ISSN-1079-7832

A Publication of the Immortalist Society
published with the support of the American Cryonics Society and the Cryonics Institute.

LONG LIFE

Longevity Through Technology

Volume 49 - Number 02

AGM Meeting Notice 10

Repair and Rejuventation 11
- York Porter

Cryonics Protocols at the Cryonics Institute 22
- Aschwin DeWolf and Chana Phaedra

If I Was Millionaire: Part II 27
- John Day and Rudi Hoffman
Introduction by Jim Yount

www.immortalistsociety.org www.cryonics.org
www.americancryonics.org

Who will be there for YOU?

Don't wait to make your plans. Your life may depend on it.

Suspended Animation fields teams of specially trained cardio-thoracic surgeons, cardiac perfusionists and other medical professionals with state-of-the-art equipment to provide stabilization care for Cryonics Institute members in the continental U.S.

Cryonics Institute members can contract with Suspended Animation for comprehensive standby, stabilization and transport services using life insurance or other payment options.

SA Suspended Animation

Speak to a nurse today about how to sign up.

Call 1-949-482-2150

or email tabitha@suspendedanimationinc.com

MKMCAD160206 216

CRYONICS INSTITUTE
Technology for Life

Why should You join the Cryonics Institute?

The Cryonics Institute is the world's leading non-profit cryonics organization bringing state of the art cryonic suspensions to the public at the most affordable price. CI was founded by the "father of cryonics," Robert C.W. Ettinger in 1976 as a means to preserve life at liquid nitrogen temperatures. It is hoped that as the future unveils newer and more sophisticated medical nanotechnology, people preserved by CI may be restored to youth and health.

1) Cryonic Preservation

Membership qualifies you to arrange and fund a vitrification (anti-crystallization) perfusion and cooling upon legal death, followed by long-term storage in liquid nitrogen. Instead of certain death, you and your loved ones could have a chance at rejuvenated, healthy physical revival.

2) Affordable Cryopreservation

The Cryonics Institute (CI) offers full-body cryopreservation for as little as $28,000.

3) Affordable Membership

Become a Lifetime Member for a one-time payment of only $1,250, with no dues to pay. Or join as a Yearly Member with a $75 inititation fee and dues of just $120 per year, payable by check, credit card or PayPal.

4) Lower Prices for Spouses and Children

The cost of a Lifetime Membership for a spouse of a Lifetime Member is half-price and minor children of a Lifetime Member receive membership free of charge until the child turns 18 years of age.

5) Quality of Treatment

CI employed a Ph.D level cryobiologist to develop CI-VM-1, CI's vitrification mixture which can help prevent crystalline formation at cryogenic temperatures.

6) Locally-Trained Funeral Directors

CI's use of Locally-Trained Funeral Directors means that our members can get knowledgeable, licensed care. Or members can arrange for professional cryonics standby and transport by subcontracting with Suspended Animation, Inc.

7) Funding Programs

Cryopreservation with CI can be funded through approved life insurance policies issued in the USA or other countries. Prepayment and other options for funding are also available to CI members.

8) Cutting-Edge Cryonics Information

Members currently receive free access to Long Life Magazine online or an optional paid print subscription, as well as access to our exclusive members-only email discussion forum.

9) Additional Preservation Services

CI offers a sampling kit, shipping and long-term liquid nitrogen storage of tissues and DNA from members, their families or pets for just $98.

10) Support Education and Research

Membership fees help CI, among other things, to fund important cryonics research and public outreach, education and information programs to advance the science of cryonics.

11) Member Ownership and Control

CI Members are the ultimate authority in the organization and own all CI assets. They elect the Board of Directors, from whom are chosen our officers. CI members also can change the Bylaws of the organization (except for corporate purposes).

The choice is clear: Irreversible physical death, dissolution and decay, or the possibility of a vibrant and joyful renewed life. Don't you want that chance for yourself, your spouse, parents and children?

To get started, contact us at:

(586) 791-5961 • email: cihq@aol.com

Visit us online at www.cryonics.org

page 41

page 22

page 27

page 10

LONG LIFE MAGAZINE

A publication of the Immortalist Society

ORGANIZATION NEWS

06 **CI Executive Report**
- Dennis Kowalski

08 **CI Membership Statistics**

09 **Cryonics Group List**

10 **AGM Meeting Notice**

FEATURE STORIES

11 **Repair and Rejuvenation**
- York Porter

22 **Cryonics Protocols at the Cryonics Institute**
- Aschwin DeWolf and Chana Phaedra

27 **If I Was Millionaire: Part 2**
- John Day and Rudi Hoffman
Introduction by Jim Yount

32 **Robert Ettinger's Legacy**
- Robert Ettinger "Goes to Court"

41 **Final Thoughts**
- York Porter

ONLINE PDF HYPERLINK COMPATIBILTY

Since different browser configurations handle pdf links differently, if you have trouble opening any hyperlink(s) in the magazine, try these steps:

1. "Copy and paste"or manually type the hyperlink or email address into your browser or your email application's address field.
2. Download the pdf file to your desktop. Open downloaded file in Adobe Reader or your preferred PDF viewer.
3. Change PDF viewing settings / extensions on your browser (*advanced users only*)
4. Try a different browser (especially if you're using Internet Explorer.) We recommend Google Chrome.

You've signed up for Cryonics Now what should you do?

Welcome Aboard! You have taken the first critical step in preparing for the future and possibly ensuring your own survival. Now what should you do? People often ask "What can I do to make sure I have an optimal suspension?" Here's a checklist of important steps to consider.

- ☐ Become a fully funded member through life insurance or easy pre-payments

  Some members use term life and invest or pay off the difference at regular intervals. Some use whole life or just prepay the costs outright. You have to decide what is best for you, but it is best to act sooner rather then later as insurance prices tend to rise as you get older and some people become uninsurable because of unforeseen health issues. You may even consider making CI the owner of your life insurance policy.
- ☐ Keep CI informed on a regular basis about your health status or address changes. Make sure your CI paperwork and funding are always up to date. CI cannot help you if we do not know you need help.
- ☐ Keep your family and friends up to date on your wishes to be cryopreserved. Being reclusive about cryonics can be costly and cause catastrophic results.
- ☐ Keep your doctor, lawyer, and funeral director up to date on your wishes to be cryopreserved. The right approach to the right professionals can be an asset.
- ☐ Prepare and execute a Living Will and Power of Attorney for Health Care that reflects your cryonics-related wishes. Make sure that CI is updated at regular intervals as well.
- ☐ Consider joining or forming a local standby group to support your cryonics wishes. This may be one of the most important decisions you can make after you are fully funded. As they say- "Failing to plan is planning to fail".
- ☐ Always wear your cryonics bracelet or necklace identifying your wishes should you become incapacitated. Keep a wallet card as well. If aren't around people who support your wishes and you can't speak for yourself a medical bracelet can help save you.
- ☐ Get involved! If you can, donate time and money. Cryonics is not a turnkey operation. Pay attention and look for further tips and advice to make both your personal arrangements and cryonics as a whole a success.

CRYONICS INSTITUTE
Technology for Life

LONG LIFE

A quarterly publication of the

Immortalist Society

24355 Sorrentino Ct. Clinton Township MI 48035-3239

President: York W. Porter Vice-President: Debbie Fleming
Secretary: Royse Brown • Treasurer: Rich Medalie
Director-at-Large: Stephan Beauregard

Volume 49 Number 2
Second Quarter 2017

PRINT EDITION SUBSCRIPTION PRICES :
Single Subscriptions delivered by mail in the USA $35 per year. Single Subscriptions delivered by mail elsewhere $40 per year. Please make your payment to the Immortalist Society. The mailing address is 24355 Sorrentino Court, Clinton Township, Michigan 40835. For PayPal payments, please use the PayPal website and the payee address of immsoc@aol.com. If you wish to pay with VISA, Mastercard, or American Express without using PayPal, please phone 586-791-5961 and have your credit card information handy.

CI EXECUTIVE REPORT

Dennis Kowalski - President, Cryonics Institute

Dennis Kowalski - CI President

Hello and welcome to the latest edition of *Long Life Magazine*!

It's mid-summer, which means elections are coming up and it's time to start considering our candidates for CI's Board of Directors. CI is uniquely democratically run and thus our members have a vested interest and a special role in determining how CI is managed. Our leadership is comprised of fully-funded members who plan to be cryopreserved themselves in the future. This gives our leadership team a personal incentive to constantly improve CI and to insure we continue as a strong and viable organization far into the future.

CI Directors serve for three-year terms, with four positions open for election each year. The four directors up for re-election this year include myself (Dennis Kowalski - President/Chief Executive Officer), Andy Zawacki - CI Chief of Operations/Secretary, Stephan Beauregard - CI Communications and Social Media, and Steve Luyckx - Chief Business Officer/Assistant Treasurer. All of these Directors have announced their intentions to run for re-election. Thanks to each of them for their ongoing contributions to CI, and best of luck in the September election.

I'm proud of our current team of Directors, but I also encourage you to consider running for the Board yourself at some point. Whether you decide to run for election yourself or not, please remember that CI is a member run organization and that there are many other ways to volunteer and help out. Donations of time and money are always welcome and they make us stronger. If you do want to run for office, please submit your request before the due date of July 30th to Andy@cryonics.org. If you are not sure about the requirements to run for office please give us a call at 586-791-5961 or email CI in advance of the due date for more information and instructions. If you would like to volunteer time or donate money please see http://www.cryonics.org/donate/ or send me an email at Dennis@cryonics.org.

Things keep moving along at CI and our progress has us looking at expanding into additional facilities to meet the pace of growth. We are currently entertaining several offers at multiple locations to accommodate the increase in current patients and future patients. I will keep everyone posted as we learn more.

Recently there has been a lot of discussion about the formation of a new international cryonics organization, so I feel it is important to address this issue publicly because there seems to be some confusion about CI's position regarding this endeavor. To be clear, in spirit, CI wholeheartedly supports international cooperation between entities as well as establishing basic standards

CI EXECUTIVE REPORT

Dennis Kowalski - President, Cryonics Institute

for standby and long-term storage facilities. I believe we have shown excellent leadership in these areas and more throughout our history.

CI has a long track record of interacting with people both supportive and nurturing to cryonics as well as those who are toxic or even detrimental to our goals. We feel strongly that it is just as important to address our critics in open and healthy debate as it is to work with our supporters. By fostering solid and trustworthy relationships with key people within the cryonics community, we have been able to develop a healthy network to communicate and cooperatively develop ideas that are mutually beneficial to everyone.

CI has also been steadfast in explaining and endorsing standards that are the most likely to produce positive outcomes and superior suspensions. Our freely available Standby Manual is just one step in this direction to support all members of the cryonics community. In addition, we support international efforts to improve standby, fund cryonics research, encourage cooperation and work with and advise international organizations and standby groups. Any efforts that advance these goals are well within CI's mission.

That being said, our Board of Directors and most CI members are uncomfortable with any effort that attempts to take authority away from CI and place that decision-making ability into the hands of an outside group or umbrella organization. The term umbrella organization infers there is now an oversight group with direct authority over CI. This is not the case, and it is important to establish that CI has not formally or otherwise entered into any such arrangement as part of an international cryonics group.

We do not support any real or perceived outside authority over the Cryonics Institute other than our own Board of Directors, our bylaws and the local laws and regulations that are set forth in the state of Michigan. This structure has served our members and organization with effective systems, procedures and internal checks and balances for over 40 years with great success, which is evident in our continued growth and long-term stability.

I don't wish to discourage anything that may produce positive results that are mutually beneficial to CI and the cryonics community as a whole, but I also want to be clear that CI doesn't endorse anyone without establishing trust and seeing the proof of concept first. Trust is not something we take lightly. It is earned over time among people and organizations that have common goals and mutual respect for one another. With that in mind, we will definitely be following the developments regarding this new organization that are now in progress and considering our options moving forward.

Finally, on a personal note, I hope that you are happy with our progress to date at CI and endorse the direction that we're heading in. If you like what you see, then I would like to ask for the privilege of your vote to continue for another term as a CI Director.

Thank you to everyone for being part of this exciting journey we call cryonics. We have a bright future together and I'm looking forward to sharing it with you this September at the 2017 AGM!

Respectfully yours,

Dennis Kowalski

CRYONICS INSTITUTE
Technology for Life

Cryonics Institute Membership Statistics:

As of July 2017, the Cryonics Institute has 1,407 members, up 23 from our last report. Of the 1,407 Members, 217 have arrangements for Suspended Animation Standby and Transport.

There are 153 human patients and 139 pet patients in cryopreservation at CI's Michigan facility.

CI continues to be an industry leader in terms of both membership and practical affordability for all.

CI MEMBERSHIP

APRIL 2017

Increase in Membership since last issue

Members	1,384	Pets	136
Assoc. Members	181	DNA/Tissue	248
Patients	151	SA	212

TOTAL **1,716**

Worldwide Cryonics Groups

AUSTRALIA: The Cryonics Association of Australasia offers support for Australians, or residents of other nearby countries seeking information about cryonics. caalist@prix.pricom.com.au. Their Public Relations Officer is Philip Rhoades. phil@pricom.com.au GPO Box 3411, Sydney, NSW 2001 Australia. Phone: +6128001 6204 (office) or +61 2 99226979 (home.)

BELGIUM: Cryonics Belgium is an organisation that exists to inform interested parties and, if desired, can assist with handling the paperwork for a cryonic suspension. The website can be found at www.cryonicsbelgium.com. To get in touch, please send an email to info@cryonicsbelgium.com.

BHUTAN: Can help Cryonics Institute Members who need help for the transport & hospital explanation about the cryonics procedure to the Dr and authorities in Thimphou & Paro. Contacts : Jamyang Palden & Tenzin Rabgay / Emails : palde002@umn.edu or jamgarnett@hotmail.co Phones : Jamyang / 975-2-32-66-50 & Tenzin / 975-2-77-21-01-87

CANADA: This is a very active group that participated in Toronto's first cryopreservation. President, Christine Gaspar; Vice President, Gary Tripp. Visit them at: http://www.cryocdn.org/. There is a subgroup called the Toronto Local Group. Meeting dates and other conversations are held via the Yahoo group. This is a closed group. To join write: csc4@cryocdn.org

QUEBEC: Contact: Stephan Beauregard, C.I. Volunteer & Official Administrator of the Cryonics Institute Facebook Page.

For more information about Cryonics in French & English: stephanbeauregard@yahoo.ca

DENMARK: A Danish support group is online. Contact them at: david.stodolsky@socialinformatics.org

FINLAND: The Finnish Cryonics Society, (KRYOFIN) is a new organization that will be working closely with KrioRus. They would like to hear from fellow cryonicists. Contact them at: kryoniikka.fi Their President is Antti Peltonen.

FRANCE:
SOCIETE CRYONICS DE FRANCE is a non profit French organization working closely withEuropean cryonics groups. For more information : J.R. Missonnier: phone: 33 (0) 6 64 90 98 41or e-mail: cryonics news.inpi@yahoo.fr.

Can help Cryonics Institute Members who need help for the transport & hospital explication about the cryonics procedure to the Dr and authority in Toulouse Area. Contact : Gregory Gossellin de Bénicourt / Email : cryonics@benicourt.com Phone : 09.52.05.40.15

GERMANY: There are a number of cryonicists in Germany. Their organization is called "Deutsche Gesellschaft für Angewandte Biostase e.V.", or short "DGAB". More information on their homepage at www.biostase.de. If there are further questions, contact their Board at vorstand@biostase.de.

