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CRYONICS

MARCH - APRIL 2018 · VOLUME 39:2

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International Cryomedicine Experts (ICE)

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Local New York Alcor Group Builds Strong Regional Cryonics Capabilities

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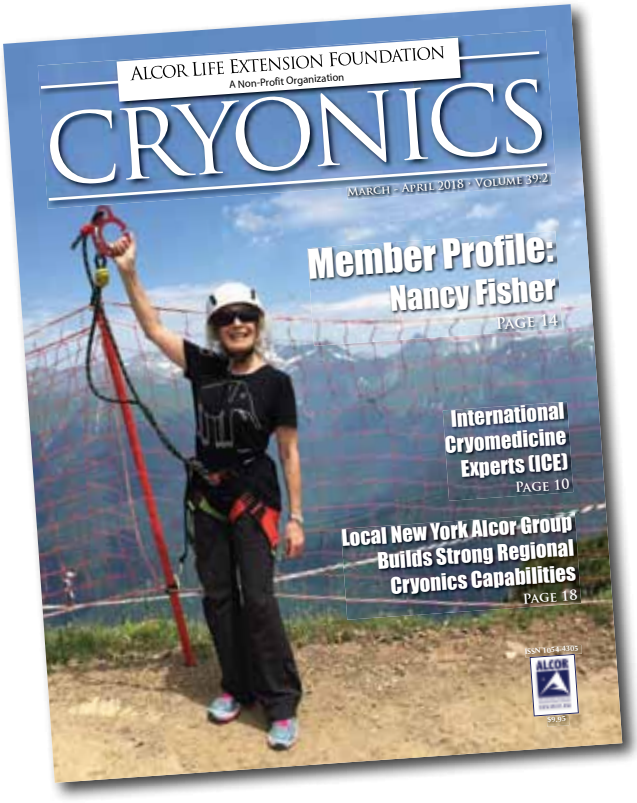
CRYONICS



COVER STORY: PAGE 14

Member Profile: Nancy Fisher

From Timbuktu to the Taj Mahal, explore the world with traveler, author, creative consultant and cryonicist, Nancy Fisher.

On the cover: Nancy Fisher stands triumphant on a skywalk in Krasnaya Polyana, the site of the 2014 Winter Olympics in Russia.

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A Non-Profit Organization
CRYONICS

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EDITORIAL

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

WHAT IS CRYONICS FIRST AID? By Aschwin de Wolf

First aid in medicine is defined as "the assistance given to any person suffering a sudden illness or injury, with care provided to preserve life, prevent the condition from worsening, or to promote recovery." Its aims can be summed up as the three P's: preserve life, prevent further harm, and promote recovery. With the exception of the aim of "promoting recovery" this framework is applicable to cryonics, too.

The rationale for allowing laypersons to provide basic medical procedures rests on the recognition that the health condition of a person can rapidly change and/or professional responders may be unable get to the patient in a timely fashion. A major difference between mainstream medicine and cryonics, however, is that in cryonics there often is no local professional response team that can deploy quickly to stabilize the patient. As a consequence, one would expect to see more situations in which the initial, or even all, aspects of a cryonics case will need to be done by local volunteers—and that is exactly what has been observed. This does not necessarily indicate a deficiency on the part of professional cryonics standby organizations. Cryonics is simply not big enough to have professional response teams in every state and major city.

The objective of professional cryonics standby teams and cryonics first aid are the same: stabilize the condition of the patient. What sets cryonics first aid apart from the comprehensive protocols of professional standby organizations is the *degree* to which this objective can be accomplished and the *equipment* used.

Cryonics first response entails three procedures: cooling, circulation, and medications administration. One clear advantage that cryonics first aid responders have is that our most effective procedure, cooling, is also the easiest to implement. What usually sets good cryonics first aid apart from suboptimal cryonics first aid is the efficiency of cooling achieved and whether induction of hypothermia is augmented by chest compressions and medications administration. When cryonics first aid is done competently response time is fast, cooling rates are fast, circulation is restored, and a basic medications protocol to prevent clotting, brain injury, and swelling is administered.

The topic of cryonics first aid has not received as much attention as other topics in cryonics. In the early days of cryonics it did not make sense to draw a distinction between cryonics first aid and advanced procedures because *all* procedures were done by (trained) volunteers. And later, when professional cryonics standby organizations were formed, the topic also received little attention because it was not sufficiently recognized that there would still be a large role to play for local cryonics groups in the provision of cryonics procedures. It is only now when we have come to appreciate the advantages of a "hybrid" standby model in which local team members provide first aid, or interact with professional standby organizations, that there is a need to clearly define the objectives, scope, and physical infrastructure associated with cryonics first aid.

Some of the current questions about cryonics first aid that Alcor seeks to address include: What is the exact cryonics first aid protocol? Which items should be in a cryonics first aid kit? Should cryonics first aid kits be available to groups or also to individual members? What makes a local group eligible for a full set of standby kits instead of a first aid kit? What will cryonics first aid training comprise? What is the difference between Alcor's first aid protocol and Alcor's abbreviated protocol designed for professional standby teams in case of a delayed response? How do professional standby teams such as ICE and SA interact with local cryonics first aid responders? Should first aid capabilities be enhanced in areas with many members and an active local community? ■

CEO Update

By Max More

CEO GOALS FOR 2018

When I first sat down to come up with a first draft of proposed core goals for 2018, I ended up with a list of 17. "When everything is a priority, nothing is a priority." Based on further reflection and input from the board and talking to staff, I've narrowed down the core objectives to 8 – with another 8 to 10 goals that I hate to set aside but that will have to receive less attention (at least from me).

We ended 2017 with 1143 full members, a net gain of 2.4%. For 2018, 6 to 8% growth seems feasible.

These goals are not set in stone since events may arise that drown out some of them while pushing others to the front. A more detailed version of the goals was unanimously agreed to at the January 13, 2018 Board of Directors meeting. Needless to say, these are in addition to all the other regular duties of the President/CEO.

1. Continue to build response capability and options.

This includes:

- Recruiting and training additional Alcor SST (standby, stabilization, and transport) staff and forming agreements with multiple on-call specialists
- Ensuring that the Watch List is maintained and refreshed regularly.
- Contracting with an additional SST provider if feasible and appropriate to fill in gaps and expand options.
- Stationing kits in areas with high Alcor-member density or where customs barriers could present an issue.
- Rebuilding volunteer local teams but with a more modest aim of basic first-response capabilities.

2. Organizational Capacity Building: Build resilience and prepare for a heavier case load and membership size.

- Identify areas of knowledge and skills possessed by long-term staff where we lack backup.
- Complete all SOPs for important tasks and post them to the Alcor internal Wiki.
- Implement a new IT system to replace the current membership system.
- Convert QuickBooks Online and integrate with new membership system.
- Implement at least one additional cooldown system.

3. Raise funds for operations (including more technical/scientifically-skilled staff, and perhaps a COO), research, and an endowment.

- Develop a comprehensive Wish List with feedback from directors, staff, and officials.
- Study the literature on fundraising and make action point notes.
- Develop a fundraising appeal, to start with a brief summary of needs and wants and suggested distribution of contributions, followed by a detailed breakdown of each for those who want more information.
- Complete full draft of presentation.
- Complete final presentation.

Meet with known members of considerable means, either in-person or by phone/teleconference.

4. Speed up production and publication of case reports.

- Review current status of multiple cases reports.
- As much as possible remove myself as a bottleneck in the editing and approval process while still having a check before drafts go to Cases.

- Catch up with post-2010 case reports – at least getting them into the review stage on the Cases list.
- Push to get reports for new cases completed within 60 days of initiation of cooldown.

5. Keep the budget in the black and aim for a 2018-19 reduction in membership dues.

- Decide on solution to cost of *Cryonics* magazine either by securing more funding or by cutting costs by reducing frequency and/or going primarily electronic-only.
- Depending on membership growth and changes in income, plan for a proposal to reduce membership dues by around 5%.

6. Website language improvements.

- Membership pages.
- Insurance FAQ.
- New webpage/area: "Remembering, Reviving, Reintegrating."
- Procedures pages.

7. Offer neuro Intermediate Temperature Storage (ITS).

- Determine availability and plausible production schedule.
- Confirm/update projected costs of operation.
- Secure Board approval and offer to members.

8. Lifetime membership.

- Suggest a total and consider whether and how to give credit for past payments.
- Settle on where to invest the funds and in which vehicles.
- Settle policy of withdrawal rate for Operations.
- Offer to members.

Other goals that I have to set lower down on my priority list – but which I'm hoping others may pick up on:

1. Increase frequency of newsletters, blog posts and Facebook posts and improve engagement with membership.
2. Expand Associate Membership.
3. Improve research coordination and fund more research.
4. Build member portal with Salesforce Communities or similar system.
5. Bring on board individuals with high levels of skill in medical diagnosis, surgery, perfusion, etc., and with a strong commitment to improving cryopreservation procedures.
6. Membership survey.
7. Alcor conference.

From the start of the underfunding Plan over five years ago, the number of underfunded members has gone down from 581 to 247.

MEMBERSHIP TRENDS

Based on Diane Cremeens' Membership Report, in 2017 we approved a *record number* of new members: 113. 131 applications were submitted. Membership growth was restrained due to a painful 74 terminations. However, 9 members were reinstated during the year – another record – and Diane is working to reinstate 5 to 9 terminated members. 2018 should look quite different. In the past year, we finally became firm with members who were not only not paying dues, but were refusing to communicate with us – making it hard to help them. Most of these people have now been cleared out. In addition, we are pushing hard to help people check on their funding (especially by life insurance) to ensure it will be adequate going forward.

We ended 2017 with 1143 full members, a net gain of 2.4%. For 2018, 6 to 8% growth seems feasible.

UPDATE ON UNDERFUNDING

A few months ago I showed numbers demonstrating the massive improvement in the cryopreservation underfunding problem. A couple of the highlights from my September board report:

- From the start of the Underfunding Plan over five years ago, the number of underfunded members has gone down from 581 to 247.
- The total amount of under-minimum funding has gone down from $28,691,837 to $10,720,606. That's a huge improvement.

Just in the last four months of the year, that improvement has clearly continued.

SEPTEMBER 1, 2017

Number of members underfunded	247
Total under minimum funding	$10,720,606
Members at or above minimum funding	903
Total amount over minimum funding	$33,837,527
Balance	+$23,116,921

DECEMBER 31, 2017

Number of members underfunded	212 *(reduction of 35 in 4 months)*
Total under minimum funding	$9,278,712 *(reduction of $1,441,894)*
Members at or above minimum funding	931 *(increase of 28 in 4 months)*
Total amount over minimum funding	$39,838,172 *(increase of $5,146,645 in 4 months)*
Balance	$29,705,458 *(improvement of $6,001,384)*

If you are struggling to keep paying dues or underfunding dues, do not forget that Alcor has a Hardship Fund. We are currently helping several members who otherwise would be unable to maintain their cryonics arrangements. As part of my fundraising campaign I will be soliciting charitable contributions to bolster the Hardship Fund. At the turn of the year, I donated $1,000 of my own money, hoping this would spur others to join in.

The total amount of under-minimum funding has gone down from $28,691,837 to $10,720,606. That's a huge improvement.

LISTEN! If you are having financial difficulties – and especially if you are a long-term Alcor member – *please* contact us to discuss options. If you don't tell us about your struggles, we can't help you. If the first thing we know is that your insurance has been cancelled for non-payment, it's probably too late. For goodness sake, don't be embarrassed. Our resources are not endless, but *we want to help you*. But you have to communicate with us.

If you are struggling to keep paying dues or underfunding dues, do not forget that Alcor has a Hardship Fund."

PRE-PAID ACCOUNTS TO KEEP PACE WITH INFLATION

Over the last few years, I've noticed relatively little interest in pre-paying part or all of cryopreservation minimums. Life insurance is an excellent way to get immediate coverage but can be expensive if you attempt to buy enough to cover costs after accounting for several decades of inflation. An alternative is to regularly add money to your pre-paid account. But if those accounts are sitting in the bank earning 0.02% you probably lack much enthusiasm for the idea.

After many talks with financial advisors, we are now putting pre-paid accounts into a variety of investments with strong downside protection but with a high probability of growing the funds enough to at least keep pace with inflation, and probably to gradually grow those funds in real terms.

Another option for pre-payment that may work well for some members is a single-premium insurance policy. This allows you to pay off an insurance policy with a single payment that guarantees a payout larger than that amount. The policy would need to be one that would keep pace with projected future inflation. You might consider this option if you are insurable — and at a reasonable rate — and if you are content with the projected returns and costs of the policy. ■

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International Cryomedicine Experts

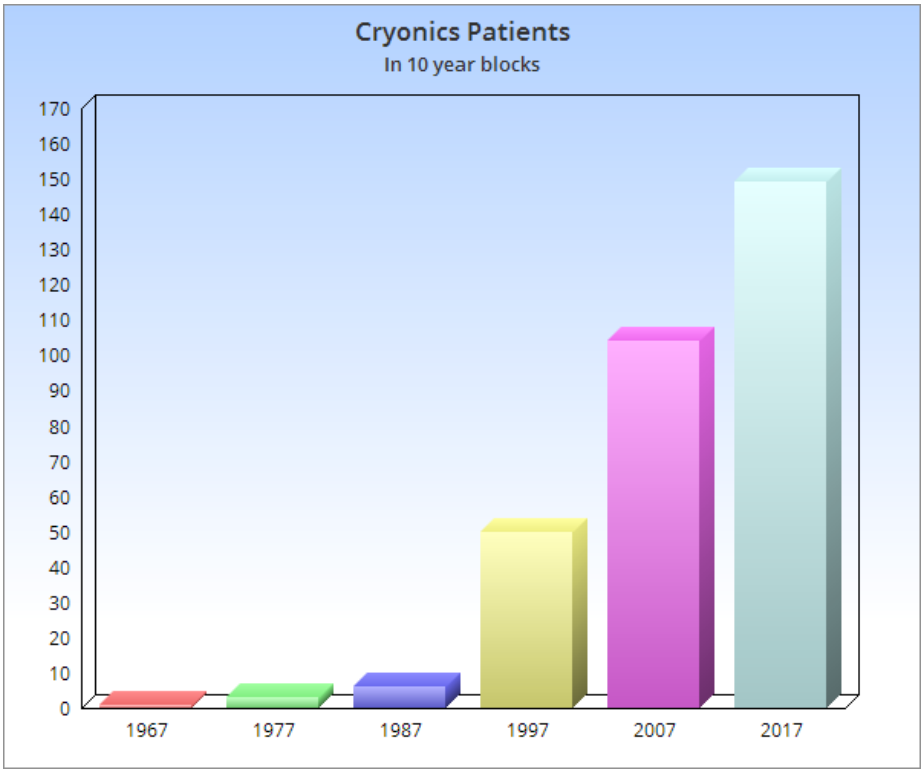
Is there a need for more than one standby team?

