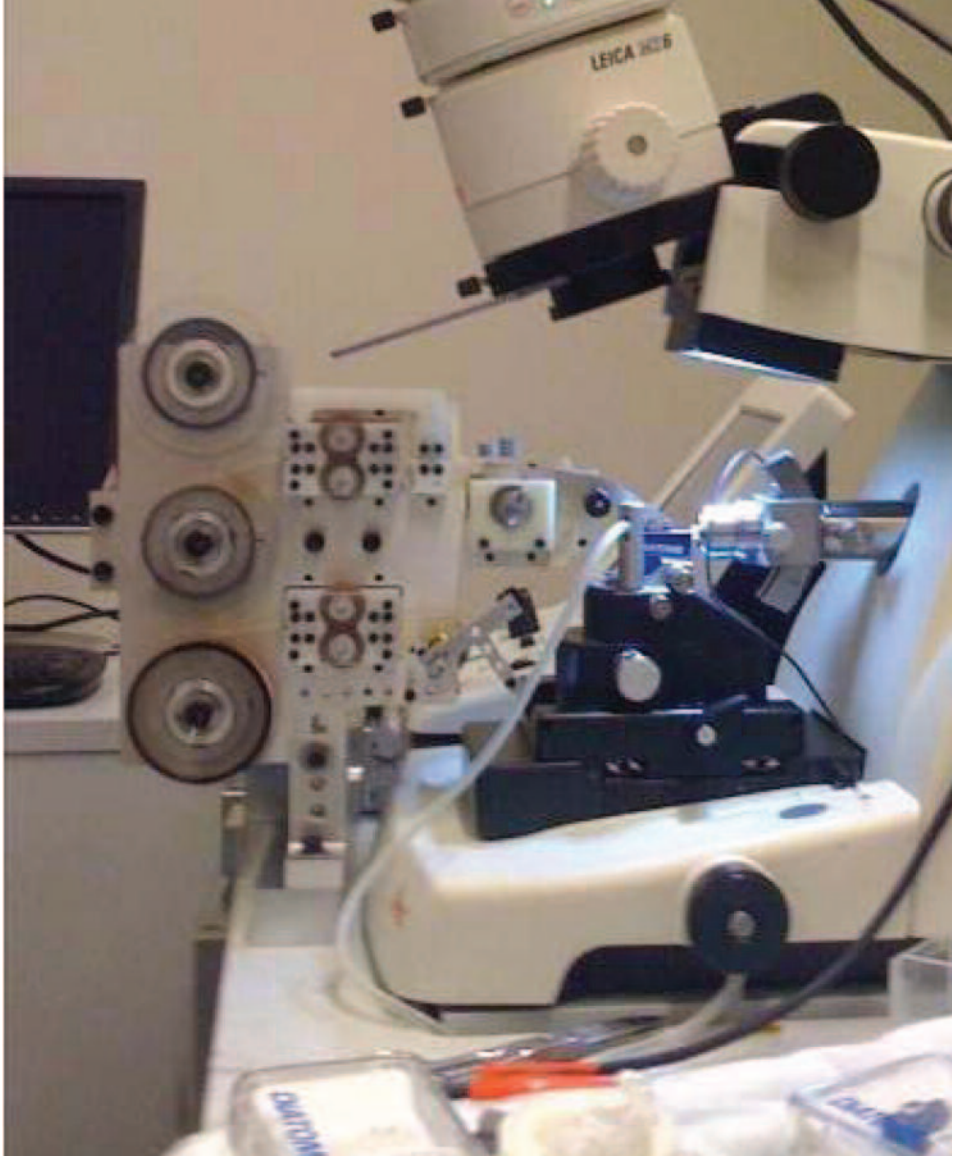
We at the BPF believe that one crucial part of this fresh perspective is to consider true alternatives to cryopreservation including room temperature chemical fixation and plastic embedding of the brain. Such a 'chemopreservation' approach, which has exactly the same goal as cryonics (i.e. placing a dying person in a long-term static state to await future technology that can revive them) was suggested decades ago (Olson 1988) but it has never been seriously pursued. In chemopreservation, fixatives like glutaraldehyde and osmium tetroxide are used to physically bind the molecular com-

ponents in tissues together preventing decay reactions from occurring even at room temperature. Following application of fixatives, a solvent-based dehydration process is used to remove all of the water within the tissue and replace it with a liquid polymer which can then be cured (Hayat 2000). The result is a hard plastic block containing a piece of brain tissue in which all the water has been removed from every nook and cranny of intra and extracellular space and has been replaced with hardened plastic. The structure of the original neural circuits is perfectly preserved in this plastic matrix creating, in essence, a perfect fossil which preserves every synaptic connection in great detail in a completely inert state that can remain for centuries unchanged even at room temperature.

This chemopreservation process is routinely used in laboratories around the world to preserve small pieces of brain tissue (typically less than one cubic millimeter in volume) for study under the electron microscope. In fact much of what we know about the fine structure of neurons and synapses is owed to this chemopreservation process. Below is an electron micrograph of a piece of mouse brain tissue that was preserved by this standard method in my laboratory. A single synaptic connection is shown highlighted in color and reconstructed in 3D.

This nanoscopic regime of synaptic connectivity is the level at which our unique memories, skills, and personality traits are written. The target of the Brain Preservation Technology Prize is to demonstrate a surgical technique (cryo, chemo, or any other) capable of preserving an entire human brain with this level of fidelity.

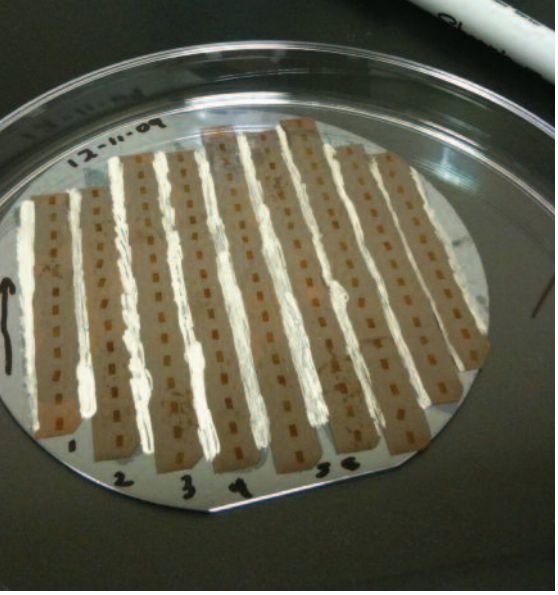
Can this standard chemopreservation technique be applied to an entire human brain? Not without modification. Current protocols call for simply immersing the small pieces of tissue in the chemical fixatives. Slow diffusion of these chemicals puts a strict limit on the volume of tissue that can be preserved by such an immersion technique; however, if the technique is adapted to instead perfuse these chemicals directly through the brain's vascular network an entire brain should be able to be preserved with the same fidelity. I have written a review (available on the BPF website) of the existing literature on such whole brain chemical perfusion; the review starts with experiments in the 1960's showing that a whole brain can be perfusion fixed with osmium tetroxide (Palay 1962). I conclude in that review that whole brain chemical fixation and plastic embedding is absolutely possible with today's technology, it is only a matter of refining the protocols. I know of at least two laboratories that are currently trying to develop these whole brain chemical fixation and plastic embedding protocols for the mouse, and several other researchers have contacted me (as a direct consequence of the Brain Preservation Technology Prize announcement) who are interested in developing these techniques for demonstration on a large mammal.