GREECE: Greek Cryonics Support Group. Sotiris Dedeloudis is the Administrator. Find them at: http://www.cryonics.gr/

INDIA: Can help Cryonics Institute Members who need help for the transport & hospital explication about the cryonics procedure to the Dr and authority in Bangalore & Vellore Area. Contacts : Br Sankeerth & Bioster Vignesh / Email : vicky23101994@gmail.com Phones : Bioster / 918148049058 & Br Sankeerth / 917795115939

ITALY: The Italian Cryonics Group (inside the Life Extension Research Group (LIFEXT Research Group)) www.lifext.org and relative forum: forum.lifext.org. The founder is Bruno Lenzi, contact him at brunolenzi88@gmail.com or Giovanni Ranzo at: giovanni1410@gmail.com

JAPAN: Hikaru Midorikawa is President, Japan Cryonics Association. Formed in 1998, our goals are to disseminate cryonics information in Japan, to provide cryonics services in Japan, and, eventually, to allow cryonics to take root in the Japanese society. Contact mid_hikaru@yahoo.co.jp or http://www.cryonics.jp/ index.html

NEPAL: Can help Cryonics Institute Members who need help for the transport & hospital explanation about the cryonics procedure to the Dr and authorities in Kathmandu. Contact : Suresh K. Shrestha / Email : toursuresh@gmail.com Phone : 977-985-1071364 / PO Box 14480 Kathmandu.

NETHERLANDS: The Dutch Cryonics Organization (http:// www.cryonisme.nl) is the local standby group and welcomes new enthusiasts. Contact Secretary Japie Hoekstra at +31(0)653213893 or email: jb@hoekstramedia.nl

* Can help Cryonics Institute Members who need help, funeral home, transport & hospital explication about the cryonics procedure to the Dr and authority at Amsterdam with branches in other cities. Contact : Koos Van Daalen / Phone (24 Hours) +31-20-646-0606 or +31-70-345-4810

NORWAY : Can help Cryonics Institute Members who need help for the transport & hospital explication about the cryonics procedure to the Dr, funeral home and authority at Sandvika. Contacts : Gunnar Hammersmark Sandvika Begegravelsesbyraa / Phones : 011-47-2279-7736

PORTUGAL: Nuno & Diogo Martins with Rui Freitas have formed a group to aid Alcor members in Portugal. Contact: nmartins@nmartins.com or visit www.cryonics.com.pt/

RUSSIA: KrioRus is a Russian cryonics organization operating in Russia, CIS and Eastern Europe that exists to help arrange cryopreservation and longterm suspension locally, or with CI or Alcor. Please contact kriorus@mail.ru or daoila.medvedev@mail.ru for additional information or visit http://www.kriorus,ru. Phone: 79057680457

SPAIN: Giulio Prisco is Secretary of the Spanish Cryonics Society. Website is http://www.crionica.org.sec. He lives in Madrid and he's a life member of CI and is willing to serve as a contact point for Europeans. He can be contacted at: cell phone (34)610 536144 or giulio@gmail.com

SWITZERLAND
www.CryonicsSwitzerland.com or www.ria.edu/cs

UNITED KINGDOM: Cryonics UK is a nonprofit UK based standby group. http://www.cryonicsuk.org/ Cryonics UK can be contacted via the following people: **Tim Gibson:** phone: 07905 371495, email: tim.gibson@cryonics-uk.org. **Victoria Stevens**: phone: 01287 669201, email: vicstevens@hotmail.co.uk. **Graham Hipkiss**: phone: 0115 8492179 / 07752 251 564, email: ghipkiss@hotmail.com. **Alan Sinclair:** phone: 01273 587 660 / 07719 820715, email: cryoservices@yahoo.co.uk

Can help Cryonics Institute Members who need help, funeral home, transport at London. Contact: F.A. Albin & Sons / Arthur Stanley House Phone: 020-7237-3637

INTERNATIONAL: The Cryonics Society is a global cryonics advocacy organization. Website is www.CryonicsSociety.org. They publish an e-newsletter *FutureNews*. Phone: 1-585-643-1167.

Please note, this list is provided as an information resource only. Inclusion on the list does not constitute an endorsement by Long Life magazine or our affiliated organizations. We urge our readers to use this list as a starting point to research groups that may meet their own individual needs. We further note that readers should always use their own informed judgment and a reasonable amount of caution in dealing with any organization and/or individual listed.

2nd Annual Meeting Reminder

This is a second reminder to everyone that the Annual General Meetings of both the Cryonics Institute and the Immortalist Society will be held on Sunday, September 10, 2017. The meeting of the Cryonics Institute will begin at three p.m. local time and the meeting of the Immortalist Society will immediately follow. While the CI facility will be open from noon to two p.m. on the day of the annual meeting for those wishing to tour it, all attendees should note that the meeting will not not be held at the Cryonics Institue facility as has been the custom for a number of years. This year's meeting will be held at the relatively nearby ConCorde Inn Hotel & Conference Center, 44315 North Gratiot Avenue, Clinton Township, (Michigan) 48036 (USA). The main telephone number is 586.493.7300 and the website can be found at www.concordeinns.com where one can view more information and can also fill out a contact form if needed.

As has been the custom for some time, a dinner and social gathering will be held the night before the annual meeting. This will happen on Saturday, September 9, 2017 beginning at 6 pm at Sajo's Restaurant, 36470 Moravian, Clinton Twp, (MI) 48035. This is not too far from the Cryonics Institute. Everyone attending this social event is responsible for their own bill at the restaurant. For more information and for directions to the restaurant you can go online to www.sajos.net.

There will be no formal dinner provided at this year's meeting, however light snacks and beverages will be available during the meeting at no charge. The ConCorde Inn has plenty of public areas available for socializing after the meeting and there are a number of excellent restaurants nearby for dinner groups to choose from.

Finally, please note that all meetings are open to the public so if you aren't able to give advance notice or you have a friend or acquaintance that is interested in being at the meeting, just make sure you and/or they attend anyway. We'd love to have you!!

Vote, Vote,Vote

The annual meetings are a great time to catch up with old friends, make new acquaintances and find out lots of good information about cryonics. A more serious aspect, if you are a voting member of either organization, is to cast your vote for the leadership of the organization. The Cryonics Institute elects four out of twelve Board of Directors members each year and voting members should receive voting forms in the mail. CI Voting Members have four votes total to cast and may give four votes for one candidate or one vote for each of four candidates or two votes for one candidate and two votes for another candidate, etc., i.e., any combination the voter wishes as long as the total votes cast aren't greater than four. Please make sure you get the form back in on time and make sure that you fill out the form as neatly as possible and sign it where indicated so your vote will count. Other instructions may come with the form as well and make sure you follow those. Any questions, get in touch with the Cryonics Institute.

The Immortalist Society elects all Board of Directors' members every year and does so like most organizations do with nominations from the floor and then votes are cast as needed from the membership. All this is done at the annual meeting itself.

The Technology of Repair, Revivial and Rejuvenation

Part I

by York W. Porter

Preliminary remarks by York W. Porter, Immortalist Society President

One of the basic questions in cryonics is just "how" it will work. Since its inception, critics have utilized the quite understandable inability of Robert Ettinger, in his original writings, to fully outline the exact specifics of future science capabilities to try to poke holes in the concept Ettinger developed. (The critics were frequently in error then, and are even more so now). While it isn't possible, even at this date, to fully determine the particular details as to the exact mechanisms that will be needed and/or utilized to make cryonics a working reality, it is possible to go into the subject to such a depth that any reasonable person would have to conclude that, whatever their particular preferences or viewpoints, cryonics is a quite sensible and rational thing to do for those persons with an interest in extended physical life.

Dr. Charles Tandy served as the editor of the book, The Prospect of Immortality: Fifty Years Later, to which I contributed a chapter (Interested readers may purchase a copy of Dr. Tandy's excellent book on amazon.com). The information presented here, as well as in future installments of this series, basically first appeared there, and then was slightly edited/updated and utilized in a series in Cryonics magazine, the house publication of the Alcor Life Extension Foundation. Readers should note that this article might differ, however slightly, from the material published in Cryonics and in Dr. Tandy's book. Please note that in some cases in this article, phrases and words have been emphasized somewhat differently from the way they appeared in their original format in various publications.

Cryonics is a concept wherein individuals who are clinically dead are placed at liquid nitrogen temperature (-196 degrees Celsius) where they remain essentially unchanged. The assumption of cryonics is that those individuals can be revived, repaired, and rejuvenated by future scientific knowledge and procedures. This paper reviews some of the proposals that have been made to try to solve the problem of revival, repair, and rejuvenation, including using nanotechnology as a part of this effort. Various cell and tissue repair devices are discussed as well as a cryobiological view of the subject of repair after exposure to cryogenic temperatures.

Author's Note: What follows is, to some degree, a chronological account of revival, repair, and rejuvenation scenarios and thoughts throughout the years in cryonics, as well as some general thoughts and information about nanotechnology itself. The information available on these subjects is fairly extensive so it isn't possible, in a single article or book chapter, or in several volumes for that matter, to cover every twist and turn in the history of things, as well as detailed explanations of each concept/objection, etc. As was pointed out extremely well in the book (and television series) Connections by James Burke, most ideas, if not all, don't arise in a vacuum and there are always interweavings in the "tapestry of history." Also, one needs to keep in mind that many papers in many fields, not only cryonics, are "upgrades" from previous work of the same author and are not "written from scratch."

In the example of Thomas Donaldson, for instance, it should be noted that in 1976 he wrote of modified biologically based repair systems in a paper entitled, "A Brief Scientific Introduction to Cryonics."[1] This seems to form the basis for his later expositions on the subject.

There is also the phenomenon of people thinking along the same general lines but coming up with unique and separate solutions. Mike Darwin's thought on the "anabolocyte" developed independently of Donaldson's musings on biologically-based repair systems even though both occurred within a year or so of each other.

Due to these scholarly concerns and the enormous amount of material to go through, what is written below (and in subsequent parts of this series) should be a "start" rather than "ending" to efforts in reading on this interesting, important topic.

The Prospect of Immortality

In his seminal book, *The Prospect of Immortality*[2], Robert Ettinger predicated his revolutionary thesis on a known fact and also an assumption. The fact, true now as then, is that individuals can be

placed at ultra-low ("cryogenic") temperatures immediately after clinical death, with essentially no further deterioration once they reach those temperatures.

The assumption was, and remains, that at some future point in time, scientific progress will make it possible to revive, repair, and rejuvenate those stored individuals to a state reflecting youthful good health. This would include dealing with any damage that the processes involved in cryonics caused the individuals, as well as the harmful effects of aging and the diseases and/or trauma they suffered before their clinical death.

In a talk personally heard by the author, Ettinger stated quite frankly and honestly that, at the time of writing his book, he didn't (and, of course, couldn't) know that the assumption was correct. But he postulated it based, in part, on the enormous progress that science had made during the decades preceding his writing. That progress, plus Ettinger's own observations as a scientifically trained and thorough investigator, holding masters' degrees in both physics and mathematics, led him to make his postulate with a high degree of confidence and reasonableness.

From the time of Ettinger's birth, in December 1918, to the time he was writing *Prospect*, in the early to mid-1960s, civilization had developed in astonishing ways. The "scientific miracles" of high-speed computers, moon rockets, supersonic jet aircraft, international telecommunications, and medical advances ranging from penicillin to organ transplants, as well as many others, were either already a reality or just on the horizon. The ability of science to continue to progress to further heights of capability seemed an easy leap in logical reasoning.

Still, the assumption remained an assumption and, in light of the fact that no such repair mechanism has yet been devised, still remains just that: a postulate which forms the second part of Ettinger's world-changing idea. Here I will review some of the advances in thinking and technology that occurred around the time of writing of the original book, and some which have developed since.

Richard Feynman's Talk

The first "solid ground" that can be said to underlie the work of Ettinger appeared independently back in 1959, before Ettinger had finished the first version of his book (in 1962). In an after-dinner talk[3] that wasn't about cryonics at all, Dr. Richard Feynman, who would share the 1965 Nobel Prize in Physics, outlined some basic principles that would powerfully reinforce the cryonics assumption.

At the time of Feynman's presentation, most people, when talking of machines, thought about all the visible-sized devices that were (and are) in everyday use, from watches, food mixers, and vacuum cleaners to cars, airplanes, and ships. Further, most people's thoughts about them tended toward "the larger and more powerful, the better and more impressive." Even Ettinger in his book wrote of "huge surgeon-machines working twenty-four hours a day for decades or even centuries…"[4] to revive, repair, and rejuvenate an individual and, in particular, the brain, "cell by cell, or even molecule by molecule in critical areas."[5] Ettinger would generally be seconded by later thinkers in the "molecule by molecule" repair capabilities that should become available, but the size of the "surgeon machines" would probably shrink too, they averred, quite a lot in fact. Though it may be natural to think of there being "plenty of room at the top" (as in, "the sky's the limit"), Feynman turned it around that December evening in '59. Titling his after-dinner talk, "There's Plenty of Room at the Bottom," he pointed out that, while a lot of technological progress had been made in miniaturizing devices and processes, more could be done, a whole lot more. "Electric motors that are the size of the nail on your small finger"[6] and "a device on the market ... by which you can write the Lord's Prayer on the head of a pin"[7] were just "the most primitive, halting step in the direction I intend to discuss."[8]

Progress was just beginning.

Not just the Lord's Prayer, Feynman speculated, but the whole *Encyclopedia Britannica*, all 24 1,000-page, double-column, fine-print volumes of the then-current edition, might be written on the head of a pin. He talked about whether computers that were then taking up entire rooms of floor space could be shrunk down toward something like the human brain, or—who could say? Like Ettinger he spoke of robot surgery, but in terms of independent units that would work inside the body itself. One of his bolder statements anticipates full-blown nanotechnology: "But I am not afraid to consider the final question as to whether, ultimately—in the great future—we can arrange the atoms the way we want: The very atoms, all the way down! What would happen if we could arrange the atoms one by one the way we want them (within reason, of course; you can't put them so that they are chemically unstable, for example)?"[9]

Could it be done? Feynman was optimistic: "The principles of physics, as far as I can see, do not speak against the possibility of maneuvering things atom by atom. It is not an attempt to violate any laws; it is something, in principle, that can be done; but in practice, it has not been done because we are too big."[10]

Feynman clearly deserves credit as one of the principal founders of the field now known as "nanotechnology"— manipulating objects in a direct fashion on the molecular/atomic scale; proper apportioning of credit is something for historians to decide. In any event, his 1959 talk has generated, at least retrospectively, a lot of interest among those now working in the field. His remarks still stand out in

both their basic points and in demonstrating the creative thinking of the man himself.

There the matter remained, at least in terms of what Robert Ettinger would postulate just a few years later. No immediate connection was made between Feynman's talk and cryonics. Ettinger wrote about "giant" surgeon-machines working "molecule by molecule" if they had to, but surely it would be make sense to make them smaller.

Jerry White's 1969 Proposal of a "Repair Virus"

For those cryopreserved in the early days, friends, family and advocates could take comfort that at least time was "stopped." You had time to figure out what could be done for the ones you cared about, while they were "on hold." Just what would be done, though, remained elusive even as a topic of speculation. Which brings us to Jerome B. "Jerry" White. White was an early and long-term cryonics activist (now a cryonics patient) who attended a conference on the subject held at Ann Arbor, Michigan in April, 1969, about five years after the commercial publication of Ettinger's book.

There White gave a presentation entitled, "Viral Induced Repair of Damaged Neurons with Preservation of Long-Term Information Content."[11] The gist of it was that viruses, which really are little machines, could be modified and specially programmed to interact with cells in a beneficial way, resulting in cell repair. It appears to be the first serious attempt to formulate a repair scenario in cryonics. A fledgling beginning, yes, but you had to start somewhere if Ettinger's idea was ever to be made to work.

