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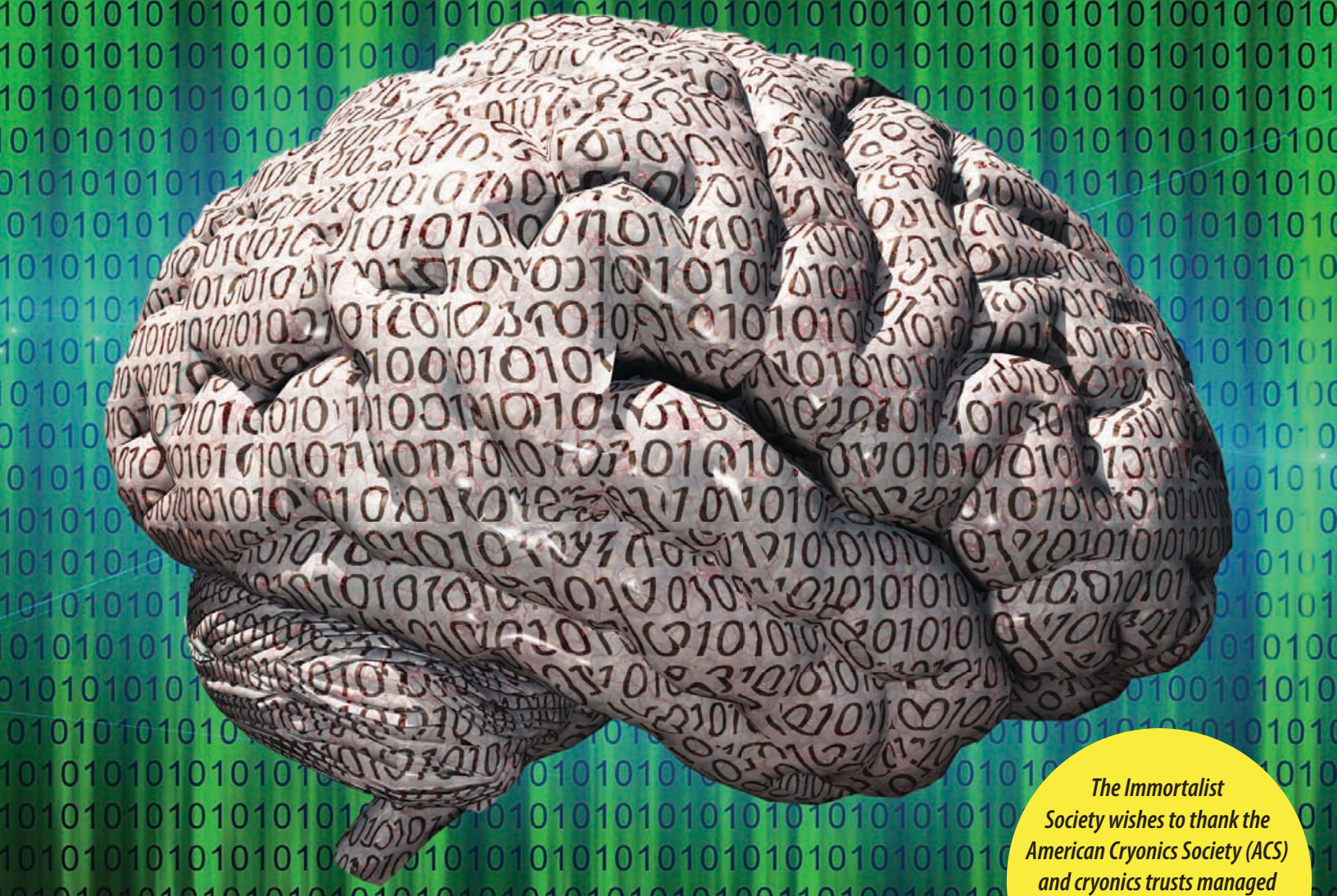
LONG LIFE

Longevity Through Technology

Volume 50 - Number 01

Concepts of Identity and the Growth of Cryonics - *p12*



The Immortalist Society wishes to thank the American Cryonics Society (ACS) and cryonics trusts managed by ACS for sponsoring non-subscriber mailings for this edition

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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.

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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

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LONG LIFE
MAGAZINE

A publication of the Immortalist Society

ORGANIZATION NEWS

FEATURE STORIES

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:

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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

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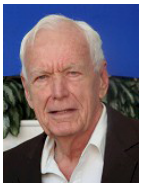

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CI EXECUTIVE REPORT

Dennis Kowalski - President, Cryonics Institute

Dennis Kowalski - CI President

Hello All,

CI continues to do well and exceed expectations on many fronts. We have 1,525 Members and 165 patients and are growing fast. We are quickly filling our current building and have begun expanding within the local CI area industrial park as well as making continued improvements at CI West. Interest and speculation on the location of CI West exceeded expectations and created some entertaining conversations and guesses among our members. However, the important takeaway message here is that CI has demonstrated the ability to adapt and grow on short notice, within budget as predicted by earlier business forecasts. As our membership and patient storage load grows, so does our financial base and resources to address this growth. Many people find it hard to believe that we can operate as efficiently as we do at CI for what we charge. The recipe for our success is simple. We do not spend more then we take in and we stick to our core mission: Providing the best chance to save as many lives as possible at the most affordable prices.

Recently CI fitted our Michigan facility with additional fixed insulated lines to transfer liquid nitrogen to all areas of the patient bay with efficiency and safety in mind. We will be fitting the 3rd and 4th rows of cryostats with a loading walkway as well. This should all be completed before the next AGM in September.

Outreach efforts and training our members about the benefits of standby continues. I am pleased to note that many members are becoming more proactive in setting up local standby with family and friends or local funeral directors. I continue to strongly believe there is no other area in cryonics that demands more focused attention than proper Standby. This is the lowest hanging fruit on the tree that can make the greatest difference in whether you get a good suspension or not. Please remember that your Standby planning efforts can make a world of difference. So keep up the good work, everyone!

I am often asked a simple question by the media and non-cryonicists alike. The question is "How do you predict that we will be able to revive people from suspension"?

That is a tough but fair question that many people both inside and outside of cryonics have been asking since this all started. However, since I don't think anyone can really predict the future, myself included, I hesitate to answer. But at the same time it begs the question of what do I, as the President of the world's largest cryonics organization, really believe?

Certainly I have some optimistic predictions, or at least high hopes, for the potential of achieving successful revival techniques in the future. When I first became interested in cryonics I had no idea how patients could be revived. I simply reasoned that cryonics had to be a better option than the self-destructive traditions of burial or cremation. I have always been optimistic about the future and see our technological advances as almost limitless and able to solve any problem if we really set our minds to it.

Death is probably mankind's most eternal problem. If we put enough time and effort into studying and understanding the aging process, fatal diseases, and even death itself, Cryonics can buy us the time to find soutions to even the most seemingly insurmountable problems. It is medical time travel - our ambulance to a future hospital.

But what that hospital might be was always a giant question mark to me until years ago when I stumbled across Eric Drexler's book "*Engines of Creation*." For those of you who aren't familiar with it, it's a fascinating exploration of the concept of molecular nanotechnology. The fundamental message is how we might reverse-engineer living systems themselves to solve many of the world's problems.

The reason we can't do this today is simply because these systems are just too small to see and manipulate with our current technology. A wavelength of light is often several orders larger than the

molecular machinery that builds the fascinating systems of life. However, that began to change in the 1980s with the advent of scanning tunneling microscopes that could see and manipulate matter on the nanoscale. The sheer complexity of these systems is almost mind-boggling, but through recent breakthroughs in AI and pattern recognition we are learning to hack what evolution has taken billions of years to figure out. We are learning to hack life itself.

It turns out that the difference between disease and health is basically just the particular arrangement of our molecules. Whether we are young or old, sick or healthy, suspended in liquid nitrogen or alive and talking has to do with how your atoms are arranged and the function of your molecular repair systems that move these atoms from one place to another.

All the excitement in stem cell tissue regeneration is really just a hack into the beginning processes of life. It turns out that your cells all have a complete blueprint for every other cell in your body. This master blueprint can be switched on to trick an older cell into becoming a brand new, healthy young stem cell. This has been proven *and this is with today's current technology!*

In my estimation, this is probably how we will start to be able to repair and rejuvenate cryonics patients who are in suspension now. All we need is one cell out of a trillion to give up its blueprint for repair or replacement of all the rest of the cells in a body. This is how our body's repair mechanisms work today, but unfortunately, they are insufficient to stave off aging. But there is also nothing in the laws of physics or biology that says we can't turn up the speed and efficiency of these repair mechanisms or reverse engineer them to build even more powerful repair systems. Potentially, we could even create repair systems that can overcome aging and even death, which in these terms can be seen as an organism simply being damaged beyond its ability to repair itself. With a strong enough repair mechanism, wouldn't an organism be capable of a greatly extended or even indefinite lifespan?

Cryonics to some people sounds too much like the mythical Fountain of Youth or a scam elixir. There seems to be no process in nature that lets animals live indefinitely. This is what many people, myself included, thought until I learned about germ line cells and stem cell generation where old cells generate brand new ones.

The proof of this is all around us every time someone has children - they are resetting the clock on a few cells whether those are sperm or eggs cells and creating brand new, infant cells from old ones. Mother Nature already has programming in our bodies to "reset the clock" and the proof is in the basic example of reproduction that all life follows in one way or another.

Now it's up to us to figure out just how Mother Nature does what she does. This is no easy task and it is why we are not reviving people now or curing aging, but I don't think anyone can plausibly argue it is impossible when it is literally happening every single day.

To me, the argument against this is as if a critic of da Vinci were arguing against heavier-than-air flight while ignoring the heavier-than-air birds flying in the sky above them.

It would take some time and other inventions, but the Wright Brothers showed us that they could, in a crude way, duplicate what Mother Nature had already proven was possible and fly. Not naturally, as birds do, but through our remarkable ability to innovate and create tools and devices to mimic, and often surpass nature. No bird flies at supersonic speeds or with sufficient velocity to travel into space. But in the span of a little over a century, mankind not only achieved flight, but flight capabilities far beyond those of our original inspiration from nature.

In this way cryonics revival has already been proven by nature. It is our monumental task, however, to figure out exactly how nature does what she does, replicate those processes ourselves and improve on them to the point where Cryonics Revival becomes a reality.

Decoding the unbelievably complex molecular and biological systems of nature is certainly a major challenge. But the encouraging news is that we have already developed systems and techniques that are capable of taking significant steps forward and those systems will only get better as time goes on.

I suspect we may need the help of advanced AI as well as molecular nanotechnology to unlock the secrets of hyper-advanced biological repair. Perhaps we will use some form of CRISPR cas 9 genetic engineering of a virus that repairs us from within. Maybe our future hospital will use very precise 3D bio printers to print up healthy new parts of our bodies using cloned stem cells.

I don't claim to know any of this for certain, but I do know that for every process we would need to revive a cryonics patient there seems to be an existing process in nature that can do the same job. Moving beyond biology, we can even consider matter itself, atoms, molecules and the like, as well as energy, as proven natural processes that follow laws and behaviors we can discover, copy and ultimately improve upon to turn to our own ends.

Nature has already proven these processes exist and they are just waiting to be reverse-engineered.

Worldwide Cryonics Groups

AUSTRALIA: The Cryonics Association of Australasia offers support and information for Australia & nearby countries. 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**

CHILE: Community oriented to provide reliable information on human cryopreservation, as far as technical scientific as well as other practical aspects. Dissemination, awareness and education on issues related to the extension of life in general and cryonics in particular. Contact José Luis Galdames via **galdamesjoseluis@gmail.com** or via facebook at Cryonics Chile

QUEBEC: Contact: Stephan Beauregard, C.I. Director & Official Administrator of the Cryonics Institute Facebook Page. Information about Cryonics & perfusion services in Montreal for all cryonicicts. Services available in French & English: **stephan@cryonics.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 with European cryonics groups. For more information: J.Roland Missionnier: phone: 33 (0) 6 64 90 98 41 or email: **cryonicsnews.inpi@yahoo.fr**

GERMANY: DGAB 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**

GERMANY: CRYONICS-GERMANY is an active group providing cryonics support, including a special 8-member Standby Response Team. Members from Germany or Internationally are welcome to join. at **http://cryonics-germany.org**. Direct inquiries to **contact@cryonics-germany.org**.

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/**

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.

THE NETHERLANDS: Dutch Cryonics Organization is the local support group since 2002 and able to provide advice, standby, perfusion and shipment 24/7, in case of need. We are an active group utilizing the latest equipment. New members from The Netherlands welcome.

E-mail: **info@cryonisme.nl**
website: **http://www.cryonisme.nl**

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

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: The Spanish cryonics group in Sociedad Crionica **www.sociedad-crionica.org.** The president is Dr. Lluis Estrada. This is a large group of people, and those interested in cryonics are welcome to contact them at **info@sociedad-crionica.org.**

SWEDEN: **www.kryonik.se** or Facebook: Svenska Kryonikföreningen. Initially, the society will focus on providing information and assistance to those who wish to sign up for cryonics. Eventually, we also hope to provide practical assistance in cases, possibly in collaboration with other European groups.

SWITZERLAND:
www.cryosuisse.ch

CRYOSUISSE The Swiss Society for Cryonics.
To join, **email info@cryosuisse.ch**

UNITED KINGDOM: Cryonics UK is a nonprofit UK based standby group. **www.cryonics-uk.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. **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.

Please send any corrections or changes to the address below. If you know of, or are considering starting a support, standby or other cryonics-related group in your area, please send details to

dg@dgmedia-design.com.