By Aaron Drake (Senior Medical Response Consultant for Alcor and Chief Specialist at Yinfeng Bio)

Many of us understand that competition in the marketplace can be a key driver of performance in the areas of improved customer service, competitive pricing, and specialization. However, having more than one standby team can also provide the benefit of mutual aid, which is defined as the ***reciprocal exchange of services when demand outstrips resources***. Mutual aid is vitally important in emergency medical services, such as ambulances and fire departments, and this concept can help address a growing concern with respect to cryonics standby availability.

Fact: ***The world of cryonics is becoming significantly busier.*** Looking at the statistics of the two major cryonics companies, Alcor and the Cryonics Institute (CI), there has been a significant increase in the number of patients cryopreserved in the last 10 years. The total number of new patients from the past decade essentially equals the totals from the preceding four decades combined. The chart below highlights this fact, but keep in mind, the associated numbers only represent cryopreservations at Alcor and CI, and do not take into account newer industry providers such as Russia's KrioRus, Oregon Cryonics, China's Yinfeng Bio or any other recent startups around the world.

While this growth is excellent for the cryonics industry, it can also present a challenge for any single cryonics member ***if their standby team is already committed to another patient.***



(Source: Alcor and CI websites)

What are the chances of two or more simultaneous patients needing services at the same time? To address this question, I turned to R. Michael Perry, Ph.D., with degrees in mathematics and computer science, and who works as Care Services Manager at Alcor. Over the years, he has developed and continued to refine a mathematical formula to predict the probability of such an occurrence.[1] Alcor has used this model to determine the level of resources required to cover the needs of its members.

$$W_{c,t}(n) = \frac{t}{P^{+}_{c,t}(n)} = t\frac{n!(ct)^{-n}e^{ct}}{{}_1F_1(1;n+1;ct)}$$

This formula calculates the expected "wait time" $W_{c,t}(n)$ for n or more cryopreservation cases to occur over a baseline time interval t, given that there are c cases per unit time interval, and that cases

occur randomly. Here we take 1 year as the unit time interval, so that t is measured relative to this unit. t itself, the baseline time interval, is just the total amount of time it takes to carry out a cryopreservation, from the initial deployment of the standby team, through perfusion and stabilization, to the recovery period afterward, so that everything is in full readiness for the next case. Here we estimate that time as 1 month (t = 1/12, in terms of the unit time interval of 1 year). In the formula, $P^{+}_{c,t}(n)$ is the probability of having n or more cases in time interval t, given c cases per year, and is determined mathematically given the assumptions we make (random cases, known expected c). Empirical studies of actual cases at Alcor suggest there should be, on average, seven cryopreservations for every 1,000 members in a given year. This does not take into account last-minute sign-ups, which are occurring with increasing regularity for all cryonics service providers. Given the current member statistics provided by both Alcor and CI, there are now roughly 2,000 funded members, including those who might get in "under the wire" as last minute cases. If you accept Dr. Perry's estimates, including the last minute cases, then **we can anticipate approximately 14 cryopreservations per year**, on average, across all US based cryonics service providers. The number of patients cryopreserved over the past few years supports this estimate.

When you plug this data into Dr. Perry's formula, the results suggest that ***about four times per year there will be standbys with some type of overlap***, or about once in three months, given our assumed baseline of 1 month. (This is the n=2 case, with t=1/12, and c=14.) Most of these will involve only two overlapping cases, but it turns out that **every nine months there will be instances of three or more cases that overlap in a one-month interval.** (n=3, again with t=1/12, c=14). So we expect that at least several times per year, one or another organization could have a case where a single standby team that tried to service everybody would already be busy with another patient, or in the recovery process. When you add to this an ever-increasing growth of membership, the likelihood of standby conflicts increases with each passing year.

It is with this premise that I decided to start International Cryomedicine Experts, more commonly referred to as the **ICE Team**. This project is a partnership between myself and long time friend and colleague, Eric Vogt. As many of you know, I was the Medical Response Director at Alcor for many years before broadening my opportunities by becoming an independent consultant to the cryonics industry. Eric, a 21-year paramedic, has been managing scores of paramedics who have worked in clinical, pre-hospital and triage environments for more than a decade. We have both been EMS instructors and have teamed up to work on many projects. Together, we provide a unique collaboration of experience and resources that can have an immediate impact on multiple areas of need that are not currently being met by existing services, as listed below.

International response. Alcor and CI have international members, who are exposed to both 1) increased risks by not having sufficient standby and cryopreservation services, and 2) increased costs associated with international surcharges and additional travel expenses. Unfortunately, many international members expect to receive a straight freeze, at best. As the ICE company's name implies, the international market is an area of specialty that was borne out of the many years of international experience I gained while providing services for Alcor's clients.

Field cryopreservation. Remember these two key words: time and distance. These are the two most important factors that can limit, or eliminate, the possibility of a quality cryopreservation. If there is insufficient time for a patient to get back to Alcor's surgery suite for cryoprotective perfusion, the only remaining option is a straight freeze. This was essentially the only option, with few rare exceptions, for international community members of US based cryonics organizations. However, continued development of portable equipment and innovative design, has allowed Alcor to begin to implement field cryopreservation, a decidedly superior option to straight freezes. There are many scenarios where field cryopreservation is being considered the best solution for domestic cases here in the US, when specific criteria exist.

Experienced emergency medical providers. The ICE Team will start with 90+ years of combined experience in EMS and the military, whose skills will immediately transfer into the field of cryonics stabilization and transport. It was once claimed that a cryonics stabilization is the same as a medical code plus ice. It is fair to say that these team members have participated in well over 1,000 medical codes during their careers and this experience will be extremely beneficial when it comes to handling the myriad of potential challenges that can occur during a stabilization.

Currently, the credentials of the ICE Team members include: four nationally and state registered **Paramedics** (all of whom are instructors); two **US Army Medics** with combat experience; one **Registered Nurse**; and even our own **private pilot**. We have also added retired **Neurosurgeon** Jose Kanshepolsky, MD, PhD, for additional surgical support. Personally, I have directed or been involved in approximately 70 cryonics cases during my career, including both human and pet cryopreservations. Dr. Kanshepolsky estimates that he has performed more than 50 cryonics surgeries. Eric Vogt already has experience in two standby cases for Alcor, and has instructed at multiple Alcor standby team training events.

Our plans are to provide a range of services: logistical support of patient transport; full service standby, stabilization and transport services; more advanced procedures such as field cryopreservation; and custom services including private jet service and special handling.

It is my hope that cryonics organizations and members alike will feel more reassured knowing that **the presence of two standby providers will assure a competitive, yet friendly, atmosphere** where increased emphasis will be placed on responsive customer service, quality assurance in the field, competitive pricing, a broader range of services, increased geographical coverage and the ability for another provider to step in and provide services in the event that the other team is already committed.

Additional information can be found at: www.cryomedics.org or by emailing: info@cryomedics.org. ■

1. See R. Michael Perry, "Expected Multiple Cases per Time Interval" (7 Mar. 2016), https://mega.nz/#!MBtmQCDR!vZ9C4ReUJwpnMOFJt1x7II0Q52edIL_QEy5wEZNHLMA, accessed 27 Jan. 2018.

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

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

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

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

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

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

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

Member Profile
Nancy Fisher

By Nicole Weinstock

It's no surprise that Nancy Fisher's favorite book is *The Hitchhiker's Guide to the Galaxy*. After all, if you've already travelled to more than 50% of the countries on Earth, you may eventually need some intergalactic destinations to keep that passport fresh. From the five "Stans" of Central Asia to the Dolomites of Italy, from a music festival in Timbuktu to the Taj Mahal to Pakistan's Hunza Valley, Nancy's wanderlust has led her to some of the most remote villages, breathtaking landscapes, and architectural marvels of the world.

"I tend to be one of those people who walks into a place and says hi, and hands out food and drink. I can work a room pretty easily." Her social spirit and adventurous nature are just a couple of the qualities that make her a welcome guest at dinner tables on all continents. And as a cryonicist of nearly 25 years, she hopes the future will expand the diversity of her experiences.

"Who knows what changes the future will bring?" Nancy says. "But I'd like to think I'm up for them."

BLACKBERRIES AND BOOKS

Though she's not one to dwell on the past, it's clear that many of Nancy's salient characteristics were formed in youth. Born and raised in the metropolis of New York, she grew up with a loving family that supported the fruition of her full potential.

"My parents always expected me to work hard, to have a good education and a rewarding profession, and to do interesting, worthwhile things with my life... there was no lowering of expectations because I was a girl."

While the school year was urban in context, Nancy spent memorable summers exploring the Catskills and Adirondacks of rural New York with her father. "He was a smart, gentle, truly good person who never lost his sense of the wonder of life or his appreciation of nature. He took pleasure in simple things like beautiful sunsets, and finding wild blackberries by the side of the road." He also inspired her to stay healthy. "He believed it was important to respect your body, to be proactive about your physical well-being. And no smoking of course, and alcohol only in moderation." These days, many of Nancy's trips, including the one to Bhutan from which she recently returned, are oriented towards hiking. "I like getting into places that you can't get to any other way than on your own two feet." She's also a devoted gym-goer. "I do most of my reading on the Stairmaster," she admits.

Nancy's creativity emerged at a young age as well. She participated in summer stock—theatre staged during the summers by resident companies in exurban locations—in her late teens, developing acting and production skills that later would be useful in her careers in advertising and television. She was also a natural when it came to writing. "I don't remember not writing. Making up poems or writing little stories or plays. I just sort of always wrote. And I always read. I never studied writing; I learned to write by reading."

Years later, Nancy is now a published author of Penguin USA, and still a devoted reader. Her recent picks include *A Man Called Ove*, Fredrik Backman's narrative of an old curmudgeon and the unexpected friendship he develops with new neighbors, *Yes, Chef: A Memoir*, by the award-winning chef and cookbook author, Marcus Samuelson, and *Eastern Approaches*, Fitzroy Maclean's classic 1949 account of his exploits as a British diplomat in Moscow, his travels in Central Asia, and his service with the newly minted OSS in North Africa and Yugoslavia before and during World War II. But nothing beats Douglas Adams's masterpiece and Nancy's self-admitted bible, *The Hitchhiker's Guide*

Nancy hiked 2,700 feet in altitude to the most famous temple in Bhutan, known as Taktsang or "Tiger's Nest" Monastery.

to the Galaxy. "I'm ready to go!" she says with enthusiasm.

FROM ADVERTISING TO TELEVISION TO MEDICAL THRILLERS

After college, Nancy landed a job as a copywriter at a New York advertising agency. She then added "producer" to her title, and later became a creative director, moving to London and back to New York along the way.

A friendly local enthused by Americans, asked to take a picture with Nancy during her stay in Khiva, an ancient Silk Road oasis in Uzbekistan.

Eventually, she started her own creative consultancy, which garnered the attention of Campbell Soup Company. Campbell invited her to pitch ideas for a national cable television program they planned to sponsor. Soon thereafter emerged *WomanWatch*, her 48-half-hours TV series featuring on-location action profiles of nearly 150 women engaged in record-breaking, boundary-pushing, and generally unique pursuits, including the first female general of NORAD (North American Aerospace Defense Command, responsible for identifying aerospace and maritime threats); a member of the first women's ascent of Annapurna; an inner city school superintendent; a Texas cattle rancher; and the first woman to walk in space. Once *WomanWatch* was up and running, Campbell asked Nancy to create a cooking show for them, and *Celebrity Chefs*, her 48-half-hours TV cooking series, hosted by Robert Morley, was born. It featured a host of celebrities including Eartha Kitt, Helen Hayes, Regis Philbin, Lynn Redgrave, Merv Griffin, Phylicia Rashad, and Tony Randall. Along the way, she also directed and produced infomercials, and home and corporate videos.

But Nancy found herself returning to a long-time aspiration: writing a novel. "I've always been interested in medicine and I've always been interested in science fiction, and you put the two together and you get medical thrillers." Penguin USA published her first medical thriller, *Vital Parts* in 1993, followed by *Side Effects* (1995), *Special Treatment* (1996), *Code Red* (1997), and *Code Blue* (2000).

When drafting her books, Nancy sometimes consulted with medical experts, including her brother, a surgeon in Minneapolis, about technical aspects of the story. "But the story is primary, the story always comes first. What you want is a basic reality check. But you always have to push the envelope." She recalls talking to a surgeon who did facial reconstructions of people who'd been injured. "I explained that a part of the story I was working on—a very small part—was a face transplant. And he said, 'Oh, no, that could never happen.' And I included it in the book anyway, and it's happening now."

Being a novelist was isolating work, and when an opportunity arose to return to the corporate world as director of communications for a mid-sized financial services company, Nancy jumped on it. "The corporate job was great because, in addition to interacting with lots of people, I got to create the department from scratch, and to use all the various skills I'd acquired over the years. I had a great time."