White's paper begins with what is, at least to this author, a lengthy and technically complicated excursion, not lacking relevance of course, into the work of Alan M. Turing and John von Neumann, who are well-known luminaries in the fields of computer science and cellular automata. The upshot is that, indeed viruses can be seen as little machines that could be modified in various, information-intensive ways, that is to say, programmed, to realize a wide variety of behaviors. While we normally think of viruses as things to avoid, there is no reason in principle they couldn't behave well, and in fact quite beneficially, when introduced into our tissues, particularly if there is something wrong that needs fixing. So different fields can help each other. In this case the specialties of computation and cellular automata are shown, or at least strongly suggested, to be relevant in biology— not that the problems are solved. But in words sometimes attributed to Louis Agassiz, the famous 1800s science teacher, (paraphrasing) "once you study one thing, you find it is ultimately connected with everything else."

White, in moving on to more concrete matters, points out that, in the repair of damaged cells, each damaged molecule that forms the cell can be dealt with in one or more of basically three ways:

1. Repair of the portion or "unit" of the molecule that is damaged and restoration of the unit *in situ* (in its original place) inside the cell itself, in effect making the damaged unit of the molecule "brand new" in terms of its molecular/cellular utility. This may happen either by the work of a biological enzyme or by modifying the damaged section to alleviate its detrimental effects.

2. Removal of the damaged unit from the molecule and replacement with an undamaged unit, which then allows the molecule to function in its intended way and location.

3. If the unit could not be repaired or removed the cell might "work around" the damage in some way.[12]

White then brings up a difficulty. The basic proposal of cryonics is to stop further deterioration by storing patients at cryogenic temperatures. Cryopreservation, however, with procedures available at the time of White's paper (and, hopefully, to a lesser degree for procedures used today), adds an amount of damage itself. This leads one to conclude the obvious need for, as White put it, "Concrete proposals for carrying out repair on the molecular level."[13]

White proposes that this be a two-pronged approach with both "a suitable enriched environment"[14] and an "augmented control program."[15] The augmented control program would make improvements in the body's genetic material through alterations in the DNA. (Thus it would have to be managed carefully!) One prospect for aiding the successful repair and revival of human tissue would be to try to use what DNA is left in the body's cells to help decipher what the original "blueprint" would have been for the whole organism. (Note: In terms of damage concern, liquid nitrogen is sometimes used as a cell lysing or perforating agent to extract DNA from the cell itself for later analysis and use.) L. K. Lozine-Lozinskii (Studies in Cryobiology [1974], p. 207) reports that DNA from the bacterium Bacillus subtilis was subjected to temperatures from -6 to -269 Celsius for 24 hours (liquid nitrogen is -196, absolute zero is -273) with no change "...in the biological activity of the DNA." According to the same source, taking DNA to ultralow temperatures (i.e., presumably below -269) "...provoked a disruption of the secondary structure of the molecules" but "[g]ross changes in the structure of DNA occur only as a result of repeated cycles of freezing and thawing."

While the subject is complex, in a nutshell, the primary structure of DNA is the nucleotide sequence. The secondary structure is the "double helix" shape and the particular configuration it takes. The ability to look at these structures gives one a great deal of informa-

tion about things. (One side of the double helix alone determines the other side by the matching base elements: adenine pairs only with thymine, guanine only with cytosine.)

Very likely not exactly the same section of DNA will be damaged in each cell, so by analyzing many millions of possibly damaged DNA fragments found in a body, the original, complete sequence or genome might be reconstructed with confidence. This should hold if even one tenth of one percent of the DNA survives its journey to liquid nitrogen temperature relatively intact (and the cited reference seems to indicate a far higher percentage).

However derived, with the knowledge of an individual's particular genome, and with enough computational power, it should be a relatively simple matter to figure out "what goes where" and whether a particular part is damaged and how. (That's the theory, anyway. Practice, of course, may well be another thing. More about that and the promise of nanotechnological repair later).

This doesn't mean that the DNA will repair itself or anything else unaided. Body mechanisms do exist to help maintain DNA and repair it, but the DNA doesn't have "built in" cell-repair capabilities, all on its own. What it does have is the ability to read the "blueprint" of what the organism "should" be like, in the organism's basic and youthful form, and how such "repair capabilities" as exist should be formed and how they should function.

Imagine, if you will, a group of highly trained mechanics coming upon a vast wrecking yard of various devices of transport: cars, buses, planes, whatever. The mechanics are instructed to "fix it"—get the "fleet" of all these vehicles (or what once were vehicles) operational again. So what do they do? First, they inspect the scene. The existence of thousands and thousands of parts, in various states of disassembly and/or disrepair, would certainly start giving useful clues. Our mechanics could then begin piecing out "what goes with what," how certain components fit together, what gear turns what gear, etc. Further imagine that during their attempts to utilize this treasure trove of parts, they also accidentally stumble upon a further treasure trove in the form of a complete set of factory blueprints, shop manuals, diagrams and videos that show exactly what component in each type of vehicle went with what. Such a find might, of course, greatly simplify and accelerate the repair process.

In the case of individual parts, our mechanics should also be able to recognize what parts are defective and take steps to fix each defect. While it might be possible for them to even make improvements upon the "natural order" of the things they found, it should, in any event, be relatively simple and feasible to use the existing parts and the blueprints of them to make the older technology work as well as it once did.

An example of improvement (hopefully) would be to take cars from, say, the 1960s, when carburetors were mainly in vogue, and modify them (objections of diehard classic car buffs notwithstanding) to be fuel-injection. One might also upgrade aircraft of earlier eras from prop-driven to jet powered, and the like. That said, however, the alternative of just restoring every conveyance to its original, assembly-line condition would be open too.

To return to the biological problem, the existence of relatively intact DNA, or the ability to figure out that state from numerous partial samples, allows the same sort of option. It would give future "body mechanics" the ability to determine, from the myriads (or they may possibly need much less) of slightly different blueprints of the cell, as well as their own knowledge of normal human physiology, how things should fit together and work in a normal, healthy state.

In Jerry White's proposal, this genome can further be augmented by appropriate "control instructions" written directly into the DNA by viral insertion. In this manner, otherwise irreversible injury might be repaired. White proposes, with considerable insight for a paper written in 1969:

> *Since a cell is formed and maintained under genetic control, it is reasonable to suggest that genetic control also be used to carry out degrees of repair greater than those the cell in its damaged condition could by itself provide. For each degree of damage greater than the normal regenerative abilities of a cell, a suitable enriched environment and augmented control program should be provided. The control program should be augmented as such, in the form of additional genetic information which will enable the cell to carry out emergency repairs, such as of a damaged membrane, gather nutrients from the environment, and restore normal functioning according to the standard control program.*[16]

Where Ettinger in *Prospect* envisioned "giant surgeon machines" doing the work, White imagined "natural processes," albeit greatly augmented, using the built-in control mechanisms as modified by intelligent guidance. The use of a virus to "inject" the needed DNA strand into the affected cell(s) is outlined in his proposal.

Modern, advanced medical procedures are amazing, yet the reality of modern medicine is still that, in most cases, it is the "wisdom of the human body" with its built-in repair and recovery mechanism that makes the difference. Modern medicine mainly provides the conditions for that "body wisdom" to exert itself and give time for the patient to heal on his own. White's proposal is an ingenious variation of this that would add more capability than Nature originally provided.

White then goes to a lengthy, in-depth explanation of how his viruses would work to add extraneous DNA to the natural strand inside

human cells and otherwise enhance the DNA's ability to direct the repair of cellular damage. Such repair would be particularly critical in neurons which are, of course, the most important cells in the human body.

White begins the last section of his paper:

> *The general method outlined here has its obvious use in the repair of nervous tissues especially human. Repair of all types of damage—caused by factors mechanical, chemical, pathological, aging, freezing, thawing, and so on—is intended.*[17]

and concludes with:

> *I hope that the method cursorily outlined here is still concrete enough to encourage those who are concerned with problems of repair of brain damage, whatever its origin.*[18]

For its time it was an outstanding effort, a real attempt to put some solid underpinnings to Robert Ettinger's assumption. It was a major step toward showing that cryonics was a reasonable thing for individuals to do, and it offered a well-thought out proposal as to how Ettinger's assumption might one day be realized.

Mike Darwin and the Anabolocyte

Eight years went by. Then, in the July/August 1977 *Life Extension Magazine*, Michael G. Darwin outlined a proposal for an artificially engineered white blood cell that he called the "anabolocyte." By then a well-known cryonics activist himself, Darwin had actually thought up the concept several years before, after participating in an early cryopreservation that didn't go as well as planned (to say the least). It led Darwin to consider the formidable problem of how the enormous number of cells in the human body might be repaired after undergoing the procedures associated with cryonics. As Darwin put it: "After a restless night worrying over this problem I came up with the idea of genetically engineered leukocytes that would be able to either repair or replace damaged cells and tissue."[19] Thus the idea of the anabolocyte was born.

"Leukocyte" is a slightly technical name for what lay people call a "white blood cell." Since most of the time one is dealing with more than one of them, a brief abbreviation of the plural, as used in medical circles, is "WBCs." These blood cells are an integral part of the human body, acting as the body's defense against infection and against foreign substances of various kinds (the "wood splinter" being a pretty common example) in which thousands and thousands of them rush to an affected area and try to maintain body integrity by eliminating the intruding object or substance. The resulting area will occasionally build up to the "abcess" stage that can result in its need to be lanced and drained (and the offending object removed, if possible) as hordes of the WBCs sacrifice themselves to the "greater good" of the body as a whole. WBCs also have particular properties of movement referred to as "amoeboid."

Rather than being passively carried along the route of the bloodstream like their cousin the red blood cell, they can wriggle or crawl along on their own. Squeezing through much, most, or all of the available volume, depending on where they are, they are constantly on the lookout for "bad guys" in a "cops and robbers" coexistence with things that shouldn't be there.

Mike Darwin was concerned that Jerry White's proposal would be problematic. It needed a living, functioning cell to allow the injection of DNA-modifying substances; only then could enhanced repair procedures begin. In a four-page article that included several drawings by the author, Darwin elucidated an interesting scenario about how injured and even non-functioning human cells might be repaired and restored to their original condition using a humanly engineered, advanced type of WBC. As he put it: "If we start with something like a normal white blood cell and assume it could be modified in most any way, we could build an ultraminiature, self-reduplicating repair unit."[20] Combining some Greek words he arrived at the name "anabolocyte" for this type cell which would engage in constructive metabolic activities. With other adaptation of terminology the modified nucleus became the "Program Module." Darwin goes on to give an interesting account of how damaged cells could be repaired in a several-step process, commenting that:

> *White cells are particularly good candidates for this type of transformation because they already embody several of the properties we are seeking. They have the capacity to move through the capillary walls to reach sites of injury and/or infection, they are compatible with human physiology, and perhaps more importantly, they have some (although very limited) capacity for attaching themselves to damaged or malignant cells to either repair them or donate a lysosome and destroy them.*[21]

Darwin further breaks the problem down by subdividing the proposed anabolocyte into components such as the "Synthesis Unit" where organelles (the subcellular structures that carry out cell functions) are manufactured for transfer into the damaged cell. The "Storage Module" in turn is a "depot" for molecules that provide energy and also for "raw materials" for the construction of needed structures. Other proposed components are mentioned. However,

> *At this juncture it is important to emphasize that this particular repair process is workable only for non-neuronal tissue. Nerve cells with information-containing dendrites and protein molecules would require an alternate repair sequence which would simply replace the*

defective metabolic equipment.[22]

Impressive as it is, the account understandably omits many details that would be needed for any actual implementation. But it helps make a plausible case that cryonics is not just "wishful thinking." It was another milestone attempt to seriously ponder how Ettinger's assumption might be realized. Darwin's effort also reminds us that we don't always have to "reinvent the wheel." Ettinger's "huge surgeon machine" was a postulated, super-sophisticated device that would work on the body. In the replacement and repair of subcellular structures, where one needs a general solution, i.e., needing *a* mitochondrion instead of "that particular mitochondrion", Nature has already provided a mechanism for their construction along with that of other cellular and subcellular organelles. Darwin's proposal is to make use of that already existing natural capability to the advantage of cryonics.

In a slight extension of Darwin's thinking, one can envision, perhaps, a group of cells cloned for no other purpose than to act as a "warehouse" of needed subcellular components for use by the anabolocyte in its repair efforts. Whatever the particulars one thinks up, the general concept of the anabolocyte was, like Jerry White's exposition, an attempt to further add concrete underpinnings to Ettinger's crucial assumption.

Thomas Donaldson's Article: "How Will They Bring Us Back, 200 Years From Now?"

Thomas Donaldson was a Ph.D. mathematician and additionally a cryonics activist who wrote extensively about the subject. Some of his writings appeared in *The Immortalist*, mouthpiece of The Immortalist Society, an organization that got its start in the 1960s as the Cryonics Society of Michigan (and still exists today). In the March 1981 issue Donaldson tackles, in some detail, a biological approach to dealing with repair issues for individuals who have been cryopreserved. Believing that finding the answer to how to revive patients from their storage at cryogenic temperatures would probably take several centuries, Donaldson offers a number of intriguing ways to begin dealing with this problem.

In 1981 cryobiologists might note that cells stored at ultra-low temperature were damaged, and ponder some general mechanisms for causing this damage. Yet, as Donaldson put it in his article, "... even in micrographs of the most severely disrupted cells, we can see without difficulty what the cell was once and what it *ought to be*," adding: "The case is very strong that all the information required to rebuild it is STILL PRESENT."[23] (emphasis original).

Both these points, of course, tie in powerfully with Robert Ettinger's assumption that future science would be able to repair virtually any damage a cryopreserved patient might have incurred. It didn't matter whether this damage was from illness and/or injury prior to arrest, or from the ravages of aging coupled with and in addition to whatever damage the cryonics procedure itself had caused. So long as the "time stopping" effect of ultra-low temperatures was employed, *eventually* science should be able to deal with it.

At bottom, if the information about how the cell "should be" is still present, and the structures of the cell, albeit injured and/or damaged, are still present, it then simply remains to figure out what tools and mechanisms of repair are needed to restore the cell to a healthy and youthful state. Not necessarily an easy task, of course, but the existence of the cells in a state of damage, coupled with the information needed for their repair and the lengthy time which cryogenic temperatures allow individuals to be stored, provides a reasonable possibility that cryonics will ultimately succeed.

Thomas Donaldson approached this problem beginning with the fact that there already exist "machines" that do, at least in general, the types of work that are required. They are biological in nature and are called *enzymes*. Enzymes are protein molecules that are involved in thousands of reactions in a cell. As Donaldson explains in the article:

> *They operate because they have a particular structure, which will actually grasp a molecule of one reactant and when after thermal motion brings them into contact with the other reactant, will release it. Their analogy to machines goes even further: some enzymes actually are designed so that they will be turned off and not act if too much of the chemical product exists; others will have many complex responses to many different chemicals in their environment. In short, they are machines the sizes of molecules.*[24]

Donaldson then goes on to explain that he expects several centuries will be needed for the chemical research necessary to develop, as he puts it, "...our own enzymes bearing little if any relation to those made by living cells."[25] Upon that development, Donaldson predicts that machines of many sizes, from the smallness of bacteria and human cells to much larger constructions, would ultimately be possible. It was, so to speak, a hybrid of biological and man-made capabilities somewhat like Michael Darwin had written of a few years earlier. Donaldson adds, referring to repair machines of the microscopic variety: "All of these could act, of course, at the same time (in a microscope, a brain under repair would appear to swarm with repair bacteria!)."[26]

(**Author's note:** In March 2008, a team from the university of Washington, Seattle and the Weizmann Institute of Science, Israel devel-

oped a manmade enzyme that, though falling far short of Donaldson's prediction, had never before been seen in nature).[27]

K. Eric Drexler and Engines of Creation

One of the most exciting developments in cryonics occurred in 1986, when a scientist by the name of K. Eric Drexler published a book with the intriguing title *Engines of Creation*.[28] Drexler talked yet again in this engaging volume about the possibility of being able to control matter directly on the atomic scale, similar to Richard Feynman a quarter-century before. Long before that and since then science had, of course, produced a large number of useful and varied substances, ranging from medicines like penicillin, to alloys, plastics and other materials that pervade our modern life. Mostly, though, it was by a "mix and stir" method involving large masses of material, perhaps with heating, hammering or other macroscale intervention, but without any ultrafine control.