Cryonics Institute Membership Statistics:

As of December 2017, the Cryonics Institute has 1,525 members, up 54 from our last report. Of the 1,525 Members, 235 have arrangements for Suspended Animation Standby and Transport.

There are 165 human patients and 148 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 2018

* New Members = Increase in Membership since last issue

Members	1,525	Pets	148
Assoc. Members	192	DNA/Tissue	263
Patients	165	SA	235

TOTAL **1,882**

Reasons to Join ACS

1) We have been in business a long time

We were incorporated in 1969; our first cryopreservations were in 1974. We are a Calilfornia nonprofit corporation formed to advance research into cryonics and cryobiology. Two well-known medical doctors, Dr. M. Coleman Harris and Dr. Grace Talbot, were among our founders which also included Jerry White and Edgar Swank. Jerry and Edgar are in cryopreservation at the CI facility.

2) We work closely with the Cryonics Institute (CI)

Starting with our first frozen patients, ACS has maintained funds to keep these patients frozen. This responsibility has required that we focus on a practical approach to managing our resources. By working closely with CI with it's ever increasing "patient load" we are able to keep long-term storage costs down while adding to the funds of both ACS and CI.

3) Initial Preparation by Suspended Animation, Inc and other Options

We don't have all the answers. Cryonics depends upon anticipating future technological developments, and taking action NOW to benefit from those breakthroughs. This means there is a speculative aspect to cryonics. We give our members a wide a choice of options which include initial preparation by Suspended Animation, Inc. We also offer less expensive options. See our website for all choices.

4) ACS Utilizes the Tools of Risk Management

The ACS program employs the tools and techniques of risk management, such as inspection and verification of good practices at facilities where ACS members are in cryostasis. Financial planning includes diversification and decentralization to help guard against adverse financial consequences for ACS assets..

5) ACS Sponsors Research

Some research programs of the American Cryonics Society have been very well publicized. The successful cool-down and recovery of Miles the Beagle led to appearances of ACS scientists on Good Morning America, The Sally Jessy Raphael Show, and The Phil Donahue Show.

6) ACS Maintains its Own Emergency Response

Long term storage should be centralized but stand-by and emergency response, by its very nature, is local. In that regard we maintain emergency response equipment and responders in the San Francisco Bay Area which can also can be deployed to most locations in the US.

7) ACS is a Democratic Society

One internal control, absent in some organizations, is the fact that ACS is a democratic organization. That is, our governors are elected from among the members, by the members. A number of procedures have evolved over the years, to help ensure that this electoral procedure is safeguarded.

8) ACS Patients have Live-Member Sponsors

To ensure that the obligation ACS has to people in suspension continue to be considered, ACS has a program whereby live members act as "Sponsors" on behalf of the people in suspension. Sponsors get reports of suspension facilities housing the patient, and information on investments used to benefit the continued suspension of that person. Whenever possible, a good friend or relative of the person in suspension is named as a Sponsor. We prefer that the Sponsor also be enrolled in our suspension program.

9) ACS Manages Growth

The strength of a cryonics society is not dependent upon how many people it has in suspension. There must be a reasonable allocation of resources to meet the obligation of those in suspension. Societies who accept underfunded or non-funded patients must then make up that deficit through raising membership dues or by receipt of an endowment. Both of these fund raising methods involve significant risk, with results considerably in doubt.

The American Cryonics Society is not a kingdom built on a house of cards. The balance between those enrolled in our pre-need suspension plan, those in suspension, and the allocation of resources between these two programs is balanced to ensure our survival and prosperity. We are not dependent upon luck, endowments, windfalls, or even growth to sustain us.

10) We Make use of Individual Trusts

While other societies have more recently begun using trusts, the American Cryonics Society adopted this technique as its primary recommended funding vehicle in 1982. The individual trust is a mechanism to isolate and manage risk, ensure some oversight, obtain acceptable tax treatment, and address various problems and requirements unique to each individual member.

11) "Freeze-Wait-Reanimate" is our Only Purpose

The American Cryonics Society is not a "Utopian" organization. We don't have a political agenda to transform our current political or social structure to make our version of a perfect world. That is far too ambitious an undertaking; and besides, we don't all agree on what political and social changes are desirable. We are a cryonics society: PERIOD. Our program is simple: freeze-waitreanimate. We support cryonics research, education, and information dissemination. That is what ACS is about. That is ALL ACS is about.

Website: americancryonics.org

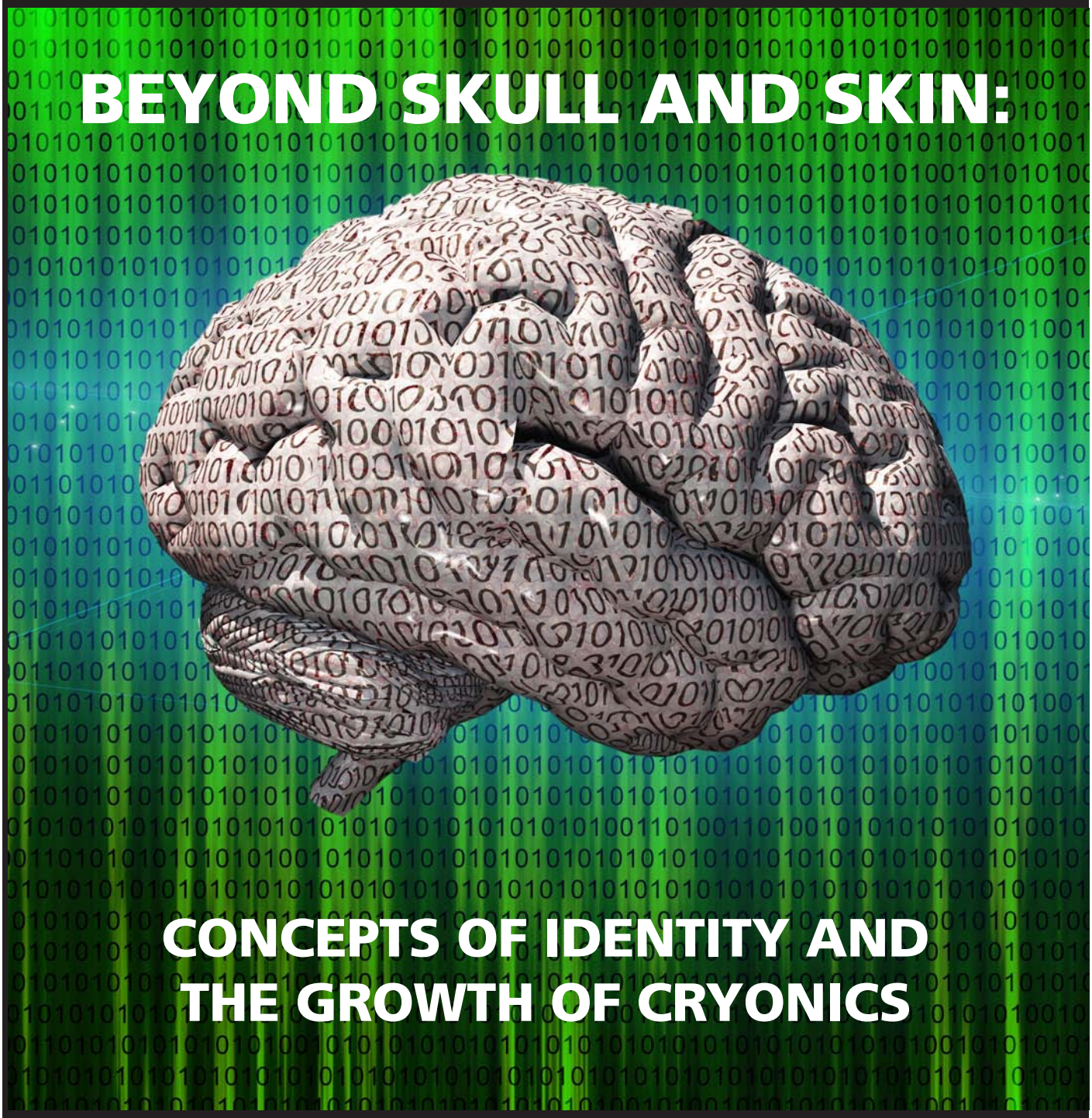
Email: cryonics@americancryonics.org

Phone: (408) 530-9001 • Toll-free: 1-800-523-2001.

Mail: American Cryonics Society - P.O. Box 1509, Cupertino, CA 95015

The ACS office is located at 510 S. Mathilda Ave. (Mezzetta Bldg), Suite 8, Sunnyvale, CA 94086
Office hours are irregular.
An appointment is required for a personal visit or interview.

BEYOND SKULL AND SKIN:



CONCEPTS OF IDENTITY AND THE GROWTH OF CRYONICS

By: Aschwin de Wolf

Preface by York W. Porter, Immortalist Society President

My friend Aschwin de Wolf writes below about the general topic that is featured in the Looking Back column that is elsewhere in this issue. Both Jim Yount's writings there and Aschwin's writing here deal with a central concern of cryonicists and that is how we can get more widespread interest and support for the topic of cryonics in general. In it's initial stages, developed in the very optimistic days of the early to mid 1960's, it appeared that cryonics was going to rapidly "catch on" and become a normal aspect of day-in, day-out life. Alas that has not been the case and although cryonics is, at this point, a topic that appears to be "here to stay", all of us involved in this endeavor fervently hope that the growth curve of this outstanding idea will, at some point, become much steeper as more of our friends and family recognize the solid logic that Robert Ettinger's idea is based on.

As an informative point "information theoretic death" is a phrase used to generally designate a situation in which structural damage to the brain of an individual is so severe that it isn't possible by any means, present or future, to reconstruct the individual to the degree that the "real person" still exists. The description just given isn't, perhaps, the best one in the world but it can be taken as a "starting point" for readers. Interested persons can simply use the "information theoretic death" phrase in an Internet search for more information. Also, it should be noted that there are some cryonicists (like myself for instance) that simply believe non-oblivion beats oblivion and that whatever level of repair is possible, so long as it results in a reasonably healthy and, hopefully, reasonably youthful anatomy and physiology, is still worth pursuing, even if present memories and personality traits may no longer be present.

It should be noted that the article below was previously published in Cryonics magazine. It is reproduced here with the permission of the author

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Introduction

"Where does the mind stop and the rest of the world begin?" So begins a 1998 paper by Andy Clark and David J. Chalmers called "The Extended Mind." In this much discussed article they defend the position that cognition, or the mind, does extend beyond the skull and can include objects or operations performed outside of the body, such as the use of calculators or notebooks. There are a lot of complicated and intricate issues involved here but I want to draw attention to the following passage at the end of their paper:

What, finally, of the self? Does the extended mind imply an extended self? It seems so. Most of us already accept that the self outstrips the boundaries of consciousness; my dispositional beliefs, for example, constitute in some deep sense part of who I am. If so, then these boundaries may also fall beyond the skin. The information in Otto's notebook, for example, [Otto has Alzheimer's disease] is a central part of his identity as a cognitive agent. What this comes to is that Otto himself is best regarded as an extended system, a coupling of biological organism and external resources. To consistently resist this conclusion, we would have to shrink the self into a mere bundle occurrent states, severely threatening its deep psychological continuity. Far better to take the broader view, and see agents themselves as spread into this world.

If we consider the idea that the self extends beyond the skull and skin, how does this affect our understanding of identity? Clearly, the self and identity are closely related and I suspect that many people would agree that a rich understanding of identity is not exhausted by considering a person's brain and body. In this article it is not my intention to wade too deeply into semantic issues, or attempt to resolve philosophical debates, but to argue the point that the public perception of cryonics would benefit from embracing a richer concept of identity that includes a person's social environment, life achievements, possessions, and other assets.

Reductionism in Cryonics

One might argue that cryonics is itself a form of reductionism because it approaches the brain solely as a biochemical entity. This can be admitted, but in this sense it is no more reductionist than the premise of mainstream medicine and neuroscience. In fact, in a properly conceptualized vision of cryonics one can remain agnostic about debates concerning "materialism" or "the soul." What matters in cryonics (and in medicine in general) is whether approaching the brain from a biological perspective can produce meaningful treatments for medical conditions. I think it is rather obvious that the answer to this question is "yes."

There is another sort of reductionism associated with cryonics that is more controversial, or perhaps I should say, less appealing to many people. The idea is that preservation of the body is identical to the preservation of a person's identity. If we can cryopreserve the person's body in a manner that permits future resuscitation of the person, then his identity has been preserved. In cryonics this idea has often been the starting point for further reductionism. The most notable example is the idea of neuropreservation in which only the brain (usually protected by the head) is deemed to be necessary for the preservation of

identity. Neuropreservation raises a lot of complex issues which I will not address here and have covered in another publication. (Long Life Editor's Note: Readers interested in that article may go to *http://alcor.org/Library/html/CaseForWholeBody.html)*

The most important point I want to make here is that our concept of the self or personal identity is not exhausted by our brains and that our existing bodies mean something to us, even if faced with the argument that an "identical" or "improved" body can be made for our cryopreserved brain in the future.

This kind of reductionism does not stop here. I have even seen arguments that what "really matters" is preserving the hippocampus, presumably being the seat of our memories. For most people, however, our life history (which is closely associated with our identity) cannot be reduced to memories and cognitive operations. The brain is about a lot of other things, too.

Reductionism can also express itself through a position that only "structural" preservation matters, usually confined to the "structural" preservation of the brain. If this argument is made in defense of the cryopreservation of non-ideal cases, under the assumption that as long as the original structure can be inferred from the damaged structure, it is a commendable position. However, how much brain structure must be preserved to prevent information-theoretic death is not something that can be known with certainty and the most conservative approach is to aim for making our procedures reversible by contemporary medical criteria. We do not yet have a good enough understanding of the neuroanatomical basis of personhood to make such a sharp departure from mainstream medical validation.