Automatic tape collection mechanism and ultramicrotome (ATUM) used to section plastic-embedded brain tissue at 30 nanometer thickness.

Putting an end to the 'Cold War'

For the last forty years a very public war has been fought between the advocates of cryonics and professional cryobiologists. This is despite the fact that there has always been considerable overlap between these groups. In 1991 Mike Darwin wrote an excellent article entitled "COLD WAR: The Conflict Between Cryonicists and Cryobiologists" giving a detailed history of the origins of this conflict. He concluded that it had little to do with the science of cryopreservation and much more to do with a clash of ideals between a few prominent individuals. This clash however snowballed into an ugly drawn out war because of the perceived need of the cryobiologists to vigorously distance themselves from macabre media reporting of some of the earliest attempts at human cryopreservation. Instead



Silicon wafer (100mm wide) holding ultrathin brain sections ready for scanning electron microscope imaging.

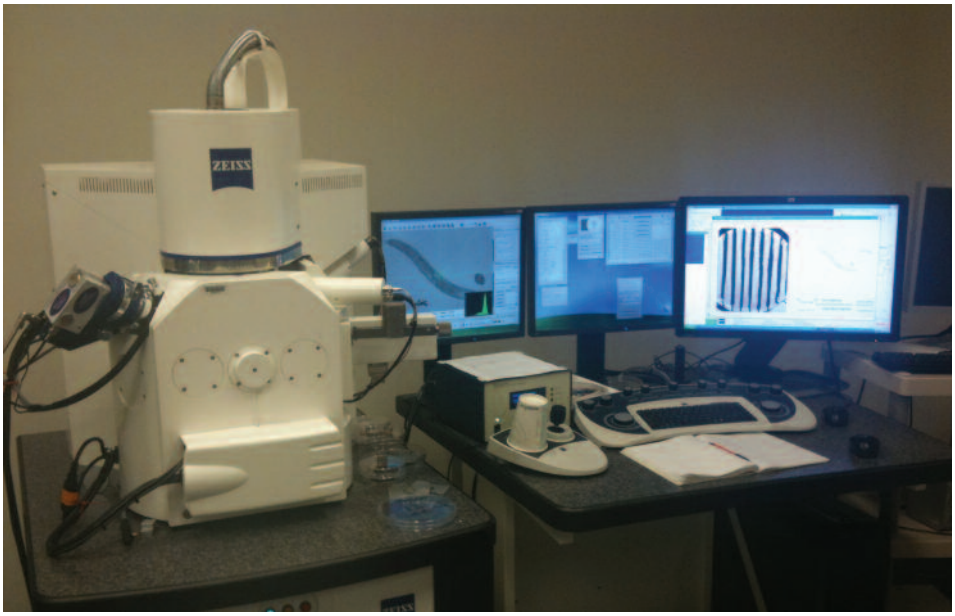
of calling for a temporary halt to human cryopreservations so that a minimum acceptable protocol could be outlined, a few prominent cryobiologists instead went on the offensive claiming that any preservation attempt on a human was futile and should be banned. Cryonicists, indignant that their right to pursue a means of personal survival was being trampled, fought back and continued to perform amateur preservations that all parties today would agree were next to hopeless. Cryobiologists in turn began to purge cryonics advocates from their professional ranks and summarily reject their papers and grant applications. The ensuing decades have only entrenched this mutual animosity.

As Mike Darwin so aptly points out, this war has next to destroyed both sides in the conflict. The field of cryobiology, originally glamorized in the public eye as pursuing the goal of reversible suspended animation for emergency medicine and space travel (think of the movie 2001: A Space Odyssey), has withered - its public stand against cryonics was synonymous with a dampening of enthusiasm for these advanced applications. The practice of cryonics, although it has managed to advance significantly in the intervening years, has paid an even higher price. There might have been dozens of professional, well-funded research labs competing with each other over the previous decades to perfect the art of human cryopreservation. The public rejection by professional cryobiologists directly prevented this from happening. If things had been different we could reasonably expect that by now every hospital would have a professional cryopreservation team on call when needed, ready to perform a regulated emergency preservation procedure known to be of high quality. Instead we have only a few unregulated companies perpetually on the brink of bankruptcy offering cryopreservation services of unknown quality under legal circumstances that preclude optimal preservation.

It is time to put an end to this 'Cold War', and I believe the Brain Preservation Technology Prize is the perfect vehicle to do this. The traditional framing of the cryonics debate within the mainstream scientific community has always been set by the cryobiologists: "Until a person can be revived from cryonic suspension the entire practice should be viewed as quack medicine; after all, the person is already dead." The Brain Preservation Technology Prize sidesteps this tired old debate by instead directly framing cryonics relative to the goals of the neuroscience community: "Can a cryonic (or other) preservation technique preserve the precise pattern of synaptic connectivity in the brain that is known by modern neuroscience to be the substrate for memory and individuality?"

The mainstream neuroscience community (much larger, more respected, and better funded than the cryobiology community ever was) retains high aspirations about its future success. Recent decades have seen tremendous strides in our theoretical understanding of the brain at the molecular, synaptic, neuronal, neural circuit, and systems levels. These advances in our theoretical understanding have been accompanied by an incredible sophistication in our ability to image the brain even at the ultimate level of tracing individual synaptic circuits. New automated electron imaging techniques (e.g. Denk & Horstmann 2004, Knott et al. 2008) have been invented within the last seven years which can image a chemically fixed and plastic embedded piece of brain tissue with nanometer resolution such that all synaptic connections between neurons within a small block can be determined with certainty. In fact, a recent paper in the journal Nature used one of these automated electron imaging techniques to reconstruct the precise neuron-to-neuron wiring of cells in a retina and compare that wiring diagram to recordings of the neurons' functioning while alive (Briggman et al. 2011). Conclusion: the neurons' original functions could be predicted based upon their traced connectivity to other neurons in the plastic block.

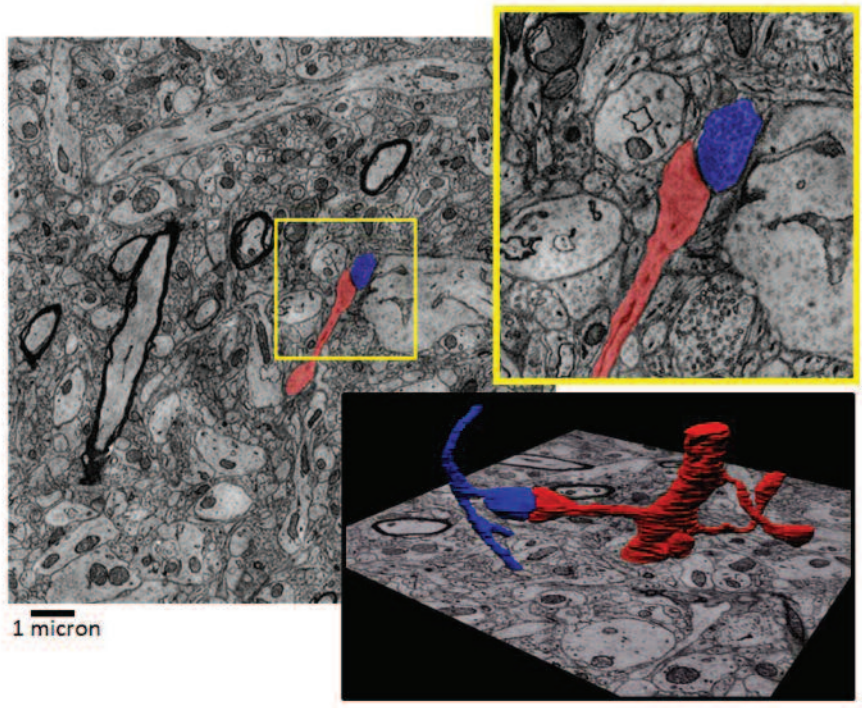
As a result of these technology developments, it is now quite acceptable among neuroscientists to discuss the future possibility of mapping an entire human brain at the synapse level (Kasthuri & Lichtman



Scanning electron microscope which can automatically image a complete wafer of ultrathin sections producing volume images with resolutions of 5x5x30 nanometers – sufficient to trace the finest neuronal processes and synaptic connections.