ANOTHER BITE FROM THE TRAVEL BUG

Nancy never forgot her love of travel, and when she got the chance, she went back to exploring the world. "I've been to more than 100 countries so far," she says, "and counting!" Over the next 10 months, she plans to be in Egypt, Jordan, Lebanon, Malta, the Balkans, Peru, Bolivia, Namibia, Afghanistan, Oman, and Iran, with a trip to see family in London tucked in for good measure.

Apart from feeding the wayfarer within, Nancy finds that travelling is a way of making connections with people and cultures one wouldn't otherwise have a chance to experience. "Being welcomed and hugged by Muslim women when visiting holy sites in Uzbekistan… Dancing with the locals late at night in a small social club in Dagestan… Being treated with respect and warmth in the mosh pit at a musical festival in the desert outside Timbuktu… these are the things you remember," she says.

Other tourists pose with Nancy in front of Registan (meaning "Place of Sand") in Central Asia's most noble square, located in Samarkand, Uzbekistan

In Baltistan, Nancy stands with members of Pakistan's Anti Terrorist Squad (ATS). They were assigned to her tour group for their travels through Northern Pakistan in 2014

She tells the story of an incident during a trip to Mali, when her guide took her small group on a walk through an open-air market in Bamako, the country's capital. Despite being explicitly told *not* to take photos of the women vending their wares, one person persisted, resulting in angry yelling, and a very hasty departure.

"I said to the guide, 'I've never felt that kind of hostility anywhere in this country. What were they saying?'" 'They said,' he explained, "'The market is dirty and we have no water to wash with, but the tourists will take our photos home and show them to their friends and they will think we are a dirty people. And we are not a dirty people!'" It actually brought tears to my eyes. It's so human and so reasonable, but it's not what you would have thought they were saying if you hadn't asked."

Nancy adds, "Most Americans don't travel very much… And as a result, we have no idea how lucky we are. We turn on our faucets and clean water comes out. Right there, we're ahead of a huge percentage of the world's population, but we tend not to understand that because we don't get out of our comfort zones and go see it."

THE FUTURE AND BEYOND

Not everyone can muster the same equanimity in the face of the unexpected, the unknown, and the initially strange. But Nancy's commitment to meandering in and out of the places and spaces of this world sans judgment—but with a lively sense of humor—has served her well...and undoubtedly prepared her for the great future beyond.

That future, a subject that is near and dear to cryonicists, has the potential to take many forms. And so do the methods of getting there. In Nancy's case, she is enthusiastic about the possibility of head transplants, brain downloads, and robotics. She's also excited about space travel. "I would love to take those "hitchhiker's guide to the galaxy" trips—in my own body or a shipboard computer or as a robot. Any way you can get me there would be fine with me. Just sign me up!"

She continues to be surprised when people say they don't want to live forever, or don't want to be "brought back" after death. Living forever has appealed to her since childhood. "It's a no-brainer," she says. "Why wouldn't you, if you could?" And cryonics seemed like the way to go ever since she first read about it in Ed Regis's 1991 book, *Great Mambo Chicken and the Transhuman Experience*. She immediately

Nancy poses in a hollowed-out tree supporting the roof of a remote beachside cafe in North Caucasus.

Travelling through the mountains of the Republic of Dagestan, a region that is generally considered a "no-go tourist zone," but in which Nancy encountered great local hospitality.

contacted Alcor and became a member. "As soon as I read about it, I knew it was something I wanted to do. I figured, 'What the heck? If it doesn't work, I'm no worse off than if I didn't give it a shot.' My brother and my daughter sort of humor me when it comes to cryonics, but they're supportive of whatever I want to do."

Nancy is part of the New York cryonics group recently created under the auspices of Alcor. They meet regularly to discuss relevant topics, concerns, and needs, and to formulate action plans. She hopes the future will see increased funding and research, the development of improved response protocols, and more options for preservation and resuscitation. She also plans to participate in efforts to create better infrastructure in her hometown. "The timeframe for getting assistance to somebody who has just died is really short wherever you live, and New York

In Sükhbaatar Square, the main square of Ulan Bator, Mongolia's capital. Behind Nancy is the Government Palace and a monument dedicated to Genghis Khan.

Ever the adventurer, Nancy explores ruins in Merv, Turkmenistan, a major oasis city on the historical Silk Road.

presents an especially tough challenge for cryonicists," she says. Among other things, the New York cryonics group is working on developing a local Alcor rapid response team provisioned with the proper standby equipment, as well as a network of supportive on-call funeral directors.

Perhaps it's all the traveling she does, or the many different "lives" she has already lived that make her so adaptable. "My nominal home is New York," she says, "but my actual home is inside me." She continues, "I consider myself a centered person. Positive, enthusiastic, flexible... I remember once saying to somebody, I feel like I have a loose soul. I could live different lives, I could live in different places, different bodies. I could come back again and again and be different people, do different things. But I'd still carry with me the person I am inside." Through cryonics, she just might get that chance. ■

To read about some of the different lives and stories from Nancy's imagination, visit www.nancy-fisher.com for a short synopsis of each of her medical thrillers. Want more? You can purchase any and all of them on Amazon.

Penguin USA published five of Nancy's medical thrillers, showcased above.

Local New York Alcor Group Builds Strong Regional Cryonics Capabilities

By Nancy Fisher

Standby kits, rapid response protocols, hands-on training, information-sharing, mutual support… With Alcor's blessing and Aschwin de Wolf's invaluable advice, a dedicated group of New York City cryonicists are creating a practical, actionable local model that not only will benefit Alcor members living in the tri-state area but could be applicable to other groups around the country as well.

As readers of this magazine are aware, a lot of the early cryonics activity originated in New York. So it's fitting that the New York City regional group has become one of the most active in the country.

We have created a forum of like-minded individuals who can depend on each other when needed. Together, we learn, strategize, and bond.

The regularly scheduled meetings focus on four general areas: speakers, fellowship, information-sharing, and hands-on training and protocols with an eye to what we can do today and how we might increase our capabilities in the future.

We are committed, motivated, and active. Our members include practicing experimental scientists, entrepreneurs, the chief legal officer of a non-profit organization, and a marketing/communications expert, among others. We invite you to join us. You don't need any specific skill set to become part of the New York regional group – just a desire to support your fellow cryonicists by taking a hands-on role in our efforts in whatever ways you can.

WHY IS A RAPID RESPONSE CAPABILITY IN THE NEW YORK AREA SO IMPORTANT?

In the case of death due to disease or natural causes, the process is generally slow and the teams at Suspended Animation (SA) and International Cryomedicine Experts (ICE), located in California and Florida, and Arizona, respectively, have time to get to the patient before death occurs. But in the case of a rapid decline or sudden death, the time it takes for them to reach a patient in New York can be lengthy depending on airline schedules, weather situations, loading and unloading of baggage containing standby and stabilization equipment, and the basic fact that these companies are located far from New York. When one realizes that even a few hours' delay in starting basic stabilization protocols can make the difference between an ideal and less-than-ideal cryopreservation, it becomes obvious that having a first response team of volunteers "on the ground" in New York that can stabilize and care for a pronounced patient until a remote team from SA or ICE arrives is of critical importance. And if the local rapid response team already has on hand the full kit of equipment and solutions that SA or ICE will need for their work when they get here, baggage transportation issues are eliminated and travel arrangements for the remote team become faster and more efficient.

BUILDING OUR GROUP, BUILDING OUR CAPABILITIES.

Currently, the New York group will receive an abbreviated standby kit, later to be

followed by a full set of standby kits, and has arranged for easy-access local storage of them so that our members can quickly retrieve and deploy them as required.

When one realizes that even a few hours' delay in starting basic stabilization protocols can make the difference between an ideal and less-than-ideal cryopreservation, it becomes obvious that having a first response team of volunteers "on the ground" in New York that can stabilize and care for a pronounced patient until a remote team from SA or ICE arrives is of critical importance.

The "first response" kit contains a body bag in which an ice water flurry can be circulated to cool down the patient as soon as he or she has been pronounced, a manual chest compression device, and equipment for administering medications to prevent blood clotting and brain damage. Training is being undertaken so that, upon being alerted by Alcor or the patient's representative, members of the New York group can use this equipment to stabilize a patient until the remote team from SA or ICE arrives.

Alcor's full set of kits includes a mechanical chest compressor (known informally as a "thumper"), a portable ice bath on wheels, and additional equipment that SA and ICE may need for more advanced procedures such as field neuro cryoprotection. Again, having this equipment readily available locally makes for more efficient and faster deployment of the remote team.

In addition, we are assembling a roster of morticians who are either familiar with or friendly to cryonics, so that the patient can be transported from hospital or hospice to an appropriate location where the local team can continue to care for the patient while awaiting the arrival of the remote team from SA or ICE.

Throughout these procedures, our local team will be in contact with Alcor, as well as other entities as necessary.

BUT THIS IS JUST THE BEGINNING…

What if the SA or ICE team is delayed by weather for several days? What if the patient's specific situation requires a blood washout or (neuro) "field cryoprotection" before the remote team arrives?

With the local availability of the full set of kits, establishing contacts with local medical professionals, plus further training, we anticipate increasing our capabilities so that we can perform the blood washout and cryoprotective perfusion procedures ourselves if directed to do so by Alcor in consultation with SA or ICE prior to their arrival.

Our ultimate goal is to create a robust and professional infrastructure that will be able to bridge the gap between the quality of care that a patient can get in the New York City area and the quality of care that patients currently receive in Scottsdale, Arizona, where Alcor is located.

This will provide a much-needed safety net for New York cryonicists. But our vision goes beyond this.

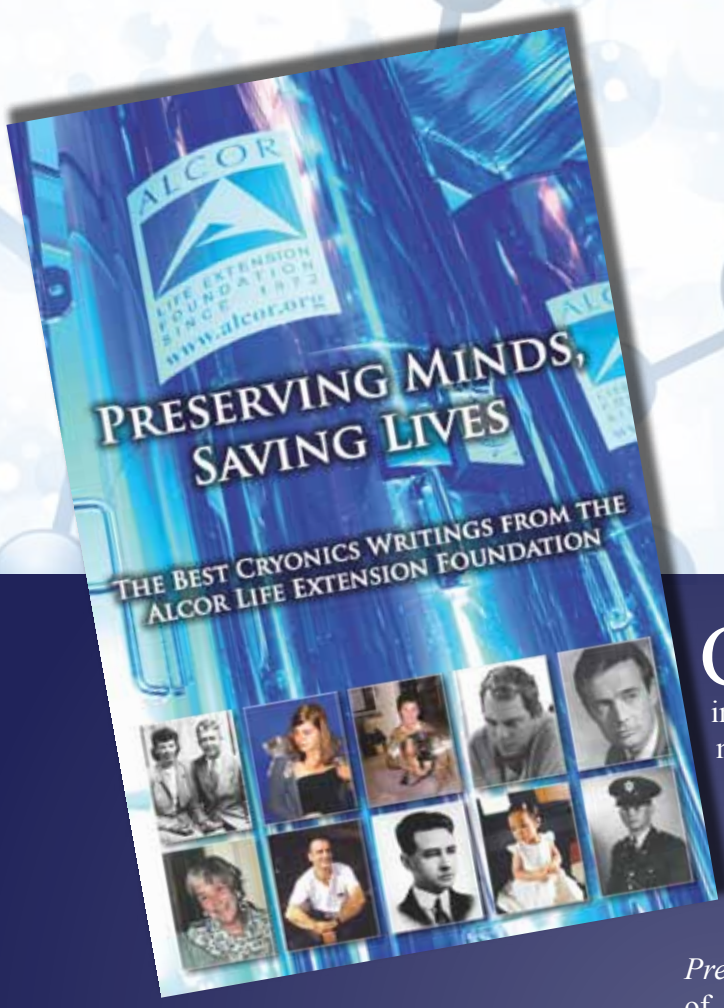
Currently, once a patient has been stabilized (cooled and blood washed out), SA or ICE prepares and arranges the transportation of the patient to Scottsdale, where cryoprotective perfusion is performed at Alcor. What we would like to see, and what we will be working toward, is the eventual creation of a field cryoprotection "satellite" facility in the New York area that would have the capability to cryoprotect a whole-body patient prior to transporting him or her to Scottsdale. (Currently, cryoprotection prior to transport is only performed on neuro patients in international and select national cases.) By creating a satellite hub for Alcor members in New York, we will provide a valuable local resource for our fellow cryonicists while locally supporting Alcor's mission. Our ultimate goal is to create a robust and professional infrastructure that will be able to bridge the gap between the quality of care that a patient can get in the New York City area and the quality of care that patients currently receive in Scottsdale, Arizona, where Alcor is located.

Expanding our involvement and capabilities via this hybrid model is exciting, and we invite Alcor members in the New York tri-state area and beyond to join our group. Interested in attending a meeting? Want to get trained in rapid response protocols and work with us here in New York? Know of a nurse, EMT, or other medical professional who might assist us locally? Care to contribute to this work in other ways? Please contact us by emailing Javier El-Hage (javier.elhage@gmail.com). We look forward to welcoming you! ■

ORDER NOW!