What Drexler proposed was something entirely different. His efforts, outlined both in *Engines of Creation* and in more depth in technical publications, dealt with a basically new concept, fleshing out the earlier ideas of Feynman with more specifics. It would, once again, be the ability to take individual atoms and molecules and combine them in any order and arrangement that the laws of science allowed, and do so with a precision that, to date, no feasible process could match.

Drexler proposed that this could be carried out through devices that were generally called "assemblers." Assemblers were going to be tiny, programmable devices that would enable one to take Atom A and place it with Atom B, add Atoms C, D, and E, etc. in whatever order, placement, and orientation one wished, all consistent with physical laws. The resulting molecule would be "assembled" in a similar sense to the way we think of manufactured goods that we make on a macroscale.

The result, from a molecular standpoint, would be a structure that, in a way, would mimic how living organisms are constructed. It would be built "from the ground up," atom-by-atom and molecule-by-molecule, as opposed to the "mix and stir" method. If (and it was, and is, a big *if* but one with numerous and world-changing consequences) it could be done, the resulting structures could be quite complex and precise, consistent, again, with physical laws.

Although some have called Drexler "the founding father of nanotechnology," it is obvious that Feynman deserves part of the credit. Drexler did, however begin to lay more specific foundations under the generalities Feynman had talked about. In doing so, Drexler also helped put more specific foundations under the postulate on which Ettinger had rested his case for cryonics.

Cryonics offered hope for the dying that, by their being stored at extreme low temperature with its "suspension" of time, future science and technology could furnish them revival, repair, and rejuvenation. Ettinger's book was a selection of the Book of the Month Club, a then-popular way for books of importance to make their way to the general public. Isaac Asimov, a well-known science and science-fiction writer, had reviewed Ettinger's work before its publication and pronounced it reasonable. Numerous media appearances followed the commercial publication of the book in June 1964, and it seemed at first that cryonics would "take off " on its own and soon become part of normal societal activity. Not so, unfortunately. Only a relative handful, about 2,000 people today worldwide (most in the United States), are signed up for the practice, with about 300 people cryopreserved. Cryonics organizations, though continuing to gain members and place people in cryostasis or "cryonic suspension," still struggle for mainstream acceptance. Even Drexler struggled with cryonics when he first heard about it. In the January 1986 issue of Alcor's publication *Cryonics*, Drexler notes that he had previously been acquainted with cryonics and didn't get very interested in it. In fact, he thought: "It's a nice idea, but it probably won't work. They're probably a bunch of crazies."[29] Years later, after his thinking in nanotechnology had matured, he began to see the logic of Ettinger's approach. In the same article Drexler continues:

> *So then I went and dug out a copy of Ettinger's The Prospect of Immortality from the MIT library, and there, lo and behold, I found out that these crazy cryonics people not only were right, but they even knew why they were right, that in the future we're going to have molecular repair technology. Ettinger wrote of repairing cells molecule-by-molecule if need be. Of course, he didn't have the numbers to demonstrate this, and there was still the question of how we would get there. But he had the basic physical perception that we'd develop molecular-level repair machines, and that doing this doesn't conflict with any physical law.*[30]

Drexler, having the courage of his convictions, mentions cryonics in *Engines of Creation*, notably in Chapter 9, "A Door to the Future." He uses the more general term "biostasis" to refer to any reasonable attempt to preserve the structure of the human body after clinical death but allows, in one observation well-appreciated by cryonicists, that "Robert Ettinger has apparently identified a workable approach to biostasis."[31]

Drexler's writings, coupled with his known expertise in nanotechnology, gave cryonics supporters a useful tool in their discussions and added to the arguments that cryonics is a reasonable thing to do. Ettinger's insight that molecular repair would someday be fea-

sible was augmented with powerful new thinking as to how it could happen. It became harder for skeptics to argue that cryonics was not something one ought to do. It showed that cryonics was not, as its critics were sometimes wont to say, "an act of faith," or "just wishful thinking." It made crystal clear that cryonics is based on reasonable premises that are, at bottom, grounded in scientific fact. As Dennis Kowalski, now president of the (Ettinger founded) Cryonics Institute, once told me: "Nanotechnology changed cryonics from 'It may work' to 'It probably will work.'"

Such a small change is, of course, all the difference in the world.

Brian Wowk's 1988 Paper on Cell Repair Technology

A native of Winnipeg, Canada, Brian Wowk earned undergraduate, Masters and Ph.D. degrees in physics-related majors from the University of Manitoba, and now is a U.S. citizen and a well-known medical physicist and cryobiologist. Along with Greg Fahy he developed key technologies in cryopreservation, including taking part in the first successful vitrification and transplantation of a mammalian kidney. For the July 1988 *Cryonics*, Wowk contributed a very interesting article, "Cell Repair Technology", where he notes:

> *In particular, it will be argued in broad technical terms why nanotechnology implies a medicine capable of reversing not only any organic disease (including aging), but also a host of supposedly irreversible injuries, including severe freezing injury, ischemic injury, and even destruction of all non-brain tissues. In short, a foreseeable future technology will be presented which would seem to give present cryonics practice a reasonable (perhaps even good) chance of success.*[32]

With these intriguing and stirring words early on, a very readable paper begins on the enormous medical promise of the concept that Drexler had championed. It seemed quite applicable to keeping cells (and therefore tissues and whole organisms) in a healthy condition to begin with and/or returning them to a healthy condition when they become sick and/or damaged.

Wowk points out that normal biological processes have, in general, involved the very capabilities that will be needed to deal with any of the problems mentioned in the previous paragraph. No doubt novel approaches will be needed also, but this remains only a difference in kind not in principle. The goal is still, as in the natural efforts of cells themselves, to return cell structure, via the appropriate positioning of atoms and molecules, to what would be found in nature in existing healthy cells and to do this, if need be, atom-by-atom.

Present mechanisms that attempt to maintain homeostasis ("steady state") in human cells and tissues, as well as in the human body as a whole are quite impressive in their abilities, but it should be remembered that they developed through natural but "blind" processes that were millions of years in the making. The ability to direct and/or improve on those processes through intelligent intervention should lead to repair capabilities well beyond what would be necessary for solving the problems of cryonics. As Wowk puts it in his paper:

> *Nanotechnology will mean no more guesswork, uncertain cures, or untreatable organic conditions; medicine will finally be equal to the task of understanding and controlling the body in terms of its most fundamental machine components—atoms and molecules.*[33]

Wowk in his proposals uses terminology somewhat reminiscent of Thomas Donaldson, calling the repair mechanisms "medical microbes or *cell repair devices.*"[34] Whichever terminology one prefers, Wowk's or Donaldson's "repair bacteria," the concept is still fundamentally the same: devices that are subcellular in size and intelligently designed to restore individual cells or groups of cells into a youthful and healthy condition.

Wowk, in his 1988 effort, goes into a great deal of detail about the baseline capabilities (access, disassembly, analysis, reassembly) that exist in cells and which, therefore, need to be present in cell repair devices. He further talks about control, communications, power needed, and operations at cryogenic temperatures. He also discusses practical consequences: the new capabilities would be applicable not just to cryonics patients but also the more conventionally ill. It was an outstanding effort.

In 2006 Wowk made an addendum to the paper stating he wished, in retrospect, that he had more adequately credited Eric Drexler for developing the basic thought of molecular manufacturing and its obvious implications in terms of biological repair. Nobody's perfect but we can credit Wowk's original paper (even) for the impressive tour de force it is, in approaching the important problems of cryonics.

Ralph Merkle Becomes Involved in Cryonics

Ralph Merkle was born in 1952 and is in some ways a "latecomer" to cryonics. Merkle studied computer science at the University of California, Berkeley and received a Ph.D. in electrical engineering at Stanford university in 1979. He is well known as a co-inventor of public key cryptography. Destined to eventually collaborate with Eric Drexler at Xerox Palo Alto Research Center, Merkle had not really given cryonics much thought until in his 30s, when he had completed his doctorate and "married, bought a house, and settled into

a Silicon Valley start-up company."[35]

In spite of considerable personal success, Merkle began thinking about the future course of his life and the inescapable fact that, like everybody else, he would be dead within a few decades. He then began, as many scientifically minded people do, with an examination of the available literature on our mortality. At first, as he puts it (emphasis added):

> *Cryonics was simply one of the items on my list of possibilities, and not very high on my list at that. My initial intuition was that the human body was a very complex machine which had not evolved to cope with freezing. This intuition persisted through my review of cryobiology, but I rapidly concluded that cryonics— unlike any other approach—**could benefit from future technology developed any time in the course of the next few centuries.**"*[36]

At this point Merkle's literature search and thinking somewhat paralleled the combination of earlier writing by Ettinger and that of Drexler. The basic possibility of putting people "on hold" through cryogenic storage was coupled with the promise of future resuscitation methods based around nanotechnology. The details of how it would all be done were understandably vague—"advanced" nanotech was still in very a primitive state.

Merkle added much to the public discussion with his paper "Molecular Repair of the Brain" in the October 1989 *Cryonics*.[37] This was followed in 1992 by "The Technical Feasibility of Cryonics," which appeared in the peer-reviewed journal, *Medical Hypotheses*.[38] Early in this second paper Merkle makes a telling point: "Perhaps the most important question in evaluating cryonics is its technical feasibility: will it work?"[39] A little further down he adds (combining two paragraphs and adding emphasis):

> *Before we can decide whether future medical technology can repair freezing injury, we must consider what fundamental limits constrain such technologies. Human tissue and human beings are made of atoms. Whether a person is healthy or ill, alive or dead, depends entirely on the arrangement of those atoms. The fundamental purpose of medicine is to cure the ill and heal the sick. Put another way, **the purpose of medicine is to change arrangements of atoms that are "unhealthy" to arrangements of atoms that are "healthy**."*[40]

Phrased this way, it is obvious that the limits of future medical technology depend on the limits of our ability to control the structure of matter. The better our tools for doing this, the better our medical technology can be. Echoing the clarity of Ettinger and Drexler in their thinking about cryonics, Merkle focuses on the central problem of the correct repositioning atoms as the pathway to resuscitation—then goes on to subdivide the problem into three basic issues:

1. Where are the atoms?
2. Where should they go?
3. How do we move them from where they are to where they should be?[41]

The attempt to provide some answers to these very basic questions results in some pretty in-depth thinking that is far beyond the scope of this article—but I summarize. Merkle delves, among other things, into (1) what computational power would be necessary to accurately identify and describe the position of every atom in a human brain, (2) a definition of death that Merkle refers to as "information theoretic death," and (3) a repair scenario he describes as "off-board repair." A brief synopsis of each point follows.

In dealing with (1), Merkle concludes that it is possible to use 1,000 atoms (at most) for digitally encoding the needed description and addressing information to locate a single atom in the brain. The total for all the brain would thus be about 1,000 times the volume of the brain itself. (This would hold assuming, for example, that the storage medium, like the brain, had about the density of water, a common value for many substances, and atoms roughly the size of the brain's, also reasonable.) This works out to be, according to Merkle's calculations, a needed storage device about a cubic meter in size.

"Information-theoretic death" (2) is a concept Merkle introduces whereby death is not considered to have occurred until "the structures in the brain that encode memory and personality have been so disrupted that it is no longer possible in principle to restore them to an appropriate functional state."[42] This definition means that if those structures can be realistically repaired, using either the existing atoms in the structure or, if necessary, atoms from outside the structure (as occurs in many, if not all, normal bodily repair mechanisms), then the person cannot be considered actually "dead."

Sometimes, of course, death would make an appearance. Suppose someone is at the center of a thermonuclear explosion and completely vaporized. That person is truly and fully "dead" since there is no longer a way to figure out what essential brain structure they had. The application of nanotechnology to cryonics, or anywhere else for that matter, can't be expected to solve every problem.

Someone whose structures are completely preserved can be thought of as "alive," however, even though they may have reached the point that conventional medicine would declare them "clinically dead" (i.e., heart, lung, and brain activity have ceased). The ability to repair any nonfunctioning structures and return them to normal activity would be equivalent to a situation in present day society where someone after cardiac arrest is "brought back to life" by resuscitative efforts. "Off board repair" (3) can be thought of as disas-

sembling the brain down to whatever level is needed (cellular, subcellular, molecular and/or atomic), to repair it, then reassembling the brain with all the structural elements in the proper place so as to reestablish normal functioning. This assumes, of course, that in Ralph Merkle's perspective, "information theoretic death" has not occurred and there is still enough information to infer the original brain structure with reasonable fidelity.

From the foregoing it is pretty evident that the technology for cryonics to work will probably be neither simple nor, at first glance, obvious. Based on the 1992 paper, and just some routine thinking, this sort of endeavor would have to involve a load of sophisticated computation, shading to advanced general intelligence. The three basic questions must, of course, be answered and answered well. Merkle acknowledges in his paper that his proposed "off board repair," despite his lavish attention to it, is not necessarily the only workable approach for the problem it's intended for. As he writes near the end:

> *A wide range of approaches other than the one considered here are feasible. The present method is not proposed as the "right" or "best" method, it is proposed as a conceptually simple and feasible method. A single feasible method of repairing freezing injury establishes the effectiveness of cryonics, regardless of the methods that are eventually implemented.*[43]

In short, this paper shows that one doesn't have to conjure up all the revival, repair, and rejuvenation possibilities that might conceivably work, for cryonics to be considered a rational approach to the problem of human mortality. It only has to be shown that one such pathway or mechanism is feasible. If that one pathway can be developed, then cryonics must be taken seriously as a means of life extension.

As was stated more reservedly earlier in the paper:

> *Examination of likely future technical capabilities supports the argument that unprecedented abilities are likely to be developed. Restoration of the brain down to the molecular level should eventually prove technically feasible.*[44]

Merkle's 1994 "Upgrade"

Merkle reworked and expanded the 1989 and 1992 papers into "Molecular Repair of the Brain" which appeared as a two-part serial in *Cryonics* (January, April 1994).[45] Details again will need to be highly abridged, but a few salient point are worth noting.

First is that the basic "fact" that underpins cryonics continues to hold true, as Merkle noted in all three of the writings we have considered:

> *Tissue preserved in liquid nitrogen can survive centuries without deterioration. This simple fact provides an imperfect time machine that can transport us almost unchanged from the present to the future: we need merely freeze ourselves in liquid nitrogen.*[46]

In the 1994 paper Merkle quotes cryobiologist (and cryonics critic) Dr. Peter Mazur in support:

> *"Cryobiologists are often asked how long cells can remain viable at -196 degrees C, the temperature of boiling liquid nitrogen (which is the usual cryogenic fluid). The answer is clear—more than 1,000 years. The reason is that direct ionizations from background radiation are the only source of damage at such temperatures. ordinary chemical reactions cannot occur." Mazur then goes on to state: "The pertinent question then is not storage stability, it is how can one get cells down to -196 degrees C and back without killing them."*[47]

(The person interested in cryonics would change this query just slightly and say "… how can one get cells down to -196 degrees C and back and have them be in a living and healthy state"? A very small change in wording, perhaps. But it implies that the pertinent question may not be whether they are "killed" by exposure to ultra-low temperatures, i.e., totally and forever beyond help, but whether it is simply that our present methodology at revival may just be too crude to revive them. Future methods may not be so limited.)