Cryonicists who believe in "substrate independent minds" (i.e. mind uploading) would even argue that repair and restoration of the original structure is not necessary and perhaps even inefficient. We can "just" do a molecular scan of the (damaged) structure of the cryopreserved brain, reconstruct the original structure "in silico," and revive the person in a computer. In this vision, identity is not just reduced to brain but to *information about the brain*.

We now have identified various concepts of identity. At one extreme we have a very rich concept that not only includes a person's brain and body but also his social environment, assets, and life achievements. At the other end of the spectrum is the idea that a person's identity can be captured by a scan of their brain (and perhaps even just the hippocampus). In the remainder of this article I will defend the position that if we want cryonics to appeal to a wider audience we should embrace a much richer concept of identity.

The Failure of the Cryonics Movement

Since the 1980s cryonics organizations have not failed in keeping their patients in cryopreservation. In that sense, cryonics has made impressive progress compared to the days when patients were often moved from one location to another because of insecure funding, sometimes culminating in having to let them thaw. Where the cryonics movement has not been particularly successful is in persuading the general public, or at least a substantial number of people, to make cryonics arrangements. This lack of enthusiasm for cryonics has been discussed intensely in the cryonics community and several reasons have been put forward: scientific credibility, affordability, transparency of cryonics organizations, ignorance, irrationality, religion, a pro-mortalist culture, or fears of the future. In my personal experience, the two major reasons for not choosing cryonics are a lack of confidence in its scientific feasibility, and a fear of future alienation.

Let me be clear that I think it is extremely important to demonstrate the scientific feasibility of cryonics. Even if it doesn't make cryonics a whole lot more popular, improving our procedures and developing credible resuscitation technologies, is of great importance to the people who *have* chosen cryonics. I do not think, however, that demonstrating the scientific feasibility of cryonics (i.e. human suspended animation) will produce a substantial attitude change towards cryonics.

First of all, I think it can be quite persuasively argued that the scientific case for cryonics is already quite strong. Ideally, we can cool down the patient to 0°C without compromising viability. The newer generation of vitrification agents can eliminate ice formation in the brain and preserve its fine ultrastructure. The ongoing trends towards miniaturization in manufacturing (such as 3D printing) and biology eventually will give rise to molecular repair technologies that can reverse aging and repair any damage associated with today's cryonics procedures. One would believe that these developments are at least plausible to hundreds of thousands of people, if not millions. Instead, the number of people who have made cryonics arrangements does not exceed 2,000 (as of writing).

There is another way of looking at this. If insufficient scientific credibility is the reason for the lack of enthusiasm for cryonics how can we explain that millions of people spend hundreds of thousands of dollars on unproven cures when diagnosed with a terminal condition? How can we explain the much greater popularity of astrology and all kinds of "esoteric" healing? A stunning number of people in the United States believe in the existence of ghosts (according to one poll, 45%!). Are we really supposed to think that the scientific arguments favoring

the claims of astrology or the existence of ghosts are stronger than those favoring cryonics? The argument that scientific credibility is holding back cryonics cannot withstand close scrutiny and fails to take into account what moves most people to endorse an idea.

For example, the famous science fiction writer and science popularizer, Arthur C. Clarke, was no stranger to cryonics. He even assisted Alcor during its legal battles in the 1980s. As he states in a supportive letter, "Although no one can quantify the probability of cryonics working, I estimate it is at least 90%—and certainly nobody can say it is zero." For a long time, Alcor's *Cryonics* magazine had one subscriber in Sri Lanka, presumably Clarke who lived there. But even Clarke had no personal interest in making arrangements. (He died in 2008, and was buried.) Clarke is no exceptional case. There are a lot of people who believe cryonics is plausible. What concerns them is not that cryonics may not work but that it *will* work, thrusting them into a distant, unknown future with obsolete skills and no money, friends or family.

Most people do not associate cryonics with *continuing* their lives but with losing everything they care for as the price of admittance to some dystopian neverland—not a very appealing prospect. I do not know if we can completely neutralize those fears, or even make cryonics at all appealing to the great majority. But I do think some progress can be made if we embrace a richer concept of identity and let it shape our communication about cryonics and the services we offer.

Preserving the Extended Self

I will refer to this richer concept of identity as the "extended self." It does not just refer to the brain or body of the patient but also to his friends and family, his career and achievements in life, his assets and possessions. The concept of an "extended self " is not just a theoretical construct but has already been used to great benefit in the study of marketing and consumer behavior. If the aim of a cryonics organization is to preserve the extended self, what changes would need to be made? In the most general sense, it would require that we listen carefully to people about what makes them uncomfortable about being cryopreserved.

We do not need to start from scratch here. We know what the predominant concerns are. I think that the common denominator that runs through most concerns is that people want their post-revival life to be a continuation of their existing life. There is one notable exception and that is people would want to be cured of the medical condition that caused them to be cryopreserved. In most cases this will require not just curing this disease but also reversing aging. It is important, however, to make it clear that these post-resuscitation decisions can and should be made by the person in question. This is why it is important to present a wide variety of visions of the future that will appeal to a wide range of people.

One unappreciated point about cryonics is that the delay between pronouncement of legal death and resuscitation only exists for people other than the patient. From the subjective experience of the patient resuscitation will be instantaneous. So I suspect that many of us would like a home to return to and continue our life. Unless we live in a post-scarcity economy where money has lost its utility it would also be helpful if we can continue to afford living in our homes and make purchases. Then there are also our personal belongings. If we are able to return to our homes a lot of those should be available once again as well. In short, "taking it with you" is not just a matter of setting up a personal trust but should extend to a person's money, property, and possessions.

Of course, we cannot expect society to remain static when we are in cryopreservation and the organizations or companies entrusted with these responsibilities will need to be authorized to adapt to these changes. Does a house need to be renovated? What kind of upgrades need to be installed to keep up with technological changes in residences? Should one's money (or a portion thereof) be exchanged to new digital currencies? Which personal belongings need to be replaced with newer items and which should be retained in their original state for personal or sentimental reasons? We cannot consult the patient in cryostasis and will need to be guided by common sense, written and verbal instructions, and practical considerations. I suspect, however, that most people would agree that an effort to maintain and upgrade our assets and possessions is much preferred to not having any at all.

When it comes to our social connections things are both easier and more difficult. Unlike managing a residence or personal belongings we would not have to make decisions about what to keep and not to keep. We would like to be reunited with our loved ones, family, and friends. Would it not be a lot easier to adapt to a new world if the people who were closest to you before you got seriously ill will be there, too? The biggest challenge here is to present a vision of cryonics where such a scenario is the logical and moral choice. Where making cryonics arrangements is the expression of social connectedness and family values, instead of being perceived as going it alone. This will not be a trivial task but I do not think we can claim, today, that we have put a lot of effort into this. I also suspect that cryonics organizations that make an effort to keep people who have been cryopreserved visible and part of our memories will have an easier time to convey the social nature of cryonics.

Reintegration

Will my skills, qualifications, degrees, and career achievements be completely irrelevant in the future? That is a frequently expressed and justified concern about cryonics. I have decided to treat this topic in this section about reintegration because I think it would not be plausible to claim that a cryonics organization (or associated organization) can successfully claim to resolve this completely.

The first point I want to make is that for many people who are revived in the future returning to their prior job may not be the most urgent matter provided their assets have been well preserved. In fact, even assuming a moderate growth rate, a patient in cryopreservation has a reasonable chance to come out rather well because no withdrawals are made for daily living expenses (aside from a modest asset management fee). Considering the fact that most people are cryopreserved at an old age, many of us will have accumulated some assets that can be preserved and invested during cryostasis.

Not everyone will be completely satisfied with this answer, or optimistic about their financial status in the future, but I think it is not realistic either to ignore this point. As far as the question of obsolete skills is concerned, I suspect we will see a lot of variability here. People with skill sets that are known to change in the future (for example, maintenance of land-line telephones) may be faced with greater challenges than people who work in "timeless" occupations such as artists who use traditional means of expression (painting) or wine makers. It will be fair to say, however, that the vast majority of people who have been cryopreserved for a long time (more than 100 years) will need to adapt to changes in occupations.

If a person comes out of cryostasis moderately secure, I do not think this constitutes a formidable challenge. The prediction that technologies will accelerate in the future does not necessarily mean that it will become harder to adapt. Even for people who are not cryopreserved during this period a greater pace of technological change will produce a corresponding demand for means to adapt to these changes. I suspect that a lot of these changes can be broken down into several distinct components and some of them can be addressed when the person is in cryostasis. For example, if society changes from email to a different kind of online communication we would expect that a cryonics organization (or whoever administers and maintains the patient's communications) would make sure that the patient will be able to access his correspondence in a contemporary format. One can think of things that can be done during a person's absence that will allow her to adapt more quickly and successfully. Reintegration does not start after resuscitation but should be an ongoing concern when the patient is cryopreserved.

The aim of a credible cryonics organization should not only be to cryopreserve the patient but to assist in re-integration into society, too. It stands to reason that when a cryonics organization is reasonably confident that resuscitation is imminent, increasing thoughts will be given to the reintegration of their patients. Not all cryonics organizations may have such a strong emphasis (or set aside money for this), though, but confidence in an organization's motivation and ability to do so could become an important criterion in choosing cryonics organizations. It is also likely that future charitable and for-profit organizations will focus their attention on reintegration of cryonics patients.

In closing, there is another aspect of reintegration that needs to be pointed out. People often tend to think of a revived cryonics patient as an "intruder" in a new society. Is that a reasonable assumption? Why not consider the idea that such people will be approached with a mix of curiosity and admiration? Why assume that revived cryonics patients only have things to learn and nothing to offer? Occasionally, advocates of cryonics are accused of being too "utopian" but it cannot be denied that a lot of skeptics have distinct *dystopian* views of the future. Which brings me to my last point. Cryonics organizations and their members should make an effort to present realistic but desirable visions of the future. The emphasis here is on *visions*. Instead of imagining the future as something scary, or at least as something presenting a series of challenges, it would be nice to be offered a panoply of good reasons to want to live longer.

Conclusion

Cryonics, no doubt, will always be associated with cryopreservation of the body or brain. That is the core activity of a cryonics organization. But if we want more people to make cryonics arrangements, we need to embrace a much richer concept of identity that gives people the impression that our ultimate goal is to ensure that their lives will be *continued* after resuscitation instead of being dumped in a foreign and incomprehensible world. I am not arguing that cryonics organizations should feel exclusively responsible for this but I do think we can do a lot better than we are doing today and hope that more people will be motivated to further strengthening their cryonics organizations along those lines.

Written by: Aschwin de Wolf on June 1, 2015.

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Keepers of the Way

Jim Yount

The following is a tribute to all of those who strive to make our journey a success. This passage from Plato, while meant to apply to the guardians of a city, may equally apply to the guardians of cryonics.

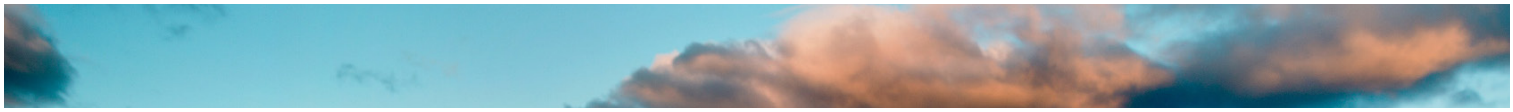
"And as we are to have the best of guardians for our city, must they not be those who have most the character of guardians? Yes.

And to this end they ought to be wise and efficient, and to have a special care of the State? True....

Then there must be a selection. Let us note among the guardians those who in their whole life show the greatest eagerness to do what is for the good of their country, and the greatest repugnance to do what is against her interests....

And they will be watched at every age, in order that we may see whether they preserve their resolution, and never, under the influence either of force or enchantment, forget or cast off their sense of duty to the State."

-- *Plato, The Republic III*



"I am keeper of the Way.

I direct all thoughtful people of the world to the Way.

I write books, I give talks, I tell one and all of the Way."

"I am keeper of the Way.

In my laboratory I find the means so that the dedicated, the proud, the aware may travel the Way to the future."

"I am keeper of the Way.

I take the traveler by the hand and direct that wayfarer to the Way. No matter that some say the sojourner is dead. I say 'deanimated' and that maybe, just maybe, life will continue after hiatus on the Way.

"I am keeper of the Way.

I am maker of instrumentality and means to enter the Way.

I add the liquid, the cold, cold liquid, that stops time for those on the Way."

"I am keeper of the Way.

The some say the Way is paved in silver and gold. I manage the finances that allows the paving to go on with the least possible to provide the most. Perhaps, my job is done well, the Way may be paved with pennies."

"I am keeper of the Way.

I watch the Way, I report, I chronicle, I look for means to secure the Way against those who may misuse, pilfer, purloin, or through pride and audacity make bad choices that lead to disaster's way."

"I am keeper of the Way.

I choose the people who have jurisdiction over the Way.

I study. I discuss. I compare. I ask questions. I vote."

"I am keeper of the Way.

Upon my analysis and decisions, those in the Way may transit the Way,

perhaps to live again."

"We are keepers of the Way.

And if just one of us makes it through the Way to the way of the future, then all the work, the struggle, the sacrifice to attain not only Élan vital, but personal Élan, will be victory supreme."

"May that One be me."

"May that One be me."

"May it be All."

"We are keepers of the Way."

The Technology of Repair, Revival and Rejuvenation - Part IV

by York W. Porter

Preliminary remarks by York W. Porter, Immortalist Society President

This is the fourth installment in this series. As stated before, 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.