Preserving Minds, Saving Lives

The Best Cryonics Writings of The Alcor Life Extension Foundation



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

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

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

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

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

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

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

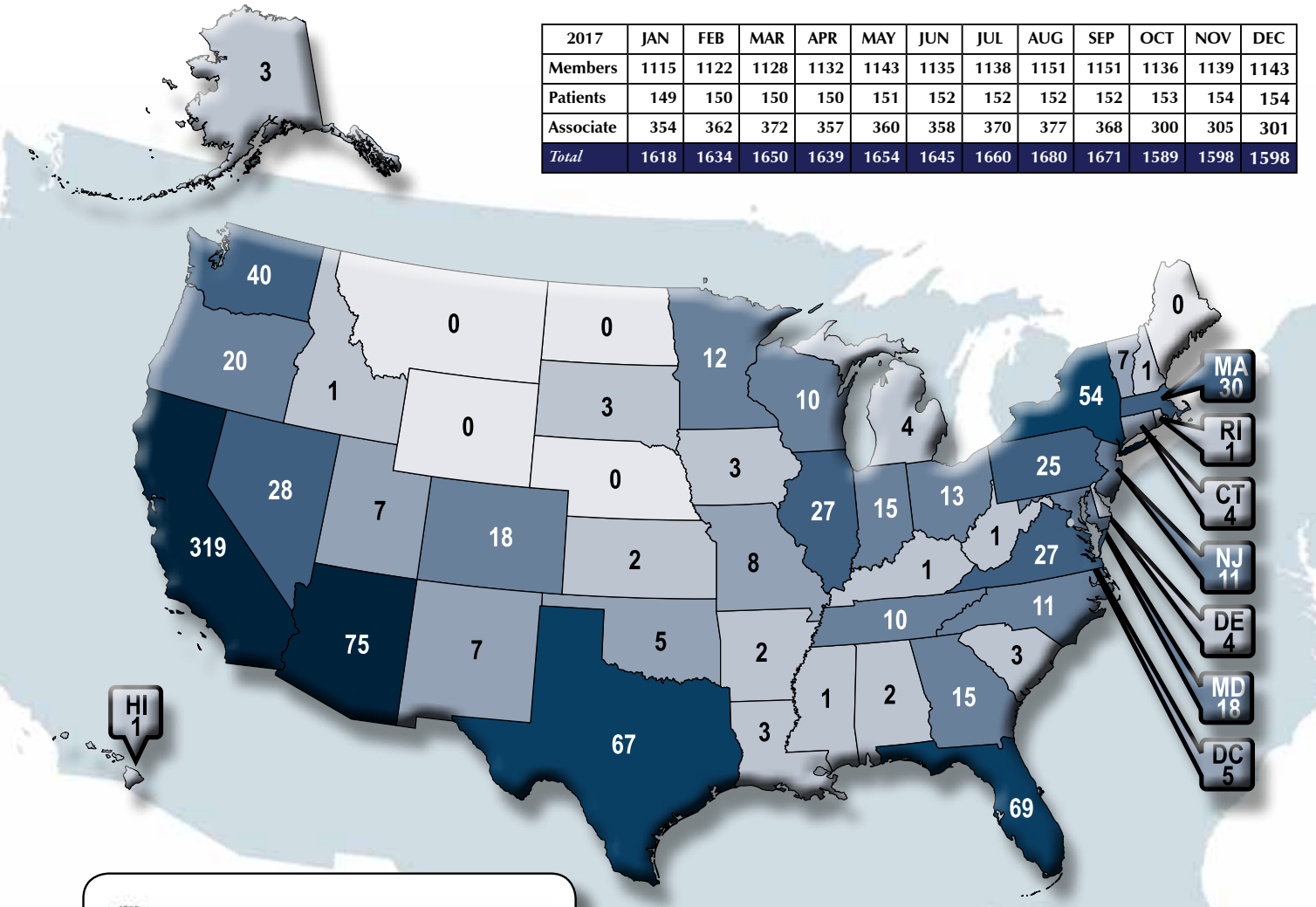
– Aubrey de Grey, Ph.D.
Biomedical Gerontologist and Chief Science Officer of the SENS Research Foundation

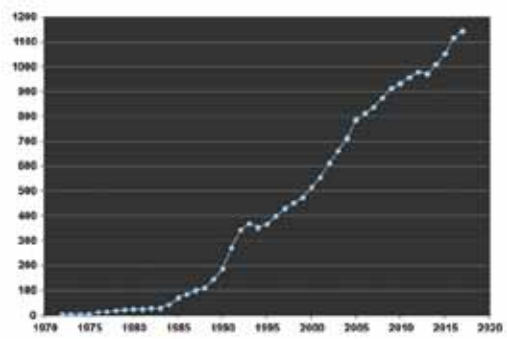
"Alcor appears to be the leading organization in the application of cryonics in medicine. I'm proud to be a part of this effort."

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

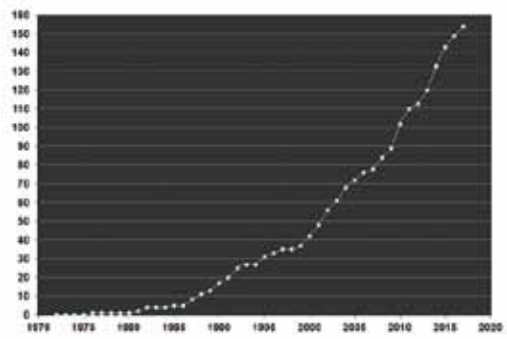
Membership Statistics

2017	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Members	1115	1122	1128	1132	1143	1135	1138	1151	1151	1136	1139	1143
Patients	149	150	150	150	151	152	152	152	152	153	154	154
Associate	354	362	372	357	360	358	370	377	368	300	305	301
Total	1618	1634	1650	1639	1654	1645	1660	1680	1671	1589	1598	1598





Number of Alcor members



Number of Alcor patients

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

International Members & Patients

Country	Members	Patients
Australia	13	3
Brazil	1	0
Canada	54	2
China	0	1
France	0	1
Germany	14	0
Hong Kong	2	0
Israel	1	1
Italy	3	0
Japan	5	0
Luxembourg	1	0
Mexico	4	0
Monaco	1	0
Netherlands	1	0
Norway	1	0
Portugal	5	0
Singapore	1	0
Spain	5	1
Taiwan	1	0
Thailand	5	1
United Kingdom	32	3
TOTAL	150	13

REDUCE YOUR ALCOR DUES WITH THE CMS WAIVER

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

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

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

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

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

Become An Alcor Associate Member!

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

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

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

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

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

VIABILITY VERSUS INFERABILITY:
A PLEA TO CONSIDER AN OPTION OF FIXATIVE-STABILIZED CRYOPRESERVATION

By R. Michael Perry

INTRODUCTION: A NEW AND PROMISING TECHNIQUE MISUNDERSTOOD AND MARGINALIZED

At Alcor's conference in October 2015 an exciting new method of brain preservation was presented by Robert McIntyre of Twenty-First Century Medicine (21CM).[1] The method that McIntyre and his team developed, called aldehyde-stabilized cryopreservation or ASC, differs from conventional cryonics practice in that a chemical fixative is introduced as part of the cryoprotective protocol prior to cooling the specimen down to cryogenic temperature. In this way any decomposition is quickly halted, but the price paid is that cell viability is sacrificed—there is no presently known way to restore the tissue or even individual cells within it, to their usual biological functioning. On the other hand, examination of brain tissue thus preserved shows excellent ultrastructural preservation that closely matches noncryopreserved controls. The results looked good enough that in 2016 the 21CM team won the Small Mammal Prize awarded by the Brain Preservation Foundation (BPF) for their preservation of the ultrastructure in a whole rabbit brain. Indeed, according to the BPF, a decidedly superior preservation was obtained, by appearances, than for more conventionally cryoprotected and preserved tissue that did not have any fixative. Sacrificing viability did not cause any known sacrifice of inferability of identity-critical structure but may even have had the opposite effect of enhancing it.[2]

For the record, at the conference and elsewhere McIntyre cautioned against the idea that ASC, despite its apparent great promise, should immediately be put to use by cryonics organizations. Further research and maybe development was called for, in his view, one difficulty being whether the method preserves memories in the brain, an issue that is complicated by present uncertainties about how memories are stored.[3] The judgment of the BPF regarding the preservation quality of conventionally cryoprotected tissue is also not the last word (more later).

The sacrifice of cell viability, however, has led to the conclusion, which I believe is unwarranted, that ASC, or a similar procedure using fixative and sacrificing viability, would be questionable as a cryopreservation protocol for that very reason.[4] We are assuming here that the eventual goal is the biological revival of a cryonics patient preserved by the method in question. Instead it is suggested that, if a fixative-stabilized cryopreservation or FSC were used to preserve a human patient, an alternative method of revival would have to be used in which the original remains are never restored to a functioning state. Instead information obtained from the remains, enough to provide a complete characterization of the patient's personality, is "uploaded" or input to an advanced computer of the future, and the patient is emulated in a revived form there. It is the best hope, some would argue, for any sort of future life for a patient preserved by FSC and forfeiting viability. And, while some are comfortable with or even highly supportive of the notion of uploading, it is philosophically disturbing to others. A commonly voiced objection is that an emulation of a person in a computer, supposing it could be done, would at best be a copy and not the original person. Many also question whether such an emulation will ever be possible at all, even if revival from well-preserved remains is achieved.[5]

Robert McIntyre presents the ASC technique at Alcor's 2015 conference.

Here I will not be concerned with the merits or demerits of the uploading idea. Instead I will focus on the issue of chemical fixation as a possible impediment to restoring a cryonics patient biologically to a functioning state, essentially keeping their original body intact (or allowing expected replacement of missing parts in cases where full body preservation did not occur). I think that there are good reasons to be confident that fixation would not be an impediment to biological revival. At minimum, we don't have any solid evidence that there would be such an impediment, while at the same time also no guarantee that revival from the usual no-fixation cryopreservation or NFC is possible. FSC can then be compared on a more or less equal footing with NFC. When so compared, I think that FSC offers possible advantages ranging from more rapid stopping of deterioration after arrest (effectively reducing ischemic exposure) to just the apparently better preservation so far observed in the case of ASC. There is also the prospect of extra protection against the possibility, in what may be a long time interval before revival is achieved, of interruption of cryogenic storage or imperfect storage. While we may hope that revival will happen fairly quickly, with patients stored up to that time undisturbed, such an outcome is not guaranteed. Instead a long time, even centuries, could be required, in a future that might have social unrest or severe funding problems leading to failure of one's cryonics organization or its successors. As demonstrated with ASC, FSC tissue should not deteriorate quickly on thawing like its NFC counterpart but could remain stable for extended periods of days or more at above-freezing temperatures.[6] Finally, there is the issue of whether FSC might offer cost advantages over NFC, depending on circumstances.

In the case of ASC, the most successful example to date of FSC, though lead researcher McIntyre cautioned against immediate use in cryonics protocols, the BPF still awarded the prize, against the best results of cryopreservation without fixation (and against other promising-looking work with plastination-fixation).[7] If a choice were to be made for a cryonics preservation between the best current FSC method (ASC) and the best available NFC, which should it be? I will not make a case here that ASC should be chosen (while not denying it either)—to that extent I respect the misgivings expressed by McIntyre. But I will argue that further research with ASC and related FSC should continue at a significant level, so that hopefully soon a suitable FSC will be validated for immediate use in cryonics, for those desiring it. Such research could have other benefits. On one hand, an FSC-like protocol that omits the fixation might still achieve the superior preservation seen in ASC and honored by the BPF (though it would forfeit reduction of ischemic exposure and robustness against thawing). On the other, it is possible that a reversible fixation could be developed so that tissue viability is conserved after all, retaining the usual, expected benefits of fixing, a "best of both possible worlds." At present one hears little of research in ASC or other related protocols; this marginalization needs to change.

I think that there are good reasons to be confident that fixation would not be an impediment to biological revival.

CRYOPRESERVATION WITH CELL VIABILITY

Cryonics has an ambitious goal: to place the recently clinically dead patient "on hold" metabolically so that deteriorative processes are arrested, and keep them in that state until future medicine or other technology can restore them to healthy consciousness. Cryonics patients then are in a state of biostatic preservation or biostasis, where biological processes including decay are held in check, awaiting future methods that will recover them unimpaired and viable. Traditionally the favored method in cryonics of inducing biostasis has involved replacement of the blood and other body fluids with a cryoprotective solution, then cooling the patient to a cryogenic temperature, the temperature of liquid nitrogen (-196°C) or possibly a warmer, still cryogenic temperature, around -140°C, for indefinite storage. (The warmer, "intermediate storage" temperature can be used to greatly reduce or eliminate tissue cracking which otherwise would have to be repaired before the patient could be restored.)

To date no human or other large organism has been restored to functioning from a cryopreserved state, though individual cells, small tissue samples, small multicellular organisms such as *C. elegans*, and organs of larger animals have been.[8] Arguments that patients who are already in cryostasis (cryogenic biostasis) will be restorable in the future depend on anticipating future technology that is more advanced than anything available today. In the optimistic scenario that is generally imagined, it should become possible to manipulate matter at a very fine scale and also at a low, cryogenic temperature, so that any damaged tissue could be repaired and the whole conditioned for a successful rewarming and return to a functioning state. The successes of nanotechnology to date, albeit limited, and the apparent promise of research in fields ranging from molecular biology to artificial intelligence, lend confidence that the necessary progress will occur and the desired restoration will be possible. However, it seems likely that technology considerably advanced beyond present levels will be needed even for the best preserved cases today or likely anytime soon.

There is also a hope that future cryopreservation methods will be gentle enough that a cryopreserved human or specimen can be restored to functioning without having to rely on advanced future repair technology. For this reason much research has focused on improving existing protocols for cryopreservation. The goal is to develop a protocol that fully conserves *viability*: the cryopreserved specimen or organism must still be demonstrably alive. Existing procedures should be applicable to restore a level of activity that would be considered "living" by current criteria. This would constitute a demonstration of *reversible, suspended animation*. Such a demonstration would not necessarily restore the organism to perfect functioning, but would lend confidence that an unproblematic restoration should be possible with future refinements of the basic technique.