As for some cryobiologists who are trying to find ways to store human organs in the belief, rather than certainty, that it can ultimately be accomplished, Merkle says it best, again, in all three papers: "Perhaps the most important question in evaluating this option is its technical feasibility: will it work?"

Here, again, Merkle hits the crux of the matter. It doesn't matter what one's philosophical leanings are, or political views, or what one may think of the wisdom of a particular action, the bottom line for pursuing the storage of human organs is the same as for human organisms (cryonics): a belief that the effort will, *ultimately*, be successful. If that belief is based on reasonable premises, that is to say, in Merkle's excellent words, if no "fundamental limits constrain such technologies," then the pursuit of any goal that will be beneficial to human life and health and improve human living conditions is a reasonable goal.

There may turn out to be practical limits that would preclude such a goal, such as an excessive energy requirement—as an absurd example, if the revival, repair, and rejuvenation of a human being took more than the expected energy output of the sun over its whole lifetime. (If one could reach them, which is not practical at all at present if ever, one could just use other stars as well since there are lots and lots of them!) No such practical limitations, however, are known to exist. Cryonics, as far as we can see, is worth pursuing.

This article is an updated version of a chapter
which appeared in the book
The Prospect of Immortality: Fifty Years Later
edited by Charles Tandy, Ph.D. Readers
interested in a copy of the book may
check on Amazon.com

About The Author

York W. Porter, born in 1952, attended Berea College in Berea, Kentucky for two and a half years and, in the Fall 1974, began working in a rural Kentucky hospital in the Department of Radiology. Diversifying through the years, Mr. Porter worked for one year on an ambulance crew and spent several years in a hospital laboratory setting, plus about a year doing respiratory therapy work. He has worked fairly continuously in the field of medical radiography, working as a staff tech at various times in four rural Kentucky hospitals, primarily in the fields of general radiography and computed tomography. He also has worked in the past, on rare occasions, at a Magnetic Resonance Imaging (MRI) center. He is the President of the Immortalist Society, at the time of this writing, and serves also as the Executive Editor of *Long Life* Magazine, the "house publication" of the Immortalist Society.

SOURCES (REFERRED TO IN ENDNOTES, BELOW)

E Robert C. W. Ettinger, The Prospect of Immortality, Doubleday, 1964.

Da Michael G. Darwin, "The Anabolocyte: A Biological Approach to Repairing Cryoinjury," Life Extension Magazine (July-August 1977):80-83. Reprinted in Cryonics 29(4) (4th Quarter 2008):14-17, http://www.alcor.org/Library/pdfs/anabolocyte.pdf, accessed 20 Sep. 2015.

Do1 Thomas Donaldson, "A Brief Scientific Introduction to Cyonics" (1976), http://www.alcor.org/Library/html/DonaldsonBrief.html, accessed 19 Sep. 2015.

Do2 Thomas Donaldson, "How Will They Bring Us Back, 200 Years From Now?" The Immortalist, Vol. 12, March, 1981.Dr1 K. Eric Drexler, Engines of Creation, Doubleday, 1986 (updated version, 2007).

Dr2 "Molecular Technology and Cell Repair Machines," K. Eric Drexler, Cryonics 7(1) (January 1986) 19-28 (Part II); full article http://www.alcor.org/Library/html/moleculartechnologycellrepairmachines.html, accessed 20 Sep. 2015.

Fe Richard P. Feynman, "There's Plenty of Room at the Bottom," http://www.zyvex.com/nanotech/feynman.html, accessed 20 Sep. 2015.

FM "Interview with Robert Freitas & Ralph Merkle," Cryonics 29(4) (4th Quarter 2008) 9-11.

Fr Nanomedicine, Volume I: Basic Capabilities, 1.3.2.1 The Biological Tradition, Robert A. Freitas, Landes Bioscience, Georgetown, TX., http://www.nanomedicine.com/NMI/1.3.2.1.htm (Darwin's remarks are in red at the very bottom of the web page), accessed 20 Sep. 2015.

Ma Peter Masur, "Stopping Biological Time: The Freezing of Living Cells," Ann NY Acad Sci 541: 514-531 (1988).

Me1 Ralph C. Merkle, "Molecular Repair of the Brain," Cryonics 10(10) (october 1989) 21-45.

Me2 Ralph C. Merkle, "The Technical Feasibility of Cryonics," Med Hypotheses (1992) 39, 6-16.

Me3 Ralph C. Merkle, "The Molecular Repair of the Brain," Cryonics 15(1) (January 1994):16-31 (Part I) & Cryonics 15(2) (April 1994):20-32 (Part II).

We Weizmann Institute of Science, "New Synthetic Enzymes Undergo 'Evolution In A Test Tube,'" ScienceDaily, 27 March 2008, www.sciencedaily.com/releases/2008/03/080326200653.htm, accessed 20 Sep. 2015.

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

Wo Brian Wowk, "Cell Repair Technology," Cryonics 9(7) (July 1988) 21-32.

ENDNOTES

1 Do1.
2 E.
3 Fe.
4 E, 38.
5 E, 38.
6 Fe.
7 Fe.
8 Fe.
9 Fe.
10 Fe.
11 Wh.
12 Wh, author's paraphrase.
13 Wh, 11.
14 Wh, 11.
15 Wh, 11.
16 Wh, 11.
17 Wh, 16.
18 Wh, 16.
19 FR.
20 Da, 15.
21 Da, 15.
22 Da, 16.
23 Do2, 5.
24 Do2, 6.
25 Do2, 6.
26 Do2, 8.
27 We.
28 Dr1.
29 Dr2, 22.
30 Dr2, 22.
31 Dr1, 136.
32 Wo, 22.
33 Wo, 27.
34 Wo, 24.
35 FM, 9.
36 FM, 9.
37 Me1.
38 Me2.
39 Me2, 6.
40 Me2, 6-7.
41 Me2, 9.
42 Me2, 9.
43 Me2, 15.
44 Me2, 14-15.
45 Me3.
46 Me2, 6
47 Ma.

Cryonics Protocols at the Cryonics Institute: Research and Practice

By Aschwin de Wolf and Chana Phaedra

Part 1: Patient Monitoring and Standby

Introduction

In this 4-part series we will review cryonics protocols at the Cryonics Institute, discuss recent research to validate and improve cryonics protocols, make recommendations to improve those procedures, and discuss future research directions in the field. Each installment will cover a single topic out of the following four: (1) Patient Monitoring and Standby, (2) Stabilization, (3) Cryoprotection, and (4) New Research and Future Developments.

Patient Monitoring

Preparation for a good cryonics case begins as soon as the member makes cryonics arrangements. From the perspective of the member it is important to keep the cryonics organization up to date about basic personal information such as current address, contact information, and funding/insurance status. This may seem obvious, but for some (frequently older) members their cryonics arrangements may not always be at the top of their mind and a cryonics organization may find itself with contact and emergency information that is no longer relevant. From the perspective of the organization, ensuring enough resources to provide services is paramount. Since the probability of a member needing cryonics service increases with age, cryonics organizations can use actuarial life tables to estimate the probability of a member needing its services or the expected case load for a given time period. For an example of how to use actuarial tables to predict caseload trends for a cryonics organization, see Mike Perry's "Tracking Caseload Trends" (*Cryonics* Magazine, Spring 2006).

Checking in with older and sick patients is not only important to prevent surprises such as unattended sudden death but also allows the cryonics organization to assist the member with topics such as designing or updating cryonics-friendly Advance Directives and to provide guidance to family and/or local team members in case the patient dies. If a member has made arrangements for standby and stabilization with an organization such as Suspended Animation, a lot of responsibility will fall on that organization, but in the absence of such arrangements timely and informed communication between older and sick members and the cryonics organization can make the difference between a good cryopreservation and a "straight freeze", which is cryopreservation without protection against ice formation as a result of many hours or days of circulatory arrest before cryonics procedures can begin.

While a straight-freeze cannot be said to automatically prevent the revival, rejuvenation, and repair of cryonics patients, obviously the less burden one puts on future science and technology, the better. Thus each case involving the use of cryonics should involve the use of the best process reasonably available and feasible. This will understandably vary somewhat given the conditions and resources present at the time an individual patient begins undergoing the process leading to them being cryopreserved by a cryonics organization. In some situations, however regrettable, this will be limited to a straight freeze. In many other cases (in fact the large majority of them), however, with some reasonable foresight and preparation, an effort that results in less damage to the cryonics patient can be carried out. We hope this four part series involving topics useful in carrying out cryonics procedures will greatly help to do just that.

Time and Temperature

To understand the importance of minimizing time between pronouncement of legal death and the start of cryonics procedures we will introduce two terms: **ischemia** and **vitrification**.

Ischemia refers to insufficient blood flow to an organ of the body. It can also mean a situation where blood flow is "normal" but the blood contains inadequate nutrients and oxygen for normal functioning of the tissue/cells to which the blood is being supplied.

For example, when a blood clot prevents blood flow to the brain and, thereby, oxygen and nutrients stop being supplied to the area affected by the blood vessels that are blocked by the clot, we call this a stroke. (There are other causes of strokes but the general principle in them is also the same). In the case of cryonics, ischemia occurs at a global (i.e., whole body) level when the patient experiences

sudden clinical death due to accident or illness or is pronounced legally dead by a physician after a terminal disease. Due to the heart and lungs stopping their usual life sustaining action, nutrients and oxygen are, of course, not delivered to the body and cells burn them up in a "last ditch" effort to try to survive.

One of the least recognized aspects of cryonics, but obviously a very important one, is that severe enough ischemia not only begins the process of decomposition of the brain but also affects our ability to cryopreserve the brain (or the whole body) without ice formation. This will be explained below and covered in more detail in future installments of series of articles.

"*Vitrification*" refers to the cryopreservation of an organ *without freezing*. To most people this is a counter-intuitive concept because we think that as soon as biological tissue is lowered below the freezing point of water that ice formation necessarily has to occur. The very good news for those interested in cryonics is that such ice formation is largely avoidable for organs like the brain and may be eliminated altogether if the blood that is in the circulatory system and also the separately existing liquid parts of the cells are replaced with a so-called vitrification solution. A vitrification solution contains high concentrations of "medical grade anti-freeze" which cannot be frozen and which turns into a glass at cryogenic temperatures. The current vitrification agent used by the Cryonics Institute is named VM-1 (Vitrification Mixture-1) and was developed by the researcher Dr. Yuri Pichugin while he was doing research for CI in years past. (Information on this mixture can be readily found at: http://www.evidencebasedcryonics.org/2008/03/31/vitrification-agents-in-cryonics-vm-1/)

As can be deduced from the very basic information just given, the mandate of every credible cryonics organization is to minimize ischemia and minimize ice formation in their patients to the maximum degree practically feasible in any particular case. As we will discuss below, if a cryonics organization fails to minimize ischemia it will become challenging to prevent ice formation, even when a vitrification solution is used. This is very important to understand.

One important distinction is that between *warm* and *cold* ischemia. For example, if a patient dies unattended at home and spends several hours at room temperature before being discovered, that is *warm* ischemia. That is to say, while the patient will start to cool down somewhat in most settings from their normal body temperature of slightly over 98 degrees Fahrenheit, that cooling will both be slow and will not proceed below the temperature of the room they are in at the time of their clinical death (i.e., when their heart and lungs stop working). If a patient is cooled down rapidly after pronouncement of legal death but spends 48 hours on water ice during shipping that is *cold* ischemia.

Both forms of ischemia produce poorer outcomes for the patient compared to immediate intervention with cryonics procedures at the moment of clinical/legal death. When the patient's temperature remains at body temperature, or stabilizes at room temperature, however, metabolism remains relatively high and these adverse changes occur at a much faster rate than they otherwise would if more efficient cooling of the individual occurs. Cooling the patient with, for example, immersing them in water which has its temperature reduced by ice reduces metabolism, thereby slowing the rate of ischemic damage. Some people invoke the so-called Q10 rule that says that for every 10 degrees Celsius drop in body temperature, metabolism drops by 50%.

Since its inception in 2008 our company, Advanced Neural Biosciences, has conducted extensive research to understand the effects of ischemia on the quality of preservation in collaboration with/financial and other support by other organizations such as the *Cryonics Institute, Alcor,* and *Longecity* as well as the *Immortalist Society*.

There are three notable effects when there is a delay between cardiac arrest (i.e. pronouncement of legal death) and the start of cryonics procedures.

1. As the duration of ischemia increases, replacement of the blood of the patient with a cryoprotectant will get progressively much more difficult to accomplish due to clotting of the blood and accumulation of fluids that constrict the vessels.

2. As the duration of ischemia increases, the patient's vessels become leaky and their organs, including the brain, start to swell (swelling of an organ is, generally speaking, called "edema"). In whole body patients severe abdominal distention is observed as well.

3. As the duration of ischemia increases the "blood brain barrier" (which is the highly selective membrane barrier protecting the brain) breaks down which can further exacerbate swelling ('edema") of the brain.

One of the most basic findings in our lab has been that if cardiac arrest is followed by immediate rapid cooling the adverse effects associated with ischemia (e.g., ice formation, swelling, etc.) are greatly reduced. This is why some cryonicists point out that the quality of our procedures are ruled by time and temperature. The goals are to cool the patient as quickly as possible and minimize the time spent between cardiac arrest and the completion of the full protocol of cryonics procedures. This mandate requires some sort of a local response team or a remote standby team at the patient side at the time of their legal/clinical death.

Standby

If we recognize the importance of time and temperature, there can be little doubt that starting cryonics procedures ***as soon as possible without delay and very strongly preferably immediately*** after the pronouncement of legal death is necessary to arrest decomposition of the brain/body and optimize the chance of ice-free cryopreservation. Again, as mentioned, any delay begins the "clock ticking" towards the time that serious complications in trying to carry out a "first class" cryonics protocol will be difficult, if not impossible, to overcome.

A typical Cryonics Institute member has four options to ensure a timely cryopreservation will occur: (1) Execute a contract with an organization, such as *Suspended Animation*, that offers standby and stabilization services; (2) Establish a local response team (which can include a local funeral director) that can perform a basic series of stabilization procedures after pronouncement of legal death; (3) Relocate to the area of the *Cryonics Institute* after a diagnosis of terminal illness or rapid decline; (4) Utilize a combination of those options just mentioned. In this article, we will only focus on local standby procedures (Option 2) because this is the only scenario that can routinely minimize the time between pronouncement of legal death and completion of cryonics procedures. In theory, it is also possible to obtain the advantages of a local case remotely by conducting cryoprotection of the patient where the patient is pronounced legally dead, but this will require a procedure called "field cryoprotection" which is not a routine procedure at any of the major cryonics organizations yet. We will review the rationale of evidence of this procedure in our third installment ("cryoprotection") of this series.

One of the most formidable challenges in cryonics remains to establish proper monitoring and logistics to ensure that there are no delays between the pronouncement of legal death of the patient and the start of cryonics procedures. In research we conducted for the *Alcor Life Extension Foundation* we found evidence of breakdown of the blood brain barrier in a rat model ***after only 30 (!) minutes of ischemia at body temperature***. When administration of stabilization medications was delayed by more than 30 minutes we did not observe any differences between administration or omission of these medications. For example, the anti-clotting medication heparin is effective in preventing the formation of blood clots after cardiac arrest but cannot dissolve blood clots that have already formed. We will review more research findings in our article about stabilization.

In our experience, many individuals and local groups spend a disproportionate amount of time on the acquisition of standby equipment and learning protocols at the expense of figuring out how to avoid a scenario where the patient dies unattended or without the presence of a person with the legal authority to pronounce the patient legally dead. As a consequence, a well-equipped cryonics organization or local group will find itself well prepared for a case without being able to respond in a timely manner or having to respond without sufficient personnel. This is a particular challenge in cases where the response team consists solely of volunteers and/or paid professionals with other, and possibly conflicting, obligations. Help of any kind isn't very effective if it isn't available at the time it is needed. This can be thought of as similar to "calling the fire department after the building has already burned down".

