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How to Sustain an Organization for Over a Century.

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

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How to Sustain an Organization for Over a Century. Part One: Corporate Longevity

By Max More, Ph.D.

The Challenge

If you have discussed cryonics with non-cryonicists a few times, you will come to hear the same few arguments. The form may vary a little from person to person, but the essence is the same. Cryonics cannot work because: frozen cells expand and burst; dead is dead; no one will want to bring you back; the soul has left the body; and because we will never have technology capable of cellular repair. Another common argument is that cryonics is pointless because cryonics organizations won't last. They will fail and you will be thawed out. Game over.

Most of these arguments can be dismissed after dissolving them with the acids of science, philosophy, and critical thinking. The argument from organizational mortality is more substantial and more difficult to rebut fully. It's also an argument that we should *not* dismiss but take seriously. After all, we don't know how long it will be before we can repair, revive, and rehabilitate *any* cryopreserved people. It will be several decades at least and possibly a century or longer. Isn't it true that very few organizations survive that long? Some have. What can we learn from them? How can we maximize the chances that our cryonics organizations will endure for a century or more?

When I start to address that argument, I usually point out that Alcor has already been around for almost half a century. (48 years at the time of writing.) Cryonics Institute is 44 years old.[1] On hearing this, many doubters are taken aback. Those with a little historical knowledge of cryonics may respond: "Okay, but isn't it true that most of the early organizations failed?" Yes, it is true. There were three public organizations that started in the 1960s: Cryo-Care Equipment Corporation in Phoenix, Arizona; the Cryonics Society of New York (CSNY); and the Cryonics Society of California (CSC). None of them lasted through the 1970s.[1]

In those early years up until 1973, seventeen documented cryopreservations took place. Only one has been maintained through to today. The first cryopreserved person, Dr. James Bedford, was initially maintained by relatives following his 1967 cryopreservation. In 1982, his continued care was taken on by Alcor. 127 years after Dr. Bedford's birth, his continued survival is now more assured than ever.

On one hand, we have a couple of cryonics organizations that are close to the half-century mark. On the other hand, we have several organizations that failed within a few years. Let's look at the lifespan of various types of organizations to determine how realistic our own chances are and how we can improve our chances.

Average Organization Lifespans

Today's cryonics organizations are corporations. It makes sense to start by looking at the longevity of corporations as commonly understood.

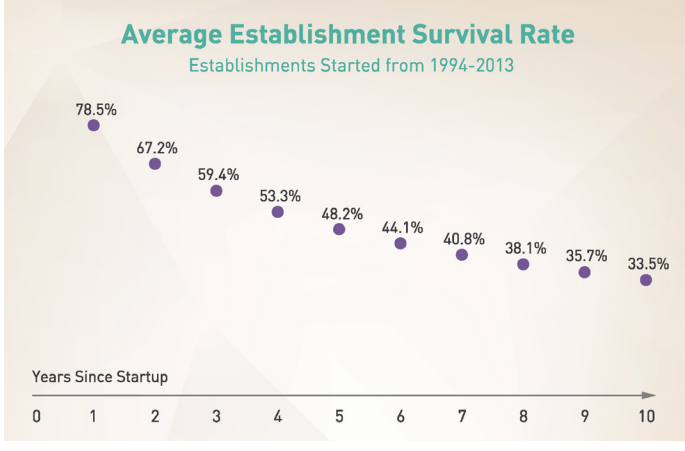
Corporations – small businesses

Small businesses are those defined as having fewer than 50 employees. Small businesses account for 99.7% of all firms with paid employees. According to the US's Small Business Administration (SBA) in 2019, there were 30.7 million small businesses in the US. 400,000 businesses closed down while 433,000 started up. [SBA, 2019] That's a stunning amount of entrepreneurial activity.

Although business churn (replacement of old businesses by new) has declined over the last two decades [Wilmoth, 2018], it still takes a brave (or reckless) person to start a small business. The smallest businesses have the gloomiest prospects. Those with fewer than 20 employees have only a 37% chance of surviving four years and only a 9% chance of surviving 10 years. A little over half (51.8%) of new businesses will die in the first five years.

Average establishment survival rate (1994-2013)

As the chart shows, two-thirds of new employer firms survive at least two years, and about half survive at least four. One-



third are still alive after a decade. Restaurants are a notoriously vulnerable business. They have only a 20% chance of surviving for four years. This is a lifespan only a Mayfly could envy. Just make sure your cryonics organization doesn't operate like a restaurant! These numbers cast doubt on the viability of cryonics as a for-profit business at this time.

It's worth nothing that corporate death does not necessarily mean a business failure. The business may have accomplished what its human creators wanted it to accomplish. In about one-third of closing firms, owners said that their business was successful at closure.

On to the Big Guys. Does greater size bring greater corporate longevity?

Public companies

Given the critical role that corporations play in modern life, you might expect to find an abundance of quantitative research into corporate mortality. It's true that an endless stream of books and articles tell us what great companies have in common and what we should learn from them. A fatal flaw lies at the heart of all such accounts. We cannot reliably learn anything about the winning characteristics by looking solely at successful companies. It may be that failed companies had the same characteristics.

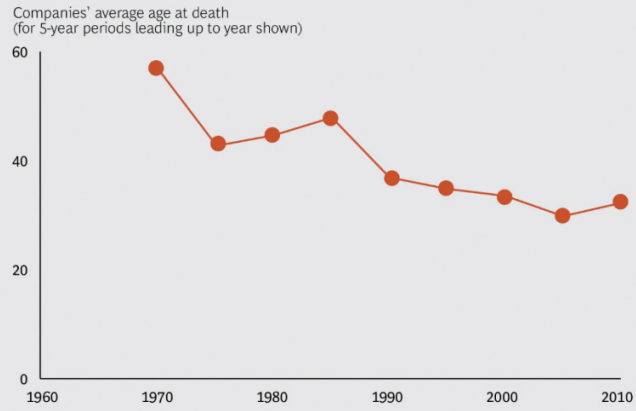
When it comes to corporate longevity and mortality, research is scarce and results of various studies conflict with one another. Can we can agree that younger companies are more likely to die than older ones? No. Some researchers claim the opposite. Yet others argue that mortality rates are independent of a company's age. Nor is there agreement on whether company lifespans are shrinking or growing.

Many commentators cite the work done by Professor Richard Foster from Yale University. Foster tells us that the average lifespan of a company listed in the S&P 500 index of leading US companies has decreased by more than 50 years in the last century, from 67 years in the 1920s to just 15 years today. Companies on the S&P 500 in 1964 maintained their position on that coveted list for an average of 33 years. By 2016 that average had fallen to 24 years. Foster's 2012 claim that by 2020, more than three-quarters of the S&P 500 will be companies that we have not heard of yet, turned out to be excessively pessimistic. Even so, we can expect about half of S&P 500 companies to be replaced over the next ten years.

According to Martin Reeves and Lisanne Püschel [BCG 2015], public companies are perishing sooner than ever before. Since 1970, the life span of companies, as measured by the length of time that their shares are publicly traded, has significantly decreased.

Not only are companies dying younger, "they are also more likely to perish at any point in time". One-tenth of public companies

EXHIBIT 1 | Companies' Average Age at Death in the US



Source: BHI analysis.
Note: Includes companies publicly traded in US (matched across Compustat and CIQ).

fail each year, which is four times the rate in 1965. Public companies traded in the US face a 32% change of exiting in five years. Fifty years ago, the risk was only 5%. The companies most likely to go belly-up were both the fastest shrinking and the fastest growing.

Research supported by the Santa Fe Institute [Daepp, 2015] published in "The Mortality of Companies" comes to a different conclusion. The researchers examined a database of more than 25,000 publicly traded North American companies, from 1950 to 2009, to extract the statistics of firm lifespans. They found that "the mortality of publicly traded companies manifests an approximately constant hazard rate over long periods of observation". That means that mortality rates are independent of a company's age.

About half of publicly traded companies die off each decade. Others find that the average life expectancy of a multinational corporation is between 40 and 50 years. Two problems exist with these numbers as measures of mortality, if we are interested in the continuation of the purpose of a corporation rather than the persistence of its exact form. The numbers for S&P turnover represent only the addition and removal of those firms from that index. Being removed from the index doesn't mean the firm went out of business. It means only that its market capitalization is no longer in the top 500.

More relevantly from a cryonics perspective, we need to ask: How is corporate life span defined? Dissolution or liquidation certainly accounts for many firm "deaths". But many more result from mergers and acquisitions as well as from splitting into more than one new entity. Merging or being acquired is not at all the same as expiring. In some acquisitions, the acquired company even continues as a business unit. Think of what it means for cryonics organizations. So long as the core assets – the patients – are preserved, the identity of the organization is not critical. That

may mean that the odds for cryonics organizations are somewhat better than suggested by these numbers for corporate survival. (I was unable to find numbers that adjusted survival rates for mergers and acquisitions.)

In his book and article, "The Living Company", Arie de Geus says: "In the world of institutions, commercial corporations are newcomers. They have been around for only 500 years—a mere blip in the course of human civilization." Despite their immense success, de Geus thinks "most commercial corporations are underachievers" because they die prematurely. Compared to what? He points to outliers, corporations that have survived for centuries, and jumps to the conclusion that "the natural life span of a corporation could be two or three centuries—or more."

He believes that "the high corporate mortality rate seems unnatural". This rather odd claim is based on his belief that "No living species suffers from such a discrepancy between its maximum life expectancy and the average span it realizes." That seems dubious, given that most members of many species have their lives cut short from injury or predation far before reaching their maximum life span.

More interestingly, he notes that "few other types of institution—churches, armies, or universities—have the abysmal record of the corporation." De Geus seems not to consider the point that corporations live as long as they need to or should to do a job. Other types of institution may be better suited to long-term survival.

Still, it remains true that we need to know which organizational forms are most durable and how to make them more durable. Or, as Mike Darwin put it: "cryonicists are faced with the task of finding not just a way to indefinitely extend the human lifespan, they must also find a way to indefinitely extend the lifespan of the corporate entities they propose will care for them and recover them from cryopreservation over a period of many decades, or centuries." [Darwin, 2011]

Where can we find exemplars of organizational longevity?

Multi-Century Old Organizations

Japan stands out as the land of super-long-lived organizations. In 2019, there were over 33,000 businesses in Japan over a century old. A 2008 report published by the Bank of Korea that looked at 41 countries found that there were 5,586 companies older than 200 years. 56% are in Japan, 15% in Germany, 4% in the Netherlands, and 3% in France. [Gittleson, 2012; Lufkin, 2020]

Train your telescope on businesses over 1,000 years old and you'll find that 8 out of 14 are Japanese. The Japanese even have a specific word for long-lived companies that have survived for more than a century, retained ownership within the same family, and in the same trade for the duration: *shinise*. The oldest of the old is Kongō Gumi Co., Ltd., a Japanese construction company

Kongo Gumi: Established in 578

started in 578 which operated continuously as an ongoing independent company for over 1,400 years. (In 2006, it became a subsidiary of Takamatsu.) When its temple building business suffered during World War II, the company responded and switched to building coffins

How do they endure for so long? The vast majority (89%) of the corporate centenarians employ fewer than 300 people. Shinise are small, typically family-run, and focus on a central belief or credo that does not revolve solely around profit. The "family-run" part is especially interesting and a little sneaky. It's true that traditional culture encourages people to work in a family business even if it doesn't interest them.

As someone who has long been future-oriented, I have a curious relationship with old institutions. From 1974 to 1980 I attended QEH, a boarding school founded in 1586. (See cover photo, taken by Max More.) Since I live in the United States, this allows me smugly to state: "My school is older than your country." I try to avoid saying so, since it tends to be bad for Anglo-American relations. The full name, Queen Elizabeth's Hospital, may sound odd but was so named because it was founded by John Carr for the education of poor children and orphans. The school has an admirable motto: *Dum tempus habemus operemur bonum* (Whilst we have time, let us do good).

After QEH and before university, I moved out of Bristol and lived in the town of Yeovil. Just a stone's throw away is another school whose age puts QEH's to shame. The Sherborne School, the seventh oldest in the world, was founded in 705. While I still lived in Bristol, I would occasionally pass by Bristol Cathedral School (1140). When the time came for university, I won a place at the University of Oxford. Oxford is the second oldest still-functioning university, founded in 1096-1167.

But "family" can be expanded to meet business needs. To keep the business in family over long periods of time, the company head legally adopts a suitable person to run his firm and then passes it on. Adult adoption is common in Japan. In 2011, more than 90 percent of the 81,000 individuals adopted in Japan were adults. When someone asks you to join their family and take over running their 1,000-year-old business, that's an offer you can't refuse. Firms run by adopted heirs outperform biologically related heirs while both adopted and genetic heirs outperform nonfamily firms. [The Economist, 2012]

What do venerable old firms do? I'll define "old" as "starting before 1300". Outside of Japan (which accounts for 23 of them), most of them are hotels, construction companies, or make confectionery, or make or serve alcohol. You may not be stunned to learn that of the 11 old firms in Germany, 7 are breweries, 2 are wineries, and one is a hotel… in the Ahr wine district. The UK boasts 8 firms from before 1300, only 3 of which are pubs.