A demonstration of reversible, suspended animation, even if imperfect, could have revolutionary impact in society at large. Today many undergo clinical death under conditions that would permit at least brief resuscitation—it is not done because it is agreed that probably more harm than

good would result. The patient would soon arrest again and, if further attempts at resuscitation were made, quickly reach a point of no return while also risking additional suffering with little in the way of quality life. But with a provably reversible biostasis procedure the patient could be put on indefinite hold, to await the powers of future medicine with confidence. Clinical death by today's often-used criteria would no longer be "death" and many things, legal, social, and political, would be forced to change. Cryonics should be seen in a much more favorable light, with widespread acceptance by the mainstream, and many lives saved that would have been lost.

That inferability rather than viability is the important criterion for effective biostatic preservation is implied by the information-theoretic criterion of death that is generally accepted in cryonics."

Clearly pursuit of viability in cryonics protocols is a worthwhile research goal, and one can hope it will be pursued with vigor and dedication, as indeed it has been up to now, and that efforts will be crowned with success in the not-too-distant future. Partial viability has already been achieved, as we noted, with individual cells, small tissue samples, organs, and organisms. That said, I am going to argue in the rest of this article that emphasis on viability is not the only approach to biostatic preservation that ought to be seriously pursued right now. There is another criterion besides viability that is also important in cryonics, arguably even *much more important* than viability: what I will call *inferability*.

AIMING FOR INFERABILITY RATHER THAN VIABILITY

We want to get the patient back, restored to a functioning, healthy state. To accomplish this it is not necessary that their cryopreserved tissues be "viable" by some present-day criterion, allowing restoration by simple rewarming, or, at any rate, passing some other metabolic or other test now considered validating. Instead (at least, I think, most in the cryonics community would agree), what is necessary is that it be possible in the future to *infer* what the healthy state of the patient was from the remains that were preserved. We must be able to tell what ought to be there from what still is there. Particularly this is true when it comes to information in the brain that encodes memories and other elements that the patient might consider important in defining who they are. This is a necessary criterion and the generally accepted view in cryonics (with some exceptions) is that it ought to be sufficient as well, given the future prospects of nanotechnology and other anticipated advances. (As for exceptions: an objection will be raised, in the minds of some, in a case where there is enough information to adequately approximate the original but little or nothing in the way of actual physical remains is still preserved, or what does remain is so badly damaged that very extensive restructuring would be necessary. The reconstructed individual may be similar to the original but, at best, "just a copy." This might especially occur in a case where only a cell sample was preserved, accompanied by a very extensive "mindfile" that well characterized the original personality, supposing of course that such an adequate characterization is possible. Here, however, we shall assume that enough of the physical remains survive in reasonably good shape—which might include good fixation of the tissue—that absence of the original material does not become an issue.)

That inferability rather than viability is the important criterion for effective biostatic preservation is implied by the information-theoretic criterion of death that is generally accepted in cryonics. A patient who has arrested isn't really dead, so long as there is enough identity-critical structure remaining in the brain and/or elsewhere to infer what the healthy, conscious functioning of that person would be. Advanced repair technology of the future could then be brought to bear to make the necessary inferences and restore the patient to healthy functioning.

The restoration of the patient overall might involve three distinct stages. First would be inference from the preserved remains of what ought to be there. Second would be refurbishing the remains at low temperature to produce a restored, intact body including the brain, which also is in a suitable condition for rewarming. This would involve reversing any effects of the cryopreservation process such as tissue fixation or a problematic presence of cryoprotective agents, eliminating any diseases and ravages of aging, and restoring missing parts in cases such as neuropreservation. (Of course, doing these things might seem impossible even in principle to many today, but is not precluded by physics or chemistry as far as we know.) Last would be the rewarming itself, after which the patient could awaken to a new life. There might be many variations of the three basic steps that would be found especially suitable, or some other approach entirely.

An alternative approach to revival of the patient is the uploading scenario we considered above, which, we noted, is not the focus here. In any case, a preservative protocol that aims at inferability only is not necessarily pointed toward uploading (nor must one that tries for viability be geared against it). Once we accept this, we also have to confess our ignorance. There are important things we don't really know at this stage about current or possible protocols, whatever our focus. This state of ignorance, though, is not in itself a reason to discourage work on one or the other approach, that is to say, to try for optimum viability on one hand, or, on the other, better inferability independently of viability. Both instead are research areas that ought to be pursued.

ALDEHYDE-STABILIZED CRYOPRESERVATION (ASC)

ASC is a technique developed in 2015 by Robert MacIntyre, in collaboration with Greg Fahy, both of 21st Century Medicine. Later McIntyre founded his own company, Nectome, to further his work with ASC or more general FSC. Quoting from his "Introduction to Aldehyde-Stabilized Cryopreservation":

> "ASC consists of multiple steps which lock the brain's molecules into place and prevent them from decaying over time. First, ASC uses glutaraldehyde to almost instantly stabilize the brain against natural decay processes. By itself,

> glutaraldehyde is able to stop decay for at least several weeks, but we need more powerful stabilization to resist decay for centuries. In the second step, we use ethylene glycol to make it impossible for dangerous ice crystals to form in the brain no matter how cold it becomes. Then the brain can be safely cooled to -135°C (a temperature colder than anything which naturally occurs on Earth!) for long term storage. At -135°C, the molecules in the brain stop moving, forming a solid, "glassy" structure in a process called vitrification. Vitrification stops all decay processes and allows the brain to be stored for centuries with no degradation."[9]

Aldehyde fixation (typically using formaldehyde or glutaraldehyde), and chemical fixation more generally, are used in laboratory work to preserve tissue or cell samples indefinitely for study. Decay processes are halted but the tissue is no longer viable by current criteria, not even at the level of individual cells. "One reason [for fixation] is to kill the tissue so that postmortem decay (autolysis and putrefaction) is prevented."[10] A good fixation, however, will preserve the fine details of cell structure so that, arguably, it should be possible to infer the necessary structural details in fixed brain tissue to determine what identity-critical details were originally present. With future methods, then, restoration of the tissue to its original function could occur as outlined above. The inferability criterion will have been met though not the viability criterion.

Both viability and inferability are not binary, on-off properties but will inevitably occur in "shades of gray." Of course, one great unknown is how well such a method as ASC would actually meet the inferability criterion, yet the same question can be raised concerning an NFC alternative. Thus for instance, we cannot assume, unequivocally, that "viability must imply inferability." Viability is much easier to test for and assess than inferability. (An attempt nevertheless to accomplish the latter is BPF's definition and assessment of the "connectome" in the preserved brain—more below.) If we could depend on viability as a sure-fire predictor of inferability, then research might rightly place almost exclusive emphasis on non-fixative approaches, as indeed has occurred up to now (ASC being an exception).[11]

That viability might *not* be an infallible predictor, though, follows by considering a typical cryoprotection protocol in which several hours can elapse while the patient is at above-freezing temperature. Many or most cells might still be viable after this treatment but that is not a guarantee that no serious damage occurred. Depending on the damage (ischemic damage), the patient could come back, say, with major amnesia. Though the cells remained largely viable, many of us would say that "we" didn't survive, but only someone potentially similar who more or less has to start all over in life, like an infant twin. (There might be possible fixes with mindfile information and the like, stored outside the brain, but we want to avoid having to resort to such if possible.) An early intervention with fixative might substantially reduce this ischemic insult, greatly improving inferability but at the expense of viability. Yet in a reasonable sense the patient will survive with this scenario, sacrificing viability but conserving inferability, while with the alternative of conserving viability but the unavoidable sacrifice of inferability, they would not. This is an important point to ponder. It does not necessarily follow that conserving viability is the best course to follow in biostatic preservation where revival of the patient is a goal.

Perhaps this is not a significant issue when cryoprotection is performed under good conditions. Many cryopreservations are done under much less than ideal circumstances, however, and fixation has sometimes been used as a preliminary, as with a "salvage job" in which some sizable interval of time elapses before the brain of the patient can be cryopreserved.[12] The question could also be raised whether *some* fixation as a curb on ischemic injury would be advisable even under the best of circumstances. What about reversible fixation—is there any possibility of this, and how would it compare with methods that are presently irreversible? Research could shed some much-needed light on these issues.

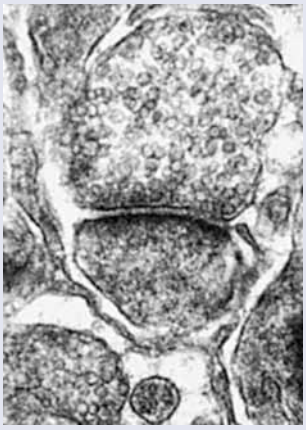
HISTORICAL PERSPECTIVES: CRYONICS AND BIOPRESERVATION IN THE PAST

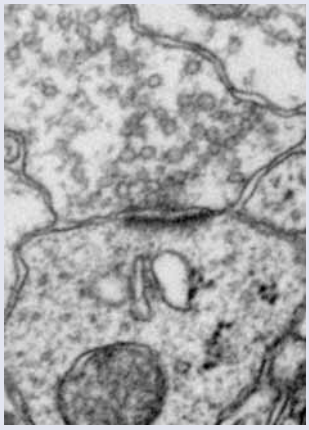
Fixation *kills*—says conventional wisdom (see quote above). On the other hand, the goal of cryonics is to place the dying patient's metabolism "on hold" so that they can journey to the future and be rescued by more advanced methods than we have today. In effect, you are keeping them alive—if metabolically inactive—for eventual rescue. It was natural then that when cryonics was starting up in the 1960s, Robert Ettinger and other pioneers would focus on cryopreservation rather than fixation. Some evidence existed that lent support to the idea that indeed cryopreservation could keep the patient alive. Rats and hamsters had been partly frozen and revived, and fully cryopreserved cell samples had been restored to functioning by simple rewarming.[13]

More was coming. In 1965 Isamu Suda and colleagues at Kobe University in Japan announced results excitedly reported in *Freeze-Wait-Reanimate* (FWR), the newsletter of Evan Cooper's pioneering, cryonics-promoting Life Extension Society (LES). In the Suda experiments anesthetized cat brains which had been cryoprotected with a glycerol solution, then chilled to -20°C and stored for over six months, showed recognizable brain waves on rewarming. A summary of the work appeared in the major science journal *Nature* the following year, and there would be follow-up studies several years later in which recovery of some level of brain activity was reported after as much as seven years of subfreezing storage.[14]

Dr. Suda's work is noted in cryonics publication from 1970.

The Suda results started to appear just before there were any cryonics patients, and there was much initial jubilation. The demonstration of viability signaled to many in the fledgling movement that





Brain ultrastructure illustrating different preservation methods. Left: rabbit brain synaptic cleft, vesicles and other structures preserved by vitrification (cryopreservation with cryoprotectant but no fixative). Right: mouse brain with similar structures preserved by room temperature chemical fixation. (Source: from material used in MP3 below; left is from 21st Century Medicine, right from Narayanan Kasthuri and Ken Hayworth, both 2007; further details in MP3).

this approach was the right one. Cryonics meanwhile garnered some scientific critics, and there were exchanges between the two groups, particularly in the pages of FWR. The idea was broached by one of the critics, cryobiologist Armand Karow, Jr., of using fixation or "pickling" as an alternative to cryopreservation. This was vetoed in light of the Suda results.[15] "Fixation killeth, but cryopreservation giveth life,"[16] was the lesson of the day. But was this the best judgment all around? Fixation already was in wide laboratory use, where it proved adequate in capturing structure down to the finest levels microscopically observable (including with the electron microscope),[17] and was inexpensive.

Cryonics by comparison was expensive and uncertain. Ev Cooper's own organization, LES, never did any cryopreservations despite his heroic efforts to create a laboratory and storage center. Discouraged, Cooper instead left the movement and eventually was lost at sea.[18] Other early organizations which did do cryopreservations eventually failed with loss of nearly all their patients. (Of approximately 17 patients who were cryopreserved prior to 1974, only James Bedford remains preserved today, now at Alcor.) Later cryonics organizations were less charitable and more demanding of up-front payments before launching a cryopreservation and have fared better, with most of their patients still preserved. But the price paid was that relatively few have been preserved, surely in no small part because of the cost.[19]

In the decades since the 1970s a few voices have been raised concerning the possibility of chemical preservation as an alternative to cryopreservation. One was K. Eric Drexler, whose 1986 book *Engines of Creation* was an important milestone in making the case for the credibility of cryonics. Cryopreserved patients, Drexler argued, might be restored to functioning through tiny devices operating at the atomic and molecular scale (nanotechnology). But not just the cryopreserved. Chemical preservation also offered basically similar possibilities since it too preserved the fine-scale structure that molecular machines could manipulate and maybe, finally restore functioning.[20]

Shortly afterward, in 1988, Charles Olson made the case for chemical brain preservation as "a possible cure for death," in a paper that appeared in the journal *Medical Hypotheses*.[21] Some possible advantages of the chemical alternative are noted:

> "The molecules in a chemopreserved brain have been extensively crosslinked and can be embedded in a plastic which was designed for electron microscopy. Consequently they will be resistant to the heat and damage generated by whatever beam of particles (or other investigative device) is used to determine the details of the internal structure. In contrast, a frozen brain is not particularly prepared to resist damage, and is acutely sensitive to any heat generated. This problem of information extraction applies to any proposed repair of the cryopreserved brain as well—repairs can be made only after the relevant details of the structure are known. Of course, these technical problems may eventually be overcome; one should hesitate before placing limits upon the technology of the limitless future."

It should also be remarked that, while a chemopreserved brain "can be embedded in a plastic" such a plastination technique, that would reliably capture ultrastructural details throughout the brain and be suitable for the sort of procedure sketched above, has yet to be perfected. Shawn Mikula's progress with mouse brains notwithstanding (see below), much more will be needed if humans are to benefit. Some additional advantages of chemopreservation noted by Olson relate to cost and convenience:

> "First of all, it is far less expensive: whereas cryopreservation requires long-term liquid nitrogen storage, chemopreservation is a one-time expense. A chemopreserved brain, embedded in a block of plastic, is inherently resistant to damage, and it can be easily stored nearly anywhere with additional forms of protection if desired. In contrast, a cryopreserved brain is at risk of thawing, and any additional protection must be done in conjunction with the liquid nitrogen storage. Finally, a form of chemopreservation of the brains of the recently deceased (i.e., funereal embalming) is already highly developed and widely practiced today, albeit for quite a different purpose. Indeed, the cost of brain chemopreservation could be less than that of a typical funeral. For these reasons, chemopreservation may succeed in the marketplace where cryopreservation has thus far had only limited success."