This "fourth installment" basically takes up with additional efforts by very talented and intelligent individuals. 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 previous installments of this series, basically first appeared there, and then was slightly edited/updated and then was 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.

Further Work By Robert Freitas, Ralph Merkle, Eric Drexler and Others

Robert Freitas obtained a Juris Doctor in 1978 from the Santa Clara School of Law. Starting out his working career with an interest in space exploration, he published the first space political advocacy handbook. His work involved the searches for extraterrestrial artifacts (SETA) and intelligence (SETI). He next extended his interest in space exploration by participating in a 1980 NASA study to determine the feasibility of manufacturing facilities in space. Combining the talents of educators and NASA engineers, this very intriguing work concentrated heavily on using machine intelligence. As the final report said: "Such systems will complement human activity in space by accomplishing tasks that people cannot do or that are otherwise too dangerous, too laborious, or too expensive."[120]

The NASA work focused on self-replicating space factories. While seeming at first glance to be far removed from cryonics or medicine, in fact there are many common elements. Artificial intelligence could control devices at rates far beyond human response times and the brain's processing speed. Mechanisms could replicate themselves as needed for particular tasks. Control devices could possibly be in one location with the actual working devices in another. Space factories would benefit from such innovations, but so could the nanoscale devices that will be needed to repair, revive and rejuvenate cryonics patients. The outcome of the job may be different, but the basic approach and skills are still the same.

In the early 1990s Freitas worked on the concept of respirocytes. (The complete paper is at http://www.foresight.org/ Nanomedicine/ Respirocytes.html.) Though covering a rather different subject from space factories, there are many parallels, as suggested by the section titles. (A sample: "Power," "Communications," "Sensors," and "Onboard Computation.") These in turn would be clearly relevant to patients undergoing cryonics procedures, including restoration to healthy functioning someday via anticipated nanotechnology or other means.

Freitas encountered the subject of nanotechnology in a somewhat circuitous way: "The first time I ever thought about atomic-scale engineered objects was probably in 1977-78, when I was working on my first treatise-length book project (Xenology). In Chapter 16 of that book, I hypothesized that 'using molecular electronics with components on the order of 10 Å in size, 10^{10} microneurons could be packed into a space of a few microns which would be 'small enough to hide inside a bacterium.'"[121] [exact online reference for this quote: http://www.xenology.info/ Xeno/16.4.1.htm#p28]

Drexler's book *Engines of Creation* came out

in 1986 but Freitas had temporarily left the field and apparently didn't see it until later. Fortunately, Drexler continued to write on the subject and Freitas did come across Drexler's book *Unbounding the Future: The Nanotechnology Revolution*.

Unbounding the Future

Having written *Engines*, Drexler wanted to bring the concept of nanotechnology to a wider audience. *Unbounding the Future*, written in collaboration with Chris Petersen and Gayle Pergamit, was one such attempt. Among its many forceful and challenging conclusions is this: "A short summary of what molecular nanotechnology will mean is thorough and inexpensive control of the structure of matter. Pollution, physical disease, and material poverty all stem from poor control of the structure of matter. Strip mines, clear-cutting, refineries, paper mills, and oil wells are some of the crude, twentieth century technologies that will be replaced. Dental drills and toxic chemotherapies are others."[122]

Although Drexler tackled several subjects in his book, a chapter entitled "Nanomedicine" is of special interest for those involved in cryonics. Various nanotech-based procedures that should prove useful in restoring breathing, functioning humans to optimum health (including aging reversal) do also apply to cryonics patients. If one can achieve the thorough and inexpensive control of matter that Drexler and his co-authors claim and then apply that level of control to the human body, the body has to run, it has absolutely no choice. If the configuration is one of youth and good health, it will "run" in that manner. If the configuration is one of disease and old age, it will "run" that way (as long as it can). In the case of youth that is regained by the use of medical nanorobots, one should be able to maintain that state through proper nanoscale devices.

The maintenance of living structures that is done, albeit imperfectly, by the body's own inborn nanotech, is already rather incredible and "miraculous." Despite its virtues, however, the whole system crashes in the end, through one pathway or another, but mainly as a complication, directly or indirectly, of aging. We then have cardiac arrest followed, in most cases, by the dissolution of brain structures that form specific patterns that are unique to each individual. Our bodies took a long time to develop, billions of years if you count the entire history of life on earth, and did so, as far as we can tell, through naturally occurring but undirected processes. Pretty impressive results for sure, but we think we can do better, especially when we can bring our conscious and machine augmented intelligence to properly bear on the remaining issues that eventually bring about our demise. *Unbounding the Future* points out, though, how limited current therapies and repair strategies are:

"Better tools could provide both better knowledge and better ways to apply that knowledge for healing. Today's surgery can rearrange blood vessels, but is far too coarse to rearrange or repair *cells*. Today's drug therapies can target some specific molecules, but only some, and only on the basis of type. Doctors today can't affect molecules in one cell while leaving identical molecules in a neighboring cell untouched because medicine today cannot apply surgical control to the molecular level."[123]

Nanomedical devices can be seen today as providing great promise to deal with diseases that have proved to be, while treatable, still incurable – the scourge of AIDS is a case in point. As with diabetes, which long predated it, the life of victims can be greatly extended, but one hopes in both cases that a complete cure can be developed.

When *Unbounding the Future* came out, cryobiologist Gregory Fahy was in charge of the Organ Cryopreservation Project at the American Red Cross's Jerome Holland Transplantation Laboratory. Fahy has written: "Calculations imply that molecular sensors, molecular computers, and molecular effectors can be combined into a device small enough to fit easily inside a single cell and powerful enough to repair molecular and structural defects (or to degrade foreign structures such as viruses and bacteria) as rapidly as they accumulate…There is no reason such systems cannot be built and function as designed."[124]

Freitas' Reaction to *Unbounding the Future*

Unbounding the Future, Freitas tells us, was inspirational: "Having fully absorbed the MNT paradigm, I immediately realized that medicine would be the single most important application area of this new technology. In particular, nanomedicine offered a chance for significant healthspan (healthy lifespan) extension. It also appeared that this objective could possibly be achieved within the several decades of life actuarially remaining to me and others of my generation."[125]

(Freitas, like this author, was born in 1952).

Freitas then took the "next logical step":

> *"But was anyone pushing it forward? I contacted the Foresight Institute and learned that nobody had yet written any systematic treatment of this area, nor was anyone planning to do so in the near future. So I took up the challenge of writing Nanomedicine, the first book-length technical discussion of the potential medical applications of molecular nanotechnology and medical nanorobotics."*[126]

Production of Nanomedicine, Volumes I, II, and III

Originally planning a single volume, in 1994 Freitas began his Herculean task of trying to write what might be called a "magnum opus." The "single volume" approach was aban-

doned for what would be a three-volume set. Volume I, while couched in the language of the physical and biological sciences, would not be specialized toward clinical medicine. Volume II would be pitched toward an audience of systems and control engineers, research physiologists, clinical laboratory analysts, biotechnologists, and biomedical engineers doing applied research. In Volume III, Freitas hoped to deal with the clinical aspects of the subject.

And the word "Herculean" might be an understatement. Freitas reports that he initially hoped to get Volume I out in 1999, Volume II in 2002, and Volume III in 2005. As for what actually happened, Volume I was published in October 1999, while, rather than publishing Volume II as one volume, it was decided there would be Volume IIA and Volume IIB. Volume IIA appeared in October 2003. As of 2016, Volumes IIB and III are still in the works. This is hardly to be disparaged in view of the numerous projects, books, and papers Freitas has worked on in the intervening years, as well as the hours upon hours necessary to turn out even one volume of *Nanomedicine*. As Freitas put it in an interview early in the project "… the problem is that I'm exploring largely uncharted territory, trying to assemble a primitive map of the terrain while avoiding the intellectual equivalent of quicksand and wild animals. There aren't any street signs or rest stops along the road — heck, there aren't many roads. Even working 16-hour days like I do, the process takes years."[127]

Basic Thrust of Volumes I/ IIA of Nanomedicine

Volumes I and IIA of *Nanomedicine* are a magnificent tour de force, establishing the foundations of the new field of medical nanorobotics. Brevity requirements limit what we can cover to only a few points, but Eric Drexler's remarks in the Foreword to Freitas' Volume I are well worth repeating:

"Current repair techniques require that the tissue be metabolizing and functioning, so inactive or structurally intact but nonfunctioning tissue is declared 'dead.' Nanotechnology will let us repair nonfunctioning tissue, leading us to reexamine the concept of clinical death used in medicine today."[128]

This paragraph is, of course, directly related to cryonics. Proponents have claimed, ever since its inception, that people utilizing cryonics—"patients"—are not "dead" in the final and permanent sense, but just beyond the capabilities of present technology to help. Future technology, as exemplified by the great potential of nanotechnology and nanomedicine, very likely will not be so limited.

The distinction is much like the difference between the concept of "clinical death" and "biological death" which is taught in cardiopulmonary resuscitation (CPR) classes. Any patient needing CPR must be unconscious and at the point of clinical death, with heart and lung activity stopped or diminished to the point of ineffectiveness. This is the first guidepost of "clinical death." They are not thought to be, however, at the point of "biological death" which is considered, quite understandably, as a much hazier point in time, but after which no resuscitative efforts are going to be effective or useful.

To cryonicists who work in healthcare (and there are several), a cryonics patient is essentially no different from a patient who arrives at the hospital emergency room in full-fledged cardiac arrest. In this case, heart and respiratory activity have stopped. Normally electrical activity of the brain will also cease within 30 or 40 seconds after cardiac arrest. The only difference is that with cryonics, the patient has a reasonable (though not guaranteed) chance at successful revival (with repair and rejuvenation) when technology catches up to the challenge. The chances of successful revival in many present day cases of cardiac arrest are, even with the most modern day "high-tech" equipment and treatment, pretty dismal. Cryonics acts as an "ambulance to the future" which is exactly what a person in this condition needs, especially in view of the generally poor outcome of present therapy for this life-threatening situation.

As Freitas puts it in terms of even normal medical procedures:

> *"Nanomedicine will involve designing and building a vast proliferation of incredibly efficacious molecular devices, and then deploying these devices in patients to establish and maintain a continuous state of human healthiness."*[129]

Similarly, the devices Freitas describes will not only be able to fix medical conditions after they have occurred but also preventively correct medical problems before they become significant, depending on the design and combination of devices used. They thus could stand, if need be, as "health sentinels," able to intervene before significant problems occur. Today, even the best "healthcare strategies" founder after a few decades due to the steady encroachments of aging, injuries, or longstanding health problems— and the patient finally goes into cardiac arrest/clinical death which ultimately proceeds to biological death, no matter what interventions are tried. Likely the watchful armada that indefinitely postpones this outcome could be attained with devices analogous to the body's own nanomedical foot-soldiers, only hopefully much better and more intelligently designed.

Such devices, with reasonable adaptations or extensions, should be up to the task of repair and rejuvenation of cryonics patients, so they too can enjoy indefinitely extended lives. Such advances will require human and artificial intelligence diligently applied, starting from scientific knowledge and well established engineering design principles largely arrived at in the past century or two. Freitas in *Nanomedicin*e makes an excellent and weighty case for the feasibility of such sweeping advances. The development of

these devices, as in the also important work of learning how to store organs at cryogenic temperatures, will proceed irrespective of any efforts to push forward the concept of cryonics itself. Indeed, even if cryonics didn't exist, the two areas of organ preservation and nanotechnology would be pursued in their own right, though cryonicists and other interested supporters can help hasten progress and time of application through effective lobbying as well as effective research. Freitas' proposal at first might seem to be "just science fiction" but he has to deal with the realities of the biological and physical world in making his concepts work and has to make sure that "everything we need" is included in the design. Resources that cannot be "found along the way" must be brought along unless there is some reasonable way to develop them in vivo or in situ or to utilize existing in vivo/in situ materials and processes. (As he notes, power might be provided for medical "nanorobots" in the form of glucose and oxygen readily available in the bloodstream.) So his designs must be both reasonable and also accurately based on known physical, chemical, and biological principles and facts, and they must also be in line with reasonable and safe engineering capabilities and practice.

At the same time, as far as possible, his system must be self-contained, much as in the Apollo moon landings of some decades ago. It was a daunting task that Freitas faced, but he made progress. As Freitas himself puts it:

"The typical medical nanodevice will probably be a micron-scale robot assembled from nanoscale parts. These parts could range in size from 1-100 nm (1 nm = 10^{-9} meter), and might be fitted together to make a working machine measuring perhaps 0.5-3 microns (1 micron = 10^{-6} meter) in diameter. Three microns is about the maximum size for bloodborne medical nanorobots, due to the capillary passage requirement."[130]

He goes on to say:

"Carbon will likely be the principal element comprising the bulk of a medical nanorobot, probably in the form of diamond or diamondoid/fullerene nanocomposites, largely because of the tremendous strength and chemical inertness of diamond. Many other light elements such as hydrogen, sulfur, oxygen, nitrogen, fluorine, silicon, etc. will be used for special purposes in nanoscale gears and other components."[131]

Nanomedicine, Volume I, is a technical book; for example, in one section we find:

"Mathematically, the positional uncertainty of a single carbon atom of mass mC = 2 x 10^{-26} kg bound in a single C-C bond of stiffness kC = 440 N/m may be crudely estimated from the classical vibrational frequency vC = (kC/mC) 1/2 = 1.5 x 1014 Hz. This sets the zero-point vibrational bond energy EC = h vC / 2 = 4.9 x 10^{-20} J = kC ΔXC 2 / 2 where h = 6.63 x 10^{-34} J-sec (Planck's constant) and ΔXC ~ 0.015 nm is the maximum classical amplitude of the bound carbon atom (roughly the same as the 3 dB point for the gaussian wavefunction, notes J. Soreff). Thus ΔXC is just ~5% of the typical atomic electron cloud diameter of ~0.3 nm, imposing only a modest additional constraint on the fabrication and stability of nanomechanical structures. (Even in most liquids at their boiling points, each molecule is free to move only ~0.07 nm from its average position.)"[132]

The list goes on of Freitas' thoughts relating to nanoscale medical devices. Human body fluids would not influence a medical nanorobot's internal operations, he tells us. The physical appearance of a human injected with these devices wouldn't change either. He also considers how to remove the robots from the body, if desired, once their task was completed. One such approach, involving his proposed "respirocytes," would couple high tech filtration and centrifugation.