QEH, Max More's school from 1974 to 1980

Europe has quite a number of firms 200 or more years old. Stora Enso claims to be the world's oldest limited liability corporation. The Finnish paper and pulp manufacturer began as a copper mining company in 1288. You can find on display the world's oldest stock share certificate granting the Bishop of Västerås 12.5% ownership. The Marinelli Bell Foundry in Italy started in 1339 but is the successor of a bell foundry in Agnone, Italy in 1040. For the better part of a millennium it has been owned by the same family and still uses the same lost-wax method of casting. It claims the honor of being Italy's oldest family business and one of the three oldest family businesses worldwide.

Fabbrica d'Armi Pietro Beretta is a privately held Italian firearms manufacturing company with multinational operations. Beretta is the oldest active manufacturer of firearm components in the world. The current owners are Ugo Gussalli Beretta and his sons, Franco and Pietro. The company followed the shinise "cheat" when the traditional father-to-son Beretta dynasty was interrupted by childless uncles. Ugo married into the Beretta family and adopted the last name.

The 300 Club is not a disco or night club. The Tercentenarians Club as it's more properly called is a UK trade association that only accepts as members firms over 300 years old and still owned by the same family that started it. [Wallop, 2013] Imagine what it's like to be responsible for running such a business. As *The Telegraph* articles notes, "They have survived at least 47 recessions, a clutch of banking crises, stock market crashes, the start of the Industrial Revolution and the end of horsepower, two world wars, the defeat of Napoleon, and the rise of the internet."

Gatherings of the Tercentenarians Club naturally sport a bit of one-upmanship. While admiring their joint venerableness, conversations may start with something like this: "1703. Oh, really? We're 1535". Just because you are ancient and retain ancient skills doesn't mean you don't keep up. Peter Freebody & Co, a team of craftsmen boatbuilders, continue to excel at design, hull construction, fine joinery work, finishing, classic craft restoration and conservation and brightwork. Yet they sport a lovely, modern website: https://www.peterfreebody.com/

Academic Institutions

A good place to look for institutions that have survived continuously for the past half millennium is universities. Of the 85 500+ year old institutions, 70 are universities. The oldest university in the world is the University of Bologna, founded in 1088. In fact, the word "university" was coined at its inception. University is defined as "a higher-learning, degree-awarding institute". We have already noted the second oldest as being the University of Oxford (1096, charter in 1248).

In third place and the oldest university in the Hispanic world is the University of Salamanca, Spain, founded in 1134 (charter 1218). All told, 39 still-operating universities were founded before 1500. More on universities and their financial organization in the next section. University of Cambridge comes in fourth, having started in 1209 (charter granted in 1231).

Religious Institutions

You might expect religious institutions and organizations to endure over long periods of time. Their core goal is not to make a profit (although they usually do) and their finances are often bolstered by required or almost-required donations or by direct government support. Not only are many religious institutions sheltered from economic vicissitudes, their support is strengthened by the perceived critical importance of the religion or institution. To keep this short, I will mention just a few enduring institutions.

- Westminster Abbey, founded 960.

- The Order of St Benedict was founded in 529 AD, in Subiaco, Italy.
- The Catholic Church, arguably dating from around 50 AD and backed by governments from the 4th century. The Papacy and the Catholic Church can also lay claim to tremendous institutional longevity. Its bureaucracy has been run by essentially the same official structure for almost 1,000 years.
- The Armenian Apostolic Church, the world's oldest national church. The Kingdom of Armenia became the first state to declare Christianity as its official religion, in 301 AD.
- Mar Sarkas is a monastery and convent in Syria built before 325 AD. The few English-speaking nuns will be happy to give you a tour.
- St. Peter's Basilica was commissioned by Constantine I, and built between 326 and 360, and rebuilt in the 16th century.
- Saint Catherine's in Egypt or, fully named, the Sacred Monastery of the God-Trodden Mount Sinai, was built between 548 and 565 and has remained in continuous operation through today. Its library contains books that date back to the 4th century.
- The Dura-Europos house church in Syria is the earliest identified Christian house church. It was a domestic house converted for worship between 233 and 256.

Investment Companies and Investment Trusts

When cryonicists talk about trusts these days, they mean one of two things, neither of which is quite the same as an investment trust. One kind of trust can be used to fund a cryopreservation. Another kind of trust, usually referred to as an asset preservation trust or future income trust, is designed to hold your assets until you can be revived.

Both of these kinds of trusts do have a crucial element in common with investments trusts. A trust of any kind is created when one person (settlor) gives property to another person (trustee) to hold for the benefit of a third person (beneficiary). In the case of future income trusts in cryonics, we hope that the beneficiary will be the same as the settlor (in personality if not in law). In this section, I'm only going to consider investment trusts.

The name is confusing and potentially misleading because an investment "trust" is a separate legal person or company and not a trust in the legal sense. An investment trust is a public listed company that offers either open or closed-end funds. It invests in the shares of other companies. Rather than investors dealing with a fund management company, they can buy and sell from the market, with shares being traded on the London Stock Exchange.

1868 saw the establishment of the first investment trust. The Foreign & Colonial Investment Trust was started "to give the investor of moderate means the same advantages as the large capitalists in diminishing the risk by spreading the investment over a number of stocks". This is one of 34 investment trusts still trading today which have survived the past 80 years. (Black, 2017) The 34 surviving trusts may be old, but they are healthy. As of 2017, they accounted for 23% of all assets in the investment trust sector.

Also starting in 1868 was the cleverly named Investment Company. Other enduring investment trusts include JPMorgan Global Growth & Income (1887), Alliance Trust (1888), BMO Global Smaller Companies (1889), AVI Global Trust (1889), Merchants Trust (1889), and the BlackRock Smaller Companies trust (1906).

Turning to banks, the oldest one still operating (and Italy's third largest) is Banca Monte dei Paschi di Siena S.p.A. (BMPS). The magistrate of the city state of Siena, Italy founded it in 1472 as a "mount of piety" which makes sense for those who are devoutly worshipful to their money. Berenberg Bank, based in Hamburg (but founded by brothers from Antwerp in what is now Belgium), can boast that it is the world's second oldest bank, the world's oldest merchant bank, and Germany's oldest bank. It's something of a financial version of the Japanese shinese in that it has been continuously owned by descendants of the Berenberg brothers in the form of a Hanseatic dynasty made up of three families.

Lloyds Bank plc, traditionally considered one of the "Big Four" clearing banks, is a British retail and commercial bank with branches across England and Wales. The bank was founded in Birmingham, England in 1765. The central bank of Sweden, Sveriges Riksbank, or simply Riksbanken (1668), is the world's oldest central bank and the world's 4th oldest bank still in operation.

C. Hoare & Co. is a private bank, the oldest bank in the United Kingdom and the world's 5th oldest bank. Sir Richard Hoare founded it in 1672. It remains family-owned and is now managed by the 11th generation of Hoare's direct descendants. More specifically, the bank is structured so that the Board consists of seven shareholding Partners, all descendants of the bank's founder, together with five nonfamily Directors including the non-Executive Chairman and Chief Executive Officer.

The survival power of family strikes again when it comes to B. Metzler seel. Sohn & Co. KGaA, a private banking company in Frankfurt, Germany. Germany's second oldest bank and the world's 6th oldest, Bankhaus Metzler began as a cloth trading business started in 1674 by a Clergyman's son named Benjamin Metzler. Metzler first got involved in money and bills of exchange in 1728. The entire capital of the bank is held by the Metzler family.

A worthy mention goes to Lloyd's, the world's leading insurance market. Modern internet companies are not the only or the first businesses to start in a coffee shop. As London grew in importance as a global trade center in the 17th century, so the need for ship and cargo insurance grew. In 1688 Edward Lloyd's Coffee House became the place to purchase marine insurance and went on to become the place for specialist insurance of all kinds.

Endowments

Alcor is the only cryonics organization in the world to have a legally recognized endowment. [Alcor, 2018] This is not to be confused with the Alcor Care Trust (formerly the Patient Care Trust). The ACT holds a large portion of the cryopreservation fee. It pays for indefinite storage and care of Alcor patients and for eventual repair and revival. The Endowment's purpose is to provide a reliable source of income over the long term to support operations.

A financial endowment is a legal structure for managing, and often indefinitely perpetuating, a collection of financial, real estate, or other investments for a specific purpose according to the will of its founders and donors. Endowments usually aim to keep the principal intact while using the investment income or a small part of the principal to support an organization each year. In fact, true endowment funds (rather than term or quasi endowment funds) come from donors with the restriction that the principal or gift amount is to be retained in perpetuity.

Roman emperor and Stoic philosopher Marcus Aurelius created the first endowments in the form of endowed chairs. Starting in AD 176, he created an endowed chair for Platonism, Aristotelianism, Stoicism, and Epicureanism. Other major cities of the empire later enjoyed similar endowments.

Islamic law was another source of early endowments. A *waqf* or "mortmain property" is an inalienable charitable endowment usually involving donating a building, plot of land or other assets for Muslim religious or charitable purposes. As in English trust law, every waqf was required to have a waqif (founder), mutawillis (trustee), qadi (judge) and beneficiaries. A charitable trust may hold the donated assets, which are an inalienable gift.

Endowments were applied to the modern university system beginning in 1502. Lady Margaret Beaufort, grandmother to the future king Henry VIII, created the first endowed chairs in divinity at the universities of Oxford and Cambridge. Henry VIII followed up 50 years later by establishing the Regius Professorships at both universities. Today's US universities enjoy some massive endowments, the largest being:

- Harvard University – $40.9 Billion
- University of Texas – $30.9 Billion
- Yale University – $30.3 Billion
- Stanford University – $27.7 Billion
- Princeton University – $26.1 Billion
  [Gorton, 2020]

The typically annual draw on an endowment is 4-6% of assets to fund operations or capital spending. In the case of Yale, usually second but currently third largest, endowment spending quadrupled over the past decade. For the 2020 fiscal year, this spending is projected to be $1.4 billion, amounting to about 34% of the university's net revenues. That's a major advantage for the generously endowed universities. It has been used to lower faculty-student ratios and attract outstanding professors with higher salaries. The income can also enable universities to disburse financial aid to desirable applicants.

Endowments try to meet two competing objectives: preserve their long-term value by keeping up with inflation and provide a steady stream of income to help run an institution. When the draw edges up to 6%, or returns take a dive, endowments can drop painfully. For example, Harvard University's endowment fund plunged from $37 billion on June 30, 2008 to $26 billion in 2009.

Endowments seem to be a promising instrument to support cryonics organizations over the long term. Alcor is so far the only cryonics organization to have an endowment. As of June 30, 2020, the endowment balance was $4,631,654. Whereas as universities typically draw up to 6% of assets annually, Alcor takes a more conservative approach. The maximum draw is 2% with a modest yearly adjustment up or down, depending on the performance of the investments. A 2% draw on the current balance would come to $92,633.

It might be argued that 2% is excessively conservative. Universities manage to increase their endowment while spending two to three times that amount. However, this is because they receive a continuing stream of contributions to the endowment. Since we cannot know that this will happen (compare the number of Alcor members to the number of alumni of major universities), the conservative approach is wise. It's worth noting that Alcor also benefits from individual trusts set up by members. They make quarterly or annual payments that help to support operations.

Direct contributions to operations, response capabilities, research, and the legal fund are tremendously helpful and encouraged. Contributions to the endowment produce a smaller immediate benefit but generate a reliable income for operations. This helps to keep a lid on membership dues despite inflation. Donors can also be reassured that contributed funds will not be spent all at once. The endowment is designed to be hard to break into. Any emergency withdrawals for urgent and unusual expenses have to win the votes of 80% of the Alcor board and 80% of the Endowment board, and two-thirds of the major

benefactors. [Alcor, 2017]

Conclusion to Part One

In our quest to find exemplars of institutional longevity, we could look at political institutions such as the Iceland parliament or Parliament of Britain (1520) or the Imperial House of Japan (660), but we have enough examples.

Cryonics organizations aren't families to which a business can be passed down through generations. Can we nevertheless become *cryo-shinise*? Can we adapt and build in similar strong elements of trust, foresight, and endurance? Will Alcor eventually decay and crumble into dust or will it stand out as a shining beacon of life throughout decades and even centuries? How can we maximize our chances of enduring?

Stay tuned for Part Two. ■

Endnotes

1. American Cryonics Society (ACS), originally called the Bay Area Cryonics Society (BACS), was founded in 1969. Arguably, it's the oldest existing cryonics organization. This is a marginal case since ACS has only a small number of cases (not more than one per year on average) and almost all its patients are stored at CI.
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Q&A with Max More, Ph.D.

1. You have been the longest serving President in the history of the organization. What do you think explains your longevity as a President?

A major part of the answer is my commitment to seeing Alcor improve and progress on every front. Even when the job became stressful and wearing, I kept at it because no one else suitable was available to take over. Finding the best person for the job is extremely difficult. So long as that person was me, I was determined to keep going even if I felt ready for a change. Finally, someone showed up who was well-suited to take over. Someone with the right background, personality, skills, trustworthiness and commitment. Thanks Patrick!

Another factor is that I have always been committed to listening to and seriously considering every point of view. That includes the views of members, staff and of the directors. I form strong views on certain issues but have always been open to modifying or dropping my views when good reasons were given for doing so. As a critical rationalist, I do my best to practice my philosophy. A huge part of that is to value learning over having to be "right." To spread that practice through the organization, when I first started as president, my first cultural memo urged everyone to "Question Everything."

The Alcor President bears tremendous responsibility not only for living members but, even more critically, for cryopreserved members who cannot speak for themselves. That's just part of the underlying stress of the job. Another one, much more painful to deal with, is that the job attracts incredible hostility. On becoming President, I immediately found that I had become the target of the most vicious, hateful, dishonest attacks. I developed a thicker skin over time. Even now, occasionally those attacks can really bother me, so I am always working on strengthening my ability to distance myself emotionally even from the most personal attacks.