Again, the plastic embedding process that would optimize long-term preservation has yet to be perfected. There is an additional

difficulty with any high-temperature (noncryogenic) tissue storage: any areas not perfused with fixative, as might occur, for example, with arterial blockage, are at risk of decay, particularly with room-temperature storage. This would have to be addressed but work should proceed in trying to address it.

The idea was broached by one of the critics, cryobiologist Armand Karow, Jr., of using fixation or "pickling" as an alternative to cryopreservation.

Olson's work is now three decades old. During this long interval others have occasionally been heard from, including this author (2007), Greg Jordan (2008), and Michael Cerullo (2015), advocating consideration of chemopreservation as a possible means of rescue from death.[22] Such usage might have flourished, as Olson speculated, yet it didn't. The funeral industry uses it as much as ever. But if you are trying for more, to eventually recover the patient, chemopreservation is only, at best, a minor accompaniment to cryopreservation, which itself, on the scale of the world's population, is marginalized almost to the vanishing point. (Worth noting here is that one organization, Oregon Cryonics, offers chemical brain fixation as a low-cost alternative to cryopreservation, though presently their operation is very limited.[23])

Had the "pickling" option not been shouted down with such force early on, and almost ignored later, perhaps many more would have been preserved, and would still be preserved today. Whether this would have been adequate for eventual revival is, I would say, highly dependent on the details of the procedure used, the storage afterward, and/or other circumstances. (The same can be said about those few who actually were preserved by cryogenic, non-fixation means.) But I think many of us would agree that it would have been better (I would say far better) than what actually did happen in which the few early patients who were preserved were mostly lost in the end. And perhaps the chemical preservative process would have been teamed up with cryopreservation to produce a technique superior to both, with better inferability and ability to weather bouts of thawing and refreezing in times of crisis. Such a technique, among other advantages, would be more adaptable to lower-cost brain-only preservation inasmuch as fixed brain tissue is much tougher and easier to handle without serious injury than its unfixed counterpart.

BPF AND THE CONNECTOME

We noted that the team that developed the ASC procedure won the Small Mammal Prize of the Brain Preservation Foundation (BPF). The BPF, headed by Dr. Kenneth Hayworth, is focused on preserving the brain's "connectome," as described at their website:[24]

> "A connectome is the complete map of the neural connections in a brain. It is sometimes referred to as a 'wiring diagram' of the molecular connections between neurons, trading on the analogy of a brain to an electronic device, where axons and dendrites are wires and neuron bodies are components. Depending on the scientist, the term connectome may or may not also include learning-relevant molecular states at each synaptic connection (the 'synaptome') and any learning-relevant changes in the nucleus of each neuron (the 'epigenome'). At the level of whole brains, there can be fly connectomes, mouse connectomes, human connectomes, whale connectomes, and so on. We can also speak of connectomes of specific brain subsystems, such as hippocampal connectomes, thalamic connectomes, and cortical connectomes."

There is some confusion above in just what *connectome* should mean. Here, focusing on the whole brain rather than parts, we use *lesser connectome* to denote just the wiring diagram of the brain's axons, dendrites and neural bodies, while *greater connectome* includes also the synaptome and the epigenome. To date only the lesser connectome of one organism has been fully mapped. This is the small, slender roundworm *Caenorhabditis elegans*, about 1.3 mm long and .08mm thick[25] (about the size and shape of a tiny but visible stub of human hair). The *C. elegans* brain has about 300 neurons, compared to roughly 100 billion (10^{11}) for a human. *C. elegans* also has about 7,000 synaptic connections versus about 700 trillion (7×10^{14}) for a human. "Construction of the *C. elegans* [lesser] connectome took a dozen years of tedious scientific manpower; every neuron was individually identified, its precise location determined, and its projections to other neurons traced and catalogued." As for completing the lesser connectome to obtain the greater connectome, we still lack any comprehensive map of the *C. elegans* synaptome or epigenome or "full knowledge of what these maps should contain."

A human brain is roughly 100 billion times as complex in its connectivity as that of a *C. elegans*. Currently recording a complete human greater or even lesser connectome is far out of reach. There aren't enough electron microscopes (EMs), and there aren't enough scientists to painstakingly interpret all the EM images it would take. Hopes for eventually being able to map an entire, greater human connectome, rest on the prospects of future technology. Great improvements in automation could bypass the need for vast armies of scientists, greatly reducing the time and doubtless error in the bargain, and would be assisted by very many small, inexpensive EMs which could operate massively in parallel.

The hope eventually is to capture human identity in a recoverable form. "As neuroscience continues to advance, BPF will do our best to help science to determine whether reliable and affordable protocols can be found to preserve those brain structures that give rise to our memories and identities, according to our best evidence to date." So far the work has built on the idea of deriving connectome data through a destructive process: slicing the fixative-preserved brain (original material) into ultrathin sections and examining the ultrastructure microscopically, after which the original material may be discarded. If the whole brain is processed in this way the connectome could be recorded, part by part, and eventually the record could be uploaded so the original personality could emerge (for those who accept the uploading idea).

Extracting brain information through essentially a destructive process is not the only scenario imagined for restoring the patient, however. The alternative of biological revival using original material is given its due: "We could also revive people by restoring biological function. This may or may not be feasible depending on the exact way in which the brain is preserved."[26] However, a point I've tried to make is that, *if uploading the patient in copy form is feasible by a destructive method of extracting brain information, biological revival of substantially the original material should also be feasible, given mature nanotechnology*. One reason to have confidence in the revival scenario is that, in fixation, little of the original material is either lost, replaced, or moved far from its original surroundings. (At least this seems to follow from the fact that, for example, glutaraldehyde or formaldehyde molecules bind to surrounding molecules in the tissue but do not either strongly disrupt or replace most of these other molecules.) So if the brain is well enough preserved for the uploading scenario it is likely well-enough preserved for the revival scenario.

THE BPF PRIZE: WINNING AND LOSING

Overall, cryonicists should be grateful for the BPF, despite some stated objections to the current practice of cryonics which can be found at the website (more later). Quoting from the mission statement:

> "The central objective of the Brain Preservation Foundation is to promote scientific research and services development in the field of whole brain preservation for long-term static storage. Through outreach to appropriate scientific communities, online activities, presentations and articles, directed research grants, challenge prizes, and other methods, we seek to explore the scientific hypothesis of whether a reliable surgical procedure exists that is capable of preserving the neural circuitry of the human brain at nanometer scale."[27]

In 2015 the BPF announced a prize competition, in two stages, with the goal of rigorously demonstrating "a surgical technique capable of inexpensively and completely preserving an entire human brain for long-term (>100 years) storage …." The preservation should have "such fidelity that the structure of every neuronal process and every synaptic connection remains intact and traceable using today's electron microscopic (EM) imaging techniques." This is not to say that actual human brain preservation would figure in the competition but only that a technique would be demonstrated that is capable of accomplishing it, according to the BPF's rather stringent standards.

There is an additional difficulty with any high-temperature (noncryogenic) tissue storage: any areas not perfused with fixative, as might occur, for example, with arterial blockage, are at risk of decay, particularly with room-temperature storage.

The two stages of the competition are to demonstrate adequate preservation of (1) a small mammalian brain (Small Mammal Prize), and (2) a larger mammalian brain (Large Mammal Prize).[28] In early 2016 the Small Mammal Prize totaling $26,735 was awarded to Robert McIntyre's group at 21CM for their work preserving a rabbit brain using their technique of ASC. There were two other competitors: (1) Shawn Mikula at the Winfred Denk lab of the Max Planck Institute in Germany focused on whole mouse brain plastination and room-temperature storage. (2) Another rabbit brain entry from 21CM used a more conventional cryonics approach, with cryoprotection and cryogenic cooling (vitrification) but no chemical fixation.[29] (The Large Mammal Prize, which would use the brain of a pig or comparably sized or larger mammalian brain, has not been awarded as of writing.)

BPF was generous in praising the winning entry:

> "The Small Mammal Brain Preservation Prize has officially been won by researchers at 21st Century Medicine. Using a combination of ultrafast chemical fixation and cryogenic storage, it is the first demonstration that near perfect, long-term structural preservation of an intact mammalian brain is achievable. …This result directly answers what has been a main scientific criticism against cryonics, and sets the stage for renewed interest, research, and debate within the mainstream scientific and medical communities. … The key breakthrough was the quick perfusion of a deadly chemical fixative (glutaraldehyde) through the brain's vascular system, rapidly stopping metabolic decay and fixing proteins in place by covalent crosslinks. This stabilized the tissue and, along with other chemicals, enabled cryoprotectants to be perfused at an optimal temperature and rate for the prevention of brain shrinkage. The result was an intact rabbit brain uniformly filled with such a high concentration of cryoprotectants that it could be vitrified solid and stored at -135 degrees Celsius. Electron microscope images from across the rabbit brain showed beautifully preserved neural circuits which look identical to fixation-only control brains."

It was noted that the Mikula results (whole mouse brain plastination) "also came extremely close to meeting the prize requirement." A less positive assessment, however, was given of the results obtained by cryopreservation without fixation (trying for viability):[30]

> "How well does 21CM's 'straight' cryopreservation technique preserve the brain? Is the brain preserved well enough to meet the requirements of the Brain Preservation Prize? Unfortunately the answers to these questions are a bit complicated. 21CM's cryopreservation protocol is designed to prevent all ice crystal formation in the brain even as the brain's temperature is slowly lowered to below -130

degrees C. To accomplish this they must remove most of the water from the brain (both inside and outside cells) and replace it with a highly concentrated CPA solution called M22. They claim that for technical reasons (having to do with, among other things, the blood brain barrier and increased viscosity of CPA at low temperatures) the ramp up in perfused CPA concentration cannot be delivered in a way that avoids osmotic shrinkage of the brain. In fact the protocol calls for the brain to be shrunken in size by approximately 50%! And 21CM has so far been unable to reverse this shrinkage effect prior to preparing and staining brain slices for electron microscopic evaluation. As a result it has been impossible so far to adequately assess how well the connectome is preserved. 21CM believes that the connectome is preserved but in a shrunken, compressed form. We at the BPF must remain skeptical since even if such dramatic shrinkage did not itself cause damage, it could certainly be hiding damage coming from other parts of the process."

Note that the BPF is not claiming that the desired brain ultrastructure (the connectome) is *not* preserved by the "straight," no-fixation protocol. But if it is, it was impossible to verify, unlike the case with the ASC method (and also the plastination method of Mikula). It is also worth noting that a more positive assessment is given for results obtained with small brain samples. "In stark contrast to the above whole brain results, similar cryoprotectant formulas and protocols applied to half millimeter thick slices of living brain have shown good ultrastructure preservation and amazingly good recovery of function after rewarming from weeks of -130 degrees C storage." But for the whole brain (of a rabbit, in this case, and all the more so for the much larger human brain) there is at least reason to be concerned. The quality of preservation of the method which favors structural preservation (inferability) appears to be superior to that which emphasizes viability.

DIRECTIONS FOR FUTURE RESEARCH

It goes without saying that more examination and testing of tissues preserved under current, NFS cryonics protocols is called for. It may indeed be true that the connectome is well-preserved by the criteria of the BPF but it needs to be demonstrated. (As I write this I understand that some interesting results of such testing are soon to be made public.) Even if fears of the inadequacy of such preservation were to be allayed, however, it still would not obviate the possible usefulness of an FSC protocol, for the other reasons we've considered.

Had the "pickling" option not been shouted down with such force early on, and almost ignored later, perhaps many more would have been preserved, and would still be preserved today.

At the 2015 Alcor Conference presentation on ASC Robert McIntyre noted that, despite the generally excellent preservation of the rabbit brain as revealed by electron microscopy, there were some signs that all was not perfect. Concerns centered on the action of the fixative glutaraldehyde in crosslinking the molecules defining the brain structure. Presently this crosslinking cannot be reversed, so future major advances such as mature nanotechnology may well be required, with the usual uncertainties as to whether and how this will be accomplished. The cross-linking, moreover, causes specific changes which raise concerns, including denaturing of proteins, washing away of small molecules such as neurotransmitters, and fraying of the myelin sheaths that enclose nerve fibers. Whether these changes are serious enough to put a hold for now on this sort of preservation, considering the possible downsides of NFC, and what might be done to reduce or eliminate them, are topics to investigate.[31]

Another topic of interest is the attempt to achieve an adequate brain preservation where the brain would be stored at room temperature, eliminating the need altogether for ultracold storage and greatly reducing both the cost and complexity of long-term storage over present cryonics practice. We have noted how Shaun Mikula's group at Max Planck Institute in Germany achieved good preservation of a mouse brain, as judged by the BPF, through a plastination technique. The fixed and dehydrated brain is embedded in a permeating, hardening plastic resin, and can then remain indefinitely at room temperature. Dr. Mikula's protocol is based on a standard procedure for preserving tissue for laboratory analysis. An important part is to preserve and stain the lipid membrane of cells, for which a mixture of osmium tetroxide and potassium ferrocyanide is used. This, however, is prone to precipitation and barrier formation within cells, which limits high-quality ultrastructure preservation and staining to a depth of only a few tenths of a millimeter, far inadequate even for a mouse brain. Dr. Mikula overcame this limitation by adding formamide to the mixture. Barrier formation was eliminated and an entire mouse brain could be uniformly perfused. Some problems still occurred: tissue cracking with one specimen, nonuniform perfusion with another, and the prize was awarded for the ASC work instead. Still, the research looks promising.[32]

Yet, there are other problems with Mikula's plastination technique, such as the high cost and toxicity of the crucial fixative ingredient, osmium tetroxide. It appears also that very long permeation times, stretching to months or years, would be needed to scale up the preservation to a human brain. An alternative might be to develop an ASC technique that, while not safe indefinitely at room temperature, could be trusted to be stable at -20°C, the temperature of an inexpensive food freezer that uses a modest amount of house current per year. Or perhaps there is a method of plastination that would avoid the use of a problematic ingredient like osmium tetroxide and also not require so much permeation time. Here I am not proposing answers to these issues but only suggesting that research should move forward along several different lines.