Concerns that nanorobots would be affected adversely by the body's already existing immune system are dealt with. First, we already have medical devices (for example, pacemakers) that in normal use are immunologically inert. Medical nanorobots may similarly be constructed so as not to cause response. In a "twist" that involves even further improvement along these lines, Freitas says:

"Passive diamond exteriors may turn out to be ideal. Several experimental studies hint that the smoother and more flawless the diamond surface, the less leukocyte activity and the less fibrinogen adsorption you will get. … However, even if flawless diamond surfaces alone do not prove fully bioinactive as hoped, active surface management of the nanorobot exterior can be used to ensure complete nanodevice biocompatibility. Allergic and shock reactions are similarly easily avoided."[133]

Freitas' *Nanomedicine* Vol. IIA (2003) is a book-length discussion of all these "biocompatibility" issues. [ref = http:// www.nanomedicine.com/NMIIA.htm]

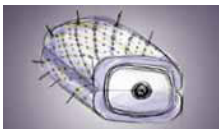
Freitas further points out that medical 'bots do not need a human level of intelligence in order to operate. Further, they should be of the kind that do not replicate themselves. There would be no good reason to place a replicating device inside a human body since it would be just as feasible (and safer) to manufacture all devices needed outside the body. "Replicators," Freitas adds, "will almost certainly be very tightly regulated by governments everywhere."[134]

Freitas indicates that glucose and oxygen may be a source of energy. One other way of powering nanoscale devices should be from acoustic energy that is applied externally (and probably in a clinical setting) via an ultrasound device. Freitas mentions other possible sources of power. With *Nanomedicine* in particular, he offers a serious, in-depth proposal to do something really great: using technology to vastly alleviate human illness and suffering and to do it in a way that is entirely plausible. Virtually all of it will also have direct and strongly positive implications for

Ettinger's 1960s "assumption" in *Prospect of Immortality*: that technology can eventually rehabilitate a cryonics patient, even if imperfect methods must presently be used in day to day cryonics practice. Freitas is also responsive to the urgent need for progress now: "My professional goal for the last two decades has been, and continues to be, to help make life-extending medical nanorobotics technologies happen as fast as humanly possible."[135]

The Concept of the Chromallocyte

In 2007, Freitas published in the *Journal of Evolution and Technology* a very important and interesting study, "*The Ideal Gene Delivery Vector: Chromallocytes, Cell Repair Nanorobots for Chromosome Replacement Therapy*." Here Freitas tackles an important aspect of medical nanorobots, the design of a device that has as its purpose to do actual work on human genetic material itself, inside an individual cell.



(Artist's Rough Basic Conception of Chromallocyte With Motility Grapples Extended)

He comments: "This is the first full technical description of a cell repair nanorobot ever published. The nanorobot design addressed in the paper is a very important one—it is perhaps the key nanorobotic system for anti-aging and life extension applications."[136]

Freitas called this proposed medical nanorobot a "chromallocyte" (pronounced "crow-MAL-oh-site"). His proposal for how to develop the device has aptly caused excitement in the nanotechnology community. It also has generated that same level of excitement among individuals interested in cryonics. The successful construction of such a device, with its ability to interact with the body's molecular architecture, would greatly accelerate development of other similar devices. As soon as any one such device was available and accepted for what it could do, the race would be on to develop more of them and to fully and completely extend the range of their medical and other applications. But it will have to ultimately be implemented by humans, aided to whatever degree by modern engineering tools including, no doubt, artificial intelligence that can zero in on the particular problems of nanotechnology. Specialized software already exists, for instance, to help in the design of nanotechnological devices.

As with NASA's tremendous efforts in landing a man on the moon back in the 1960s, problems will no doubt arise on the way toward full-fledged development of nanotechnological devices. (But there may also be now unforeseen opportunities to arise as well). What Freitas said about so-called "nanofactories" seems quite applicable:

> *"It has been my experience that when you sweat the technical details, you start discovering all sorts of hidden roadblocks, detours, and needed workarounds/redesigns that were not recognized or anticipated from the outset. You'd be surprised at how many seemingly plausible diamond mechanosynthesis reactions turn out not to work so well upon closer inspection. I expect the universe to remain equally recalcitrant…"*[137]

The Basic Function of the Chromallocyte

Freitas' chromallocyte is a medical nanorobot that would go into the body's cells and deal directly with genetic anomalies, whether inherited or acquired. It would do its work by replacing problematic versions of DNA with corrected, error-free versions. Freitas refers to this as "chromosome replacement therapy or CRT." It should be noted that each chromosome includes a mass of protein that is about equal to the mass of the DNA. In the nucleus of a cell there is very little (if any) free DNA. Chromatin is, then, the combination of the DNA and protein in the nucleus of non-dividing cells. Freitas' CRT method would thus upgrade the entire nuclear store of chromatin. (Today's working technique of CRISPR-Cas9 seems to be a decided step toward something of this nature; research on this and related technology is ongoing and vigorous.)

DNA is the "master chemical" of the body. Maintaining a fresh and "correct" version of this controlling substance should optimize the cell's own nanoscale ability to maintain maximum health, which in turn should optimize the body's health overall. With the addition to the mix of regular maintenance procedures and appropriate cell repair via medical 'bots, all as needed to maintain optimum health and vigor, the functioning of an organism should be brought under a degree of control that is undreamed of even in today's "high tech" medical endeavors.

Many diseases that both plague individuals and add to the considerable and growing cost of medical treatment today, result from the body's gradually losing control over its own cellular machinery. An example is the slowly increasing incidence of cancer as one gets older. In youth, normal body processes tend to identify abnormal cells and eliminate them. With loss of cell control due to genetic alterations and/or errors that accumulate with time, the incidence of cancer rises steadily with each passing decade of life.

The chromallocyte would also perform an "extra" correction to eliminate any genetic defect that was present from conception. Even cancer cells themselves could be dealt with by correcting their genetic anomalies to make them "normal" again and not prone to unchecked replication.

Freitas speculates about the prospects of additional help as provided by respirocytes, microbivores[ref = http://www.jetpress. org/volume14/freitas.pdf], and other nanoscale devices, leading to indefinite youth:

> *"Related medical nanorobots with enhanced tissue mobility could similarly consume tu-*

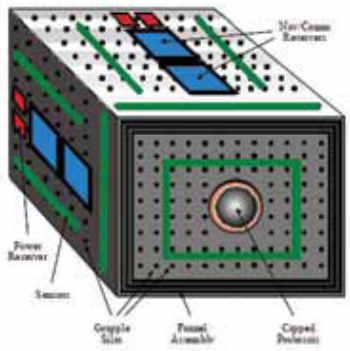
mor cells with unmatched speed and surgical precision, eliminating cancer. Other devices could be programmed to remove circulatory obstructions in just minutes, quickly rescuing even the most compromised stroke victim from near certain brain damage. … The implications for extension of healthy lifespan are profound. Perhaps most importantly, chromosome replacement therapy could be used to correct the accumulating genetic damage and mutations that leads to aging in every one of your cells. With annual checkups and cleanouts, and some occasional major cellular repairs, your biological age could be restored once a year to a more or less constant physiological age that you select. Nanomedicine thus may permit us first to arrest, and later to reverse, the biological effects of aging and most of the current medical causes of natural death, severing forever the link between calendar time and biological health. … This sounds almost miraculous, but getting there is primarily an engineering and R&D challenge."[138]

Some Details About the Chromallocyte

The chromallocyte is, of course, a highly technical device and it will not be possible to go into much depth here. Freitas' original article on the chromallocyte is recommended for those seriously interested.[139] What will be covered here is, it is hoped, a fascinating nontechnical introduction; any errors of interpretation or representation are entirely those of the author of the article you are reading now.

Projections show the chromallocyte will consist of about 4 trillion atoms and be a boxlike shape with dimensions about 3 x 4 x 5 micrometers. (Note: 1 micrometer = 1 micron; different authors prefer one term or the other.) A human hair by comparison is about 75 micrometers thick; a red blood cell is about 8 micrometers across, and a cell nucleus is about 5-10 micrometers across. The chromallocyte in particular should be able to penetrate the nucleus enough to carry out its work.[140] Its volume will be less than one percent of a typical cell volume, though up to around a quarter of the nucleus's volume.

The "front end" of the chromallocyte is what Freitas calls the Proboscis. This essential part sits in the center of one of the 3 x 4 micrometer "box ends" (see schematic illustration). It has two major functions, to gather and clear out old, error-laden chromatin in the cell, and to insert fresh, corrected chromatin back in.



Front View

Gathering and clearing out old chromatin proceeds as follows. The chromallocyte inserts itself into the nucleus of the cell. (There are sensors on the Proboscis to prevent excessive extension through the far wall of the nucleus.) After biochemically blocking various normal cellular responses and triggering chromatin detachment inside the nucleus, the Proboscis is extended to the proper length, and some tines are deployed and placed in a chromophilic configuration to attract the chromatin. The Proboscis then is rotated to spool up the chromatin, like thread being wound up on a bobbin. (Special care is taken to insure that the Proboscis is rotated slowly enough and is well anchored enough that the torque developed by spooling will not cause damage to the structures the Proboscis is anchored to, especially the nuclear membrane.)

Besides the Proboscis there is a second important part of the chromallocyte, an assembly that resembles, to some degree, the collapsible drinking cups available at sporting goods stores and which is called the "Funnel." (See the illustration below.) This part can be extended and deployed to initially act as a gathering site for chromatin. It can then surround and seal both the Proboscis and the spooled up chromatin that is wrapped around it. (After the Funnel forms the seal, the surface chromophilicity is switched off and the tines on the Proboscis are retracted.)

Artist's illustration of chromallocyte with the "Funnel" and "Proboscis" extended

One safeguard after spooling up the old chromatin is to release an enzyme to digest stray strands of DNA that might have escaped the spooling process. The enzyme is then recaptured. It will help insure that no old DNA or even intact genes that might remain could possibly interact with the new chromatin to be injected or could find their way to neighboring cells or could duplicate DNA that is being injected, and/ or cause presently unforeseen problems by remaining in the cell undergoing CRT.

At the appropriate time after the preceding steps, new chromatin is injected into the nucleus through a bore in the center of the Proboscis, which then acts like the familiar hypodermic needle utilized in health care centers today. The new chromatin is held in a third and very important component, two storage tanks which are located at the base of the chromallocyte, and are called the North and South Vault, respectively. (Some logistical details dictate that precisely two vaults are convenient here.) The active injection of the new chromatin into the nucleus is accomplished, if need be, by pumps and water purges. This will help in capturing old chromatin by the partial vacuum that forms as new chromatin is forcibly pumped from the storage tanks. The old, spooled up, chro-

matin "waste" enclosed in the Funnel ends up in the storage tanks where it remains until the entire chromallocyte is removed from the patient's body.

This process is also helped to a successful conclusion by changing the chromophilic tines configuration of the Proboscis to a chromophobic one. The pressure brought about by the Funnel being gradually, mechanically retracted helps squeeze the old chromatin toward the base of the chromallocyte. To aid in the process, an enzyme that helps break down the old chromatin (and which is then reacquired by the chromallocyte mechanism similar to the recapture of enzymes used to deal with "stray" DNA or intact genes) might be used. It would make the old chromatin more fluid and insure that no unwanted residual material remains attached to the Funnel interior, the Proboscis exterior, or any other part of the device that has been in contact with "used" chromatin.

By a lucky happenstance of nature, if the new chromosomes to be injected are divided into "odd" and "even" numbered pairs, the volume needed to store each set in the base of the chromallocyte turns out to be almost identical. Thus two storage tanks of about 20 cubic microns each turns out to be sufficient and both will fit nicely on either side of the base of the chromallocyte. Vault unloading can be "pulsed" between the North and South Vaults to vary the sequence of chromosomes to be injected, although the chromosome sequence within one vault was fixed at the time of loading.

Mechanisms such as a diaphragm or some sort of piston driven device may be needed to insure, in part, that old and new chromatin remain separated during the entire extraction/injection process. These might also help prevent water leakage around the chromatin, help provide smooth passage of new chromatin, and also serve as a barrier if an enzyme was needed to break up and decrease the viscosity of the old chromatin.

Telescoping "grapples" are kept in the body of the chromallocyte and can be deployed to latch on to individual cellular fibrils or other structures in their vicinity. They will also help the chromallocyte penetrate both vascular walls and cell or nuclear membranes since, as Freitas puts it, "molecular handholds" are abundant. At the end of the grapples are reversible footpads. This combined arrangement provides the means of motion for the chromallocyte. "Silos" in the body of the chromallocyte to store the grapples, capped with irislike covers, help keep the chromallocyte exterior smooth to reduce resistance as the chromallocyte moves through a liquid or semiliquid environment.