If a professional standby and stabilization organization such as *Suspended Animation* is not always able to respond in a timely matter it may seem daunting for a cryonics organization that does not offer standby or a group of volunteers to do so. There are a number of things that the organization, however, can do to close the gap between pronouncement of legal death and the start of cryonics procedures in many cases:

1. Track the state of the patient during terminal illness and decline. Until recently, this required frequent cooperation and information requests from the patient's caregivers. Recent developments in the field of wearables and health tracking devices now allow for remote monitoring of trends such as heart rate and sleep.

2. During the phase of (rapid) decline, make sure that there is always someone present with the patient who can observe cardiac arrest and immediately notify a medical professional who has the authority to pronounce the patient legally dead.

3. Ensure that are multiple professionals with the authority to pronounce the patient legally dead in the vicinity of the patient. Preferably, such professionals should be present during the decline of the patient.

4. Place basic stabilization equipment at the location of the patient or in a nearby vehicle.

5. Cooperate with hospital staff to permit interventions that benefit subsequent stabilization procedures such as leaving IV lines in place and the administration of medications to prevent blood clotting such as heparin.

A succinct way to summarize the essentials of the above would be to say "*right time, right people, right equipment, right procedures.*" If a cryonics organization fails to incorporate this mandate into its daily operations, most of the research that is conducted to improve cryonics cannot be translated into meaningful action. In our second installment of this series we will break down into more detail what

initial stabilization of cryonics patients entails and what our research can contribute to optimize these procedures.

Health Tracking Wearables in Cryonics Patient Monitoring: A Case Study

In January 2017 the authors of this article were provided the opportunity to consult and assist in the cryonics case of former American Cryonics Society President (and one of its founding members) Edgar Swank. One of our first recommendations was to use a health tracking device to monitor the condition of the patient remotely. Since this was a first, and because of our own familiarity with the device, we decided to equip Edgar with a FitBit Charge 2.

The FitBit Charge 2 is a commercial device readily obtainable from the company online, on Amazon, or through some local cell phone carriers. Meant originally for the fitness industry, we have been able to adapt it for cryonics use due to its ability to provide constant monitoring of an individual's heart rate coupled with the ability to use a phone to send this information to a remote location.

In anticipation of fitting Edgar with the FitBit wristband, we spent some time the morning of January 7, 2017, obtaining a FitBit Charge 2 and a phone to "sync" it with in order to collect continuous heart rate data. After successfully setting up the phone app and ensuring that we could also remotely view data via the web application, we were taken to the White Blossom Care Center in San Jose, California to fit Edgar with the band.

We were able to quickly fit the wristband monitor to Edgar's left wrist without any problems. We then set up the phone at his bedside with Bluetooth on so the data would sync regularly. (For those not familiar, Bluetooth is a wireless technology that was designed to take the place of "hard wired" cables in sharing data between devices). The phone was left plugged in so there would be no need of charging it. The FitBit charger was left on the same nightstand, plugged in and ready to charge the FitBit should it be necessary. It is possible to monitor the battery life of the FitBit remotely, and we found that it would not need recharging until almost a week of use. This is consistent with reports that say that a FitBit Charge 2 only needs to be recharged every five days or so.

We began collecting data immediately. Figures 1-6 below present the data as viewed from the remote website application, which is all we had access to after returning to Portland, Oregon.

On January 7, as shown in Figure 1, a stable heart rate of approximately 80-90 bpm (bpm means "beats per minute") was collected over the evening.

On January 8 (see Figure 2), heart rate continued to be stable in the 80-90 bpm range until noon, when it rose to approximately 100 bpm for the rest of that day until 6am the following day.

After 6 am on January 9, heart rate remained stable at approximately 90 bpm. (See Figure 3)

On January 10, heart rate remained stable between 80-90 bpm until 1 pm, when it sharply rose to above 100 bpm, and jumped further still at 6 pm to approximately 105-115 bpm. (Figure 4)

On January 11, heart rate appeared variable throughout the day with a large spike up to 130 bpm at 5 pm followed by a brief absence of signal before resuming at around 100 bpm, but with increased variability. (Figure 5)

On January 12, heart rate maintained a highly variable pattern around 100 bpm throughout the morning, then spiked to over 150 bpm before plummeting to approximately 60 bpm until 4 pm, when an absence of signal indicates probable cardiac arrest. Afterwards, short bursts of activity are seen on the monitor coinciding with the application of manual chest compressions applied to Edgar Swank's chest, then one notes a much longer burst of activity appears which coincides with the application of the AutoPulse Resuscitation System by the personnel of Suspended Animation, Inc. While AutoPulse normally assists medical teams in providing CPR on regular patients, it is used in cryonics patients to provide CPS (named CardioPulmonary Support since the end goal of cryonics is not immediate resuscitation but the ability to help maintain tissue viability until adequate cooling can be carried out and desired substances can be introduced and circulated through the patient's body).

Two of the advantages of AutoPulse Resucitation System use in a cryonics setting are that it provides a more precise compression regimen than humans can ordinarily maintain and it also frees up personnel for other tasks as well as taking over in what is normally the very fatiguing work of providing chest compressions. (See zoll.com/autopulse for further info on the use of this device. One may also see numerous videos of this device on YouTube).

Overall, we believe that remote physiological monitoring seems to be a very useful adjunct to cryonics patient care. It seems to be encouraging that having access to real-time continuous heart rate data in patients that are nearing clinical death can provide a cryonics team with valuable information to supplement what is gathered from hospice care workers and others involved in the regular "on-site" assessment of a patient. We are hoping that collecting such continuous data across multiple cases will inevitably allow us to

search for patterns in the decline of patients that are nearing clinical death that may be more difficult to observe otherwise by the relatively brief taking of the patient's pulse at various times throughout the day as is done in traditional hospice and other medical settings. Some literature already exists on this topic and we hope to combine our observations with a reading of those clinical papers to further validate efforts on behalf of cryonics patients to provide as an efficient and effective effort towards maximizing the goals of giving each individual the best cryonics care possible consistent with the circumstances present at the time of their clinical death.

Premedication in Cryonics Patients: Basics and Research

Disclaimer: The Immortalist Society and any other cryonics organization cannot provide medical care for living patients and must regard the care and medication of legally living members as the sole responsibility of members and their treating physicians. To avoid conflicts of interest and any potential legal/ethical issues and to avoid any impression whatsoever that the Immortalist Society is attempting to engage in medical practice, the Immortalist Society cannot advocate any particular and specific premedication protocols for cryonics patients. ***Again, all care and medication of members is the sole responsibility of those members and their treating physicians! The material that follows is for informational purposes only!***

The subject of premedication in cryonics is a complicated and potentially controversial one. Following Michael Darwin, who has written an extensive treatment of the topic for the now defunct stabilization company BioPreservation in 1997, the most basic definition of premedication concerns pharmacologic treatment of the patient during the patient's critical illness with the aim of preventing or mitigating the changes that occur as a result of cardiac arrest and/or the delays attendant to the pronouncement of legal death.

For a detailed discussion of this topic we refer the reader to Darwin's

Figure 1 Edgar Swank heart rate data January 7, 2017

Figure 2 Edgar Swank heart rate data January 8, 2017

Figure 3 Edgar Swank heart rate data January 9, 2017

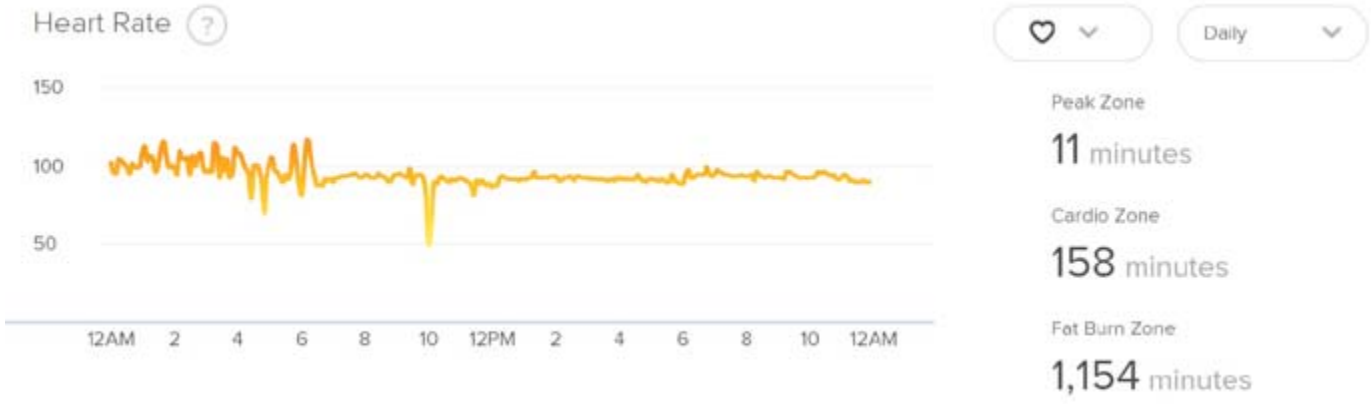


Figure 4 Edgar Swank heart rate data January 10, 2017

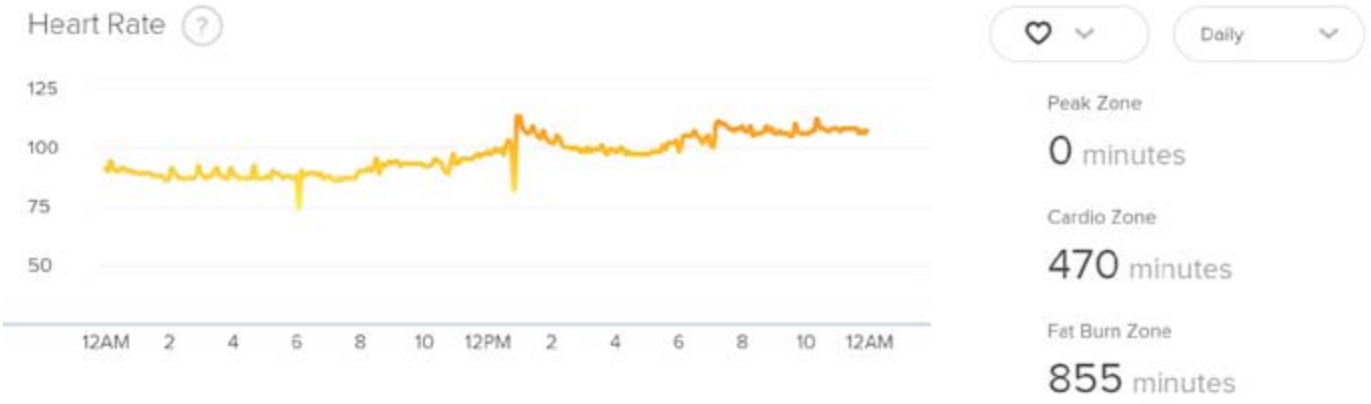


Figure 5 Edgar Swank heart rate data January 11, 2017

Figure 6 Edgar Swank heart rate data January 12, 2017

paper. The paper may be found at http://www.cryocare.org/index.cgi?subdir=bpi&url=tech20.txt). One fundamental distinction we'd like to make here is between pharmacologic interventions that prevent a certain adverse event following cardiac arrest from occurring at all versus pharmacologic interventions that aim to reduce the magnitude of a specific kind of injury. A good example of the former is prevention of blood coagulation and a good example of the latter is free radical damage following ischemia.

An extensive collaboration with the *Alcor Life Extension Foundation* (which will be discussed in future installments of this series) has given us some insights about which medications could be potentially effective to be used for premedication of cryonics patients. We found strong evidence for sodium citrate and heparin. Both agents interfere with blood clotting, and sodium citrate may have some additional anti-ischemic properties. While sodium citrate is increasingly recognized as the most potent stabilization medication in cryonics, this agent cannot be given in the manner needed for cryonics when the patient is still terminal because it will induce immediate cardiac arrest. Heparin, on the other hand, is routinely given to patients where blood clotting is a (potential) problem and should be given the highest priority in a cryonics premedication regime, provided good cooperation exists between the patient, the doctor(s), the hospital, and cryonics organization.

We have not found strong evidence for any other medications, vitamins, or nutrients to be used in cryonics premedication but the medical literature seems to indicate that taking a suitable multivitamin may prevent arrhythmia or sudden cardiac arrest in the dying patient and is a very inexpensive item. If not contraindicated or disapproved by licensed health care professionals in charge of the patient, the administration of aspirin could be another weapon against blood clotting that can occur during the dying phase and immediately after cardiac arrest. Melatonin is an over-the-counter supplement that the literature seems to indicate has potent anti-oxidant properties and that might also assist in managing sleep and moods in the dying patient. In short, heparin, aspirin, supplements to address vitamin, nutrient, and mineral imbalances, and a potent antioxidant like melatonin are some readily available substances that we believe should be able to improve the level of cryonics care in the typical patient. All of these substances will, of course, have to be given consistent with the judgment of licensed health care professionals in charge of the patient before the patient's clinical death. Many times, however, as long as those professionals do not perceive any harm to be done (i.e., a multivitamin is frequently taken by many individuals with a variety of conditions and, as mentioned, melatonin is a readily available over the counter substance which many individuals take on their own volition to aid in sleep and for other reasons), it may be easier to get those professionals to acquiesce in their use.

New Cryonics Survey

Bestselling Author and Futurist Melanie Swan is conducting an online survey of the cryonics community at: http://bit.ly/2uqdSdF

There is no deadline for participating and Swan plans to publish some results in the August edition of Cryonics magazine.

Current survey results to date can be viewed here: goo.gl/zPTKE5.

If I Had a Million Dollars: Part 2

Respected cryonics advocates give their thoughts on how they would use a million to benefit cryonics and themselves

Article introduced by Jim Yount, Chief Operating Officer, American Cryonics Society

Continuing our series, here are two more "millionaires." Here respected cryonics advocates give their thoughts on how they would use a million to benefit cryonics and themselves.

We thought we would ask some of the people who are knowledgeable of present cryonics and who have thought a lot about the future as to just how they would want their own million used for cryonics. In asking this question we should keep in mind that cryonics is a personal choice, and expect that people who make that choice will want their money to be used in ways that they and their cryonics family members have the best chance money can buy for ultimate reanimation and future comfortable lives.

Our millionaire series started with Long Life Volume 48, Number 04 4th quarter, 2017 with York Porter and Marta Sandberg telling us how they would use a million dollars to benefit cryonics. In this issue longtime cryonists John Day answers that question as does estate planner and cryonics life-insurance salesperson Rudy Hoffman.

Jim Yount

John Day

In the way of introduction, John Day has this to say about himself.

I grew up on a farm in northern California, went to Cal Tech for three years and figured out that I didn't want to be a Physicist, then went to UC Berkeley for a year and figured out that I would never get past the language requirement. So I worked for ten years designing, building and testing oddball electrostatic printing equipment. During this time, bit by bit, I got a degree in Physics and a Masters in Industrial and Systems Engineering.

When I was at Cal Tech I took a class that gave me a taste of computer science and programming by working with one of the first ever programmable electronic computers, the LGP-30. It was a vacuum tube machine with no random access memory (this was in 1961). Since then I have done a lot of programming on my own time, projects like looking for a stock market "system" (never found anything good), and participating several times in an international gomoku tournament (my program "shifty" never did better than second behind a guy with a much faster computer).

Once I could show programming experience, I took a job at NASA's Ames Research Center where I helped analyze science data for the next thirty odd years. It was one of those systems where the "programmers" have all the fun figuring out how to do things and the scientist/manager gets all the credit.