2007) and the future possibility of simulating an entire brain (Markram 2006). In private discussions I have had with dozens of neuroscientists over the years, I have found that most readily agree that in the future we will create fully artificial brains that will be intelligent and conscious in a human way. Many agree that we will eventually be able to upload individual human minds into computers by scanning their brain circuitry.

Given their progressive attitude toward the future, I have no doubt that the target goal laid out in the Brain Preservation Technology Prize will be readily embraced by researchers in the neuro and cognitive sciences. Once the first teams begin to show real progress toward winning the prize, I fully expect to see a watershed change in attitude toward the idea of cryonics within the scientific community as a whole – at this point the 'Cold War' will be ended and a new era of cooperation between the scientific community and the cryonics community will have begun. ■



Scanning electron microscope image of a small piece of brain tissue that was chemically fixed and plastic embedded and then sectioned on the ATUM. A single synapse is highlighted in color and rendered in 3D after tracing through a stack of about 100 serial images. Every human brain has trillions of such connections. Modern neuroscience is founded on the premise that the precise pattern of connections between our neurons (our 'connectome') encodes all of our memories, skills, and personality traits . Our unique connectome is thus a static representation of our individuality. The Brain Preservation Technology Prize requires that a competing team prove that the connectome has been preserved across the entire brain.

About the Author

Kenneth J. Hayworth, PhD

Kenneth Hayworth is president and co-founder of the Brain Preservation Foundation. He is currently a post-doctoral researcher at Harvard University. Hayworth is co-inventor of the Tape-to-SEM process for high-throughput volume imaging of neural circuits at the nanometer scale and he designed and built several automated machines to implement this process. Hayworth received a PhD in Neuroscience from the University of Southern California for research into how the human visual system encodes spatial relations among objects.

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Some Thoughts on Ken Hayworth's Proposal

By Mike Perry

I think it is commendable that Ken Hayworth is offering a prize for demonstrated, near-perfect brain preservation at the synaptic level where identity-critical structure appears to be seated. I'm sure it will aid the cryonics movement, both at the technical level and publicity-wise. Neuroscientists may then have a more favorable attitude toward cryonics (or whatever preservation approach is found effective) and some may be persuaded to support cryonics, along with medical professionals and scientists more generally and, following their lead, the public at large.

Here though I have to inject a firm doubt that it will start a major wave of signups among any of these groups, even the neuroscientists themselves. Experience of some decades suggests that people have deep-seated emotional reasons for rejecting cryonics, that lie within the subconscious and are generally not fully understood. Sometimes, for instance, they will cite the cost of the procedure as their reason for not making the arrangements, and steadfastly maintain this position as if it were the primary deterrent. But if you then make an offer to bear the cost yourself or otherwise raise the funding, they simply switch to another reason to decline. (Or, as in one case I know of who is now buried, exercise a "pocket veto" by not further commenting.) In general the arguments given against choosing cryonics, if not focusing strongly on religious issues, seem to be of a straw-man character that obscures deeper psychological impediments. Such obstacles will only be overcome by particularly strong evidence. At minimum, perhaps it would take the successful, repeatable resuscitation of a cryopreserved organ such as a heart or kidney, which could then be used to save the life of a patient. Of course I would be glad to be proved wrong but that's the way matters appear to stand. And of course I think the effort is worth it even if only a modest or nonexistent uptick in signups results, given the expected technical advances and attendant favorable publicity. (Indeed, cryonics signups could be increased substantially and greatly benefit the movement even if the effects on the population as a whole were minuscule.)

I also want to comment about the overall tone of Ken's proposal: optimistic in important ways, but sometimes more pessimistic than it should be. He makes a good case that the basic idea of cryonics is sound and ought to be pursued. And, of course, we do want better procedures and it would be good to have a mechanism in place to reward a successful effort to find one. Such an effort is certainly warranted—our procedures are not as good as we'd like and we don't expect they will be anytime soon. I will also here note my heartfelt approval for Ken's interest in finding a viable, low-cost alternative to expensive cryopreservation. "Improvement" can have a financial as well as a technical dimension, at least for the many of us who are not wealthy.

Ken, on the other hand, is pessimistic about present and past protocols for cryopreservation (though in fact an Alcor member of long standing, as he informs us). Some of it I think is unwarranted. For example, he says, "As a neuroscientist I have no problem stating the minimum conditions that [cryopreservation] needs to meet for it to allow possible future revival of the individual with memories and personality intact – the precise connectivity of the brain's hundred billion neurons must remain intact." This appears to overlook the possibility that the connectivity, while not intact, is still inferable from what remains. (By analogy, when a document is run through a paper shredder it is certainly no longer intact but might still be reconstructible from the fragments, particularly if the text alone is what we are interested in. As an example, Wikipedia reports in the article "Paper shredder": "After the Iranian Revolution and the takeover of the U.S. embassy in Tehran in 1979, Iranians enlisted local carpet weavers who reconstructed the pieces by hand. The recovered documents would be later released by the Iranian regime in a series of books called 'Documents from the US espionage Den.' The US government subsequently improved its shredding techniques by adding pulverizing, pulping, and chemical decomposition protocols.") Of course it may be that many or most in the neuroscience community (and scientists more generally) will feel as Ken does—that the connectivity must be intact—but I think that position is questionable in view of the prospects for future tracking and analysis of structure at the molecular scale. (It is worth noting here that this tracking should be con-

siderably finer-scale than what Ken's proposal offers and would open the prospect of deductions of original structure that might be impossible using the anticipated techniques based on electron microscopy.)

Continuing in this vein, I have some disagreements with what is said in "Ending the Cold War," even though I am certainly in favor of its overall aim of reconciling cryobiologists with cryonicists. One thing Ken suggests is that a "temporary moratorium" on cryopreservations might have been a reasonable policy back in the early days when procedures were admittedly very crude. Not so! If I or a loved one were dying I would want the best procedures available, in spite of all uncertainties, rather than just giving up. (And I think very many cryonicists will agree with me on this.) In particular I consider a straight freeze to be better than no preservation at all, by a wide margin, even though looking at the resulting neural rubble under the microscope tells me that it will be a big challenge for advanced future technology to untangle, if it can. But let the attempt be made! (I will note too that some of this "rubble" is caused by cells shrinking to small volume leaving large, ice-filled spaces in between, which is not the same as wholesale fragmentation.)