In case the device finds itself detached from all fibrous moorings (therefore having to "swim for its life"), there are two possible strategies. First, the Proboscis can be extended to search for mooring structures within reach of the chromallocyte grapples. Second, if this fails, the grapples can be used as "cilia" to produce forward motion like a paramecium. The grappling mechanism itself was previously described in Freitas' work on the microbivore. [ref = http:// www.jetpress.org/volume14/freitas.pdf]

The "brain power" for the chromallocyte is twofold. Onboard will be a computer similar to that of the microbivore. The chromallocyte computer will have extra memory due to the greater demands placed on it. Greater reliability and safety are called for since failure of the chromallocyte could have more serious consequences than failure of the microbivore. In addition, through ultrasound signaling, a physician can send/receive signals to/from the chromallocyte. Most of the time, however, the device will operate semi-autonomously.

While the microbivore had an oxyglucose fuel cell system, the larger chromallocyte has less free space onboard and resources for energy production in its environment inside cells will be limited. Thus power for the chromallocyte will be sent externally via ultrasound waves and received through ten external receptors located on the chromallocyte surface, providing a tenfold redundancy that is, where possible, a standard design feature of the device. (The surface will also have to have receptors and transmitters for acoustic signaling from/to external sources.) For onboard energy storage, each chromallocyte will be equipped with ten diamondoid flywheels to provide ample redundancy. Internal power distribution will be through diamondoid cables.

New chromatin will be manufactured using "generic" human genetic information coupled with a chromallocyte-based "microbiopsy" of at least one hundred cells of the target organ. This will reveal how the individual's genomic structure differs from the general population's. The information can then be incorporated into the new, "corrected" chromatin to be inserted into the target organ's cell nuclei. All cells of the target organ need to have the same basic genetic structure. If necessary, an additional "microbiopsy" of the organ or others may be made if further genetic information is needed before the actual replacement of chromatin begins.

Freitas proposes that a basic mission for a chromallocyte will occur in five phases and take about seven hours, including patient preparation and recovery room time. The first phase will consist of an organ survey. Navigational guides and information necessary to help the chromallocyte do its job are put in place using a navigation grid and navigational aiding nanorobots. In this way the organ's structure is mapped and each cell to receive CRT is assigned an address. (It should be noted that the chromallocyte is not to be a stand alone device but part of an extensive system, including "navicytes" – navigational nanorobots – coupled with chromatin/chromallocyte nanofactories and other things that must be present to assist the chromallocyte in doing its work.)

For the next phase samples of DNA are collected from the target organ via the microbiopsy and analyzed to determine corrections that need to be made. The upgraded DNA is then manufactured in a specialized desktop device outside the patient's body and loaded into the chromallocytes' twin vaults as described above. Up to a trillion or more chromallocytes are prepared in this way as needed, each programmed to the unique address of one target cell.

For the third phase the patient is placed on an ultrasonic vibrating table with gel interface to facilitate sound transmission, to both power the chromallocytes and allow for 2-way signaling. The patient is sedated and either respirocytes are injected or hypothermia is used to greatly reduce oxygen demands, allowing for a slower pulse rate and reduced blood velocity, both of which are conducive to the chromallocytes' work.

At the fourth phase, the chromallocytes are introduced, one for each nucleus to receive the CRT procedure. Additional or recharged respirocytes are added as needed. Microbivores stand sentinel to insure the sterility and safety of the procedure by dealing with bacteria or viruses that might have been accidentally introduced and also any non- or poorly functioning chromallocytes. Other devices will have been deployed as needed for navigational or other purposes. The chromallocytes assisted by all other devices complete their mission. Those that are not needed to be left in the patient, then return to their insertion point to be removed from the patient's body.

Finally, for the fifth phase the patient is removed from sedation and normal vital signs are restored. Before the patient is discharged double checks are made to insure that any nanodevices not intended to be left in place have indeed been removed.

Some caveats are noted for the CRT protocol with suggested remedies. The body's cells have numerous feedback mechanisms that protect them from injury or death. Injury that the cell's defenses respond improperly to can trigger programmed cell death (called "apoptosis"). Some activities of the chromallocyte could trigger such a response. Freitas proposes as a possible remedy to release engineered apoptosis inhibitors into the cell. A kind of cellular anesthesia would result where self-destruction is put on hold. The inhibitors would only act long enough for the chromallocytes and other devices to do their work and then be disabled and removed.

As an additional safety precaution, chromallocytes will not be allowed to "free float" in the body. They will be limited to vascular surfaces when traversing the bloodstream, both during infusion at the beginning of the procedure and in extraction from the body at the end. In the case of a failure and immobilization of a chromallocyte in a cell, the usual outcome would be the death of the cell and eventual ejection of the inert device into the extracellular medium. Natural body processes and/or devices such as the microbivore or scavenger nanorobots would then take care of the problem. This event should be extremely rare due to the built in redundancy and design strength safety factors of chromallocyte systems. Freitas is careful to choose a robust design approach, with built-in redundancies and extra strength to reduce the likelihood of failure to minuscule levels. Research and development will, in any event, provide feedback for any possible alterations the design may need.

Numerous internal and external sensors (temperature, chemical, pressure) will aid the chromallocyte in effectively and safely carrying out its work. These were previously proposed for the microbivore, showing how subsequent designs can benefit from prior work. The chromallocyte is larger than the microbivore and is expected to use about twice the number of sensors.

Ralph Merkle and Robert Freitas' Joint Efforts

Ralph Merkle and Robert Freitas are world class authorities in nanotechnology. It is not surprising that their paths would cross, with opportunities for joint ventures. Space limitations again will limit our coverage, but a couple of items can be mentioned.

KSRM: In 2004, Freitas and Merkle teamed up on a book, *Kinematic Self-Replicating Machines*, which dealt with the ability of automated systems to replicate themselves without direct human intervention. The volume opens with a history of the field all the way back to Descartes (much as *Nanomedicine* starts with an extensive review of the history of medical practices). It then discusses the difference between self-replication and self-reproduction, talks about safeguards to insure that replicating processes remain under control, and considers more generally the strong and essential need for public safety in regard to replicating machinery.

Nanofactory Collaboration: In Robert Freitas' own words from a few years back:

> *"Several years ago, Ralph Merkle and I founded the Nanofactory Collaboration to coordinate a combined experimental and theoretical R&D program to design and construct the first working diamondoid nanofactory, which could then build medical nanorobots. This long-term effort must start by developing the initial technology of positionally controlled mechanosynthesis of diamondoid structures using engineered tooltips and simple molecular feedstock. Our Collaboration has led to continuing efforts involving direct collaborations among more than two dozen researchers at a dozen organizations in 5 countries—the U.S., U.K., Russia, Australia, and Belgium. A dozen peer-reviewed papers are published or in progress as of 2008."*[141]

(Those interested in further info can go to: http://www.molecularassembler.com/ Nanofactory/)

Freitas further observes: "The development pathway will be lengthy and difficult. First, theoretical scaling studies must be used to assess basic concept feasibility. These initial studies would then be followed by more detailed computational simulations of specific nanorobot components and assemblies, and ultimately full systems simulations, all thoroughly integrated with additional simulations of massively parallel manufacturing processes from start to finish consistent with a design-for-assembly engineering philosophy. Once molecular manufacturing capabilities become available, experimental efforts may progress from component fabrication and testing, to component assembly, and finally to prototypes and mass manufacture, ultimately leading to clinical trials."[142]

The road may be long, as even Freitas affirms, but at the same time it is a road that can be traveled. With constant feedback from each of the steps, nanoscale automata will emerge and find increasing application in medicine along with other fields.

Other Workers in Nanotechnology/The Impact on Cryonics

There are, in addition to Drexler, Merkle, and Freitas, other researchers who are trying to push nanotechnology forward with all due diligence and speed. Cryonicists will surely benefit from those efforts even as advances in other fields also help the practice of cryonics (cryopreservation of human organs for transplantation, for instance). Those involved both in and outside of cryonics must become aware of these technologies, at least at a journeyman level, and push political and social leaders to favor them, which means making sure, in the first instance, that the leaders themselves are well-informed. The benefits are such that we can expect a feedback effect with initial benefits leading to more research leading to still more benefits and so on. Society in general and cryonics in particular should both stand to gain immensely. The whole thrust of the entire effort in this article (printed in this magazine in several parts) has been to expound on the technology of revival, repair, and rejuvenation, as far as cryonicists are concerned. This comes down, in a nutshell, to a couple of points analogous to those Robert Ettinger made in *The Prospect of Immortality* many years ago:

1. Persons placed in cryogenic storage stay that way – just as they were when the procedure was finished. No significant change will occur in their state once they reach those ultralow temperatures. With future developments in cryobiology and cryonics, it is reasonable also to hope that "damage free cryonics" will eventually be practiced.

2. Whether damage free cryonics ever becomes a reality or not, the development of nanotechnology (which might better be termed "nanoengineering") will result in the great and fundamental ability of human beings to manipulate matter at the molecular and atomic scale. Biological structures will then be modifiable in such a way and with such economy as to enable us to restore them to a functioning state, including structures that aren't functioning at all. The restoration will ensure the full youthful health and vigor of the cryonics patient, and may offer options beyond our imagining today.

As Ralph Merkle, in his Afterword to Freitas' *Volume I Nanomedicine*, so well put it: "The future capabilities of nanomedicine give hope and inspiration to those of us who still have decades of life to look forward to, but some are not so fortunate. Many others who rightfully should live several decades more might find that chance cuts short their expected time. Heart attacks and cancer can strike us down even in the prime of our lives. They do not always wait their turn and politely arrive only when expected. How can today's dying patient take advantage of a future medical technology that is as yet only described in a handful of theoretical publications? How can we preserve the physical structure of our bodies well enough to permit that future medical technology to restore our health?

"The extraordinary medical prospects ahead of us have renewed interest in a proposal made long ago: that the dying patient could be frozen, then stored at the temperature of liquid nitrogen for decades or even centuries until the necessary medical technology to restore health is developed. Called cryonics, this service is now available from several companies. Because final proof that this will work must wait until after we have developed a medical technology based on the foundation of a mature nanotechnology, the procedure is experimental. We cannot prove today that medical technology will (or will not) be able to reverse freezing injury 100 years from now. But the patient dying today must choose whether to join the experimental group or the control group. The luxury of waiting for a definitive answer before choosing is simply not available. So the decision must be made today, on the basis of incomplete information. We already know what happens to the control group. The outcome for the experimental group has not yet been confirmed. But given the wonderful advances that we see coming, it seems likely that we should be able to reverse freezing injury – especially when that injury is minimized by the rapid introduction through the vascular system of cryoprotectants and other chemicals to cushion the tissues against further injury."[143]

In closing, then, it should be noted that the case for cryonics, as made by Robert Ettinger back the 1960s, was a reasonable one to begin with. This four-part article has outlined some reasonable scenarios for how the revival, repair, and rejuvenation of cryonics patients may be carried out. It would happen through technologies that are not yet fully developed, but still are based on solid scientific and engineering thinking and principles.

A cryonics patient has already had something very bad happen to them in the very fact of their clinical death. Other than the cost of the cryonics procedure, however, which can often be very reasonably managed through life insurance, they have nothing to lose and everything to gain by taking advantage of this revolutionary concept.

Numerous well-trained and properly credentialed people have gained knowledge in quite a number of cryonics-related fields. There can be little doubt, therefore, that cryonics is a reasonable thing to do. On the contrary, failure to avail oneself of this concept continues, with the passage of years and piling up of more and more solid evidence in its favor, to be perhaps the most unreasonable life choice one can make. The odds in favor of the modified "Pascal's Wager" that cryonicists are making continue to get better with each passing day. The alternative to cryonics (or some effective form of biostatic preservation) continues to stay the same: oblivion and personal extinction. The choice, then, is clear and simple. Cryonics cannot be considered just "an act of faith," as some of its critics used to say, but must be considered, instead, very, very clearly and very, very substantially as "an act of reason." To not do so has to be considered, with the evidence that has built up, a very, very irrational decision, to say the least.

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ENDNOTES:

120 ..... FG.
121 ..... RF4.
122-124 ..... DPP.
125-126 ..... RF4.
127 ..... RF3.
128 ..... ED.
129 ..... RF2.
130-131 ..... RF1.
132 ..... RF2.
133-134 ..... RF1.
135-137 ..... RF6.
138 ..... RF8.
139 ..... RF7.
140 ..... CT.
141 ..... RF8.

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.

Looking Back:
Jim Yount And The Spectre of Future Horribilia

(Editor's note: The Immortalist Society Vice-President, Deb Fleming, made an excellent suggestion a while back that Long Life should have a regular column called "Looking Back" in which articles of interest from prior issues appear. The column below, from the February, 1990 issue of The Immortalist, as Long Life magazine was known in those days, is one such offering).

Introduction by York W. Porter, President Immortalist Society

My long time friend and co-member of the Board of Governors of the American Cryonics Society, Jim Yount, is a very prolific writer with a very understandable-to-the reader type of exposition. In this offering, Jim recalls an encounter with some college students and the varying reactions that he got in two groups of them. Though we are a long way from succeeding at convincing the majority of others in the world that cryonics is a great concept, that goal still is a central interest to most cryonicists everywhere. To this end, there have been numerous suggestions and attempts down through the years, the magazine you are reading being among them. Still, as we like to say in the field of radiology, "One look beats a thousand expert opinions". Similarly, the actual effort in trying to persuade folks to become involved in cryonics offers feedback for those of us trying to do just that.

The Specter of Future Horribilia

By: Jim Yount

One of the biggest obstacles to acceptance of cryonics is the prejudice, held by many of our contemporaries, that the future will be horrible. In part, this is because the Future is misconceived as a PLACE.

A few years ago I was invited to speak to a "Futurist" class at Foothill College here in the San Francisco Bay area. The "Futurist" movement was then focused on the future as a "place" of scarce resources, where all were to concentrate on conserving resources and recycling. Many of the proponents of this philosophy looked upon cryonics as less than desirable. You recycle your garbage, not your body!