2. What were the major challenges that you faced when you became president?

At first, just getting up to speed. Certainly, it helped that I had been involved in cryonics since 1986, had started the first cryonics organization in the United Kingdom, and had been trained in certain procedures. For the first months, I listened a lot and absorbed the organization's culture, relationships, interpersonal dynamics, procedures, and recent history and priorities. The need for more effective succession planning is something I've been improving (codifying much of the relevant knowledge) and, of course, my experience is available to my successor, Patrick.

At times in the past, Alcor had been running with a financial deficit so cost saving measures were implemented. Fixing that was one of my first priorities. Where possible, rather than hiring additional people, I consolidated responsibilities so long as the assigned work could be done by others without overburdening the staff. Other measures are mentioned below.

Another challenge was learning to work with the Board of a non-profit. My relationship with the Board was a major challenge. I think having a learning curve in that regard has probably been true of every President. Alcor's board is incredibly active and involved in almost every aspect of the organization. The "Board" consists of a number of individuals each of whom have strong opinions and personalities. It takes time to figure out how best to work with each director and with the Board as a whole. It can be difficult to find the right balance between listening and deferring and holding your ground.

3. What were the major changes, and setbacks, that took place during your presidency?

Most of the major positive changes I'll cover below. Here, I'll mention just two. The first is a series of expansions and upgrades to the building and the equipment. We have essentially doubled the space available for secure storage of patients. We've done a lot to improve the appearance of a building constructed in the 1970s. We have more office and workshop space thanks to the expansion into "Alcor East" (really just two units toward the east end of the building). We have upgraded the equipment in the operating room, including vastly more effective and cooler LED lights, in-line refractometers, a new, custom-designed OR table, a big screen to observe in real time variables such as perfusion pressure, temperatures, flow rates, and cryoprotectant concentration. The list goes on. (Steve Graber played the biggest role here.)

More recently, we have added a second OR dedicated to pet cryopreservations but that can also be used in case of two simultaneous human cases. A major change has been the introduction of CT scanning for almost every patient. Alcor had rarely done CT scans in earlier years as the technology was very expensive and still emerging as it related to cryonics research. Around 2011 or 2012, we increased the frequency greatly. A few years later, thanks to the generous and smart donation by Brad Armstrong to the Hal Finney Cryonics Research Fund, we were able to buy our own CT scanner. That enabled us to do CT scans not only after cooling but prior to surgical procedures for perfusion.

One major change was the development and implementation of the Underfunding Plan. I can't take much credit (or blame!) for that but it was a massive step toward resolving the growing

problem of a potential future financial catastrophe resulting from members with severely sub-minimum funding. Along with that plan came a clear message that there will be no grandfathering of cryopreservation minimums. We all must expect and plan for inflation-adjustment of minimums. Happily, since I started as President, we have not had to raise those minimums, thanks to a combination of low inflation and cost-saving measures, but with time, adjustments due to rising costs sometimes have to be made.

With regards to setbacks, although rare, unfortunately, legal battles when they arise cost substantial sums of money just to defend or prosecute and they can be a distraction due to the time and energy involved. Of course, I cannot talk about specifics, but I do believe Alcor's history of successful outcomes in legal matters strengthens Alcor's position against future attacks. So successfully fighting against an attack is critically important to protect the rights of our patients who cannot otherwise speak for themselves, which is why Alcor fights these battles.

Staff turnover, when it occurs, can also present a setback due to the time and cost of training new individuals in the highly specialized aspects of what we do. There have been several changes to staff in the last several years, and finding high-quality replacements always takes time. Happily, though, open positions such as the Medical Response Director, have been filled by individuals of integrity, dedication, and talent.

4. Do you see Alcor as being stronger now than it was when you first took over as president? And if so, what are the changes or improvements that have most contributed to that change?

A good team became stronger over time. Overall, I think the Alcor team functioned more smoothly and cooperatively than before my arrival. The few exceptions show just how crucial it is to carefully select new team members for qualities other than qualifications on paper. In the past, we have often been faced with the problem of too few plausible candidates for positions at Alcor. Perhaps due to an improved public image and to professional interactions with existing staff, we are finding far more qualified candidates. This allows us to be more selective. This bodes well for the quality and compatibility of team members going forward. This trend is supported by more emphasis on succession planning.

Size of membership matters greatly in supporting Alcor's operations. During my time, membership grew around 40%. That is in spite of a slowdown (and slight reversal in one year) as two rounds of major increases in membership dues took effect – combined with the economic fallout from 2008. The Underfunding Plan also resulted in the loss of dozens of members despite our best efforts to provide options for underfunded members. That was painful but necessary. I pushed for reductions in dues and those seem to have helped. I also introduced discounts for long-term members to help retention.

Unfortunately, when we lose members, it's all too common never to learn the reason. They simply stop communicating. Given budget restraints, we must pick and choose our battles, but we choose areas to improve, such as initial communications with potential new members and then apply resources to beef up those capabilities. One problem area in the past has been the lack of a powerful IT infrastructure – a customer relationship management system. As a small non-profit with limited resources, sometimes we have to wait to implement major upgrades. We have been upgrading our IT and my push to adopt Salesforce (or equivalent) finally bore fruit. The results have been so pleasing that I think everyone is now on board with continuing to realize my goal of easing the signup and membership maintenance process by simplifying paperwork, putting more of it online, automating it, and using online notarization. The new leadership clearly supports continuing in this direction. This is crucial if we are to be able to handle growing numbers of applicants.

We are always striving to improve, so we are always working on succession planning and improving training processes. Of course, like any emerging technology, as science evolves, there are also updates needed for protocols, SOPs and manuals. When updating procedures, which is a crucial aspect of running any organization, having access to long-term organizational memory is helpful but of course some of that can be lost when a key person departs, so succession planning is a key element of our growth. Managing finances is also a key element of operations that always requires careful planning, especially for a tightly run non-profit. During my tenure Alcor's finances moved into a healthier level. Unfortunately extraordinary fees such as legal costs can obviously hurt budgets, so that is always something that presents a challenge.

5. What accomplishments during your presidency are you most proud of?

I'm proud of working to reduce membership costs and of creating various funding options. The latter have not yet been exploited much but I believe they could be in the future. I was pleased to catch an unnoticed increase in liquid nitrogen costs early on and to negotiate a 40% reduction in cost. I was also able to reduce operating expenses (especially electricity). I think it was a good move to increase the financial allowance for members to relocate to Scottsdale if they are terminal.

Also on the financial front, I noticed the lousy, sub-inflation returns on Alcor's operating and reserve funds and moved them into investments designed to safely generate a reasonable return over the medium term. In 2016, for instance, this generated substantially greater returns.

Although the donors should get the major credit for stepping up, I played a primary role in raising almost six million dollars in donations. As mentioned above, $5 million of that was dedicated to research, the results of which you will be hearing more about soon. Both before and after that fantastic donation, I facilitated new research, such as the *c. elegans* memory preservation work, the brain-only study initiative, the CT scanning project, and many internal technical improvements.

One particular strength of mine is the ability to communicate complex ideas in a way that most people can understand and find reasonable. Since you've given me a license to boast a little, I'm going to throw out this quote within-a-quote: "In 1995, Jim McClellan interviewed More for the UK newspaper *Observer* and noted, 'The funny thing about Max is that while his ideas are wild, he argues them so calmly and rationally you find yourself being drawn in.'" Over the following 25 years, I've continued to refine my communication abilities. This has benefitted Alcor by giving us a higher profile in the media and, more importantly, a far more *positive* profile.

I have overseen and participated in dozens of cryopreservations. I've helped coordinate responses; I've talked to Medical Examiners; I've taken refractometry readings; I've cleaned up spills in the OR; I've helped transfer patients into long-term storage; I've scribed in the OR; and I've talked to relatives and hospital administrators. That helped me get a firsthand idea of the challenges, unexpected obstacles, and problem-solving approaches involved, especially in the operating room and in the area of logistics.

By observing all those cases and overseeing them, I not only learned a lot, I was able to contribute fresh ideas to improve processes. For instance, the surface convection cooling device (SCCD or "squid") was not being used. A probe into the reasons for that led to a redesign and reintroduction, thereby improving the existing 'state of the art.'

I was also instrumental in implementing Dr. Steve Harris' method for calculating the optimal time to discontinue cardiopulmonary support (CPS), which improves on the old default calculations.

While focusing on the big picture, I always tried to keep an eye out for operational and environmental details that could be improved. That led to the installation of a backup generator with 30-hour runtime in case of power outage during surgery and perfusion; to improved security; and to insulation that slashed power bills.

I'm very much looking forward to continued progress in a project to automate and move online membership application and document processing. We managed to upgrade our IT infrastructure, including adoption of a CRM (Salesforce), better group collaboration forums, new timecard system, and online/cloud-based accounting. Also, very importantly, we set in place new technology to store backups of patient and member files to the cloud.

We made several improvements to both physical and information security, and I was able to get the Board to institute a new policy of carrying out background check for all new directors, staff, and others. Working with our partners and groups outside the USA, I was able to make modest improvements in our international response capabilities.

I chaired and shaped two successful conferences – which wouldn't have been possible without staff support, most of all Marji Klima. We haven't had a conference since 2015 for a couple of reasons, but I look forward to being involved in our next one.

I'm not sure it's *my* accomplishment, but I like to think I had something to do with Linda Chamberlain returning to work at Alcor. Linda has been an unrelentingly productive and dedicated part of the team. We affectionately call her "Mad Dog," not because she foams at the mouth but because once she has sunk her metaphorical teeth into a task, she will see it through no matter what. Having Alcor's co-founder working with us again has been valuable both practically and symbolically.

It goes without saying that none of these accomplishments would have been possible without the support of staff, directors, and others. I could provide a very long list of thank yous to everyone, but this is a *Cryonics* article, not the Academy Awards.

6. With 9.5 years as president, what advice can you pass on to those who follow you?

Choose a short name. You will be signing a lot of documents.

No matter how busy you are, don't forget about your health. This can be a highly stressful job and it's easy to let healthy habits deteriorate over time. That only adds to stress and reduces performance. Investing time and focus on exercise and good nutrition has a high payoff both personally and organizationally.

7. Can you name a topic (or a number of them) that you changed your mind about during your Presidency?

I tend to favor maximal openness. I have always been open about my cryonics arrangements. For instance, during the Dora Kent crisis in the late 80s, my professors (at USC) and fellow grad students all knew about my cryonics involvement. Since cryonics clearly involves a range of philosophical concerns, it was natural for me to discuss it. In fact, it became an important part of my doctoral dissertation. No doubt many of them found me eccentric (even for a philosopher) but my unabashed, unapologetic approach combined with a willingness to explain cryonics in rational terms minimized negative consequences. However, as President, I came to understand why openness has to be limited sometimes.

Most obviously, respect for legal considerations and consideration of possible misinterpretations limits what and when you should say certain things (no matter how truthful). I've also come to accept

that sometimes you need to have a private conversational space to develop ideas and policies before opening up to the membership as a whole, otherwise you can get deadlocked spending time arguing points that may be more quickly dismissed when vetted in a small private conversation. The tug of war between openness and private discussion during board meetings remains a live issue.

Other than openness, it's hard to think of any major topic on which I've changed my mind in a fundamental way. One big reason for that may be that I tend to be cautious about forming a hard opinion or belief about something, especially when I see a diverse range of views among extremely smart people. More than most, I hold my initial beliefs lightly, especially where hard evidence is lacking or where many alternatives exist. My view solidifies only as I hear and absorb multiple viewpoints.

8. Speaking on a personal level, which Alcor policy would you most strongly like to see changed?

A change in the structure of membership dues. We are discouraging younger people from joining due to the cost of the dues relative to their income. Younger people will be paying dues for much longer and typically will not need to be cryopreserved anytime soon. I have explored options for introducing a lifetime membership, but there may be better approaches. It's a tricky issue because future costs are impossible to predict with certainty. Should younger people pay lower dues because they will be paying for more years? Should members pay less if they earn less? Long-term discounts help to some extent but do nothing to encourage younger members to join rather than to cryocrastinate.

I would like to eventually raise the draw on the Endowment from 2% to 3%, on the condition that we are seeing inflows of funds (and not just investment returns). The logic of the 2% draw is that it results in a very small risk of running out of money even in a prolonged downturn in investment returns. Other non-profits draw more like 4% or 5% and still grow their endowments. That's because of new inputs. This change is not something I would favor pushing hard for until we see a more robust stream of additions to the Endowment.

9. Having observed Alcor and its operations from the inside, have you become more or less optimistic about its longevity and the revival of our patients?

We still have some work to do before I would feel highly confident in Alcor's indefinite longevity. (I'll be delving into this matter in the next issue.) Due to our modest size and limited resources, we still have a need for backup of key personnel and as a non-profit, of course we can always use additional funding. However, we are definitely heading in the right direction.

As Alcor closes in on its 50th anniversary, I am more confident in the organization's survival and ability to one day revive our patients. But that confidence is relative; we still have a long way to go to gain widespread public awareness and to become an unstoppable force.

I remain hopeful that some of our wealthier members will contribute far more to the Endowment and to research and building up our capabilities. If I had great wealth – and especially if I were my current age or older – I would want to provide support not only because I believed in Alcor's mission but as a pragmatic matter, to improve my own chances. (Some wealthy members have contributed substantially; perhaps others are waiting for the right time or the right cause.)