GO OR NO GO: PATERNALISM VERSUS THE RIGHT TO CHOOSE

In the early days of cryonics, a commonly

voiced objection, particularly noted among scientists, was that it should not be applied until the process is perfected.[33] Others disagreed, some of them also with scientific backgrounds and supporting, scientific arguments, though these were a minority. The scientific mainstream never endorsed cryonics but the practice persisted, in part because of the tradition in the U.S., where cryonics got its start and still has its largest following, of respecting the right of personal choice, particularly in matters of life and death.

The cross-linking, moreover, causes specific changes which raise concerns, including denaturing of proteins, washing away of small molecules such as neurotransmitters, and fraying of the myelin sheaths that enclose nerve fibers.

Carried to a logical conclusion, the right of personal choice should mean that I can do whatever I want so long as the corresponding rights of others are respected. So for instance I might take substances that I thought might extend my life or enhance my well-being, based on my own judgment, or might arrange for a premortem cryopreservation in case I was diagnosed with early-stage Alzheimer's disease. Today the right of personal choice is limited, both in the U.S. and elsewhere, and many of us think it should extend farther, but clearly such an outcome will take time.

On the cryonics front, there has been recent criticism, notably by Kenneth Hayworth of BPF, that somewhat echoes the opposition of half a century ago, to the effect that current methods are "unproven" and need more work before being offered to the public.[34] (So if meanwhile someone arrests do we just give up on them? And what about those already cryopreserved? Do we give up on them too?) Presumably this means that those wanting cryonics would be denied their wish, much as new medical procedures are kept away from potential users until they are fully authenticated by testing and endorsed by the scientific and medical establishments.

In the case of Hayworth, people ask whether, given the success of the ASC procedure which won the prize for its excellence, cryonics organizations should start offering the procdure to their members. His personal answer (speaking for himself, not on behalf of the BPF) "has been a steadfast NO." His reasoning is that these same organizations have been offering for years a procedure "that was not able to demonstrate, to even my minimal expectations, preservation of the brain's neural circuitry. This result, I must say, surprised and disappointed me personally, leading me to give up my membership in one such organization and to become extremely skeptical of all since." The ASC technique was tested under "ideal laboratory conditions" and he asks: "Should we really expect that these same organizations can now be trusted to further develop and properly implement such a new, independently-invented technique for use under non-ideal conditions?"

Ah yes, but these same organizations did not have a Ken Hayworth method to do the testing he was able to carry out. Are they "irresponsible" just because they went ahead anyway, given that the alternative was just to give up and lose the patient altogether? And what about the Hayworth method anyway? Is it true that unless this one method can show, today, that the neural circuitry is preserved it is not preserved in any form and will never be inferable by any technology of the future? Some light would be shed by further testing of the non-fixative protocol that failed the Hayworth test—results of such testing could be forthcoming soon as we've noted.

For now, Hayworth does not advocate the immediate use of the ACS method either, despite its apparent excellence: "If this was a new drug for cancer therapy, or a new type of heart surgery, many additional steps would be expected before even clinical trials could start. Why should our expectations be any lower for this?" Well, because the patient is lost unless you do something, and, most importantly, *this is what many of us want to be done, when it's our turn, rather than passively submitting to the Reaper.* It is our choice. Should we have the right to choose, given we are not imposing our choice on anybody else? The same issue could be raised, of course, with any type of possible therapeutic treatment, particularly in the case of a condition that is terminal. Should the patient who faces certain death otherwise have the right to choose, even if the proposed treatment has not gone through all the usual steps of verification and refinement and been approved for clinical use by a government agency? Many of us feel very much that they should, at least under broad conditions that are far from generally met today, and the controversy with others who do not goes on.

Robert McIntyre, for his part, also does not think the ASC method should be used immediately (though he does not level criticism like Hayworth does against existing cryonics organizations). Instead, more or less agreeing here with Hayworth, he feels it should be further tested, validated, et cetera. He says: "Developing human brain preservation is a worthy and important goal, which is why I started Nectome in order to pursue it. But rushing to preserve people with ASC right now without a fully vetted technique would be recklessly premature."[35]

Certainly there is nothing wrong with testing, refining, and vetting your technique. *It should be done*, just as Hayworth and McIntyre insist. *Let it be done!* However, *doing it will take time*. So let it be done *concurrently* with current cryonics practice. Techniques which *very clearly might be superior* but still haven't been as exhaustively vindicated as we would like could be offered on an elective basis. Unavoidably, at some point the cryonics organization is going to have to make what, in its judgment, is the best choice to make given that just giving up on the patient is not an option. This is in contrast to postponing all its activity until some point in the future when it's clear that all the scientific and medical obstacles have been overcome and the practice, were it to start up at that point, would no longer be controversial. By that time we could all be dead, and some of us will have our time of need, very likely, long before that. Existing cryonics organizations should, of course, use the best-appearing methods currently available, as far as they are able (funding may sometimes be a limitation), and should update these methods according to reliable, ongoing research and testing.

So far, a method of preservation not using fixation has been judged by BPF to be wanting and inferior to two that do

use fixation. Whether this is actually the case remains to be decided. But even if the verdict is to vindicate the non-fixation approach, it will not demonstrate the superiority of that approach in all respects to one which incorporates fixation as part of the protocol. To summarize, we noted that fixation could reduce the ischemic insult to the patient prior to deep cooling, and could also provide a safety net against (at least temporary) interruption of cryogenic storage, particularly if revival must be long postponed. We have to allow, also, that fixation could induce significant damage that would not happen in its absence. But so far there is no strong indication that memory-bearing structure or other identity-critical elements would be seriously affected by, for example, a procedure such as ASC.

For these reasons I am in favor of quickly implementing a hybrid technique for brain preservation that combines chemical fixation with cryoprotection and long-term, cryogenic storage. Such a procedure should only be elective, of course—a non-fixative alternative would still be available as before. Members could choose which they preferred, much as today with whole body versus neuropreservation. And research meanwhile could press forward to further validate and refine, or substitute, the methods to be used. I mentioned some possible options such as a lower-cost alternative that might use conventional rather than cryogenic freezing, and such possibilities could be investigated also. In any case, it is better to act than remain inactive on such important issues as these. ■

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Suspended Animation

Suspended Animation (SA) was established in 2002 in South Florida. And in 2014, opened a California office as a for-profit corporation with the goal of providing the best possible standby, stabilization, and transportation procedures for members of cryonics organizations. In September 2016, SA became certified as an ISO 9001:2015 compliant organization, indicating SA adheres to the International Standards of Organization quality management system.

The founders of SA believed that if the company did not seek members or provide patient storage, it would be better able to focus on research and development work. Also, when Suspended Animation assisted other organizations instead of attempting to compete with them, cryonics generally would benefit.

SA develops new equipment, techniques, and technologies to minimize the cellular injury that normally occur after legal death. SA is a company devoted to research and development of advanced technologies to improve human cryopreservation. We apply our procedures to clients who have made separate arrangements for long-term cryopreservation with cryonics organizations. Currently, Suspended Animation provides standby stabilization, initial cooling, and transport services to the Alcor Life Extension Foundation, the Cryonics Institute, and the American Cryonics Society. SA is able to deploy for up to three cases at any given time within the continental United States.

Our research projects include a portable liquid ventilation system to enhance rapid cooling in the field, custom modification of advanced rescue and transport vehicles, and equipment to enable low-temperature human vitrification. By intervening as rapidly as possible after cardiac arrest, we aim to reduce the need for cellular repair when future scientists attempt to revive patients who have been cryopreserved. Besides the portable liquid ventilation system the following types of equipment acquired or developed by SA are medical-grade Sorin Centrifugal Pump Console (SCPC), several types of Portable Ice Baths (PIB), the AutoPulse cardiopulmonary support system, a mobile operating vehicle specially modified for cryonics, and an auxiliary support vehicle.

To fulfill its mission to develop and deliver state-of-the-art standby, stabilization and transport technology and services, Suspended Animation employs and contracts with a variety of physicians, perfusionists, emergency medical technicians, scientists, engineers, and designers.

Through specializing in standby, stabilization, and transportation, Suspended Animation can make faster progress toward reducing ischemic damage prior to vitrification than a full-service cryonics organization that must divide its attention over a wider range of tasks.

To fulfill its mission to develop and deliver state-of-the-art standby, stabilization and transport technology and services, Suspended Animation employs and contracts with a variety of physicians, perfusionists, emergency medical technicians, scientists, engineers, and designers. SA has a staff of four full time employees and more than 30 emergency medical professionals across the country, who are ready to respond to clients 24/7.

On a day-to-day basis, Suspended Animation staffs are dedicated to developing and refining new equipment, treatment modalities, and procedures while maintaining contact with clients, and organizing training sessions and emergency simulations to insure readiness.

When one of SA's partner organizations requests our assistance, SA will deploy a team and equipment as near as possible to the patient, and prepare for an outcome. If legal death is pronounced, SA will perform stabilization procedures as defined in our contracted organization's approved protocol.

Suspended Animation, Inc. is an innovative biotechnology company whose mission is to deliver donor tissue stabilization services for our clients. To accomplish this, we maintain a state of constant readiness so that we are able to achieve efficient and timely deployment of trained health professionals to the patient's site. Our practices are quality- and customer-centric with a focus on meeting applicable requirements and maintaining an effective quality management system driven by continual improvement. ■

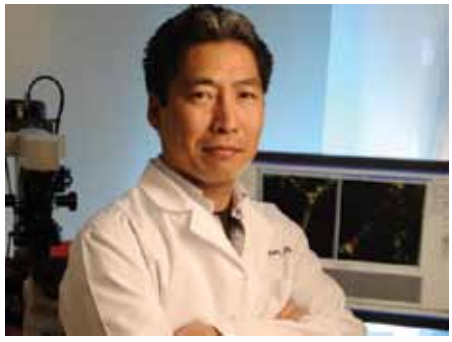
Young Again: How One Cell Turns Back Time

The lineage of cells that joins one generation to the next—called the germline—is, in a sense, immortal. Biologists have puzzled over the resilience of the germline for 130 years, but the phenomenon is still deeply mysterious. Over time, a cell's proteins become deformed and clump together. When cells divide, they pass that damage to their descendants. Over millions of years, the germline ought to become too devastated to produce healthy new life. On [Nov. 22] in the journal *Nature*, Dr. K. Adam Bohnert, postdoctoral researcher at Calico Life Sciences in South San Francisco, Calif., and Cynthia Kenyon, vice president for aging research at Calico, reported the discovery of one way in which the germline stays young. Right before an egg is fertilized, it is swept clean of deformed proteins in a dramatic burst of housecleaning. The researchers discovered this process by studying a tiny worm called *Caenorhabditis elegans*. The worm has been a favorite of biologists for 50 years because its inner workings are much the same as our own. …

Carl Zimmer / *New York Times*
22 Nov. 2017
https://www.nytimes.com/2017/11/22/science/youth-cells-aging-worms.html

Scientists Find Key to Regenerating Blood Vessels

A new study led by researchers at Sanford Burnham Prebys Medical Discovery Institute (SBP) identifies a signaling pathway that is essential for angiogenesis, the growth of new blood vessels from pre-existing vessels. The findings, published in *Nature Communications*, may improve current strategies to improve blood flow in ischemic tissue, such as that found in atherosclerosis and peripheral vascular disease associated with diabetes. "Our research shows that the formation of fully functional blood vessels requires activation of protein kinase Akt by a protein called R-Ras, and this mechanism is necessary for the formation of the hollow structure, or lumen, of a blood vessel." says Masanobu Komatsu, Ph.D., associate professor at SBP's Lake Nona campus. "The findings are important because they shed new light on the biological process needed to increase blood flow in ischemic tissues." Previous efforts to treat ischemia by creating new blood vessels have focused on delivering angiogenic growth factors like vascular endothelial growth factor (VEGF) to ischemic sites. But all…have failed….



The laboratory of Masanobu Komatsu, Ph.D., studies the regulation of blood vessel growth and remodeling to aid the treatment of cancer and heart disease. Credit: SBP. Usage Restrictions: None.