When I have given talks on cryonics, most times, I have gotten a polite, if sometimes skeptical reception. Not so with this group. If I had been advocating the cannabilistic consumption of our infants as a means of population control, the concept would have been better accepted than cryonics. The questions from the students were directed by this perception of a future of scarcity: "Where will we put everyone?" "How could people be so thoughtless as to foist the presence of themselves upon future generations?" "Don't you read the papers? Aren't there problems enough without your kind making more?"

At about the same time, I gave a talk to

another class at Canada College, just up the road from De Anza. It was a Sociology class I addressed, as I recall. The reception was quite different from the Foothill College welcome. The questions were mostly the practical kind. "How does one go about making such arrangements?" "Who looks after us and our money while we wait?"

"If you could take a pill, and that pill would make you live forever, how many of you would take it?" I asked the Canada class. All class members raised their hands.

"If you knew you were dying, and you knew for sure cryonics would work, with the experience being like walking through a door, would you sign up?" Most students raised their hands.

"You are not told that you are dying, but you know you will die someday. The method of cryonic suspension may or may not work. Would you sign up?" More than 2/3 of the class raised their hands.

The response in the Foothill class to the same three questions was (surprise!) much different. As I recall, only a couple of people raised their hands to the first question and no one to the second and third.

The difference between the two classes was the way cryonics and the future were presented by the instructors. The Canada teacher confessed a long-time personal interest in cryonics and generally seemed to regard technology as a means to solve problems. The Foothill instructor was cold and reserved towards me and joined in several times in the interrogation session with his own lambastes.

We as cryonicists would much rather deal with people with the "positive future" attitude. However, both of these attitudes are wrong. Both of them come from regarding the future as a PLACE rather than as a continuum.

In 50 years if the pessimists are correct, we will be in the world of scarcity the Foothill teacher preached. But is that THE future? Why not wait a little longer? In 100 years the cryonauts who were not wanted earlier might be both welcomed and needed.

It is interesting that while our detractors seem oh so concerned that energy is being "wasted" to keep a few people in suspension, they turn a blind eye to the thousands of

acres of land currently used for cemeteries. This land has a potential for growing food crops and generating solar power.

The most dangerous aspect of the "negative future syndrome" is not that the nay-sayers don't want to make the trip themselves and disapprove of others making it. It is that many of them also support legal prohibitions against others signing up. The justification is that society, as a whole, should determine how its resources are to be used.

The future, they conclude, will be a place of limited resources. The people in that place called the future will have no use for people frozen today. Therefore the people of the present, acting for the greater good of the future, have the right and duty to prevent people from being suspended.

The "good of society" approach bumps heads with "individual rights". This is no surprise. Many times the two "rights" are at odds. Few people argue that society has the right to prevent some members of society from taking the lives of others. Indeed, society as a protector is one of the primary justifications for a legal system. The challenge to cryonics advocates is to extend the present attitudes of society to protect life to the protection of POTENTIAL life.

The cryonicist often encounters people who, while not going so far as to deny our own right to be suspended, have such a dark picture of the future that they reject cryonics out of hand as an option for them. This can be especially disheartening when the rejecter is someone important to us. Many times such rejection is because the person simply doesn't understand the concept of cryonics or our program. Often introducing him/her to other cryonicists and encouraging group discussion can provide this needed background information in a non-confrontational climate. It's not so much that we brighten the future for the pessimist; we just remove a little of the gloom from the suspension option.

For the true dyed-in-the wool dark futurist out to save the world from the likes of us the process of education/attitude modification is daunting indeed. While someday there may be enough of us to make waves in the oceans of nay-sayers it may be best to ignore them for now. Our efforts can better be spent with those who may accept cryonics with much less persuasion.

Robert Ettinger: *The Legacy Continues*

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

The Legacy Continues: Robert Ettinger on Substrate-Independent Minds

Preliminary remarks by York W. Porter, President, Immortalist Society:

The topic of "downloading" (called by some "uploading") is the concept where an individual's mind is transferred to a computer. Robert Ettinger, whom I was deeply privileged to know personally, was not a fan of this concept, at least with the knowledge we presently have. (That makes two of us, by the way). Nevertheless, some very intelligent and talented people have a significantly different view. In this article that was put together by Aschwin de Wolf in a combination of Ettinger's writings and de Wolf's comments, Mr. Ettinger's basic thinking on the issue is discussed.

No matter what one's stance on this topic, it is definitely a fascinating one. Readers should note, as indicated below at the beginning of the article, that this particular writing appeared in Cryonics magazine and is used here by permission of the author. Some rearranging/emphasis changes may appear here which represent entirely the efforts ofthe Long Life magazine editor so things here may not appear exactly as in the original version. For the original presentation, one will need to read the version as presented in Cryonics magazine.

CAN YOU BUILD A LOCOMOTIVE OUT OF HELIUM?

October 13, 2014

Version as published in *Cryonics*, 4th Quarter 2011.
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Article Introduction and Afterword by Aschwin de Wolf

Introduction by Aschwin de Wolf:

Robert Ettinger, the "father of cryonics," was cryopreserved on July 23, 2011. While Ettinger's book *Man into Superman* (1972) is considered an important contribution to transhumanism, he increasingly came to recognize that most people do not desire a hard break with the past and resist radical transformation. During the last years of his life he became a vocal critic of 'mind uploading' as a means of personal survival and spent a considerable amount of time refining his arguments why mind uploading is not likely to work. This document organizes excerpts from his last book *Youniverse* and mailing list messages on the topic of substrate-independent minds.

In the afterword, I make a brief attempt to place his contributions in a broader philosophical context. The title of this document refers to a message that Robert Ettinger sent to the Cryonics Institute mailing list on July 21, 2011. In response to the claim that the human mind is a machine, and that the function of any machine can be duplicated by a machine built of another material, Ettinger asked, *"Can*

you build a locomotive out of helium?"

(Long Life Editor: Mr. Ettinger's writings begin immediately below, categorized somewhat.)

Mind Uploading

A large and burgeoning group of scientists, including some of the brightest, believe that—in principle—computers will fairly soon be able to *think* in the fullest sense of the word. They will be living, conscious entities with feelings and subjective experiences.

A corollary—many believe—is that your persona could be uploaded into a computer and *you* could then live an incomparably bigger and better life as a simulation or emulation.

I think the uploading thesis is probably wrong, although (as usual) it's too soon to be sure. But the issue is a significant part of modern philosophy, and potentially has enormous practical importance.…I am among the radicals in the expectations for AI. But intelligence is not life. It is by no means proven that life as we know it with subjective experience can exist on an arbitrary substrate, such as silicon. (*Youniverse*)

Information

One extreme school of thought holds that *information* and its processing constitute everything that is important. In particular, *you* are essentially just a collection of information, including a program for processing that information. Your 'hardware'—the nervous tissue that embodies and handles the information—is only secondary.

My conclusion will be that it is *not* necessarily possible—even in principle—for consciousness to exist on an inorganic substrate, and in fact that it is unlikely.

Sometimes the doubters are accused of dualism—the increasingly discredited belief that the living and inanimate worlds, or the material and the spiritual worlds, are separate.

This certainly is not true of me or of many others who question the information paradigm. I am a thoroughgoing materialist and reductionist. I will not feel in the least dehumanized if it turns out the information paradigm is right…I have strong doubts, but they are based entirely on the evidence, or lack thereof.

The most radical of the 'strong AI' people believe that all thinking is information processing, and all information processing is thinking; and they appear to believe that consciousness is just an expression of complexity in thinking. People who talk this way must be admired for boldness and strength of conviction, but I think not for clarity of thought.The point is, all physical phenomena, all interactions, involve information processing in some sense. But that isn't *all* they do. A computer, or a person with pencil and paper, could figure out—describe or predict—what the atoms do, and that would be an analog of the information processing part of the phenomenon; but only the actual, physical atoms can form an oxygen molecule. And to anthropomorphize or analogize 'feelings' and 'thoughts' into these phenomena is simply unjustified. It amounts to declaring, by fiat, that thinking and feeling are inherent in information processing; but saying so doesn't make it so. *(Youniverse)*

Turing Tests and Zombies

Alan Turing was a brilliant mathematician and computer pioneer. He played an extraordinary part in winning World War II through his work in cryptography for British Intelligence. He also showed many of the potential capabilities of general computers. But one of the works for which he is most famous is badly flawed or has been badly misused—the 'Turing test' for intelligence/- consciousness.

Again, I am a firm materialist and reductionist: I readily concede the possibility that a machine could (conceivably) have life and consciousness. But I deny that we can *assume* that (inorganic) machines have this potential; and with still more help from Turing I think I can make the case persuasive.

'Uploaders' or 'upmorphists' or patternists generally maintain that our identity resides in our information content. Their most extreme position is patently absurd—that 'we' literally persist, in some degree, if any of the information about us is preserved, even our writings or biographical data. (Shades of Woody Allen! 'I don't want to live on in my works; I want to live on in my apartment.') Anyone who believes this needs more help than I can provide.

Turing ingeniously showed that a strip of paper tape marked in squares, with zeroes or ones marked on the squares according to certain rules, along with a simple mechanism for moving the tape and making or erasing marks, could be a universal information processor—i.e., it could accomplish any information processing task that any digital computer (serial or parallel) could do, given enough time. It could even produce any result that a quantum computer might, albeit at a teeny-tiny fraction of the speed.

You certainly can't claim that a paper tape (even when it is moving) is alive or conscious! Yet that tape, in theory, could produce any response that a person could to a particular stimulus—if by 'response' we mean a signal sent to the outside world, suitably coded. It could converse with perfect fidelity to an individual's character, and over a teletype could fool that person's husband or wife.

My original objection to the uploading assumption was simply that we don't know anything about consciousness or feeling, hence it is premature to assume that it can exist other than where we know it exists, viz., in organic brains. It is entirely possible that meat machines (as opposed to machines of silicon or metal etc.) have some unique quality that allows the emergence of feeling and consciousness. Until we can isolate and define the mechanisms of feeling—of the subjective condition—we must reserve judgment as to the possibility of inorganic people. (*Youniverse*)

Uploaders tend to put faith in the Turing Test for human intelligence, and to believe that zombies cannot exist. Let's take a quick look.

Communicating (say) by email, a testor tries to determine whether the testee is a human or a computer program. Passing the test supposedly proves the testee is human or equivalent. But the test is clearly worthless, since it produces both false positives and false negatives. As much as 50 years ago Eliza, a program pretending to be a psychiatrist, fooled many people—false positives. And of course a child or a retarded person could perform below par and produce a false negative. The Turing test is baloney.

In similar vein, uploaders tend to believe that something which outwardly behaves like a person must be a person. They reject the possibility of zombies, systems that by their actions appear to be sentient but are not. Yet it is often easy to fool people, and, as already noted, programs have fooled people even though no one claims the programs were alive. *(Cryonics Institute Mailing List, September 9, 2010)*.

Imperfect Simulations

...any simulation created in the foreseeable future will be imperfect, because it will necessarily reflect current theories of physics, and these are *known* to be incomplete and almost certainly in error to some extent or in some domains. Whether this would necessarily result in *material* deviations of the simulation from the course of nature, and in particular whether it would preclude feeling, we don't yet know. But we do know that the simulation would be wrong, which in itself is enough to justify withholding judgment on the possibility of living computers. (*Youniverse*)

Analog Failures

The uploading thesis depends on the assumption that any organic process in the brain can be duplicated by analog in some other medium but this not only isn't obvious; it's nonsense.

For example, suppose a certain process depends on magnetism, and all you have to work with are the mechanical forces transmitted by rigid bodies. Can you make an electric motor out of tinker toys? Can you build a synchrotron out of wooden boards and nails? Uploaders think a computer (of the electronic variety) can be a person: how about a Babbage mechanical computer made of rods and gears? Presumably, any kind of information processing and storage can be done by a collection of rods and gears but could rods and gears conceivably be conscious? I doubt it; not all media are created equal. So it is entirely possible that organic brains have potentialities not realizable anywhere else in the universe. (*Youniverse*)

Just ask yourself what consciousness is—what physical condition or process constitutes consciousness. You don't know, hence you cannot know that a simulation fills the bill. (*Cryonics Institute Mailing List, September 16, 2010*)

Petitio Principii

It seems to me that all the computer-metaphor people… keep making the same error over and over again—assuming as a premise the very hypothesis they are trying to establish. When the premise is the same as the conclusion, naturally the conclusion follows from the premise. They refer repeatedly to 'all computational devices' etc., implying that the brain is just that—another computational device—when in fact that is precisely what is at issue: Is the brain possibly something more than a computational device? The computer metaphor is plausible (and I am not in the least uncomfortable with it) but plausibility isn't proof. (*Youniverse*)

The Map is not the Territory

Adherents of the 'information paradigm,' I believe, are deceived in part by glibness about 'information' and hasty ways of looking at it. Apparently it needs to be said again and again: a description of a thing or a process—no matter how accurate and how nearly complete—is not the same as the thing or the process itself. To assume that isomorphism is enough is just that—an assumption, not self-evidently permissible.

Even though (for example) a computer program can in principle describe or predict the behavior of a water molecule in virtually all circumstances, a water molecule for most purposes cannot be replaced by its description or program. If you pile up 6.02×10^{23} computers with their programs, you will not have 18 grams of water, and you will have a hard time drinking it or watering your plants. (*Youniverse*)

Eliezer Yudkowsky (and other uploaders) claim that mapping a system results in a map that effectively has the same properties as the original. Well, look again at one of my counter-examples. I write down with pencil and paper the quantum description of a hydrogen atom in its ground state. It could hardly be more obvious that the marks on paper do not constitute a hydrogen atom. And if you put

side by side two papers describing two hydrogen atoms, they will not combine to form a hydrogen molecule. In principle, of course (the math is difficult) you could write down expressions corresponding to the formation of hydrogen molecules from hydrogen atoms, but you will still have just marks on paper.