I worked on the SETI project and data from the Pioneer series spacecraft and other high profile projects. The way NASA does things deteriorated a lot during that time, but that is another story.

It may not be as much fun to brag about, but I have also had a full family life. Produced three kids with a total of five college degrees, and they are all favorably disposed toward Cryonics.

I first heard about Cryonics in 1962 or 1963 when there was an article in the newspaper with the address of the New York Cryonics Society. It instantly made sense to me and I wrote to them. They wrote back and made it sound like California was on the back side of the moon, but even though I moved a couple of times somehow they kept track of me and when the Bay Area Cryonics Society was formed, Edgar Swank sent me a membership form. I filled it out and in 1969 I sent it in. Trans Time was formed, the Bay Area Cryonics Society changed to the American Cryonics Society, and I was sucked in to awful all day meetings every month. I created the Facility Group which collected investment money, bought a building, and rented it to Trans Time on favorable terms for ten years. During that time I served as Trans Time "capsule guy", I think they designated me as chief engineer. I designed and had built the Trans Time 13 person capsule and built/invented a lot of the equipment Trans Time used. I also participated in Paul Segal's famous dog freezing experiments and wrote the software he used to collect data.

Since I have retired, I am still writing computer programs, some related to chess, some related to investing (still nothing good) but I

have completed one project worth mentioning. All my life I have kept open the tiny improbable possibility that there might be something to some of the UFO reports people talk about. I spent a lot of my time for more that a year searching out the best information I could find on all the best cases. I have reached a solid conclusion. I am completely sure, satisfied in my own mind, that there is nothing there. At least if there are aliens involved with UFO's, the study of them best fits the area of theology, not science.

If I Had a Million Dollars

by John Day

If someone offered me a million dollars simply on the condition that it be used for cryonics purposes, I would be purely selfish. I would split it three ways. One third to be held for my benefit by the American Cryonics Society according to procedures I have already established. One third to be set up as a family Cryonics Trust. The remaining third to be placed with another cryonics organization. I would have to review, and perhaps visit, all existing cryonics organizations, including those not in the United States, to find the one most likely to survive and use the money for my personal benefit in preference to other people. I am not an all-for-one and one-for-all type person.

A more likely case is that someone would ask my advice as to how they might use a million dollars for the general benefit of cryonics. This is harder because, as much as I hate to say it, a million dollars is not enough. I don't believe there is any way to apply that amount of money to existing cryonics activities/organizations that will significantly change the trajectory of the cryonics "industry".

When cryonics was a new, exciting idea a lot of very competent people volunteered their time, were active in cryonic organizations, did research into cryonics methods, thought about how to make cryonics procedures and organizations work better, and generally reinforced each others' enthusiasm. Today cryonics is boring. People maintain the cryonics organizations more out of a sense of dedication than any confidence that they are on a path to success and great things in the foreseeable future. Cryonics depends on unpaid and underpaid volunteers, and sooner or later there will come a time when there aren't enough of them.

The solution is that cryonics must become a business. Services must be provided by employees who believe that they cannot make more money doing any other equally desirable job. There must be technicians and qualified scientists and clerical personnel and salesmen and financial personnel and a CEO and a board of directors or other oversight group. Yes, people can wear more than one hat, but for every one of these functions there must be a backup person to take over if the primary person quits. The absolute minimum number of employees for a reliable self sustaining business is about six or eight not counting the oversight group. If we ignore any return on capital invested, such a business unit might just barely sustain itself on ten customers a year each paying around $150 to $200 thousand. The maximum number of customers such a unit could service is probably around 100 per year at $50,000 each. Nothing in this range looks likely any time soon, so why is this a solution?

There are people out there who can afford to set up and endow such a unit to continue independent of any customers it may have. Even allowing for other costs, plant and equipment, oversight group, future growth, and unpredictable events the whole thing should come in under $100 million dollars. Within 50 miles of where I sit there are 50 billionaires who could do that without blinking.

So what would my advice be for someone with a million dollars? Use it to develop a very detailed business plan for such a unit. Do the legal work, set up the oversight group, maybe even locate a possible site. Make pictures, plan out work and storage areas, get resumes from potential employees, maybe even get quotes on plant and equipment.

HIRE SOMEONE WHO KNOWS WHAT THEY ARE DOING TO SHOP THE PLAN AROUND.

Rudi Hoffman

Rudi says of himself:

Rudi Hoffman is the world's leading cryonics insurer, having provided the financing arrangements for about 67% of every human signed up and funded for cryonics on the planet. Focusing on the needs of cryonicists since he personally signed up for cryonics in 1994, Hoffman's practice is increasingly focused on cryonics estate planning. His mission is to spread the idea that "both cryonics and cryonics estate planning are affordable through the leverage of life insurance."

If I Had a Million Dollars

by Rudi Hoffman CFP CLU ChFC

For the last 23 years as I have done what I hope is my best to spread the idea and affordability of cryonics to more people. I have often asked myself, "Self, what would you do if you had more money you could commit to supporting and marketing cryonics?"

This article is an attempt to condense what Mr. Self responded. While it is just actually a different part of my brain (you probably have read the research indicating the modularity of the brain and consciousness), it may be helpful to have Mr. Self as a separate character for purposes of this short article.

First, Mr. Self is quite annoyed that cryonics as a science and legitimate medical technological intervention is still so shockingly small in it's adoption. "How can it be," he asks incredulously, "That cryonics is over 40 years old and has less than 2500 people signed up?"

Well, I respond somewhat testily, this memeset just does not seem to resonate with most people, even early adopting science loving religious skeptics. Research indicates that even when people know of this idea, only a small percentage take the actions necessary to become signed up and properly funded.

Mr. Self thinks this is a poor excuse. "You have not actually MARKETED this idea!" he rants.

"Do you recall how WE got involved with cryonics? It was the article and full page advertisement in OMNI magazine. That article and advertisement in a national science/science speculation magazine netted perhaps 50 people as members, and was the result of a $25,000 grant for the purpose of marketing cryonics. Now you have one MILLION imaginary dollars to play with, what are you going to do?"

Ok, I respond. You don't have to yell. I am right here, pretty close, in fact. Recall, Mr. Self, that that $25,000 is the ONLY time we know of that serious money has been put into marketing cryonics. Every other member we know of has come to this idea through their own independent research.

But, let's get to the allocation of our million dollars, shall we, Mr. Self? How about this as a first pass allocation strategy?

$25,000 FOR A CRYONICIST SURVEY

Given that we do not have hard data and research as to the exact demographics, interests, professions, and proclivities of existing cryonicists, we are going to commit $25,000 to fund a SURVEY OF CURRENTLY SIGNED CRYONICISTS.

We need to have PRECISE and QUANTIFIED data on our target market. Of course, we know that there are some groups who are hugely disproportionately represented in our membership.

These include:

1. software engineers (some 63% of my cryonics clients),
2. people who are skeptical of the claims of religions (atheists, agnostics, secularists, humanists of all stripes),
3. a disproportionate number of gay, transgendered, bisexual, and "post-gendered" individuals,
4. folks who are interested in life and health extension,
5. a large percentage of libertarian oriented, free market individualists.

A fellow cryonicist client is a professional demographer. He designs and carries out these exact type of demographic surveys, and does extensive analysis of the resulting data. This data gathering is time-consuming, detail oriented, and expensive. But worth it, which is why smart marketing and management people invest in this research. What motivated you to take the multiple steps and significant costs involved in signing up for cryonics? Articulating this for yourself, and then having a mechanism for cryonics leadership to understand DEEPLY the emotional keys to trigger action will be helpful, don't you think?

This means we would have a solid and reliable data set from which to make informed decisions about best paths forward and marketing strategies.

$500,000 TO NATIONAL ADVERTISING

I suspect that the survey will reveal the reading and blogging and website habits of the people we want to reach. These will probably include "Discover" and "National Geographic" magazine. Also we may want to reach the readers of "Reason" magazine (subtitle: Free minds, Free markets) as well as the magazines "Free Inquiry" and "Skeptical Inquirer". These last two are magazines going to skeptics, agnostics, humanists, and atheists. I was proud to have an article published in Free Inquiry some years ago, "Many are Cold but Few are Frozen: Cryonics Today".

(I thought the article was pretty good, but I am sad to say it did not net many new cryonicists.)

CONTINUES ON PAGE 35

Robert Ettinger: *The Legacy Continues*

Introduction by York W. Porter, President of the Immortalist Society and Executive Editor of Long Life Magazine

Looking Back:

Robert Ettinger "Goes to Court"
Introduction by York W. Porter,
President of the Immortalist Society

Cryonics has regrettably struggled to some degree, since its inception, to be taken completely seriously. After an initial burst of enthusiasm in which it seemed that it would easily become a part of day-to-day life in the mid twentieth century, things settled into the "long slog" of decades of persistent effort and action on the part of cryonicists to bring things to where they are today. One of the primary individuals bravely and persistently leading that effort was the "father of cryonics", Robert Ettinger himself. Cryonics is, indeed, gradually making progress and the plethora of well-educated individuals in the fields of medicine, science, and nanotechnology who have been willing to speak up on its behalf is a testament to that progress.

While things are better, much better in fact than where they were in decades past, they still aren't as advanced as they could be. During his years of working on behalf of his world changing concept, Robert Ettinger continued to think of ways in which that concept could get, frankly, a "fair shake" (which he wisely knew would ultimately lead to its acceptance). This isn't an uncommon problem in science. Even the great Albert Einstein had resistance to his concepts of relativity, with some of that resistance apparently resting, quite sadly, on an anti-semitic viewpoint, instead of on the basis of what we like to think of as the rational and cool-headed analysis of scientists. Even the anti-semitic opposition to relativity fundamentally went away, with a few pockets of this type of ignorant resistance, as factual evidence on behalf of Einstein's concepts began to build up more and more.

Thankfully, and to its detractors credit, anti-semitism has not been a problem in the opposition to cryonics but in a similar way to relativity, evidence favorable to cryonics, substantial when Robert Ettinger first began to write about it in the early 1960's, has continued to build up as well. Hopefully the day will come, with additional progress, where cryonics will finally become a routine procedure available to individuals whose illness and/or injury is beyond the palliative effects of current day medical technology.

Scientists are far from the cold and calculating, semi-robotic figures of fictional writings and Hollywood movies. They are, quite understandably, human at bottom and are subject to the same feelings, emotions, and biases that can plague other humans. Especially if they are talking about subjects out of what can sometimes be their relatively narrow area of expertise, their judgment quite frequently is no better than their fellow humans.

An example of this appears to be the situation with Dr. Michio Kaku, a theoretical physicist who has spoken in the negative as concerns the concept of cryonics. Dr. Kaku is undoubtedly very intelligent and is obviously well educated. Further, his demeanor, at least on television, is one of seeming to be a quite nice individual as well, which he quite probably is in regular life. Those characteristics, however, don't automatically make him correct in his viewpoint on cryonics since he is far afield from the area he trained in and, therefore, more likely to make errors in information understanding and in thinking about the subject. Several quite extensive and excellent rebuttals have appeared online concerning mistakes and problems with his viewpoint. Further, a Ph.D. in any area, even in cryobiology, doesn't confer infallibility on anyone and concepts and ideas and the evidence for and against them still have to be looked at in the cold light of logic and reason no matter who proposes or opposes them.

Still the so-called "layman" is faced with the onerous task of trying to sort things out and trying to understand the underlying technical debate that is going on. Part of that task is attempting to discern "fact from fiction" in the discussion. In the late 1960's, as a method of trying to deal with the problem of bias and other non-objective factors in science, as well as to try to help non-scientists to improve their understanding of what can be critical issues in society, Dr. Arthur Kantrowitz, an American scientist, engineer, and educator, proposed the concept of what came to be known as a "Science Court". The idea was to find a better way to present scientific information in such a way that laymen, and especially policy makers, could understand and benefit from scientifically based discussions and controversies. Dr. Eric Drexler mentioned in his book Engines of Creation what he calls a "fact forum". Whether one calls the approach a "Science Court", a "fact forum" a "debate" or something else, and whatever particular rules and actions are used in that approach, the point is that cryonics has never had a fair hearing in the court of public opinion. One thing that has greatly helped has been the development of the Internet. Things are now such that cryonics organizations can take their case directly to the public. It still takes, however, a pretty determined lay person to sort through and try to sort out the "wheat from the chaff" and sometimes, quite unfortunately, but also quite understandably, laymen fall prey to the number of initials after someone's name rather than the validity of their thinking as their decision making approach. (This ties in, I suppose, with the saying "Science progresses, funeral by funeral.")

Appealing to a Science Court

By: Robert Ettinger
December, 1986

Eric Drexler's *Engines of Creation*, recently published by Anchor/Doubleday, is primarily about nanotechnology or molecular engineering; but one of the many tangential ideas discussed is that of the *fact forum*—or, to use a term he prefers to reserve for government, the science court.

The need arises because many issues in public policy aspects of science are not properly addressed at present. From our perspective, the most obvious case is that of cryonics. Most of the "experts" are hostile, and they abuse their perceived authority, making irresponsible statements and never holding still for cross-examination. (For example, they talk glibly of the "low probability" of rescue of frozen patients, without ever even pretending to make a calculation of probability, let alone displaying it and defending it.)

Refereed scientific journals in some cases serve as a kind of court or platform for more or less orderly debate; it takes a long time, but in some areas each contending professional gets to say his piece, repeatedly if necessary. But if the subject matter is too general or includes any subtlety or has emotional or political overtones, the journals are apt to fail badly.

Regulatory bodies at present may act effectively as "courts"—an example Mr. Drexler uses is the FDA, which approves or forbids the marketing of drugs. But the agency inevitably focuses mostly on possible death or damage through use of a drug, and much less on possible lives or health lost through *failure* to have the drug available. It is much easier to prove that one life was lost than to prove a thousand lives might have been saved.

In a similar way, business organizations are likely to screen ideas primarily with an eye to avoiding pitfalls, rather than an eye to seizing opportunities—especially if the opportunities are not of the short-term variety.

Political forums are even worse, except perhaps in the very long run. Taking the case directly to the public is likely to mean a contest in spending, in hype, in screaming and even to coercion-extortion-blackmail.

The science court—in any of many possible formats—might sift the facts much more efficiently, and present the

public at least a clearer view of the options.

The aim of the court would not be to issue a judgment, but to identify areas of agreement and disagreement, to label and quantify them.

In the format I suggest (considerably different from Mr. Drexler's), there would be one witness or more for the *pro* side of the debate, and one or more for the *contra* side. There would be an attorney for each side (who might or might not be one of the witnesses). There would be a real judge (perhaps retired), with experience in a court of law—this partly for its public relations value. Finally, there would be a lay panel of "jurors"—but their function would only be to ask questions: the contenders have the task of making their points so as to satisfy both technical and lay people.

Why not a technical panel? We are dealing with questions in *public policy*, and laymen must make the final decisions—just as civilians make the final decisions on matters of military spending policy. Expert input is essential, but the bottom line, and indeed every logical pivot and important item of evidence, *must* be understandable to laymen.

Proceedings would typically extend over several days at least, to allow time for review, writing of interim position papers and summaries, introduction of new evidence, etc.

Problems and Possibilities

A crucial initial problem, especially for a cryonics trial, will be to entice contra participants. They may need to be bought—given financial inducements; otherwise they might feel disinclined to help publicize our views. (On the other hand, some might be so vain and stupid as to imagine they could demolish us, and welcome the opportunity.)

But other interesting possibilities exist aside from cryonics.

An example might be the hoary but still interesting case of vitamin C. Novel laureate Linus Pauling is the most famous proponent; he might be willing to participate. The public might pay to attend. Any number of establishment *contras* would probably be available; they would parade their list of inconclusive experiments, and would be baffled to have to admit that none of those studies involved the dosage levels recommended by Pauling.