Alcor has long enjoyed several advantages over other cryonics organizations when it comes to longevity. Having a Patient Care Trust Fund and the Alcor Care Trust helps to ensure Alcor's longevity. The structure of these trusts and the excellent management of their assets has increasingly solidified Alcor's ability to maintain patients over the long term.

I would like to say that most members do not see and have little or no awareness of the tremendous, unpaid work done by the Board of Directors. Although those of us in the day to day management of Alcor may gripe about being slowed down by protracted Board discussions, the directors are each extremely smart and have deep expertise in various areas. Some people complain that the Board is not elected by the members. Those complaints fail to realize that Alcor's model is the standard one in the non-profit world, and for good reason. (Again, I'll discuss this more in my article next issue.) The Board plays a critical role in Alcor's longevity.

In addition to our internal capabilities, we have long benefited from Suspended Animation. More recently, International Cryomedicine Experts (ICE) – formed by former Medical Response Director Aaron Drake with Eric Vogt, has further boosted our ability to respond far afield and in more places at the same time.

Finally, over the last few years, I've been encouraged by new interest in Alcor from attorneys and financial planners. Along with more positive media attention, these are early signs of greater cultural acceptance of cryonics.

10. Do you have some non-cryonics related projects in the pipeline we should be excited about?

It's too soon for me to have thought much about projects outside of cryonics. Obviously, I remain highly involved although no longer on a daily operational level. I have and remain available to Patrick Harris as he transitions from COO to CEO. Much of my attention is still given to thinking about cryonics, writing articles and blog posts, and doing media for Alcor. Once my creative mojo has ramped up some more, I would love to write a book on cryonics. No, I want to write THE book on cryonics! A book that is accurate, informative, and engaging. ■

The Alcor Meta-Analysis Project

By Michael Benjamin

Since its inception in 1972 Alcor has cryopreserved more than 170 patients. For the majority of these, case reports and comprehensive case data are available. There have been several attempts to look at trends and the quality of patient care during specific periods, though there has never been a comprehensive and systematic attempt to do a full-scale meta-analysis and review of Alcor case work. Advanced Neural Biosciences (ANB) and Alcor have embarked on an effort to do just that. ANB began the Alcor Meta-Analysis Project in January 2019 with the goal of developing a quantitative method or methods to evaluate the quality of each cryopreservation case based on a thorough review of all the available case data.

The project has 3 phases.

Phase 1 is a review and collection of relevant data points from all case reports, all raw data such as temperature data taken throughout each cryopreservation case, and any relevant scientific papers. CT scans of cryopreserved patients, which were started in 2010, will also be incorporated into the review. The scans were initially intended to be used for validation of the placement of acoustic fracturing probes but have proven to be a valuable tool in assessing the degree of cryoprotection, ice formation, and cerebral dehydration. Precise quantification of the degree of these variables will be correlated to variables such as stabilization protocol, duration of cold and warm ischemia, transport time, choice of cryoprotectant, surgical techniques, and perfusion protocols to understand the relationship between the conditions under which a patient is cryopreserved and outcome. The results from CT scans done by an external provider were so promising that Alcor bought its own CT scanner and intends to scan the brains of all of its existing patients.

A database is to be created where all of the collected data is stored and made accessible through a user interface that will allow for viewing by Alcor personnel, updating and adding new data for all cases going forward.

In phase 2, new outcome metrics that look at variables such as cryoprotectant distribution and ice formation, are to be developed from the analysis of Phase 1 data. These metrics will be combined with previous attempts at creating methodologies to develop quantitative case outcomes. The most notable of these have been methods to quantify the total amount of ischemic exposure time prior to long term maintenance. R. Michael Perry's "Measure of Ischemic Exposure" (MIX)[1] and Steve Harris's "Equivalent Homeothermic Ischemic Time" (E-HIT)[2] were among the first attempts to mathematically model ischemic exposure in a case. For a more complete history of previous attempts at using mathematical modeling for developing quantitative case outcome measures, see "Mathematics and Modeling in Cryonics: Some Historical Highlights," by R. Michael Perry and Aschwin de Wolf[3].

For phase 3, using the data and metrics collected and developed in phases 1 & 2, it will be possible to identify several areas where protocol and procedure upgrades would likely have the maximum impact at improving patient preservation outcomes. New experiments to both validate the models and identify additional areas where the biggest improvements can be made will be designed.

So, at the completion of the project, Alcor will have, 1) a complete secure database of all the important case variables gleaned from case reports, raw data and CT Scans, 2) a user interface for easy access to the database to view, update existing data and upload new case data as it becomes available, 3) a single or set of case metrics that provide a quantitative result that measures the quality of each patient preservation, 4) a set of recommendations of new and/or updated protocols for future cryopreservations, 5) additional research recommendations for further in vivo research projects, and 6) a paper including the exposition of the cryonics case outcome metric(s) and experimental validations, which will be submitted to a scientific journal.

Where are we now?

As of this writing, Alcor has 178 patients in suspension. For each of those patients ANB and Alcor have chosen 605 data points, or variables, to be gleaned from the case reports. That is a total of 107,690 data points from the case reports alone. These datapoints include variables such as the time between pronouncement of legal death and start of cardiopulmonary support, the type of cardiopulmonary support, medications administered, average cooling rate during cardiopulmonary support, any organ preservation solution used, the duration of cryoprotection, exposure time to highest concentration of the cryoprotectant, weight gain or loss after cryoprotection, cryoprotectant, acoustic fracturing data, and CT scan data. Adding raw data, such as extensive temperature data, we have over 1 million data points.

Gathering the case report data requires reading through each case report or case files for cases that do not yet have full case reports completed, with a fine-tooth comb. While most of the information we require to do the meta-analysis is embedded in one form or another in the case reports, it can be a challenging task to put the pieces together that exist in different areas of each report. It is sometimes more of an exercise in document forensics than just reading through a report. The earlier case reports were not always in a formal format driven by report guidelines, but the quality of case reports has greatly improved over time. There are many variables that contributed to how case reports were written early on, including quickly evolving procedures, changing personnel with reports written by different people and different writing styles, many of whom were part time or volunteers, lack of cooperation from medical facilities, and difficulty finding cooperative funeral homes. This often created challenges getting through procedures in a timely organized fashion and getting all the notes written down in a standardized way.

As an example of the forensic nature of gleaning data from some case reports, timelines of events were not always written out. The times of an event, such as the start and end time of a washout or medication administration duration, were sometimes in different parts of the report or were only implied by the start or end of other steps that generally preceded or followed the event in question. You might see something like "cryoprotective perfusion started at 4:15 pm." Then the next thing you see is "cooldown started at 6:47 PM." The assumption in this case would be that cryoprotective perfusion ended sometime close to 6:47 PM as cooldown usually comes right after cryoprotective perfusion. Now this is not a perfect solution, so the data has to be weighted compared to more accurate data from other cases with clear time stamps, for use in the final analysis. This all creates multiple layers of complexity in ensuring our final analysis yields a good quantitative valuation of the quality of a preservation. It's no wonder a full analysis of all cases has not been done before – this requires significant effort and manpower.