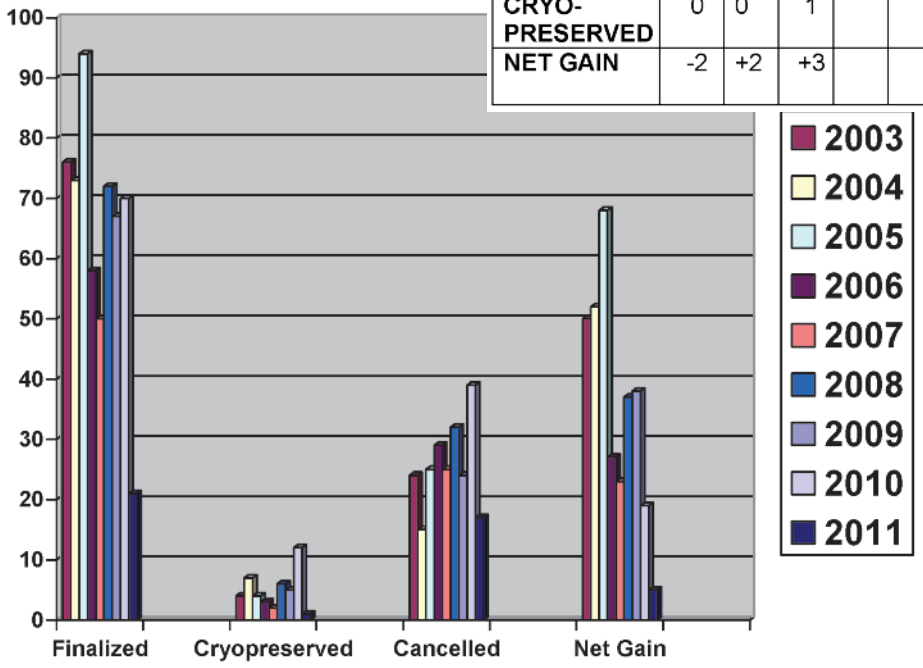
As a further thought, we don't demand perfect recovery with clinical cases today for treatment to be worthwhile. The recovered patient may be quadriplegic, or have one or another neurological deficit, yet still feel (as others agree) that, in balance, their life is worthwhile and not wish it had ended. With cryonics cases arguably the worst deficit the patient is likely to suffer, in view of future medicine, is some amnesia, and even this would be amenable to amelioration through use of outside sources of information which could be used to reconstruct memories, language skills, or other capabilities. (Toward this end, Alcor members can store a banker's box of records free of charge. Another possibility is to store a permanent "mindfile" using CyBeRev, a free service of the Terasem Foundation.) In short, there is reason for hope even with very crude methods of cryopreservation.

Again, though, I commend the effort Ken Hayworth has made in setting up a brain preservation prize, and hope it bears fruit. ■

I thank Hugh Hixon, Saul Kent, Ralph Merkle, Aschwin de Wolf, and Brian Wowk for their helpful advice and comments.

Membership Statistics

2011	01	02	03	04	05	06	07	08	09	10	11	12	
TOTAL	930	932	935										935
FINALIZED	3	7	8										18
REINSTATED	1	2	0										3
CANCELLED	6	7*	4										17
CRYO-PRESERVED	0	0	1										1
NET GAIN	-2	+2	+3										+5



On March 31, 2011, Alcor had 935 members on its Emergency Responsibility List. Eighteen (18) memberships were approved during the first three months of 2011, three (3) memberships were reinstated, seventeen (17) memberships were cancelled and one (1) member was cryopreserved. Overall, there was a net gain of five (5) members this month.

SENS: *A Reply to Ben Best*

By Aubrey D.N.J. de Grey

SENS, my proposal for combating aging with regenerative medicine, was first formulated in 2000 and first published in 2002 [1]. In 2005 and 2006, the first scientific critiques of SENS [2,3] appeared that were worthy of the name – in other words, that focused squarely on the scientific details of SENS rather than speaking in generalities. Both featured many profound flaws, as outlined in my replies [4,5], but I was under no illusions that this meant that SENS will definitely work. Accordingly, it has been a source of disappointment to me that the subsequent five years have not seen better-informed and better-founded critiques, even though an undercurrent of intuitive pessimism about SENS undoubtedly survives. I am therefore gratified that Cryonics Institute CEO Ben Best has published a careful analysis of what he sees as deficiencies in SENS, in the previous issue of CRYONICS [6].

Ben's first criticism is a terminological one, and to a large extent I accept it. Specifically, he disputes the legitimacy of describing the SENS approaches to combating mutations, whether mitochondrial or nuclear, as "damage repair." In the case of mitochondrial mutations I think it is just about reasonable to claim that the SENS approach is indeed damage repair: the approach is to render such mutations harmless by inserting suitably modified copies of the relevant genes into the nuclear DNA, and the goal is to restore function to mitochondria that have lost the ability to metabolise oxygen because of mutations [7]. In other words, this intervention will indeed repair dysfunctional mitochondria, in the sense of restoring their function. However, I concede that its main impact will be pre-emption of dysfunction more than repair, since the genes will mostly be inserted into cells whose mitochondria are not yet mutated. Similarly, the approach that SENS highlights for combating the effects of nuclear mutations consists of repairing and/or pre-empting those effects, rather than repairing the mutations themselves. In this case the intervention entails eliminating cells that have become "death-resistant" (typically as a result of nuclear DNA damage), replacing cells that have died (again typically as a result of nuclear DNA damage) and have not been automatically replaced by division of other cells, and most importantly eliminating the genes that allow rare cells which mutate into a "quiescence-resistant" state to divide indefinitely as tumours [8]. This last item is clearly mostly a case of pre-emption rather than bona fide repair: it is repair only to the extent that cells which are already cancerous or pre-cancerous can be eliminated by the apoptosis that results from further cell division following the therapy.

Therefore, my only objection to this criticism is Ben's characterisation of it as "a procrustean attempt to force two strategies into a model purporting to only be concerned with damage and repair." It is not the model itself that purports to revolve around damage and repair, but merely the sound-bite description of that model. I know that both Ben and our readers appreciate that painfully approximate terminology is a sad necessity in the quest to communicate our message to those whose attention has not yet been gripped by the understanding that the defeat of aging is humanity's most important mission. Accordingly I am pleased that Ben took the trouble to stress that this criticism of SENS is minor.

In the remainder of what follows, therefore, I shall address the more substantive issues that Ben raises, and explain why I feel that they do not stand up to detailed scrutiny.

First of all, Ben focuses on nuclear DNA damage that does not fall under the three categories addressed by aspects of SENS (see above). I will hereafter refer to such damage as "non-specific." Before continuing, I should mention another terminological issue – one which does not lead to any dispute between Ben and myself, but which may confuse readers. Ben very reasonably uses the term "DNA damage" in the way that it is customarily used by those who work on DNA repair; however, it is important to clarify, which Ben indirectly does but only later on in his article, that this usage is unfortunately at variance with the way in which I use the term "damage" when describing SENS. Specifically, "damage" in the DNA repair literature refers to molecular changes that the cell possesses machinery to repair, such as double-strand breaks, whereas in SENS, "damage" denotes precisely the changes that the cell *cannot* repair, such as mutations. Accordingly, in what follows I shall studiously avoid using the term "damage" at all, and instead refer to "mutations" (which should be understood to include epimutations, explained below) and "lesions" (a term also commonly used in the DNA repair literature to refer to damage that is amenable to repair). Thus, a lesion is what happens to DNA as a result of free radical attack and such like, and a mutation is what happens to DNA when the cell's machinery fails to repair a lesion correctly but instead "repairs" it wrongly.