SBP / EurekAlert!
23 Nov. 2017
https://eurekalert.org/pub_releases/2017-11/spmd-sfk112017.php

Lifespan Prolonged by Inhibiting Common Enzyme

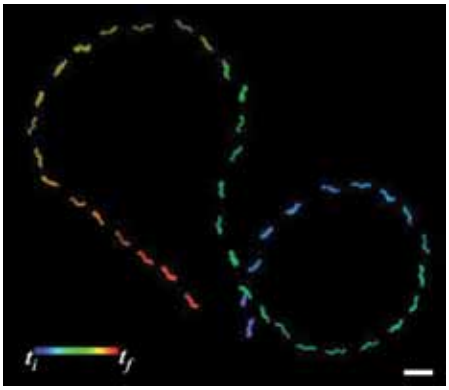
The enzyme RNA polymerase III (Pol III) is present in most cells across all animal species, including humans. While it is known to be essential for making proteins and for cell growth, its involvement in ageing was unexplored until now. A study, published Nov. 29 in *Nature* by researchers from University College London, the University of Kent and University of Groningen, found that the survival of yeast cells, and the lifespans of flies and worms were extended by an average of 10% following a modest reduction in Pol III activity in adulthood. "We've uncovered a fundamental role for Pol III in adult flies and worms: its activity negatively impacts stem cell function, gut health and the animal's survival. When we inhibit its activity, we can improve all these. As Pol III has the same structure and function across species, we think its role in mammals, and humans, warrants investigation as it may lead to important therapies," said first author, Danny Filer (UCL Institute of Healthy Ageing). The effects of inhibiting Pol III were found to be comparable to the action of the immune-suppressing drug rapamycin …

University College London / ScienceDaily
29 Nov. 2017
https://www.sciencedaily.com/releases/2017/11/171129131437.htm

Biotemplates Breakthrough Paves Way for Cheaper Nanobots

An international research team has demonstrated a new technique for plating silica onto flagella, the helix-shaped tails found on many bacteria, to produce nanoscale swimming robots. As reported this week in *APL Materials*, from AIP Publishing, the group's biotemplated nanoswimmers spin their flagella thanks to rotating magnetic fields and can perform nearly as well as living bacteria. "We have shown for the first time the ability to use bacterial flagella as a template for building inorganic helices," said Min Jun Kim, one of the authors of the paper. "This is quite a transformative idea and will have a great impact on not only medicine but also other fields." Other recently developed methods for constructing these helical

structures employ complicated top-down approaches, including techniques that involve self-scrolling nanobelts or lasers. The use of this specialized equipment can lead to very high startup costs for building nanorobots. Instead, Kim's team used a bottom-up approach, first culturing a strain of Salmonella typhimurium and removing the flagella. …



Trajectory of a templated helical silica nanoswimmer manually controlled to move in an approximate figure-eight pattern; scale bar is 5 μm. Credit: Jamel Ali

American Institute of Physics / ScienceDaily
30 Nov. 2017
https://www.sciencedaily.com/releases/2017/11/171130150414.htm

Can Young Stem Cells Make Older People Stronger?

Can one grow old without growing frail? One company is banking on the idea that with the right treatment, the answer can be "yes" for many more people. In clinical trials published in October in the *Journals of Gerontology*, Longeveron, the firm developing the therapy, reports that a single infusion of mesenchymal stem cells from younger donors had no apparent safety downsides for people with aging-related frailty—and spurred improvement in many of their symptoms. The work is "one of the first studies that actually attempts to address [frailty] in a well-defined or well-described fashion, and certainly, to my knowledge, the first such study with mesenchymal stem cells," says Keith March, a cardiologist who directs the Center for Regenerative Medicine at the University of Florida and was not involved in the trials. "We looked at a variety of measures, and what was exciting to us was we saw four or five different things in different organ systems that improved—and this was repeated in two studies, in two separate groups of people," says Longeveron cofounder Joshua Hare.

Shawna Williams / *The Scientist*
11 Dec. 2017
https://www.the-scientist.com/?articles.view/articleNo/51135/title/Can-Young-Stem-Cells-Make-Older-People-Stronger-/

DNA-Based Chemical Oscillator Offers New Level of Molecular Control

In a new study, David Soloveichik and his research team in the Cockrell School of Engineering at The University of Texas at Austin show how to program synthetic oscillators and other systems by building DNA molecules that follow specific instructions. Soloveichik, an assistant professor in the Cockrell School's Department of Electrical and Computer Engineering, along with Niranjan Srinivas, a graduate student at the California Institute of Technology, and the study's co-authors, have successfully constructed a first-of-its-kind chemical oscillator that uses DNA components—and no proteins, enzymes or other cellular components—demonstrating that DNA alone is capable of complex behavior. According to the researchers, their discovery suggests that DNA can be much more than simply passive molecule used solely to carry genetic information. "DNA can be used in a much more active manner," Soloveichik said. "We can actually make it dance—with a rhythm, if you will. This suggests that nucleic acids (DNA and RNA) might be doing more than we thought…"

Cockrell School of Engineering, Univ. of Texas at Austin
14 Dec. 2017
http://www.engr.utexas.edu/news/8288-chemical-oscillator

Breakthrough Sensor for Photography, Life sciences, Security

Engineers from Dartmouth's Thayer School of Engineering have produced a new imaging technology that may revolutionize medical and life sciences research, security, photography, cinematography and other applications that rely on high quality, low light imaging. Called the Quanta Image Sensor, or QIS, this next generation of light sensing technology enables highly sensitive, more easily manipulated and higher quality digital imaging than is currently available, even in low light situations, according to co-inventor Eric R. Fossum, professor of engineering at Dartmouth. Fossum also invented the CMOS image sensor found in nearly all smartphones and cameras across the world today. Documented in the Dec. 20 issue of The Optical Society's OSA *Optica*, the new QIS technology is able to reliably capture and count the lowest level of light, single photons, with resolution as high as one megapixel, or one million pixels, and as fast as thousands of frames per second. Plus, the QIS can accomplish this in low light, at room temperature and while using mainstream image sensor technology …

Dartmouth Engineer Magazine
18 Dec. 2017
https://engineering.dartmouth.edu/news/dartmouth-engineers-produce-breakthrough-imaging-sensor

Inflammation Drives Progression of Alzheimer's

According to a study by scientists of the German Center for Neurodegenerative Diseases (DZNE) and the University of Bonn now published in the journal Nature, inflammatory mechanisms caused by the brain's immune system drive the progression of Alzheimer's disease. These findings, which rely on a series of laboratory experiments, provide new insights into pathogenetic mechanisms that are believed to hold potential for tackling Alzheimer's before symptoms manifest. The researchers envision that one day this may lead to new

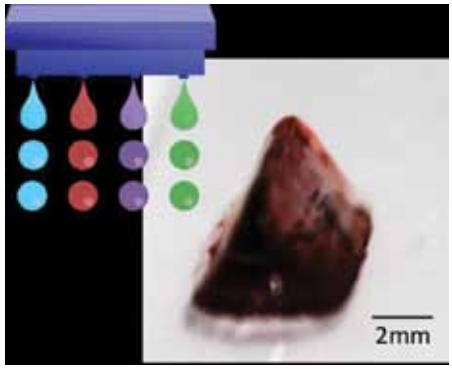
ways of treatment. Other institutions from Europe and the US also contributed to the current results. Alzheimer's disease is a devastating neurodegenerative condition ultimately leading to dementia. An effective treatment does not yet exist. The disease is associated with the aberrant aggregation of small proteins called "Amyloid-beta" (Abeta) that accumulate in the brain and appear to harm neurons. In recent years, studies revealed that deposits of Abeta, known as "plaques," trigger inflammatory mechanisms by the brain's innate immune system.

Inflammatory mechanisms caused by the brain's immune system drive the progression of Alzheimer's disease, according to new research. Credit: © Dmitry / Fotolia

German Center for Neurodegenerative Diseases / ScienceDaily
20 Dec. 2017
https://www.sciencedaily.com/releases/2017/12/171220131656.htm

Growing Organs a Few Ink Drops at a Time

Before any real applications, "bioprinting" of human organs still faces many technical challenges. Processing the bio-ink and making it stick to itself and hold the desired structure have been proving particularly difficult. Few methods currently exist for gluing bio-ink droplets together and these do not work for every kind of cell, motivating new alternative approaches. Building on their previous work, researchers at Osaka University have now refined an enzyme-driven approach to sticking biological ink droplets together, enabling complex biological structures to be printed. They recently published their findings in *Macromolecular Rapid Communications*. Lead author, Shinji Sakai says, "Printing any kind of tissue structure is a complex process. The bio-ink must have low enough viscosity to flow through the inkjet printer, but also needs to rapidly form a highly viscous gel-like structure when printed. Our new approach meets these requirements while avoiding sodium alginate. In fact, the polymer we used offers excellent potential for tailoring the scaffold material for specific purposes."

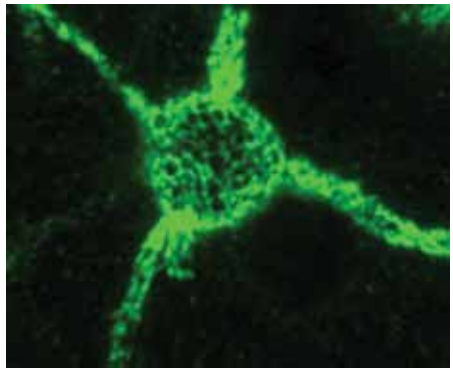


This is a photograph of a 3-D hydrogel construct obtained through drop-on-drop multi-material bioprintinig. CREDIT:Osaka University

Eurekalert! / Osaka University
27 Dec. 2017
https://www.eurekalert.org/pub_releases/2017-12/ou-goa122717.php

Neurons' Sugar Coating Is Essential for Long-Term Memories

How the brain is able to store memories over long periods of time has been a persistent mystery to neuroscientists. In a new study using a rat model, researchers from the Centre for Integrative Neuroplasticity (CINPLA) at the University of Oslo show that long-lived extracellular matrix molecules called perineuronal nets are essential for distant memories. The new research published in Proceedings of the National Academy of Sciences, shows that removal of the nets disrupts distant but not recent memories. Previously, researchers have mainly focused on molecules inside the nerve cells. The team of investigators, led by Drs. Marianne Fyhn and Torkel Hafting, studied perineuronal nets that tightly cover the outside of neurons. The nets are made up of sugar-coated proteins, forming a rigid structure that contains holes where connections to other neurons are kept in place. When new memories are formed, the connections between neurons change. The authors hypothesized that perineuronal nets might stabilize the new, memory-related connections to support long-term memories. To test memory function, the team performed a classical conditioning experiment …



The image shows a perineuronal net (green) surrounding a neuron Credit: Kristian K. Lensjø

Medical Express
27 Dec. 2017
https://medicalxpress.com/news/2017-12-neurons-sugar-coating-essential-long-term.html

Double Strike against Tuberculosis

In search of new strategies against life-threatening tuberculosis infections, a team from the Technical University of Munich (TUM), as well as Harvard University and Texas A&M University in the USA have found a new ally. They discovered a substance that interferes with the mycomembrane formation of the bacterium. It is effective even in low concentrations and when combined with known antibiotics their

effectiveness is improved up to 100-fold. Among the greatest challenges when treating life-threatening tuberculosis infections is the increasing resistance to antibiotics. But the pathogen itself also makes the life of doctors difficult: its dense mycomembrane hampers the effect of many medications. A team of scientists headed by Stephan A. Sieber, Professor of Organic Chemistry at TUM, has discovered a substance that perturbs the formation of this membrane significantly: the beta lactone EZ120. It inhibits the biosynthesis of the mycomembrane and kills mycobacteria effectively. It is effective even in low doses, and exhibits only low toxicity to human cells.

Technical University of Munich (TUM) / ScienceDaily
28 Dec. 2017
https://www.sciencedaily.com/releases/2017/12/171228100908.htm

Engineers Hack Cell Biology to Create 3-D Shapes from Living Tissue

Many of the complex folded shapes that form mammalian tissues can be recreated with very simple instructions, UC San Francisco bioengineers report December 28 in the journal *Developmental Cell*. By patterning mechanically active mouse or human cells to thin layers of extracellular matrix fibers, the researchers could create bowls, coils, and ripples out of living tissue. The cells collaborated mechanically through a web of these fibers to fold themselves up in predictable ways, mimicking natural developmental processes. "Development is starting to become a canvas for engineering, and by breaking the complexity of development down into simpler engineering principles, scientists are beginning to better understand, and ultimately control, the fundamental biology," says senior author Zev Gartner, part of the Center for Cellular Construction at the University of California, San Francisco. "In this case, the intrinsic ability of mechanically active cells to promote changes in tissue shape is a fantastic chassis for building complex and functional synthetic tissues."

Cell Press / ScienceDaily
28 Dec. 2017
https://www.sciencedaily.com/releases/2017/12/171228132039.htm

A Roadmap to Revival

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

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

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

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

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

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

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

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

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

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

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

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Alcor makes available to every member and patient, without charge, one acid free Memory Box about the size of a standard banker's box (H10" x W12" x L15") for memorabilia to be stored underground at a commercial storage site called Underground Vaults and Storage (UGVS) in Kansas. Additional Boxes are a one-time charge of $250 each for perpetual storage.

Some of the most popular items that have been placed into storage are such things as letters, cards, photographs, diaries, journals, notebooks, books, clippings, army records, directories, recipes, video tapes, cassettes, medical records, flash drives, and external drives.

If you would like to begin working on your own Memory Box, or perhaps contribute items to a Box for an Alcor Member already in stasis, or if you have any questions, please contact **Linda Chamberlain at linda@alcor.org or call toll free at 877-462-5267 ext 115**.

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MEETINGS

ABOUT THE ALCOR FOUNDATION

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

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

ARIZONA

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

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

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

CALIFORNIA

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

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

FLORIDA

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

NEVADA

LAS VEGAS: A new group for the Las Vegas areas has been started for those interested. Contact Gilda Cabral at gcabral@korns.com or Mike Korns at mkorns@korns.com for details on upcoming meetings.

NEW ENGLAND

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

NEW YORK CITY

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

PACIFIC NORTHWEST

Alcor Pacific Northwest organizes meetings for Alcor members in the Pacific Northwest. Meetings are usually held in the Portland area but other locations are possible, too. The contact person for the meetings is Aschwin de Wolf: aschwin@alcor.org. See also: https://www.facebook.com/alcor.pnw/

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

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

TEXAS

DALLAS/NORTH TEXAS: Please join us at www.meetup.com/North-Texas-Cryonauts/ or contact David Wallace Croft at (214) 636-3790.

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

JAPAN

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

ALCOR PORTUGAL

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

UNITED KINGDOM

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

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

What is Cryonics?

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

How do I find out more?

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

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

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

How do I enroll?

Signing up for cryopreservation is easy!

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

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

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

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

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