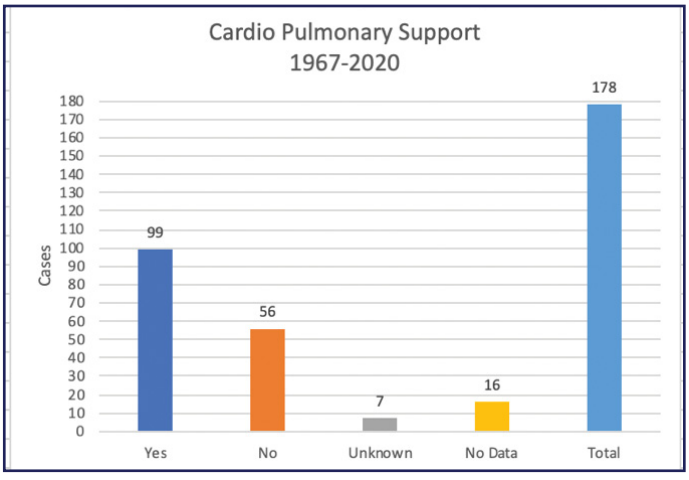

Figure 1

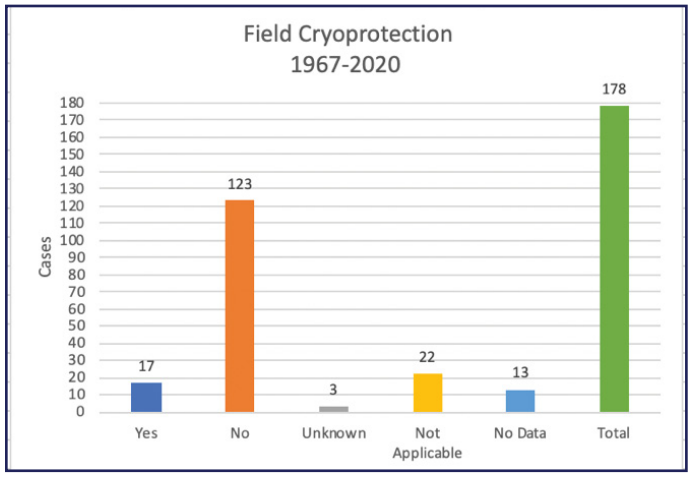

Figure 2

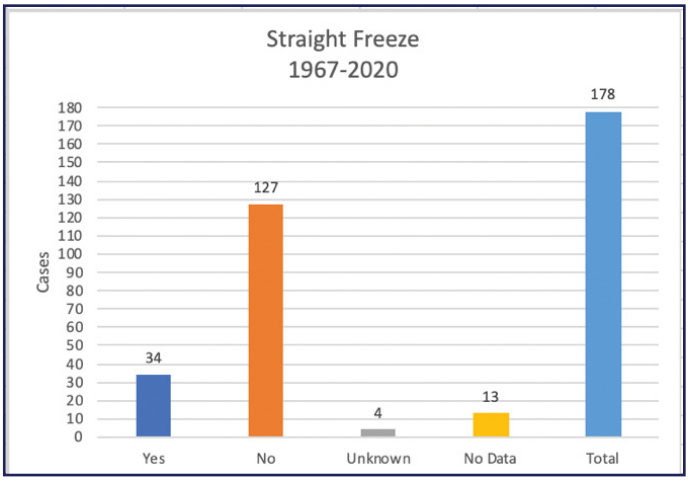

Figure 3

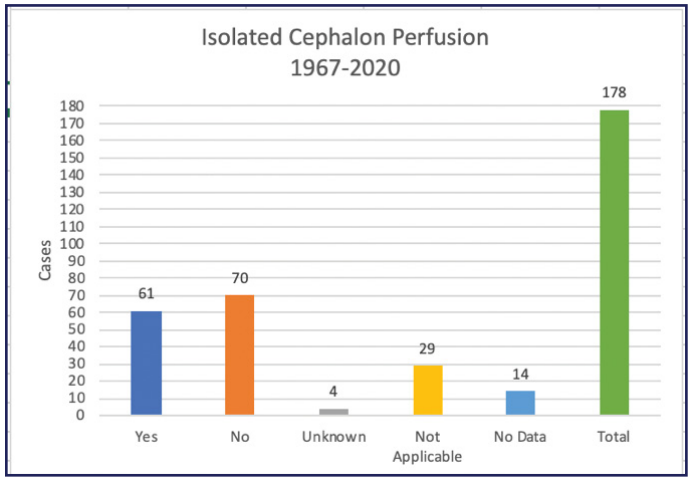

Figure 4

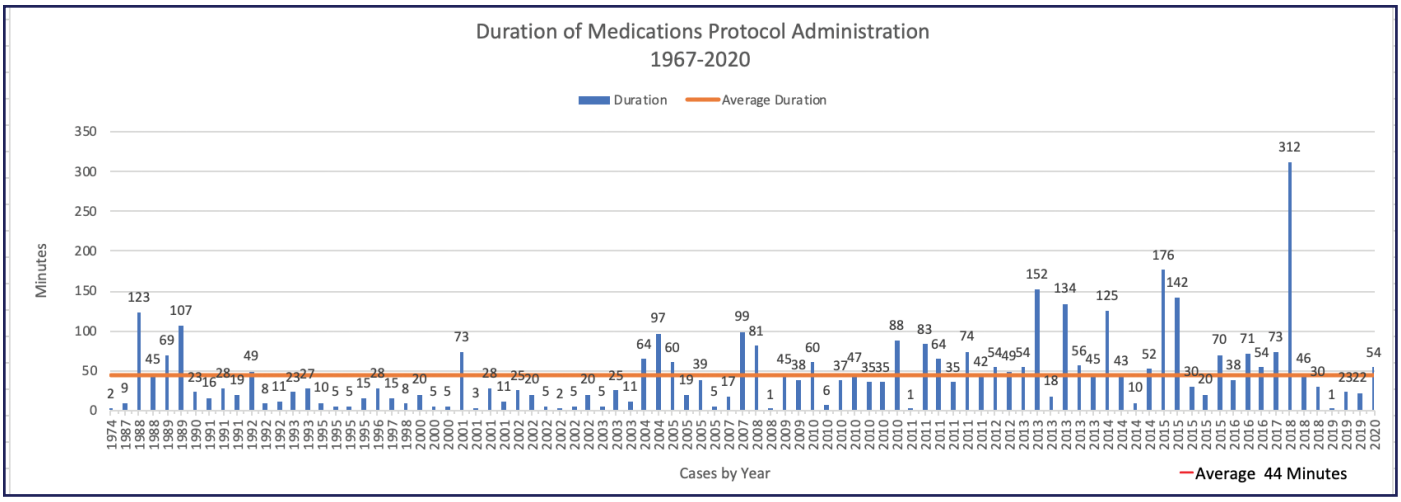

Figure 5

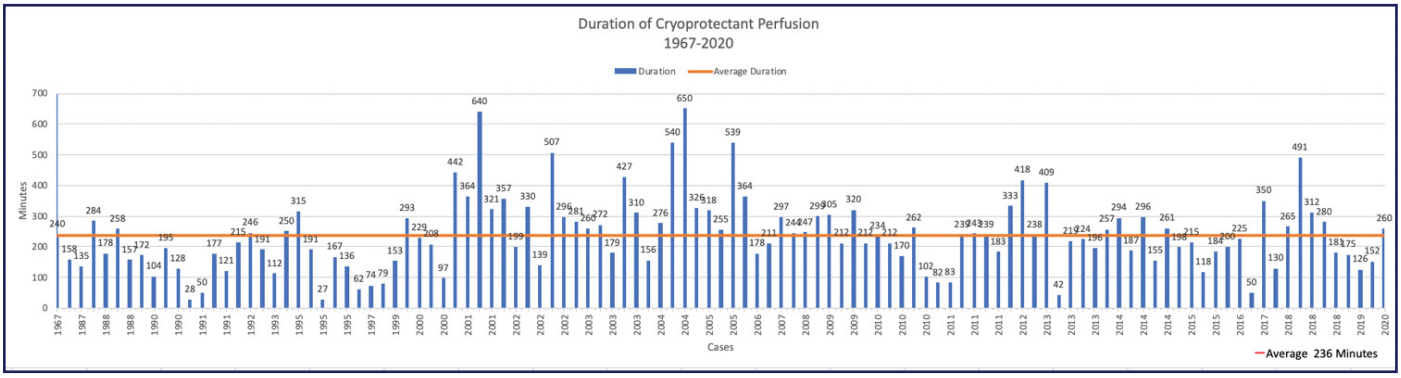

Figure 6

How are we handling all this data? We are entering the data into a secure, HIPAA compliant database. The 107,690 variables gleaned from the case reports are being entered by hand, be it in a spreadsheet first that gets imported to the database later, or through a database interface application built by ANB. For large datasets, such as temperature data, most of them are in spreadsheet form that require some cleaning up to be put into a format that can be uploaded to the database. Then there are cases where the temperature data is in print form only. Methods like text recognition and transfer to an up-loadable spreadsheet are used to simplify extraction and entry into the database. This data still has to be checked carefully for errors which can also be time consuming. When those methods are not feasible, for instance when the print copy is poor and the text recognition software cannot recognize all the data, it has to be entered manually into the database.

The full set of data is 605 variables per case. As of this writing, we have completed a subset of that data for every case of 60 variables per case. This subset started at 50 variables and grew to 60. With 178 cases to date, that is 10,680 data points. The full set is actively being collected and entered into the database. We carefully built the database to ensure the best design for the type of analysis we will be doing and to ensure security of the data, making it HIPAA compliant. The database interface provides a number of functions to the user, including viewing, adding and updating data, and provides a plethora of chart options that can be used for statistical analysis. The database contains all data gathered up to this point and a set of statistics has been compiled on the subset of data (see Figures 1-6). The focus now is the completion of collection of and entry into the database of the remaining full set of variables. Initial work has also begun on evaluating quantitative metrics to determine preservation quality.

Where are we going? We expect to have the complete set of data entered into the database by the end of the fourth quarter of 2020. We are simultaneously working on creating new models/metrics for the quantitative measures and evaluating them in congruence with the existing MIX and E-HIT methodologies. By the end of 2020, for each of Alcor's cases, we will provide a succinct report of about 10 variables that will weigh heavily in the derivation and testing of a quantitative metric of case quality.

Once this project is completed, it will benefit Alcor and the cryonics community as a whole in a number of ways.

- All Alcor's case data information will be entered in a comprehensive database, which can be subsequently used by Alcor to update and consult.
- The complete meta-analysis will provide Alcor with important information about trends and outcomes of Alcor procedures.
- Recommendations to improve procedures, case work, and case logistics.
- Development of a quantitative outcome metric will provide Alcor and outside observers with an objective, evidence-based metric to assess the quality of specific cases.
- The experimental research component of this project will provide Alcor with information about the range of typical patient scenarios, including the modelling of unusual scenarios.
- Systematic documentation and analysis of Alcor's CT scans will permit Alcor to understand the relationship between the characteristics of a case and its (expected) outcome.
- Collection of individual case data and their analysis in a broader scientific framework will be the first step to understanding a patient's future revival needs. ■

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Alcor Longevity Circle of Distinguished Donors

The Alcor Board of Directors is pleased to announce the formation of the **Alcor Longevity Circle of Distinguished Donors**. This new organization will honor those members and their foundations that have donated in excess of $100,000 over the past few years to support Alcor and its affiliated organizations. In addition to being recognized in Alcor publications and at conferences and other events, members will also be entitled to:

- Exclusive access and a quarterly conference call with Alcor Directors, officers, and officials to get in-depth briefings and ask questions and make suggestions.
- Special recognition, seating, and access to officials at Alcor conferences.
- An exclusive yearly, hosted in-person event honoring members with face-to-face interaction with Alcor Directors, officers, and officials.
- A unique, professionally designed and engraved memento of their membership.

These benefits are, of course, overshadowed by the immense gratitude members' and patients' families will always have for these especially generous individuals. The Board looks forward to announcing Charter members of the Longevity Circle who qualify by December 31, 2020. New levels of membership (higher and lower levels of participation) may also be announced in the future. ■

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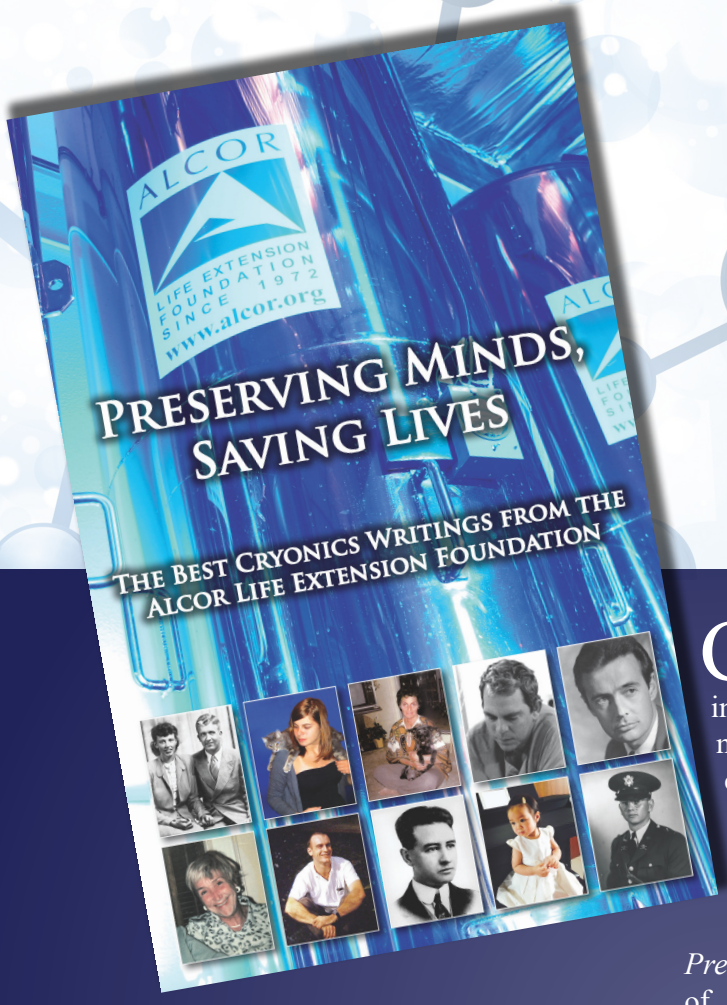
Preserving Minds, Saving Lives

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."

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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.

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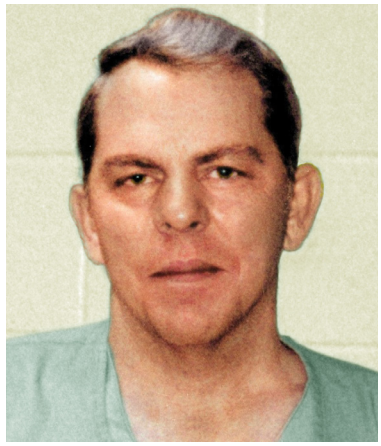
Jerry Leaf: Researcher, Surgeon, and Cryonics Advocate

By R. Michael Perry



I have been to war, and fought with valor.

I have explored the unknown, and discovered.

I have friends, and I care for them.

I have found a fine woman, and I love her.

I have fulfilled my commitments, and my name is integrity.

I could not share my grief nor my anger, and now I am alone.

I now have to decide, and live or die.

– Jerry D. Leaf

Foreword

It was the summer of 1991, 29 years ago as I write this, that Jerry Leaf, prominent cryonics researcher and longtime activist in the field, became a patient at Alcor. He was the victim, at age 50, of a coronary attack. His story I have told briefly before, later reprinted with minor edits.[1] An abridged version of this synopsis is included here as an introductory section, followed by summaries of major experiments, cryopreservations, and other highlights of Jerry's career. After this is some quoted material written in tribute by Ralph Whelan and others. The old term "cryonic suspension" is used throughout the quoted material for what we usually call "cryopreservation" today, and sometimes I have used the older term to avoid incongruity.

18-year-old Jerry Leaf in Guatemala, 1959.

Introduction

Jerry Donnell Leaf was born April 5, 1941 in Artesia, California, close to Los Angeles, the son of Frederick Oliver and Alice Rowena (Barnes) Leaf. He spent much of his life in the Los Angeles area, punctuated, as a young adult, by excursions to places far around the globe.

After graduating from high school in 1959, Jerry and a friend set off for the wilds of Guatemala, where they spent a month roughing it. On returning, Jerry enlisted in the U.S. Army, was sent to Germany, and witnessed atrocities attributable to the East German communist regime. He wanted to strike back against world communism, so he volunteered for a Special Forces unit, and was sent on a secret operation to Vietnam. Bluntly, he became an assassin, "delivering death," though under circumstances he felt were justified. "I do not regret having fought against an organized political system," he said in 1986, "which, even today, threatens the freedom of its own citizens and those of neighboring countries."

Combat took its toll; the casualty rate in his own unit would eventually exceed 50%. The extreme hardship provided its own hard-won perspectives that would later bear fruit: "There is a special kind of chemistry and feeling that is shared by people who face death together over a period of time. I came away from these missions with the face of death having a very specific meaning; it was defined by a roll call of men we carried out of North Vietnam. They went home; there were no MIA's. I lived because of these friends, and it was the worst feeling not to be able to reciprocate."

Jerry's wartime experiences would in fact orient him toward an unusual career in trying to extend human life. He lost his own fear of death "somewhere in the jungles of Vietnam" but retained "the fear of not being able to save someone else that I care about" – and a love of life. After Vietnam he returned to Germany, and then to the U.S. "I began to become increasingly concerned over the issue of life and death – over the tremendous importance and preciousness of life." When he left the military, he tried gold panning for a few weeks in northern California and roughed it for a few more weeks in Honduras, alone. In 1965 he married Kathy Connaughton; they would have two children. Meanwhile he had enrolled in Cerritos College. In 1966 he heard about a lecture on cryonics (given by Robert Nelson), attended, and started corresponding with cryonics groups.

Jerry with wife Kathy and daughter Kristen

After receiving a bachelor's degree in philosophy, Jerry began doing graduate work in low-temperature biology at the University of Nevada, but within two years gave it up. The university was oriented toward ecological studies. Jerry "began to realize that I knew more about low temperature biology from my independent studies than they did! That, coupled with the lack of equipment available for graduate research caused me to make the decision to return to Southern California."

Jerry never did get an advanced degree. Instead he started working in the operating rooms at UCLA. In time he would become an instructor in thoracic surgery, coauthor over 25 papers from the UCLA laboratory, and set up a program for the cryogenic storage of heart valves and arteries for transplantation into children. Meanwhile he began to acquire equipment for his own use. In 1977 at Trans Time he directed the first total body washout and recovery of a dog by cryonicists. (The animal lived 17 hours.) Soon after this he was the team leader in Alcor's first experiment, a cryopreservation of a dog whose tissues were tested afterward for quality of preservation. (Recovery of live neurons from liquid nitrogen temperature was demonstrated.) Jerry then set up an independent company, Cryovita, to further pursue this work, opening an office in Fullerton in 1978.

Jerry was also a longtime member of the Society for Cryobiology, where he tried to educate the scientific establishment about cryonics and win its acceptance. Unfortunately, this would prove elusive. In 1982 he campaigned, courageously if unsuccessfully, against an anti-cryonics faction within the Society. They were able to rewrite the Society's bylaws to deny membership, and expel existing members, for "any practice or application of freezing deceased persons in anticipation of their reanimation." Though Jerry was never expelled, known cryonicists were afterward excluded. It was clear that the scientific mainstream was not the place to turn to for support.