OK, so to Ben's concern. In a nutshell, he appeals to the "coincidence" that various syndromes which exhibit many facets of normal age-related ill-health at an abnormally early age are caused by congenital defects in DNA repair. I have two responses to this. First, Ben is implying that because breaking some process accelerates lots of aspects of aging, therefore an intervention that does not improve that process would fail to deliver postponement of aging. This is only true if the proposed means to postpone aging leaves untouched key pathways in the *mechanism* by which imperfections in the process in question mediate accelerated aging. For example, if the various progerias caused by defects in DNA repair and maintenance

occur because the resulting lesions and/or mutations cause premature accumulation of death-resistant cells, and/or premature loss of vital cells (most notably stem cells), and/or premature emergence of cancer, the claim that SENS will work is not challenged, because SENS addresses those things. I am not aware of evidence against this scenario – and, indeed, Ben highlights evidence that these are indeed mechanisms underlying the progerias. Second, Ben notes that the double strand break repair mechanism normally defective in progerias is homologous recombination, even though the mechanism agreed to be the main source of mutations is non-homologous end-joining. There is a clear disconnect there.

Ben goes on to acknowledge that SENS incorporates elimination of death-resistant cells and replacement of lost cells, but then he makes the erroneous claim that such approaches cannot be applied to non-dividing cells such as neurons. In organs such as the heart, it is critical that new cells should integrate properly and form the appropriate junctions with existing cells, but the burgeoning field of heart repair using stem cells is founded on the belief that that is by no means a fanciful goal. Ben correctly highlights the brain as the organ in which this replacement-associated integration is the most critical, but I believe he is wrong in his belief that the replacement – slow replacement, to be sure, but replacement nonetheless – of lost neurons necessitates a loss of personal identity, memory etc. Rather, my view is that the distributed, holographic structure of memory, combined with the fact that recalling a memory automatically reinforces it, allows for the retention of all memories and other aspects of personality that are significant enough to care about, even if all neurons were progressively replaced over a very long life.

Ben then cites evidence not relating to progerias that he claims also demonstrates a key role of non-specific mutations. However, here he confuses lesions with mutations. He notes that lesions are more abundant in old rats than young, and that this is probably due to lower activity of repair machinery, which in turn probably results from lower energy availability. He infers, and I see no reason to disagree, that this drives an age-related acceleration of the accumulation of mutations. But what he fails to show is that the absolute abundance of mutations, even taking into account this acceleration, rises to anywhere near the level that would be needed in order for non-specific mutations to contribute to ill-health. Moreover, he overlooks the essential point that this acceleration applies with equal force to mutations of the three categories that SENS obviates. As I have noted in print in the past, it may be precisely the risk of ill-health posed by those mutations (specifically those causing quiescence-resistance, i.e. cancer) that has driven evolution to make our natural DNA repair and maintenance machinery as effective as it is [9].

Finally, Ben notes that even though there may be evolutionary arguments (see above) to be optimistic that non-specific mutations are of no importance in aging, it would be much better if we had definitive data on the question. Here I agree wholeheartedly – and I have put my (or, to be more precise, SENS Foundation's) money where my mouth is. Jan Vijg's group has demonstrated, in many papers over the past decade or more, that nuclear mutation load accumulates during development in every mouse tissue but during adulthood only in a few, and not at all in the cerebral cortex [10]. If mutations do not accumulate, then their accumulation definitively cannot contribute to aging. It therefore remains only to examine whether types of irreparable DNA damage not assayed in Vijg's studies may accumulate. There are such types: in particular, there are epimutations, i.e. random and unregulated changes not to the DNA sequence but to the "decorations" that determine which genes a given cell transcribes (forming RNA and thence proteins) and which it does not. While the evolutionary logic I have provided applies equally to epimutations as to mutations, no direct evidence of the form available for mutations has been forthcoming.

Therefore, in recognition that the evolutionary arguments noted above do not give adequate peace of mind for this critical purpose, SENS Foundation has for the past two years been funding a project in Vijg's lab to explore exactly this. The most challenging aspect of the project, at its outset, was development of the necessary technique for determining the epigenetic state of single cells, starting from pre-existing techniques that needed to pool 1000 or more cells. I am delighted to report that this has now been achieved (as will be described in a forthcoming publication), so we are now on the verge of answering this question. Of course, if epimutations are indeed found to accumulate in the cortex during adulthood, it will remain to determine whether the extent of that accumulation is sufficient to contribute to aging – but if they do not, we can truly rest easy in the knowledge that the three SENS strands targeted at the cellular consequences of mutations (and epimutations), once successful, will allow us to neglect such mutations in the course of our attempt to postpone age-related ill-health, at least until we have lived a very great deal longer than anyone lives at present. ■

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Hugh Hixon, Research Fellow, has worked at Alcor since 1983. He has devoted more than half of his life to cryonics.

Member Profile:

Hugh Hixon

By Chana de Wolf

If you have been an Alcor member for an appreciable amount of time you have most likely heard of, or even met, Hugh Hixon. Hugh, who serves as Research Fellow at Alcor, has been employed at the organization since 1983 and is responsible for several of the technical developments that Alcor utilizes in the field and the OR during cryopreservation cases. Hugh is the quintessential 'tinkerer' – the guy who has been around longer than anyone else, knows the most about cryonics technologies, and who can utilize that breadth of experience and knowledge to improve both the processes and equipment involved in carrying out a case and in maintaining patients in long-term storage.

Over the years, Hugh has become an integral part of Alcor operations. His involvement in everything from solution preparation to dewar maintenance to doing cryoprotective perfusions reflects his interest in every aspect of the field. Indeed, whenever there has been a scientific or technical void at Alcor, Hugh has done his best to fill it. In speaking with him, it is apparent that he views cryonics not just as a part of his life, but *as* his life. And with good reason: Hugh's history is practically one and the same with Alcor history.

Of course, Hugh's life didn't start with cryonics. Born in 1942 in Long Beach, CA, he grew up in the area and became interested in chemistry at a young age, primarily due to a fascination with explosives. In high school he read most of an industrial chemistry textbook, which described such processes as the production of carborundum (silicon carbide) jewelry by exposing a mixture of sand and charcoal to extremely high temperatures (2500 - 3000°C) inside of an industrial furnace.

The seeds of intrigue planted, Hugh extended his quest for chemical knowledge at the University of Redlands, where he obtained a Bachelor's degree in chemistry. Working for only a short while after graduation, he then received a draft notice and "escaped into the Air Force" where he was a munitions officer. Jumping from Lackland, TX, to Denver, CO, to Las Vegas, NV, Hugh fulfilled his duties in aerospace munitions, learning much about thermonuclear weapons, but primarily performing administrative duties such as managing the bomb dump in Las Vegas.

Following the Pueblo incident in South Korea, Hugh was sent to the Taegu, Korea, Air Force station for 9 months, then went back to the U.S. at Cannon Air Force base in Clovis, NM, for 2.5 years before leaving the service. "It was interesting work," he explains, "but ultimately, I didn't have quite the attention to detail that you need to have as an officer."

Picking up where he left off, Hugh went back to school, entering the graduate program in biochemistry at California State University at Long Beach in 1973. "I became a tenured graduate student," Hugh jokes. "I spent over a decade in grad school, and didn't obtain my Master's degree in biochemistry until 1983." Spending such a long time in school allowed Hugh to explore his interests in depth and to take a lot of additional classes that a biochemist wouldn't normally take, including advanced inorganic chemistry, organic catalysis, electrochemistry, solvation chemistry and internal chemical reactions.

During that time, around 1977, Hugh's college roommate, Laurence Gale, introduced him to cryonics. Fred and Linda Chamberlain, founders of Alcor, had recruited Laurence into Alcor after meeting him at a series of Libertarian/Randian seminars, and Laurence sought Hugh's help with some problems Alcor was having at the time. By 1978, Hugh had participated in his first cryopreservation; he was becoming more involved in cryonics every day.