Vitamin sellers (Kent & Faloon?) might sponsor the event, along with a university.

A more important probability from the immortalist perspective is aging research. The NIH, and all other agencies and institutions, have persistently refused to allocate appropriate sums in research aimed at extending the life span: instead, they spend disproportionate amounts to find cures for individual diseases, where success would save vastly fewer total years of life and for less money.

An aging research trial would be much more than a compendium or symposium on current directions in gerontology. It would forcefully contrast the cost/benefit potential of aging research vs. other types of spending. In order to do this—to educate the "jury" (and the *contras*) in analysis—it would be necessary to challenge traditional views of what is "natural" and "normal". The process would not stop until further reconciliation of views appeared temporarily impossible.

A single trial of this type would certainly be inconclusive, in the sense that divergent opinions would still remain. But important progress, and important converts, might be made. We could hardly lose.

Perhaps some of our readers will offer further and more specific suggestions for one or more of the above suggested trials in science court.

Final Editor's Note: There was, years ago, a local and very limited attempt in the Detroit region to carry out Mr. Ettinger's suggestion on a very small scale but there has never been a full fledged debate on a national scale regarding the subject of cryonics. Opposition and advocacy of ideas is a fine thing in and of and by itself but there is no reason that Robert Ettinger's concept, now having been around for over fifty years and showing no sign of weakening and, as a matter of fact, gradually gaining adherents, shouldn't be given a full fledged airing in a setting where the rules and procedures are such that advocates, both pro and con on this topic, have to proceed in an honest and objective fashion and in, even more importantly, a fashion that is useful to individuals who don't have technical expertise being able to make a reasoned decision. Call it a debate, call it a science court, call it what you will, intellectual integrity and honesty in public discourse demands no less.

If I Had a Million Dollars: Part 2

Continued from page 31

$250,000 TO MARKETING SPECIALISTS TO DO INTERNET MARKETING

We know our tribe is tech oriented, and many of us practically live online. Buying Google key words for targeted advertising works, as I can document having done this myself. Placing positive articles in influential publications for "free" publicity, creating public perception of the legitimacy of cryonics, getting our best presenters into venues like the TED Talks are all possible.

Mr. Self is objecting, in the strident, overly critical way he sometimes does.

"You are trying to sell a product that does not demonstrably work! What about money for research so we have a product we can market with integrity?"

Okay, I reply with annoyance. We are going to get to that. Even though the technical state of cryonics is probably and arguably not the main reason this idea is not more widely adopted. I have talked with people who were certain (with the obnoxious personality style of those we can say are "often wrong but never uncertain") that small animals had been brought back from cryonic temperatures, who were still completely disinterested in signing up for cryonics.

So, if we are trying to improve the technology with our rapidly dwindling money, where do we allocate it? To 21st Century Medicine, the Life Extension Foundation funded lab in California? To Suspended Animation Inc., also funded by Bill Faloon and LEF? Direct contributions to the Cryonics Institute, Alcor, the American Cryonics Society, or KrioRus?

No. These are all great organizations, doing history-making research. But there is a newer organization that has had remarkable success in just a few years of operation. Imagine an organization that can change the popular consciousness about whether we can preserve organs, and gain grant money from DARPA and mainstream pharma companies. Imagine that in two years they have created symposia that attracted hundreds of mainstream scientists from institutions like Harvard, Yale, and even the White House Science Advisors. This organization actually exists, and they are hitting the right social leverage points to change our culture, which is why we are committing the balance of the money to:

$225,000 TO THE ORGAN PRESERVATION ALLIANCE

The OPA is taking the ideas of organ banking and research into the MAINSTREAM. Working at the highest levels, with influencers in government, academia, science, and medicine, these remarkable people have made more progress in two years than cryonics has made in many years. As an aside, the leaders at OPA are smart enough to realize that cryonics has a public relations problem that ORGAN PRESERVATION does not. For this reason, Rudi Hoffman was graciously DISinvited to their first scientific summit, as I am irredeemably tied up with the ideas of cryonics.

Organ banking, it is obvious to nearly everyone, is considered a public good and the next step in modern regenerative medicine. Cryonics? Not so much.

IN CONCLUSION

Rather than lobbying for others to magically fund these wishes, I have been working pretty hard for the last several decades to promote cryonics, along with making a sufficiency of money to donate to good leverage points like the ones above. I truly wish I was in a position to write some big checks to make a difference. Alas, this is not the case yet.

I do thank the many people reading this who have trusted me and handled their cryonics funding through me. And those real visionaries taking the next step and doing a cryonics trust (about $4000) and funding this with a second and hopefully large permanent policy (perhaps one to three thousand a year premium). Cryonics estate planning is real, and affordable to many, because the cost of cryonics trusts has dropped and you can fund a cryonics trust with life insurance.

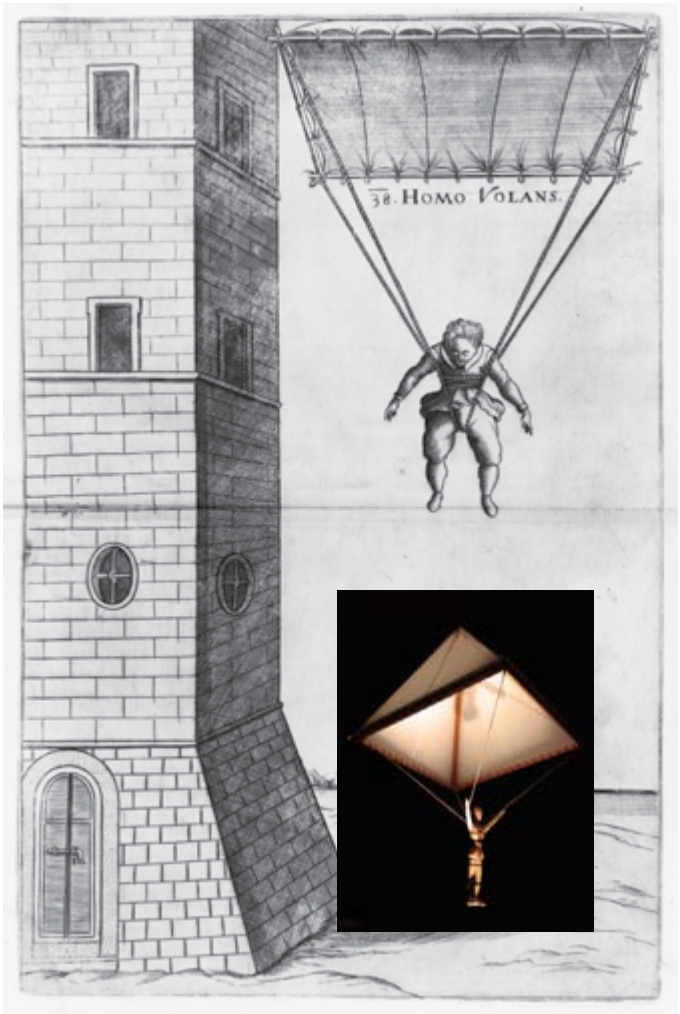
If we learn to work together, trust each other's skill sets AND intentions, and have the courage to take a calculated risk on bold initiatives, we can make the speculative contributions in this article REAL.

And that is one thing Mr. Self and I, and hopefully you, can agree on.

Final Thoughts

York W. Porter - Executive Editor

Jumping out of a perfectly good airplane...



I admit to not being the most physically brave person on the planet. Apparently this is a family trait as one of my relatives, who was in the Battle of the Bulge in World War II, laughingly told my Dad that the mere sight of the first group of enemy soldiers my relative ever came upon, prompted him to rapidly turn around and run the other way just as fast as he could! At any rate, one of the specific things I could never understand would be why folks would apparently completely enjoy themselves by jumping out of what seem to be otherwise perfectly good airplanes. In this sport of "skydiving", even folks who aren't in the predicament of being passengers in a plane that is in dire trouble, like to participate. Former President George Herbert Walker Bush (the "first" President Bush) had the absolute need to bail out of a damaged combat aircraft he was piloting in World War II but also later participated, even on his ninetieth birthday, in "bailing out for pleasure". As my friend Bob Ettinger would put it about Isaac Asimov's initial support in getting *The Prospect of Immortality* published but then not availing himself (Asimov) of cryonics "Go figure!".

The first parachute designs go back to at least Leonardo da Vinci's time period in the late 1400's. I suspect, given the experience I had early on while growing up, like many young children, of trying to use an umbrella as one while jumping off of a couple to three steps, that the concept had been around for ages before, perhaps in the form of using a sheet to accomplish the same "umbrella effect" at ultra low altitudes.

Be that as it may, the first parachute that actually worked may have been one demonstrated by a Croatian, one Faust Vrancic, way back in 1617 when he apparently decided to jump from a tower in Venice while using a parachute that had a rigid frame, as opposed to the soft parachutes we're used to thinking about today. He later published drawings and text about his efforts and results. Though I don't know that this resulted in any sort of up swell in "parachuting for pleasure", knowing teenage boys as I do, having been one decades ago, I wouldn't be surprised if other, probably unsuccessful and injurious attempts, followed which were initiated by this group of "too much testosterone and not enough brain cells" crowd of young men in their formative (but also too frequently senseless) years.

Time and technology apparently progressed and, by 1785, a dog was

dropped from a hot air balloon. The no doubt terrified pooch was apparently placed in a small basket and the parachute was, presumably, of the rigid frame design used by Vrancic. The brief account I read said the drop was a necessary one which was the result, I'm guessing, from the fact that hot air balloons were prone to failure from time to time back in those days. "Women, children, and dogs first" might have been the rallying cry!

Once again, the clock continued to turn and the technology improved and, by some point in the 1790's, Jean-Pierre Blanchard, the same fellow who dropped the dog from the hot air balloon, had developed a parachute out of silk. This parachute could be folded and didn't require a rigid frame. This was, of course, a great leap forward and by the late 1790's, an apparent daredevil by the name of Andrew Garnerin dazzled folks by jumping out of hot air balloons. His parachute was soft but apparently made out of canvas instead of silk.

Along with advances in technology frequently comes, of course, tragedy and one Robert Cocking is noted to be the first person to die in a parachuting accident way back in 1837. (My own suspicion is that some hapless teenage boy, as mentioned above, was probably the real first victim but apparently history doesn't record that). Cocking was a professional artist with an intense interest in science. Having seen Garnerin, the artist and science buff Cocking spent many years developing a parachute of his own design that he believed would be an improvement. Sadly, it failed to work as he wanted and he plunged to his death when he tried to use it. (Recently, of course, in another sad incident a United States Navy Seal lost his life in a parachute accident showing that, in spite of the passage of decades, no technology is, as yet, absolutely perfect).

The Great War…

In the early 1900's, a conflagration broke out such as the world had never seen to that point. That was, of course, in the outbreak of World War One, also known, at that time, as "the Great War". I have spent some time reading on it, having gone through Barbara Tuchman's noted work, *The Guns of August*, a couple of times, but I still have never figured out how the two deaths of an Austrian Archduke and his wife could ultimately lead to something in which millions were killed and more millions wounded.

It was the first war, of course, involving the use of the airplane and the fighter pilots of the time, looking at least through the lens of Hollywood, were portrayed as the "knights of the air". In the movie *The Blue Max* the exploits of a fictional handsome German pilot Bruno Stachel (played by George Peppard) was explored and there seems to be some truth to these pilots actually being sort of the "rock stars" of their day, independent of the Hollywood version of them.

The reality was much different, of course, as life expectancy for pilots was, according to various sources I looked at, to be somewhat between a few hours flying time to a few weeks of total living time. Whatever the correct figure, death was coming in a brutal fashion. The most merciful would be if they were killed instantly by a bullet. In a plane that caught fire, however, the pilot had the unpleasant choice of staying with the plane and probably burning to death or jumping to his death, which occurred on impact with the ground a few thousand feet below after what had to be moments of horrible contemplation.

And why didn't they avail themselves of the technology of parachutes which, as we have seen, had been around for a long time? While I don't definitively know, a few answers come to mind.

First is the fact that one is dealing with relatively young men, not much older than the foolhardy adolescents mentioned earlier. This age group (again, trust me, having been one) has an over evaluation of their own invincibility and an under evaluation of their own mortality. Even cryonics founder Robert Ettinger relayed the story of being shot at in World War II by a German soldier who was some distance away and then casually strolling to safety, basically just to show that German fellow that Ettinger wasn't scared of him. It was, of course, a very stupid thing to do, as Ettinger later freely stated, but that's young men for you.

Second, there was the usual amount of bureaucratic inertia at work. The "Not Invented Here" syndrome affects all kinds of otherwise seemingly intelligent and diligent groups of people. Just because something hasn't been done a certain way before seems to make everyone suspicious about making a change.

Third, "daredevils" and "stunt performers" primarily used parachutes in the time before the Great War. The thought that any "serious minded" person would engage in this practice seemed ludicrous at the time.

Fourth, I'd say the parachute technology of the time was relatively primitive and, perhaps (though I don't know this), quite bulky. Weight in aviation is very important, as is space on board to store things. More weight for a parachute would mean less weight for machine gun bullets and bombs.

But, whatever the real reasons, quite thankfully albeit gradually, things began to change to where by World War Two, parachute technology was widespread, saving the life of many an airman. A web page which may be of reader's interest (http://www.ejection-history.org.uk/project/Parachutes/1914_18.htm) shows a list/some photos of several pilots in the Great War who were able to parachute successfully to relative safety. It is interesting to note that the dates on the majority, if not all, of the pilots (as opposed to observers in balloons) appear to be in 1918, which was near the end of the war.

Still, in view of the fate of pilots in either burning to death/jumping to their death in earlier times, the Ettinger phrase of "Go figure!" seems quite appropriate in many circumstances of their lack of use.

Similarly, that phrase seems to apply to those of us advocating cryonics to those that don't avail themselves of this wonderful concept that Robert Ettinger conceived and is basically responsible for. To the pilots of World War One, using a parachute could, though not absolutely, assure some sort of chance at survival in needed circumstances. The lack of use of them meant basically no chance of survival at all in those same circumstances. The same lesson applies to cryonics today as regards any sort of fatal injury/illness.

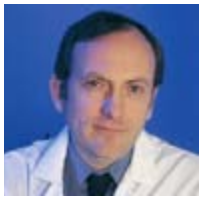
Let cryonics be your parachute in life. "Strap on" and join us today!!!

Inspiration | Information | Celebration

Join us for the largest ever gathering of radical life extension enthusiasts to:

* Become a more empowered and effective advocate.
* Interact with leaders of radical life extension.
* Have a blast celebrating our unlimited future together with music and performances.
* Learn the latest scientific advancements.
* Connect with like minded people.
* Gain vital insights to extend your health and well-being.

Keynote Speakers



Dr. Michael West
BioTime Inc, CEO

Suzanne Somers
Best selling author Co-founder ForeverHealth.com, Partner in Lifewave Technology & Medical Energetics, Lecturer & Entertainer, Entrepreneur.

Dr Robert Reis
University of Arkansas, Professor of Geriatrics, Biochemistry/Mol.Biol., and Pharmacology

Dr. Michael Rose
University of California, Director and Professor at the Department of Ecology and Evolutionary Biology

Dmitry Kaminskiy
Deep Knowledge Ventures, Managing Partner

Presented by

COALITION FOR RADICAL LIFE EXTENSION

A not-for-profit 50 1 (c) 3 organization

FOUNDING SPONSORS

LifeExtension Foundation for Longer Life®

PEOPLE UNLIMITED INC
Live now, live forever

REGISTER NOW

Long Life is a publication of the Immortalist Society
24355 Sorrentino Court, Clinton Township, MI 48035-3239