In the years following, Cryovita would instead work closely with Alcor, which would also be headquartered at the Fullerton address. (The two organizations moved to a facility in nearby Riverside in 1987.) In July 1984, Alcor/Cryovita under Jerry's direction, assisted by Mike Darwin and others, revived a dog after total-body washout and hypothermia. It became a longterm survivor without detectable deficits, which again was the first achievement of its kind by a cryonics group. (A non-cryonicist, Gerald Klebanoff, had pioneered this work in the 1960s.) Soon Jerry and Mike were reviving dogs from 4 hours of bloodless perfusion at 4°C, which lent much confidence that at least the initial stages of a cryopreservation were reversible. Their work led to such innovations as use of an extracorporeal membrane oxygenator for body washout, a better base perfusate, and silicone oil or "silcool" instead of isopropyl alcohol as a heat exchange medium in patient cooldowns as then performed (nonflammable and less injurious on contact with tissue).

When the Dora Kent crisis erupted at the end of 1987 Alcor's promising research was put largely on hold, and Jerry's courage found a new outlet. His staunch dedication to Alcor and its patients during this well-publicized confrontation cost him his job at UCLA, but his support never wavered, and it helped pull the organization through. By mid-1991 the crisis had been weathered and Jerry was eager to resume cryonics research – but it was not to be. He was a heavy smoker who had tried to quit but not succeeded. On the night of July 10, 1991, aged fifty, Jerry Leaf suffered a cardiac arrest. He had not had a prior history of heart disease and thus was a possible candidate for autopsy. Fast action by Alcor personnel, especially Saul Kent, working through attorney Christopher Ashworth, prevented this, and Jerry was cryopreserved, though after a delay of several hours due to the unavoidable complications. Alcor suffered because of his untimely demise, but benefited greatly while he was active, and cryonics achieved a new level of technical competence and respect.

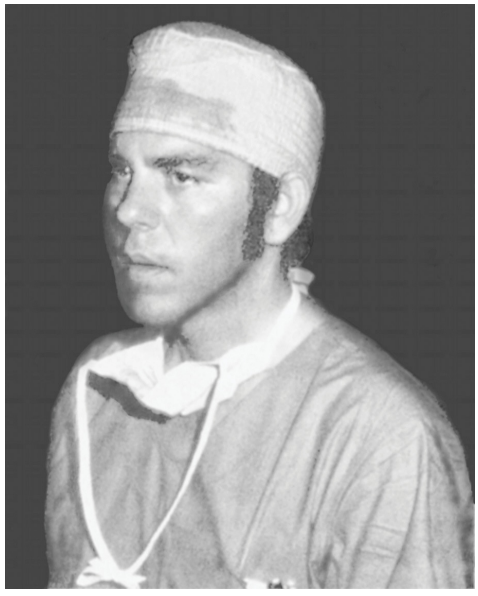
We now turn to a closer examination of Jerry's career in cryonics, filling out or adding to much of what is briefly sketched above. The principal sources are *Cryonics* magazine for the period 1981-91, and before it, *Long Life* magazine, 1977-80 and its sister publication, *The Cryonicist!* In quoting material I've made minor corrections, inserted material in square brackets [], and indicated elided material as usual (…). Occasionally I've modified typefaces or capitalization in the interest of uniformity and readability. In a few cases I've also made substitutions for pseudonyms when the real names later became public.

Dog Experiment, July 1977[2]

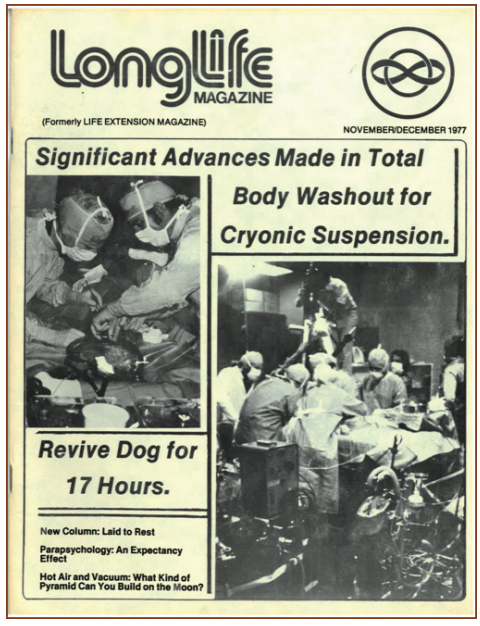
The experiment was performed at Trans Time's facility in Emeryville, California, starting Friday evening, July 22. Art Quaife in an introductory article notes that the Trans Time Board of Directors paid Jerry Leaf a visit and were impressed with his "extensive experience in cardiopulmonary bypass operations using hypothermia," and because "he owned substantial surgical equipment for his private laboratory." Jerry agreed to "come to the Bay Area with his equipment to demonstrate these surgical procedures on experimental dogs." (It would be on a weekend with an ABC-TV film crew visiting, to prepare a feature on Trans Time for their show *Special Edition*.) Quaife and his group "wished to learn how Phase I of cryonic suspension should be carried out in a medical setting, while attempting to duplicate Dr. Gerald Klebanoff's success in reviving dogs after total body washout."

"Phase I of cryonic suspension" refers to the initial procedure of cryoprotective perfusion, "total body washout," in which the blood and body fluids are replaced with "base perfusate" in preparation for introduction of cryoprotective agent(s) (Phase II). Jerry Leaf in his own writeup of the experiment summarizes the objectives as follows:

"With this experiment we hoped to achieve four main objectives. First, to test the feasibility of using a limited bypass procedure – femoral-jugular-femoral bypass – for obtaining deep hypothermia and total body washout. Second, to determine the value of a physiological solution similar to Klebanoff's[3], as a perfusate for total body washout. Third, to establish a model for future experiments. Fourth, to demonstrate and teach, by direct participation, those Trans Time personnel who will later be involved in the use of this procedure as a research model."



Jerry at dog experiment



Cover of Long Life magazine showing scenes from the experiment, including TV filming. Jerry can be seen in the upper right of the left image on the cover, with Jerome White.

A technical section, here greatly abridged, describes in detail what was done. A mongrel male dog weighing 22 kg was anesthetized. Both femoral arteries and the right external jugular vein were cannulated, to achieve "femoral-jugular-femoral bypass." Using a roller pump, the dog's blood was then replaced with perfusate consisting of lactated Ringer's solution (85%, v/v) with plasmanate (10%), and heparinized sodium bicarbonate (5%). During the replacement, known as total body washout, the temperature dropped from its normothermic value of 37°C (canine body temperature, similar to human body temperature) to 22°C. The dog's heart stopped beating at 25°C. With the washout complete and the blood almost entirely replaced by perfusate, blood reperfusion was initiated, this being about 40 minutes after the start of the washout. Rewarming also occurred during this phase, and the heart started beating again at approximately 27°C. "At 33°C," Jerry reports, "the bypass was terminated and the dog was able to sustain his own blood pressure at acceptable levels." Later the dog resumed breathing, though did not recover consciousness or become a long-term survivor. The experiment was a milestone in cryonics, nonetheless. Jerry summarizes the significance:

> We learned enough to make the next experiment work the way it should. The dog survived 17 hours after revival. A veterinarian determined that the dog had pulmonary edema and that little could be done for him. The surgical procedures started at 1:30 PM on July 25 and the dog expired on July 26 at 9:45 PM. Contributing factors in the development of pulmonary edema were: (1) extended bypass time, (2) too high venous pressure sustained too long, (3) low onconicity of perfusate.

Understandably there was disappointment, but still the results were encouraging, as one other highly interested observer, Saul Kent, would proclaim:

> The entire weekend was an exhilarating experience for all who attended, despite the long hours and tediousness of much of the work. For once, we were taking a giant step towards extending our lives entirely on our own – without the help of any institution or the hindrance that such an association often involves. We were proud of what we accomplished and determined to continue to move forward.

The technical success of the experiment had an important consequence, Quaife tells us in his introduction, in that "Jerry has agreed to head up our Trans Time suspension team in the Los Angeles area." Manrise, an organization for doing cryopreservation that was started by Fred and Linda Chamberlain, had just merged with Trans Time, so now "we plan to integrate the former Manrise equipment and personnel with Jerry's laboratory. We will then be capable of conducting cryonic suspensions using the best medical techniques and equipment available anywhere."

Second Dog Experiment, September 1977[4]

Close on the heels of the experiment above, the Trans Time team conducted a second canine experiment, this one sponsored by Alcor, to assess the quality of brain preservation after cryopreservation. Here there was no attempt to resuscitate the animal but instead a head-only (neuro) cryopreservation was performed, then the brain examined. Laurence Gale's writeup of the experiment opens as follows:

> Sunday, the 24th of September, the Trans Time Team performed the first of a series of Alcor experiments designed to gain information about the cryonic suspension and, eventually, reanimation of animals. Much of the data and evidence used in past human suspension efforts has been derived from research done by others on cells and organs such as sperm and kidneys. The application of this research to the suspension of humans is uncertain.

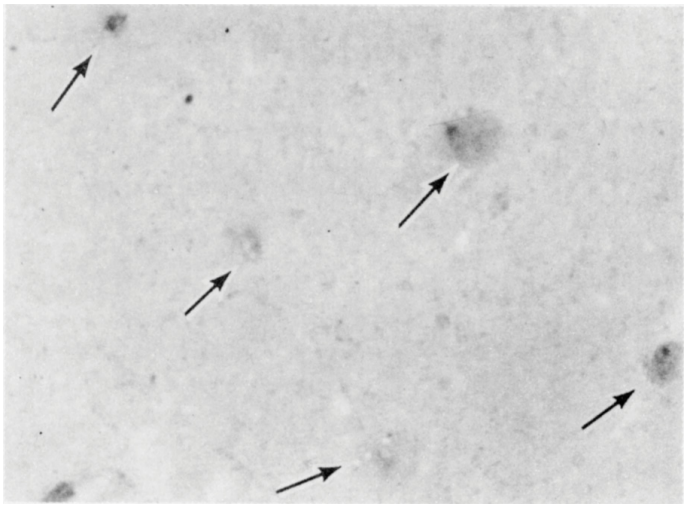
As Gale's report indicates, this experiment was intended to duplicate, as far as possible in a canine model, the cryopreservation procedure used for Fred Chamberlain II two years earlier. It was hoped thereby to "increase the skills of the suspension team and establish a quality base line for future experiments." Jerry Leaf's importance to the occasion and more generally is not overlooked: "His pharmacological knowledge and surgical proficiency make Jerry the ideal focal point around which the Trans Time suspension team is built."

For the procedure, the experimental animal, a male German Shepherd mix weighing approximately 25 kg, was anesthetized, intubated, and placed on a respirator. Cooling was initiated "by placing bags of ice around and on top of the animal." This proved to be a slow process for a furry creature this size, but after about 5 hours the core temperature had dropped from its initial value of 37°C to 27°, enough to begin perfusion with DMSO-based perfusate. This step was completed in about two hours at a head temperature of 17°. Further cooling of the head to dry ice temperature (-78°) required about 8 hours; later the brain was examined with light and electron microscopy, with "moderately encouraging" results:

> Most of the micro-structure (cellular, nuclear and mitochondrial membranes) are well-preserved. The major damage is in the fine cellular organelles (endoplasmic reticulum, microtubules, synaptic vesicles) and here some cells appear to suffer somewhat greater damage than others. …

...

> Though still preliminary, the following pattern appears to be emerging. Most of the damage occurs in subcellular organelles and not in the cellular organization of the brain. It is a reasonable idea that the



Light micrograph at 1260x magnification showing live nerve cells in dog brain (cerebral cortex) which were chilled to liquid nitrogen temperature and rethawed.

> informational content unique to the brain (memory, for example) is contained in its cellular structure, i.e. the precise connections nerve cells make with each other, and that the subcellular elements provide the energy transductions necessary to read out the information contained in these circuits. …

The subject of the experiment. Science and humanity owe an incalculable debt to research animals like this one that assist in advancing human knowledge with the aims of saving human and other lives and improving the quality of life all around.

Sam Berkowitz Cryopreservation, July 1978[5]

This last-minute, New York case started when the patient arrested on the morning of July 14, 1978 and Trans Time was contacted. The wife and son, Eva and Joe, had been enthusiastic cryonicists and members of the Cryonics Society of New York and did not mind if their names and that of the prospective patient were made public. CSNY was now inactive, however, and none of the Berkowitzes had cryonics arrangements. Funding was verified (by Saul Kent), and plans were made to ship the body to California for cryopreservation. But where to in California? The Trans Time facility in the San Francisco area was ready, but Jerry Leaf, in Fullerton near Los Angeles, was wanted to direct the operations. On the other hand, Jerry had his own organization, Cryovita, with his own team. Art Quaife comments:

> …Jerry Leaf and Fred Chamberlain [Fred III, the son of Fred II who was cryopreserved in 1976] had been alerted of the possible upcoming suspension, and preparations were underway in Los Angeles. Jerry had previously promised to have our Suspension Team trained and his laboratory fully operational by October, so we were jumping the gun in asking them to conduct a suspension then. We realized that the incomplete facility setup and team training would inevitably lead to some snags and delays in conducting the suspension, and considered instead using our San Francisco based team. But we finally decided that Jerry's superior surgical skills and equipment, along with the fact of recent training sessions, would outweigh the expected delays. After receiving the go sign, Jerry spent a long night at Cryovita Laboratories making preparations, while Fred and Linda Chamberlain alerted all of the Suspension Team members to arrive at Cryovita at 5:30 A.M. the next morning.