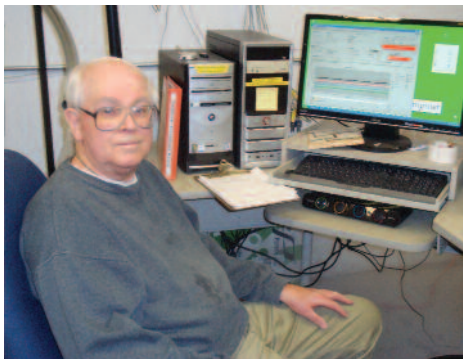
It wasn't long before some cryonicists, Thomas Donaldson in particular, were stumping for research. Jerry Leaf, who worked in the Department of Thoracic Surgery at UCLA, heeded the call, bringing surgical experience and perfusion technology to cryonics. Hugh met Jerry and they performed their first case together, flying the patient from New York to California for perfusion-based cryoprotection. It was a large leap forward of technical capability in cryonics.

In 1982, cryonics activist and pioneer Mike Darwin moved his Indianapolis based cryonics operation out to California and merged with Jerry Leaf's company Cryovita, becoming part owner (Hugh later became part owner, as well). That same year, Hugh and Jerry made their own personal cryopreservation arrangements with Alcor and Hugh joined the Alcor Board. Mike Darwin, who had shown promising leadership qualities, was installed as Alcor President. The next year (1983) Hugh finally got his Master's degree in biochemistry.

Given his now-serious involvement in cryonics, it shouldn't come as a surprise that Hugh basically went straight from graduate school to a career at Alcor. He was officially hired as Facilities Engineer in 1983, and initially did a lot of the necessary administrative work, including editing, publishing, and mailing *Cryonics* magazine.

Meanwhile, research moved forward with a grant to Alcor from the Life Extension Foundation which was headed by Saul Kent and Bill Faloon. Alcor and Cryovita developed the MHP-2 washout solution which is still in use at Alcor today. A consequence of the intense experimentation was that the surgical team got a lot of bypass experience. Hugh recalls that "Jerry did the surgeries, while Mike did the perfusions. Initially, I was batching the perfusates and doing the blood chemistry, running the Radiometer blood-gas machine."

In 1988, following the Dora Kent case – which resulted in severe tensions between Alcor and the Riverside, CA, coroner's office – the Board replaced Mike Darwin with Carlos Mondragon as President. "There were a couple of years of fighting at Riverside," Hugh remembers. "The media frenzy surrounding the Dora Kent case led to Jerry Leaf losing his job at UCLA. Meanwhile, the Society for Cryobiology blacklisted anyone associated with cryonics as well as vendors who sold products to cryonics organizations, making it difficult for Alcor to obtain dewars for patient storage. Then, to top it all off, Jerry Leaf went down and was cryopreserved in 1991." "It turned out Jerry was the glue holding everyone together," Hugh laments. More infighting and tensions led to Carlos Mondragon's replacement by Steve Bridge as President, and Mike Darwin leaving the organization. With Jerry Leaf and Mike Darwin no longer active at Alcor, Hugh, who until then had been in a rather subsidiary position in the OR, suddenly had to pick up the slack. "At that point, there was a pretty steep curve for learning how to do perfusions," he admits.



Captain at the helm: *Hugh monitors the computer used to control patient cooldown to cryogenic temperature. He is responsible for the development of many technologies used by Alcor today.*

A commitment to cryonics is necessary to ensure long-term care and to increase the probability of resuscitation.

A strong push was made to move Alcor out of Riverside for several reasons. To begin, Alcor was simply outgrowing the Riverside facility. Additionally, ongoing political struggles after the Dora Kent case had resulted in a change in the facility's zoning to prohibit animal experimentation. In the same vein, continued problems with the local coroner's office did not bode well for operations. And last, but not least, Riverside was also in an earthquake zone, putting the patients in long-term care at risk. That's when David Pizer, a member and businessman with strong ties in the Phoenix area, suggested that Alcor move to Arizona. Given the situation in Riverside, Phoenix was inviting. There were practically no risks

of natural disaster, and the political climate looked friendly. With Dave Pizer's help, Alcor made the move to Arizona in 1994 and was welcomed with open arms by the City of Scottsdale, where the facility remains to this day.

Things have gone fairly smoothly for Alcor since relocating to Arizona, though internal and external politics have continued to exert their effects, as evidenced by a succession of President/CEOs. Steve Bridge kept a promise to resign after 4 years in 1997 and was followed by a return of Fred and Linda Chamberlain (1997-2001). (They had been Alcor's original CEOs, 1972-1975). After the Chamberlains there was Jerry Lemler (2001-2003), Joe Waynick (2003-2005), Steve van Sickle (2005-2008), Tanya Jones (2008-2009), Jennifer Chapman (2009-2010), and now Max More (2011-). But through it all, Hugh has remained a constant fixture, even in the face of personal adversity.

And what more frightening foe could a cryonicist face than something life-threatening? Plagued by a genetic predisposition for coronary artery disease, Hugh underwent bypass surgery in 1996. "That bought me 10 years without any problems," he explains. When he had angina in 2006, ending with a mild heart attack, Hugh was ready to try something new. Ever the experimentalist, he took part in a treatment known as enhanced external counterpulsation (EECP). Immediately relieved of CAD-related symptoms, Hugh was amazed at the results. "My angina had come back, and was unstentable. Nitro relieved the angina, but at the cost of continuous nitro headaches," he recalls. "EECP worked spectacularly for me."

Hugh's working day frequently includes filling the cooldown dewar with liquid nitrogen in preparation for an upcoming patient.

Through it all, Hugh was at Alcor doing was he does best: technical development. Over the years he has invented such useful devices as the "crackphone," which determines cracking temperature and degree of cracking during cryopreservations. He used his experience in the construction of the Cryovita Labs Mobile Advanced Life Support System (MALSS) to design and build Alcor's Mobile Advanced Rescue Cart (MARC). He is the initial fabricator of the Bigfoot Patient Pod System and he modified the MVE Bigfoot dewar design for simpler manufacture. Hugh also designed and was instrumental in constructing the Patient Care LN2 Bulk Fill System, in addition to conceiving, designing, and constructing the LN2 Vacuum Transfer System and the LN2 Vapor Cloud Extractor ("fog sucker"). He has contributed to the development of several iterations of cooldown boxes and control systems at Alcor.

Hugh also designs Alcor's perfusion tubing packs, makes cryoprotectant solutions for perfusions, occasionally participates in field washouts and patient transports, and, of course, still performs cryoprotective perfusions, resulting in his participation in a record number of cases. "By default, I've turned out to be the person at Alcor who knows the most about cryonics technologies," Hugh points out. "And because I do so much stuff, when I have an angina attack, it tends to make people really nervous."

Indeed. As Hugh has aged, his continued struggles with CAD have brought this issue to the forefront. All are agreed that, given his long history in cryonics and breadth of knowledge across so many fields, Hugh is simply irreplaceable by any other single person. It is more likely that at least two people will be necessary to perform the varied duties and functions that Hugh will eventually leave as his legacy.

"The most challenging aspect of cryonics is to understand what we are doing and make it work," he says. "Ultimately, it must be possible, because we're alive. We basically just need to control molecular biology. But how easy will this be? We don't know yet. All we can do for now is cryopreserve the patient and either wait for nanotechnology or come up with a reversible cryoprotectant." To that end, Hugh will undoubtedly continue to contribute ideas and design concepts to improve Alcor's operations and services right up until the moment he requires them himself.