Once more, a simulation is just a coded description of a thing, not the thing itself.

(*Cryonics Institute Mailing List, September 18, 2010*)

Identity

The term 'identical' is used in different ways by different people. To some, two systems are identical if they differ only in location, e.g. two hydrogen atoms in ground state. But I have pointed out that a difference in location necessarily implies other differences as well, such as gravitational fields. Hence my position is that, if the question arises, are A and B identical, then they are not.

If two systems differ in spatial or temporal location, then they may be identical to most observers for most purposes, but survival of one does not imply survival of the other. Suppose you, as you are now according to local observation, also exist at a great distance in space or time (either past or future), just by accident. I see no reason for the survival of B to imply the survival of A. (*Cryonics Institute Mailing List, September 16, 2010*)

Afterword by Aschwin de Wolf:

Robert Ettinger presented a number of distinct arguments (no fewer than fifteen, by his own count!) against mind uploading and I cannot pretend to have presented them all in this document. I think there are a number of core positions associated with Ettinger's argument that can be stated quite succinctly, however.

Whether mind uploading is possible is ultimately an empirical question and cannot be settled conclusively by analogies or thought experiments.

A description of a material object is not necessarily the same as the object.

A simulation *must* be erroneous because the program necessarily is based on our incomplete knowledge about physics.

Consciousness may be substrate-dependent.

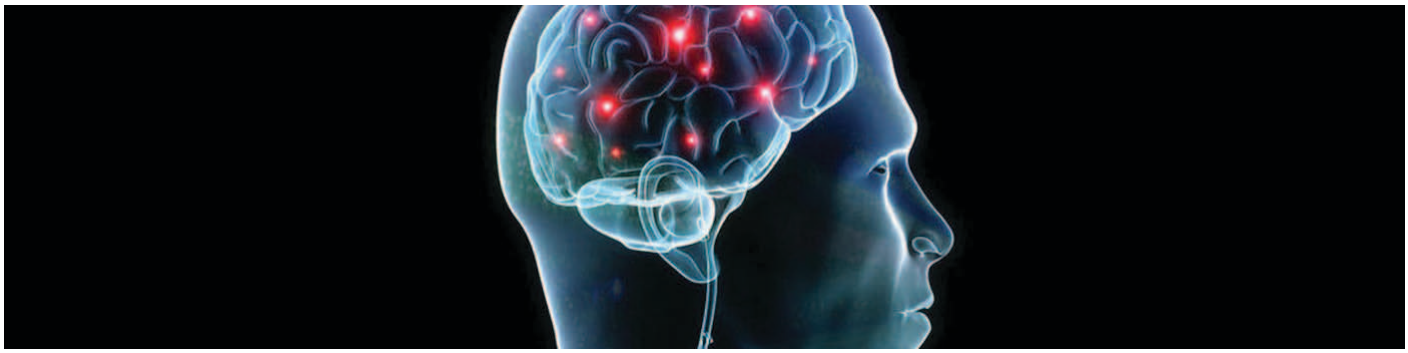
A copy of a person may not constitute personal survival.

The common denominator that runs through Ettinger's critique of substrate-independent minds is a thorough empiricism about knowledge. Ettinger does not categorically rule out the feasibility of mind uploading but takes people to task for dogmatic claims on these topics in absence of empirical corroboration.

Ettinger was particularly irritated by the claim that materialism commits a person to the acceptance of mind uploading. He could not see how a rejection of the soul excludes the view that certain materials are uniquely suitable, or even *exclusively* suitable, for a certain function. One might add that it is even conceivable that the mind *is* substrate-independent but that existing organic chemistry provides the most versatile basis for advanced consciousness and survival.

Most of the issues that Ettinger was concerned about may be resolved by the time he will be resuscitated but it is possible that some of the issues that are at stake in this debate are ultimately un-falsifiable or even pseudo-problems. For example, how could we settle the question of whether a copy is "really you?" Obviously, a copy of something will always confirm that (s)he is really him- or herself but that is of little help in resolving the question. Similarly, we may never be able to conclusively verify (or falsify) that a computer has consciousness or feelings. Is it even conceivable that new super-intelligent life forms will replace humans without being conscious or having feelings! Evolution selects for fitness, and whether this implies consciousness is an open question.

So who is right, Robert Ettinger or his critics? I think what captures Ettinger's perspective the best is to say that if you expect an answer *right now*, you have not paid close attention to his argument.



Final Thoughts

York W. Porter - Executive Editor

Watches and I don't always get along. Down through the years, I've gone through quite a number of wristwatches with some of those, regrettably, being occasionally bought as presents for my birthday or at Christmastime. Hospital work, while not particularly stressful physically, at least compared to some things I've done in life, is apparently pretty rough on anything that is around your wrist or on your hands. This, coupled with the needs of cleanliness is why many hospital workers do not wear any jewelry near their hands at all. Frequently, that jewelry just winds up nicked and damaged with the occasional loss of precious stones through the extensive use of a health care workers hands and arms with the resulting seemingly unavoidable bumping up against various hard surfaces that exist in any hospital setting.

So, one is faced in hospital work with the usual problem of the correct time. Virtually all the hospitals I've worked in have large time pieces in the hallways or in the particular department one is in at any given time but, for some reason, it seems like there is nothing like the "do it yourself" approach where one may check the time for themselves. In my own case, this has resulted by the purchase of an inexpensive pocket watch that allows me to keep up with the time no matter where I am and which also avoids the problem of my arms accidentally smacking against a watch damaging surface. My pocketwatch is a cheap analog type even though digital clocks abound, of course, throughout many places today. I find myself even looking at my pocket watch out of habit even though, for instance, the current time is readily available on the many computer screens I deal with. Beat and battered with the nickel plating continuing to rub off revealing the apparent nature of the underlying copper cover underneath, it still keeps me in pretty good stead in terms of knowing a pretty close approximation to what time it actually is.

But, of course, some watches, unlike mine, aren't so cheap. Back in the mid 1800's, a gold pocket watch valued at a little over a hundred dollars would rank at about three thousand one hundred dollars today. Don't know if there was a similar model for the "working man" back then or not, but if there wasn't, guess folks like myself would be asking someone else, as I occasionally do today, "Do you have the correct time, sir?"

The request for the correct time isn't, of course, that uncommon and on virtually every occasion I've found if one approaches the person with some sort of time piece on their arm in a friendly and smiling way, the answer comes forth pretty readily. Maybe pity for what is obviously a country boy in the big city plays a part sometimes as well when I'm doing what little traveling that I do but, again, most folks are basically pretty friendly and helpful, whether in large cities or small towns, and they will more than easily oblige one in this simple and obviously useful request. In spite of my problem with watches, I have actually been on the receiving end of this request from time to time in my life as well.

But some requests are a little more involved and it seems incredible, though it is true, that sometimes one can borrow the timepiece to use for one's own for a while if the presentation is done well enough. Such was the ability of one William Thompson, a resident of New York City back in the mid 1800's. He was one of the first people whom the term "confidence man" was applied in the popular press.

Thompson's approach was apparently relatively simple. The first thing that it involved was being pretty nattily dressed. (I definitely wouldn't make much of a worker in the "confidence" industry since I am well known for my usual state of definitely *not* being much of a "clothes horse"). Thompson would approach an individual on the street and strike up a conversation as though they were old friends. The person he ran into was apparently in the situation I find myself when someone who knows me from my work in the local hospital meets me in the local Walmart and informs me that "Momma is doing a lot better" while I'm basically wondering "Who are you and who the heck is Momma?"

Thompson used his "gift of gab" to rapidly convince the listener that he must be some acquaintance or friend that the listener has simply temporarily forgotten. Human pride being what it is with all levels of income, the person listening is too embarrassed to admit he simply doesn't remember Thompson (which, of course, he wouldn't since they had never met the first time!!). After a few moments of well-designed talk, Thompson would then, on some pretense, "borrow" the "friend's" watch with a strict promise to meet him tomorrow in the same location to return it. (It also apparently worked for borrowing money as well. Remember that a relatively small amount of, say, fifty dollars back in those days would be like fifteen hundred these). Only later would the lender realize they had been swindled. Even then some of them, being a person of substantial means, wouldn't report the crime to the police, being susceptible to another universal human failing, that of not wanting to be "embarrassed" by being blatantly taken in by the now obvious crook. These folks decided to just absorb the loss themselves.

A modern version of this scam is used by phone. I was partially subjected to it one day when a "nephew" called. Problem he had was that I have a limited number of nephews and the name my "nephew on the phone" gave didn't match any of their names. I gather this scam does work, though, from time to time, when someone calls posing to be a relative in a very large family and is asking for a fairly small amount due to a "car breakdown" or something like that. Fortunately I had read of this scam before receiving the call and, luckily for me, it was in the afternoon when the blood flow to my brain is still going pretty strong. I'm a "morning" and "day-shift" person when it comes to decision-making and maybe if they had called later in the day, the scam would have worked just fine with the scammers being a little bit richer for their efforts.

Thompson was eventually caught and found to be a graduate of the "college at Sing Sing", i.e., a convict who had previously served time. Even in the jail, however, his charming ways apparently continued and he was able to try to bail himself out through the help of one of the guards, and also gained the confidence of an Assistant District Attorney. Unfortunately, Thompson appeared before a judge and blabbed about a crime Thompson had committed in Philadelphia. Very bad move on Thompson's part and his bid for freedom failed.

And, of course, Thompson wasn't the only purveyor of scams down through the history of humankind. One of these methods is outlined in the film *Paper Moon*. The first person goes into a store and pays for a few items with a twenty-dollar bill. Unknown to the clerk, the twenty has been marked. (Hang on, all will become clear shortly).

Next the accomplice (in this case, a little girl) buys a quarter item and pays for it with a five-dollar bill. The clerk gives change, and then the little girl, half way to the door, says a mistake has been made and that she had paid with a twenty. The clerk, of course, quite understandably denies this. The little girl is insistent and finally breaks into tears. When the store manager comes over, the little girl says that her Aunt had mailed her the twenty-dollar bill and that it says "Happy Birthday" with the little girl's name on it as well. A customer chimes in, the manager finds the bill which has already been marked as described, becomes convinced that the little girl is right, and has the clerk give the whole twenty back to the little girl (with a piece of free candy as well). The little girl and her accomplice have gotten all the merchandise for free!

There are a ton of other scams as well, of course, that have only been made somewhat "high tech" as in the case of the "nephew" who called me or in the case of the ubiquitous e-mail scams telling

you that you are the recipient of a large sum of money. In this latter scam, it is set up such that you have to put up a "small sum" to get the wheels turning towards your receipt of your newly found fortune. This scam goes back to even before e-mail using the old fashioned post office to send regular letters back and forth with the scam letters appearing to be from a very official source.

Which brings us to cryonics. Very, very regrettably, albeit perhaps somewhat understandably, the concern about cryonics being a scam came up relatively early in its history and occasionally rears its ugly head even today, although much, much, much less than before. Even in my case, my parents, quite reasonably as I look back to the 1960's although puzzling to me at the time, were concerned that it might be some sort of a fraud. Fortunately for me, a talk with our family doctor, who also happened to be my first cousin, and his reply of "Who knows? It might actually work" was enough to ease their minds and to allow me to pursue this interest pretty much unhindered.

If you're concerned that somehow cryonics isn't what it seems to be, I can understand that. Cryonics is an amazing concept and, as is often said, "if it seems too good to be true it probably is". The key word here is, however, the word "probably". Sometimes dreams of mankind do come true. We are now able to do a plethora of things that seem to have been impossible when they were first proposed. Technology continues to advance in ways that are truly amazing. In my own case, the first time I came across the field of computed tomography (the so-called "CAT scanning") was in an article in *Scientific American* from way back in the mid 1970's. While quite interesting and intriguing to me at the time, I was convinced at the time that this would be something only available at the large medical centers where I figured (quite correctly so far) that I would never work at. Nowadays, of course, both CT scanning and MRI units are pretty much widespread and I have run them both. Although my MRI career was just a "time to time" thing that appears, for the moment, to be at an end, my work in CT scanning continues onward with me normally doing several studies every time I work at the hospital where I'm employed. What seemed to be a rare technology is now wide spread and a common part of my life.

Similarly, cryonics is, we believe, on its way, albeit gradually, to becoming an accepted and normal part of life. There are lots of things it doesn't do such as make things great with your significant other. It doesn't make your kids "Straight A" students. It doesn't fix (or have anything directly to do) with your local, state, or national political leadership. It doesn't make things "peachy keen" with your boss and/or co-workers. All those things are things it isn't designed and can't be expected to fix. What it does do and what it can do is offer you and your loved ones a realistic measure of hope when terminal illness or accident is upon you or them.

You should, of course, approach cryonics cautiously and in a very careful manner. You should approach any cryonics organization as you should approach anything that is new to you with the attitude of "trust but verify". You should also realize, though, that cryonics has been around for decades now and, while not being carried out "perfectly", as is the case with any human endeavor, a lot of very intelligent, very well meaning and, in many cases, some very well educated individuals are involved in it and dedicated to it being run in an ethical and upright fashion.

Your talents, whatever they are, can be used. Investigate cryonics thoroughly, look at it in depth, come to a few meetings and meet some folks, and then join us and help by putting your shoulder to the wheel. Believe me, you'll be very proud and very glad that you did. Do it today!

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