There was more to be done. Art, who was president of Trans Time, wanted to be present at the event. Trans Time had a temperature chest that would be needed for the perfusion and it would have to be sent down to Cryovita before the procedure could start. Arrangements to airlift it fell through, so John Day drove all night to get it there in time. Cryovita enlisted a local mortician, Joseph Klockgether in Buena Park, to handle paperwork issues, a particularly fortunate move, it would turn out. (Readers may remember that Klockgether had before worked with Robert Nelson in his unfortunately ill-fated operation; later Klockgether would offer years of valuable assistance to Alcor.)

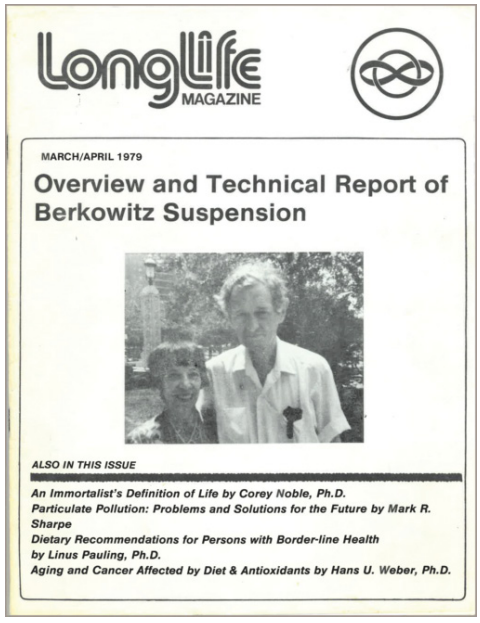
Quaife notes that perfusate mixing "took far too long, in part due to an early error in counting out liters of sterile water, which took considerable time to rectify." Finally, things were approaching a state of readiness to begin perfusing, when there was more drama:

> At about 1:00 P.M. [July 15], the perfusate mixing was completed, John Day arrived with the temperature chest, and Paul Genteman and I returned with more ice and dry ice. As final circuitry setup was proceeding about an hour later, we had an unwelcome visit from a Fullerton policeman and plainclothes detective. They had received a report of "strange doings" at Cryovita, including personnel sighted in surgical garb and the

possibility that there was a corpse on the premises. They interrogated Jerry and me about our purposes. Soon thereafter, the Orange County Coroner arrived to continue the investigation. We explained that all of our purposes were lawful, that the body was an anatomical donation under provisions of the Uniform Anatomical Gift Act. The coroner wanted to see the paperwork that legally consigned the body to us. Because Sam Berkowitz was not a Suspension Member, we didn't have available an Authorization of Anatomical Donation to get the coroner immediately off our back. At one point in the discussions, the coroner threatened to impound the body. Fortunately, Joe Klockgether then came over with the needed paperwork (Burial Permit, Funeral Director's Certificate), which satisfied the officialdom, and they all left.

Technical details of the case are abundantly covered in Jerry Leaf's report (copy available from Alcor). These I have mostly omitted here; some excerpts from the Introduction convey a general impression of the procedure, with comparison to open heart surgery, and offer some interesting commentary:

> The logical surgical approach would be the one that could give maximum access to the major vessels of the body, in case embolectomy [removal of blood clots] was necessary. I chose to use a thoracic approach that would give superior exposure of the heart and all of its major vessels, a median sternotomy approach. Using this approach one can easily access the inferior and superior vena cava, the aorta and great vessels, virtually all the major inflow and outflow tracts of the body. This approach also lends itself to total body perfusion, using cannulation techniques common to extracorporeal perfusion during open heart surgery.
>
> Fortunately, in the case of Sam Berkowitz, we encountered no significant intravascular clotting. The probable explanation can be found in the immediate cause of death. The fact that a highly vascular tumor had hemorrhaged with a large loss of blood caused a nearly complete expenditure of the clotting factors. Hence there was little ability to clot after circulatory arrest.
>
> In suspensions where intravascular clotting may be a significant factor, DMSO may be the cryoprotective agent of choice, because of its superior penetrating ability. Trans Time supplied the DMSO based cryoprotective perfusates. I requested that perfusates be prepared in 5, 10, and 15% (v/v) DMSO concentrations. Stepped increases in DMSO and osmolarity of the perfusate should help prevent osmotic shock, avoiding disruption of the capillary bed. The integrity of the capillary bed is the key to preventing problems of edema, which can force premature termination of perfusion. We saw no signs of edema during the perfusion of Sam Berkowitz.
>
> In general, many problems encountered in past cryonic suspensions were not encountered or were avoided by taking the proper precautions. One problem I had not expected was interference from the legal system. The police and coroner's office held up our suspension procedure until they were satisfied that no violations of legal statutes were taking place. Art Quaife set the tone for our interaction with the authorities and was responsible for a successful conclusion of the incident.


LongLife MAGAZINE

MARCH/APRIL 1979

Overview and Technical Report of Berkowitz Suspension

ALSO IN THIS ISSUE

An Immortalist's Definition of Life by Corey Noble, Ph.D.
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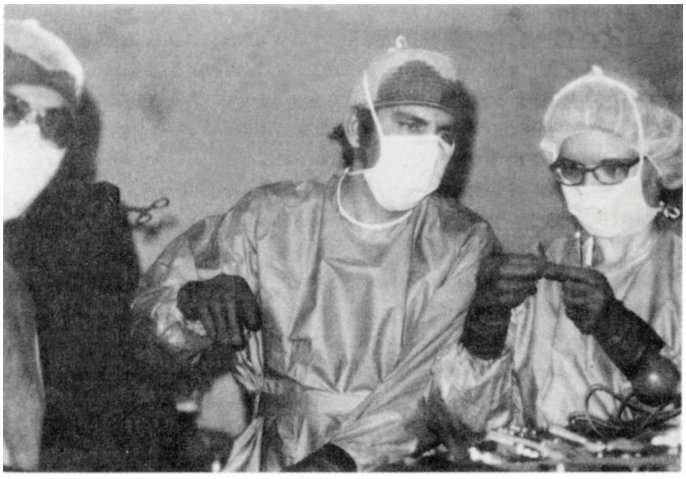
Dietary Recommendations for Persons with Border-line Health by Linus Pauling, Ph.D.
Aging and Cancer Affected by Diet & Antioxidants by Hans U. Weber, Ph.D.

The perfusion was carried out in stepped increases of concentration of the main cryoprotectant, DMSO, up to 15%, as indicated. In all, this appears to have taken about 30 minutes, though extra time was required for some interleaving events. Berkowitz was then packed in dry ice and shipped to Trans Time's facility in Emeryville, where he was stored in the usual liquid nitrogen.

Sadly, the Berkowitz cryopreservation would terminate five years later (October 1983), in an ugly confrontation with the relatives who, being told that more funds were needed to continue with the preservation, were unwilling to continue payments and instead at one point sued Trans Time for "breach of contract."[6] Berkowitz reportedly ended up in a family plot in New York in a large flask of formaldehyde. Some team members had to pay out of pocket for some of the shipping expenses (and some resigned). The original contract, for approximately $15,000, had provided for only one year of cryogenic storage. Jerry Leaf was very disappointed at this loss of the patient which undid what he had worked so hard for, to try to save a life. It was the only case, he said, of a human cryopreservation he had done that had later terminated. (Mike Darwin also said that he had contacted

the family, telling them that their proposed immersion of the patient in formaldehyde would not preserve the brain inside the skull. He offered instead to continue Mr. Berkowitz as a neuro for free but they turned him down.) A lesson to be learned from this is that pay-as-you-go is a bad policy for cryopreservation which must continue indefinitely. Better to insist on one up-front payment which can cover indefinite patient maintenance through interest income, even though it is considerably more expensive.



From left: Paul Genteman, Jerry Leaf, Betty Leaf at the Berkowitz suspension

K.V.M. Cryopreservation, November 1978[7]

This case presented a problem that is very common in cryonics. The 65-year-old woman had arrangements with the Bay Area Cryonics Society (BACS, now American Cryonics Society, ACS), though living out of state. She had been treated for chronic liver disease, but her condition improved, and she was released. She lived alone, though usually was visited daily by a close relative. The visits were briefly interrupted when he took a short business trip. When he returned on Nov. 3, 1978, he was informed she had just died. Jerry's report gives details:

> She died late at night, so that even if daily contact had been continued, it probably would have been hours before she would have been found. This points up the need for biomedical monitoring systems for suspension patients in similar situations. It is the weak link in an otherwise well-designed emergency network.
>
> …
>
> The technology is available for physiologic monitoring of patients in the home environment. Pulse transducers with built-in transmitters for activating automatic telephone dialers are needed. If such a system can be purchased, it would be advisable that cryonics organizations purchase them for lease to suspension patients.

These words, written more than forty years ago, have an eerie relevance today, as some of us are painfully aware. Today we still are lacking an effective system for vital signs monitoring and notification in case of emergency. For the case at hand, at least there were some mitigating factors inasmuch as it was cold outside where arrest occurred.

> Mrs. K.V.M. fell unconscious, on her front porch late at night. She was not discovered for several hours. The ambient temperature was 1 degree C. She was transported to the hospital where she was pronounced D.O.A. (dead on arrival). The cause of death was given as coronary occlusion. She was kept in a refrigerated room at the hospital until arrangements were made for her transport to Los Angles, California, packed in ice. She was picked up at the Los Angles International Airport and brought to the suspension facility in Fullerton.

The report continues with details of the perfusion which, as above, I've mostly omitted. As before: "A median sternotomy approach was used to maximize access to the major vessels." However: "No Phase I perfusate was used because the core body temperature was already low enough for introduction of cryoprotective agents and further delay was not warranted." DMSO was the main cryoprotectant and a three-part step ramp was used as before, with concentrations of 5, 10, then 15 percent.

A concluding section ("Retrospective") notes some lessons learned and plans. Jerry was "trying to acquire a fluoroscopy unit so we can use dye injection techniques to view the vascular distribution of perfusates during perfusion. This will allow us to select the minimum necessary arterial pressure required for good perfusion of the entire vascular bed, or determine if any areas are underperfused." (This goal would remain unrealized but has now become more realistic with Alcor's acquisition of a CT scanner. It remains a work in progress.)

A whole-body cryopreservation like that of Berkowitz before, the case also had a similar funding problem when inadequate amounts were collected for indefinite long-term maintenance. Happily, however, the patient was converted to neuropreservation (in 1983, see below) and her preservation continues today at Alcor.

Lucille Rothacker Cryopreservation, January 1979[8]

Performed at the Trans Time facility in Emeryville, the cryopreservation of Lucille Rothacker, a woman in her seventies with terminal cancer, was the first, well-documented neuro (head only) case. (Fred Chambrlain Jr. in 1976 was also preserved as a neuro, and in fact the first ever, but only a very brief case summary had been published.[9]) Jerry Leaf and Art Quaife in their writeup of the case start by comparing the whole-body and neuro options:

> There are two distinct clinical cryostasis procedures being developed for cryonic suspension: whole body preservation, and neuropreservation. The more conventional, whole body preservation, has been reported previously. A neuropreservation (brain preservation) case report will be presented herein. Manrise Corporation previously documented a neuropreservation case, but did not publish a report. Trans Time, Inc. previously reported on the current case, but in summary form.
>
> The reasons for developing isolated brain preservation (neuropreservation) have been discussed by Michael Darwin. Whatever clinical justifications may be put forward for neuropreservation, there are also research goals. All cryonic suspensions are experimental, and will hopefully contribute research data relevant to the long range goal of human suspended animation. Neuropreservation provides a unique opportunity to work with the human central nervous system as an isolated entity. In addition, samples from other organ systems can be isolated and preserved for studies of the effects of long term liquid nitrogen storage on human tissues.

For the cryoprotective perfusion, the procedure was much like that used for the whole-body cases before except that the neck vessels were used exclusively (no median sternotomy). Major vessels to and from other parts of the body were clamped off so the head would receive most of the perfusate. First a washout was done to remove blood and other body fluids, then cryoprotective perfusion was carried out with DMSO in concentrations of the now-usual 5, 10 and 15%. A critique at the end of the report explores such issues as how to better isolate the head vasculature from the rest of the body to prevent dilution of the perfusate during perfusion.

As Jerry notes at the end of the report, this was his first human case using Trans Time's northern team at their own facility in Emeryville instead of the other team at his Cryovita laboratory in Fullerton. Overall, he was impressed:

> I was gratified to find that our Northern Team is quite capable and deserving of praise for their performance. With this experience behind me, I am confident in stating that the top two suspension teams in the United States are both working here in California.

ICE, December 1979[10]

In addition to Cryovita, Jerry started and headed another organization, the Institute for Cryobiological Extension or ICE. It was a sister, nonprofit with a dual purpose: (1) to do research for the development of suspended animation of humans, and (2) to provide cryonic suspension services to interested members. In December 1979, however, Jerry reported a change of plans: "The cost of cryonic suspension capability was investigated over the past year and it was concluded that it would be more cost effective to utilize existing services offered by the Alcor Life Extension Foundation." Henceforth research would have exclusive priority at ICE. "The publishing efforts for ICE will be through existing scientific journals, for completed research projects, and by our own annual report, *ICE Proceedings*."

It is significant that ICE is deferring responsibility for cryopreservation services to nearby Alcor, and not Trans Time, which was much more distant and harder to access when needed. (Other problems with Trans Time were also developing, see below.) One hears little of ICE, however, and it appears that this organization was never very active, its intended functions incorporated by other organizations or initiatives.