Steve Van Sickle, former Alcor CEO, and Hugh Hixon prepare liquid nitrogen ice cream at the author's wedding.

Accordingly, Hugh's advice to fellow members is: "Don't be in a hurry to get cryopreserved; there are still a lot of problems to be solved;" and "Don't lie to yourself about the chances for success, either generally or personally; it's an experiment. But it's not a dice roll; we can affect the outcome. Lying leads to failure."

If our little experiment ultimately is successful, I'll be first in line to thank Hugh Hixon. ■

2011 Q2 Readiness Update

By Aaron Drake, NREMT-P, CCT
Alcor Medical Response Director

Alcor's Recent Cryopreservation

In late March this year, Alcor was notified that a member in Pennsylvania had entered the hospital with severe abdominal pain and was critically ill. As her medical providers predicted that she would probably not survive, Alcor's Medical Response Director, Aaron Drake and Readiness Coordinator, Steve Graber were on a plane to the east coast within the next three hours. Upon arrival, the member's health condition had stabilized and appeared to have improved somewhat. Hopes were raised for a recovery, but diagnostic tests and blood labs indicated a terminal outcome was likely. The pause in the patient's health decline provided an opportunity to request the services of Suspended Animation to help perform a field washout and perfusion.

On the third day of the standby, the member succumbed. Highly cooperative hospital administrators and physicians allowed the Alcor team to perform stabilization and cooldown procedures in the patient's private room immediately following pronouncement. The patient was then transferred to a local mortuary where Suspended Animation completed the next step. The family had prepaid additional funds to Alcor for a private jet to eliminate potential delays associated with commercial air travel. After a six and half hour flight, the patient arrived at the Scottsdale Airport, located just a few blocks from Alcor.

Alcor's surgical team was standing by and performed vitrification procedures throughout the night. On Saturday, March 26th, member A-2478 became Alcor's 104th patient.

Southern California Response Vehicle

The newly remodeled Southern California response vehicle has returned to Playa del Rey, CA and is once again ready for deployment. Alcor decided to perform a series of upgrades to the interior of the van to make it more versatile on standbys and stabilizations. The upgrades include adding an electric/hydraulic hoist and sling lift system rated at a capacity somewhat greater than 250 kilos. We added an integrated side storage rack/bench with heavy duty straps for Pelican supply and medication case storage. The floor of the van was retro-fitted with a heavy duty track and strap system to secure the Portable Ice Bath during transport. For internal power, a 2 kilowatt 110v AC inverter was installed underneath the new bench and two 28" long white LED lighting strips of approximately 580 lumens each were installed across the ceiling. We are very excited about these new upgrades as this vehicle serves a large percentage of Alcor members who reside in the Southern California region.

Team Training

Alcor recently conducted two training sessions for the Laughlin, NV and the Scottsdale, AZ teams. The Laughlin team which now has 16 staff members who are trained and able to respond for cases. The training included two full scenarios where all medications and supplies were used on a mannequin in a real-time environment. The visit also provided an opportunity to deliver their newly organized medications and supply kits.

The Scottsdale team also held a one day training review where 16 people were in attendance in addition to four Alcor staff members. The Scottsdale team training is different from that of regional teams as different equipment and supplies are used due to the availability of Alcor's rescue vehicle.

Medication Protocols

The medication protocols used in the immediate stabilization of cryonics patients varied a bit between Alcor and Suspended Animation. To bring these two into alignment, Alcor's Research and Development Committee reviewed and adopted a new uniform-dose based set of medications. This approach will simplify the administration of medications and eliminate the need to perform weight based drug calculations, when the patient's weight is only a guesstimate. There was further refinement of appropriate dosages to achieve desired effectiveness.

To implement these changes across Alcor's network of eight teams requires a coordinated effort to ensure that all medications, package labeling, instructions and reference materials are modified to reflect the new protocols. In Alcor's kits, each medication, specific preparation supplies and administration instructions are packaged as a single unit to aid the team member and reduce the chance for error. To decrease the cost of replacing all of the medication packages simultaneously, a staggered replacement approach will be used over the course of the next month to ship these supplies to each of the teams. ■

About the Author

Aaron Drake
NREMT-P,CCT, Medical Response Director

Aaron Drake is a Nationally Registered EMT-Paramedic (NREMT-P) and a Certified Cardiovascular Technologist (CCT) who serves as Alcor's Medical Response Director. In this position he is responsible for the standby, stabilization and transport operations of the Alcor Foundation.

Global Catastrophic Risks

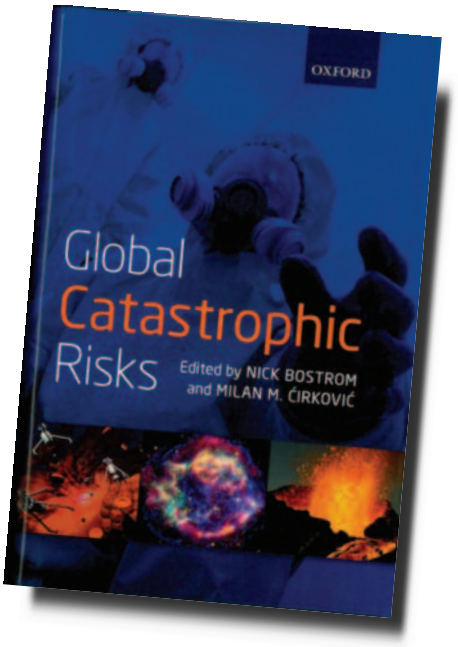
Edited by Nick Bostrom and Milan M. Æirkoviæ (Oxford: 2008, Oxford University Press).

BOOK REVIEW BY R. MICHAEL PERRY

This ample volume considers events that could wreak havoc on a global scale, and possibly destroy civilization or earthly life altogether. Projecting such future possibilities is hazardous; unexpected developments could easily confound predictions, and the detailed analyses and calculations which frequently occur in the book and call for close study could quickly lose relevance. A pioneering work of this sort is welcome nonetheless. Human causes of devastation are given their due, but also natural calamities such as asteroid impacts. Some of the possibilities are remote but are included because they would be so devastating that the estimated probability times the estimated severity is still significant. The distinguished cast of some two dozen contributors includes many PhDs and one Nobel physicist, Frank Wilczek. Careful thought and research are evident throughout, along with scrupulous concern over how we can avoid or mitigate the effects of catastrophic events. There is, moreover, a spirit of cautious optimism in some of the more speculative chapters, such as one on the future of artificial intelligence. Things could turn out much the worse, of course, but need not and instead could benefit humanity in ways unprecedented and hardly imagined.

Just what is a global catastrophic risk? In the Introduction the editors offer a guideline: "A catastrophe that caused 10 million fatalities or 10 trillion dollars worth of economic loss (e.g., an influenza pandemic) would count as a global catastrophe, even if some region of the world escaped unscathed." On this basis, global catastrophes are nothing new but include such occurrences as the Black Death in medieval Europe and the two world wars in the 20th century. The asteroid impact that is thought to have killed the dinosaurs some 65 million years ago illustrates another possibility—on an even grander scale—though a similar event in the future might be forestalled by intelligent intervention. The severity of a risk of such disasters is characterized by three variables: (1) *scope*—how many are affected (humans or possibly other creatures); (2) *intensity* (how severely they are affected); and (3) the *probability* of the event. Contributors to the book were asked not only to estimate present-day risks but also to assess how these risks might develop over time. This is an especially important consideration in view of technological progress and its effects on the attitudes, practices and goals of people throughout the world.

The book is divided into four main parts covering (1) background, (2) risks from nature, (3) risks from unintended consequences, and (4) risks from hostile acts. The background contains eight chapters covering, among other topics, (1) the long-term fate of the universe, (2) evolution theory and the future of humanity, (3) cognitive biases potentially affecting the judgment of global risks, (4) catastrophes and insurance, and (5) public policy toward catastrophe. Under risks from nature are three chapters dealing with (1) megascale volcanism and other disruptive geophysical processes, (2) comet and asteroid impacts, and (3) radiation from supernovas, gamma rays, solar flares and cosmic rays. Risks from unintended consequences include (1) climate change, (2) plagues and pandemics, and (3) bad effects from unfriendly AI. Finally, there are risks from hostile acts. One looming risk is from nuclear weapons, whether from governments or non-state agents (terrorists). Add to this the misuse of biotechnology and



nanotechnology. Finally, there is the possibility of totalitarian takeovers, maybe as a reaction to terrorism on an unprecedented scale, which in turn could be made feasible through new, readily available technology.

In all it is not a cheery picture if you choose to focus on the bad side. Unfortunately in particular, making trouble appears to be getting easier as technology advances, even as means of dealing with the problems are also improving. Terrorism at least is recognized as a threat and is solidly opposed by most people everywhere, which tends to make it harder to carry out. One of the most feared anticipated forms, the as-yet unrealized use of nuclear weapons, appears to be especially difficult to engineer—one ground for hope. No private group has yet made or acquired any nukes, as far as anyone is aware—though some have tried—and there is reason for cautious optimism that it will not happen soon. If it does happen, say,

a few decades hence, we may hope that safeguards will be in place to quickly neutralize the threat.

The main safeguard could be advanced artificial intelligence, which by then might have sharpened and refined itself through decades of recursive self-improvement and interactions with the humans it was created to serve. An entire chapter of the book is devoted to the possible risks that superhuman AI itself could pose and how these risks might be remedied, the key being to create friendly AI that will have humanity's best interests uppermost. Overall, I found this chapter, by Eliezer Yudkowski, the most interesting of all in the book. In short, we are talking about creating something at least vaguely godlike, to minister to our needs whatever they may be, and in particular protect us from catastrophic risks.

The creation of such a system would, needless to say, not be undertaken lightly but would exercise human talents to the utmost in view of the possible consequences of a serious misstep as well as the benefits that could otherwise accrue. If all went well we could find ourselves freed of diseases and aging as well as the need to labor for a living, under the benign patronage of a great, caring overseer which would look after us like our parents once did. (As one spinoff of this engineered benevolence, cryonics patients could be resuscitated without charge.) Though in theory this might be fine, at least until we could "grow up" and attain a more advanced status ourselves with powers enhanced through the help of our AI genie, many of us find this idea unsettling. We want to be our own bosses, in case our mechanized supernanny did manage to malfunction, and more generally because it somehow seems right and fitting. So best of all would come the prospect of greatly enhancing our own powers with whatever help our protector could provide, which would narrow the gap between itself and us to essentially the vanishing point. A glorious future could thus unfold, but we must take the right steps to lead up to it. ■

About the Editors

Nick Bostrom

Nick Bostrom is director of the Future of Humanity Institute at Oxford University. He previously taught in the Faculty of Philosophy and in the Institute for Social and Policy Studies at Yale University. He has a background in physics and computational neuroscience as well as philosophy. Bostrom's research covers the foundations of probability theory, scientific methodology, and risk analysis, and he is one of the world's leading experts on ethical issues related to human enhancement and emerging technologies such as artificial intelligence and nanotechnology. He has published some 100 papers and articles, including papers in *Nature, Mind, Journal of Philosophy, Bioethics, Journal of Medical Ethics, Astrophysics & Space Science,* one monograph, *Anthropic Bias* (Routledge, New York, 2002), and two edited volumes with Oxford University Press. One of his papers, written in 2001, introduced the concept of an existential risk. His writings have been translated into more than 14 languages. Bostrom has worked briefly as an expert consultant for the European Commission in Brussels and for the Central Intelligence Agency in Washington, DC. He is also frequently consulted as a commentator by the media. Preprints of many of his papers can be found on his website, http://www.nickbostrom.com.

Milan M. Ćirković

Milan M. Ćirković is a research associate of the Astronomical Observatory of Belgrade, (Serbia) and a professor of cosmology at the Department of Physics, University of Novi Sad (Serbia). He received his Ph. D. in Physics from the State University of New York at Stony Brook (USA), M.S. in Earth and Space Sciences from the same university, and his B.S. in Theoretical Physics from the University of Belgrade. His primary research interests are in the fields of astrophysical cosmology (baryonic dark matter, star formation, future of the universe), astrobiology (anthropic principles, SETI studies, catastrophic episodes in the history of life), as well as philosophy of science (risk analysis, foundational issues in quantum mechanics and cosmology). A unifying theme in these fields is the nature of physical time, the relationship of time and complexity, and various aspects of entropy-increasing processes taking place throughout the universe. He wrote one monograph (*QS0 Absorption Spectroscopy and Baryonic Dark Matter;* Belgrade, 2005) and translated several books, including titles by Richard P. Feynman and Roger Penrose. In recent years, his research has been published in *Monthly Notices of the Royal Astronomical Society, Physics Letters A, Astrobiology, New Astronomy, Foundations of Physics, Philosophical Quarterly* and other major journals.

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

Scottsdale:
This group meets the third Friday of each month and gatherings are hosted at a home near Alcor. To RSVP, visit http://cryonics.meetup.com/45/.

At Alcor:
Alcor Board of Directors Meetings and Facility Tours – Alcor business meetings are generally held on the first Saturday of every month starting at 11:00 AM MST. Guests are welcome. Facility tours are held every Tuesday and Friday at 2:00 PM. For more information or to schedule a tour, call D'Bora Tarrant at (877) 462-5267 x 101 or email dbora@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 (408) 245-4928 or email Mark_galeck@pacbell.net.

DISTRICT OF COLUMBIA

Life Extension Society, Inc. is a cryonics and life extension group with members from Washington, D.C., Virginia, and Maryland. Meetings are held monthly. Contact Secretary Keith Lynch at kfl@keithlynch.net. For information on LES, see our web site at www.keithlynch.net/les.

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 AlcorNE mailing list, please contact Bret Kulakovich at 617-824-8982, alcor@bonfireproductions.com, or on FACEBOOK via the Cryonics Special Interest Group.

PACIFIC NORTHWEST

Cryonics Northwest holds regular meetings for members of all cryonics organizations living in the Pacific Northwest.

For information about upcoming meetings and events go to: http://www.cryonicsnw.org/ and http://www.facebook.com/cryonics.northwest

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

British Columbia (Canada):
The contact person for meetings in the Vancouver area is Keegan Macintosh: keegan.macintosh@me.com

Oregon:
The contact person for meetings in the Portland area is Chana de Wolf: chana.de.wolf@gmail.com

Washington:
The contact person for meetings in the Seattle area is Regina Pancake: rpancake@gmail.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.

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:
We meet at least quarterly for training, transport kit updates, and discussion. For information: Steve Jackson, 512-447-7866, sj@sjgames.com.

UNITED KINGDOM

There is an Alcor chapter in England. For information about meetings, contact Alan Sinclair at cryoservices@yahoo.co.uk. See the web site at www.alcor-uk.org.

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 $150 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.

Call toll-free today to start your application:

877-462-5267 ext. 132
info@alcor.org
www.alcor.org

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