Two Cases Back-to-Back; Mike Darwin Joins the Effort, January 1980[11]

In an interview in 1986 Jerry Leaf comments:

> In 1980 I had the occasion to make personal contact with Mike Federowicz [aka Mike Darwin], who I had corresponded with before. Mike had transported a Trans Time patient to Southern California and then stayed on to help with a second suspension which came on the heels of the first. Mike had been working in a cryonics group in Indianapolis, Indiana for a number of years. At that time I tried to open the door as far as doing what I could to persuade him that Southern California offered an attractive alternative to the difficulties he was experiencing in Indiana. I needed someone else out here to work with who had a background in clinical medicine, such as Mike did, and he himself had begun to move toward clinical models of perfusion – using roller pumps and so on. I felt that he and I working together would allow us both to accomplish a lot more than if we were working alone. He was the only one else in the world who seemed to be aware of the fact that something needed to be done to upgrade the level of care – and to realize that that meant medical technology.

To fill in some details, both cases (both whole-body) were from the northern group. Wilfred Demar was a 77-year-old man who had lost his right hand in World War I. His wife Mary had previously been cryopreserved at Trans Time (in 1974). Mike Darwin had organized Soma, Inc. somewhat along the lines of Cryovita, to carry out cryopreservations and related operations in the Indianapolis area where he lived. Mr. Demar meanwhile had fallen gravely ill and was in a hospital in Green County, Wisconsin. Mike in Indiana was closer than Jerry in California (about 300 miles versus 2,000), so the Soma team hurried to the bedside. There Mr. Demar arrested on Jan. 15,

1980. A stabilization was done at a nearby mortuary: the legally deceased patient was given metabolic support using a heart-lung resuscitator while the temperature was lowered over a period of hours to the neighborhood of 12°C. The patient was then packed in ice and air-shipped to California, accompanied by Mike. Body washout by the Cryovita team began the following evening, followed by cryoprotective perfusion.

> Perfusate temperature averaged 4°C ± 1°C, and esophageal temperature averaged 6°C ± 2°C. Glycerol was selected as the CPA of choice, based on experience with previous animal and human perfusions. Continuous perfusion for 6.75 hours at 50 mm Hg arterial pressure was used. The average pump flow rate was 0.8 liters/min. … Terminal arterial glycerol concentration was 2.85 Molar and venous concentration was 2.67 Molar. …

One innovation deserves mention: a small opening or "burr hole" was cut in the skull to observe the brain during perfusion. This innovation was also used in the second case, below, and variants have now been widely adopted. (Two burr holes are usually used in Alcor's perfusions, one on each side of the head.)

Around 1:30 a.m. Jan. 17, when the cryoprotective perfusion had ended and the patient had just started cooldown to dry ice temperature, the Cryovita team were informed that a second Trans Time patient had just arrested. Janice Foote, a 35-year-old woman from Stockton, California, had suffered from "numerous chronic illnesses including profound immune deficiency, multiple opportunistic infections, adenocarcinoma of the throat, therapeutic radiation overdose, idiopathic liver disease, and an unclassified central nervous system myelopathy." Her cause of death was (an unexpected) aspiration of food following a grand mal seizure. Sent by air ambulance, she arrived at Cryovita a few hours later. At this point the team, exhausted after the effort with Demar (the amount of work required in a case like this is hard to imagine if you haven't been there), could only see that she was packed securely in ice and resume operations later, after a few hours' rest. The unexpected arrest was remote from cryonics facilities, plus there was the delay caused by the case ahead of her in the queue, so in all about 24 hours elapsed from arrest to start of perfusion. Quoting further from a report by Mike Darwin, Hugh Hixon, and Jerry Leaf:

> Perfusion consisted of blood washout and extracorporeal circulation with a heart-lung machine, employing the aortic root and right atrium for vascular access. Perfusion was closed-circuit, employing a glycerophosphate-based perfusate using PVP-40 as the colloid [with] glycerol as the cryoprotective agent. The concentration of glycerol was gradually increased in the recirculating system until the venous concentration reached 2.85M. Following perfusion the patient was cooled to dry ice temperature at a rate of approximately 2 degrees centigrade per hour by submersion in an isopropanol bath and gradual addition of dry ice.

The two patients were then transported together to Trans Time's facility in Emeryville, California for liquid nitrogen vapor phase cooling and placement in long term cryogenic storage,

Janice Foote, nursing school graduation class, 1967

Like some others before her, Ms. Foote as a whole-body patient would encounter funding problems, but be one of the lucky ones whose cryopreservation now continues as a neuro (see below).

A final note: "Mike Darwin" is the well-known pseudonym of Mike Federowicz, which he adopted or accepted in his Catholic high school for being an atheist who believed in Darwinian evolution. Jerry Leaf did not like using pseudonyms, for whatever reason adopted, but preferred a person's legal name.

"Monkey Business" with the Media, April 1981[12]

Though recognizing the value of publicity in cryonics, Jerry had misgivings:

> I have often debated with myself about the value of interacting with the news media. If research is to have public support, the public needs to be informed. However, each of my personal encounters with the media has been followed by disappointment and regret.

These misgivings were rather strikingly confirmed in an incident in April 1981. Representatives of Asahi Television, a Japanese network, wanted to do a video segment on research being done at UCLA by Dr. Gerald Buckberg, a well-known heart specialist whom Jerry worked under. Buckberg was unwilling "since he would have no control over the context in which his research would be presented." But, in addition, Asahi wanted to cover the research done at Cryovita Laboratories, which was Jerry's own laboratory, not associated with UCLA. "They claimed to be making a documentary about advances in medical research that could affect important changes in future medical practices."

Though Buckberg declined, Jerry was more willing. "Cryovita Laboratories and I, being less endowed with research funds, were inclined to allow Asahi to record an experiment, if Asahi paid the cost." Jerry's report continues:

> The next day, during a lunch engagement with the Asahi representative and a 15-man assembly of cameramen, technicians, directors, etc., we discussed the proposed videotaping at Cryovita Laboratories. After discussing the experimental design and laboratory environment, the Asahi representative asked if I would also be willing to place a human, whom they would provide, into deep hypothermia at 15°C. They were seriously requesting that I reduce a living human to a state close to clinical death, then reanimate him, all for a few feet of videotape to amuse their Japanese television viewers. This segment would dramatize the future possibility of human suspended animation. I told them how life-threatening such a procedure would be and that it had no scientific merit. I also pointed out that such drama goes beyond the format of a documentary on scientific research. Later, after considering their ignorance of the subject matter they were supposed to be documenting and the obvious intent to dramatize, I declined to allow them videotaping privileges at Cryovita Laboratories. My laboratory would not be a stage for docudramas.

Meanwhile, "the Asahi crew had gone to the San Francisco Bay Area to videotape cryonic storage capsules at the Trans Time facility and document Dr. Paul Segall's experiments in deep hypothermia with hamsters." Soon Paul was calling Jerry and asking if he would be willing to come up there and do experiments using primates. There were two main experiments Asahi wanted, (1) a total body washout with attempted revival, similar to the first dog experiment of 1977, and (2) a cryopreservation, similar to the second dog experiment. The subjects of the experiment would not be canines but Capuchin (Cebus genus) monkeys.

The upshot was that the experiments were done as Asahi wanted (in reverse order). The less-demanding cryopreservation was directed by Jerry Leaf:

> The first Cebus monkey was used to simulate cryonic suspension. The animal was anesthetized and surface cooled with ice packs. Perfusion was done through the aorta and the right atrium with glycerol perfusate and recirculation system such as we currently use with humans. Glycerol concentration was slowly increased to 30%. After perfusion, the animal was placed in [a] dry ice and alcohol bath by Art Quaife and cooled to approximately -75 degrees C, then transferred to liquid nitrogen vapor for further cooling toward final storage temperature. …

The body washout with an unsuccessful attempt at revival was mainly carried out by Paul Segall and Harold Waitz:

> The second Cebus monkey was used in an attempt to duplicate Paul Segall's hamster experiments [involving successful revival of these small mammals]. Harry Waitz and Paul Segall did most of the work on this experiment. The monkey was anesthetized, and respiration was supported on a ventilator. Deep hypothermia was induced by surface cooling with ice packs to a final systemic temperature of 6 degrees C. Hyperventilation with 100% oxygen was used, as suggested by studies at UCLA, rather than the hypoventilation (high CO2) used in the hamster model. Rewarming produced inadequate cardiac function and resulted in cardiac arrest. Contributory factors may have been: lack of an IV for pharmacological intervention, too-rapid rewarming, waiting too long to begin CPR, and the age of the animal. Harry and Paul did a fine job, and I was sorry I was unable to assist them to a more favorable outcome.

Overall, Jerry was disappointed and frustrated, including no small irritation at the media people:

> They didn't care if we did a legitimate experiment as long as it looked good on videotape. We spent considerable time explaining that we could not justify using an animal for an experiment unless it served some scientific purpose. Apparently, in Japan a monkey has little more status than a rat does in our country. Paul insisted that they purchase standard stainless steel holding cages, as required by the USDA, which are expensive. Using Paul's analogy, "to the Japanese, these expensive cages seemed like buying gold-plated rat cages." We were faced with demands to use an expensive animal model and experimental protocol, yet Asahi resisted paying the actual cost required. Asahi was constantly asking for more, wanting to evade the expense required, and making requests which would interfere with the experimental design.

Jerry concludes with words of advice:

> Media people always seem to be in a hurry to finish their assignments, as is to be expected since time is money and they have deadlines to meet. It is up to us to stand firm on what we think are necessary conditions for cooperative effort. Always be willing to say no. If the production company or writer involved doesn't have time, money, or knowledge to do the subject justice, why should we risk the negative potential of an unjust treatment?

Capuchin monkey, species **Cebus Imitator**, *in its natural habitat in Costa Rica. Several species of the Cebus genus are found in various locations in Central America. (The monkey here seems to have a look of frustration as if in sympathy with Jerry's own problems with the media.)*

Cryo-82[13]

"Cryo-82" was not a cryonics event but instead the annual business meeting of the Society for Cryobiology, held in Houston, Texas, 1 July, 1982. For years there had been growing hostility between cryobiologists, most of whom were not cryonicists, and cryonicists, most of whom were not members of the Society. Matters were to come to a head at the July meeting. The Society's directors intended to vote for a change in the bylaws, that would enable them to "refuse membership to applicants, or suspend or expel members (including both individual and institutional members) … engaged in or who promote … any practice or application of freezing deceased persons in anticipation of their reanimation." Word of this pending action was leaked by clandestine channels, and Jerry Leaf, a member in good standing of the Society since 1970, came prepared. He made a valiant attempt to get the board and, through a later mailing, the rest of the Society members to consider his own position, favoring cryonics as a legitimate field of inquiry in cryobiology. In the end, however, the Society adopted the change in their bylaws (the anti-cryonics wording stood until 2017). In the mailing (full text reprinted below, along with Jerry's recounting of the incident) he explains his position:

> Cryonics involves the experimental application of cryogenics, cryobiology, and medicine. I have made arrangements for funding and donation of my body, after clinical death, to be used for such an experiment. I have done this because I think experiments with humans can provide advanced knowledge, along with animal research, that will result in the eventual development of suspended animation. Suspended animation, as a clinical modality, could extend the period of time available to pursue therapy for some patients designated "terminally ill," thus saving human life. I fully understand the experimental nature of today's cryonic suspension.

One has to ask, is there anything unreasonable in the above? And the answer, "No, of course not," seems inescapable. Cryobiologists, starting with Harold T. Meryman who was then president of the Society, clearly had nonscientific motives for their objections to cryonics, as Leaf's article underscores. Today the prejudice, now of very long standing, appears to be gradually weakening, as suggested by the 2017 change in the bylaws, but by indications is still strong. (The brain is an organ just like the kidney, heart, lung, and others considered "legitimate" to study as subjects for cryopreservation with intent to eventually reanimate. Isn't it past time for cryobiologists to grant legitimacy to the study of this one organ, on the same scientific footing as the others? The objector might argue that today one does not transplant brains, unlike the other organs, but that in and of itself would not invalidate the study of the brain as a target for cryopreservation, nor preclude possible benefits from such study.)

Postmortem Examination of Three Cryopreserved Patients, late 1983[14]

Jerry Leaf played an important part in a salvage operation for three cryopreserved patients whose funding had run low and were in danger of termination, as occurred with Mr. Berkowitz. In this case, the patients were converted to neuropreservation, which continues today. The patients were K.V.M. reported above, her husband, and Janice Foote. The first two are now at Alcor, and Janice is with another organization. In the report the patients are anonymously referred to as P1, P2, and P3. Following the neuroconversion, the rest of the remains were thawed and examined for whatever could be learned about the cryopreservations that had occurred years before. This was a unique opportunity which I think is still unmatched in the history of cryonics. A paragraph near the end of the report summarizes the findings. (Many more details will be found in the report.):

> On gross external and internal observation, all of the remains appeared well preserved post-thaw. The skeletal muscles in both P1 and P2 had a softened, somewhat "mushy" feel which was not present prior to freezing and which was noted only to a slight extent in P3. The remains of all three patients exhibited considerably less rigor post thaw than was observed at the conclusion of perfusion. The change in tissue texture and reduction in rigor suggest the possibility of autolytic degradation of skeletal muscle. The texture and appearance of the

> heart and the other abdominal and thoracic viscera were for the most part unremarkable. The pancreas of P3 appeared edematous with separation of the parenchyma into rosette-like islands embedded in a clear, gelatinous matrix. This type of edema has been observed during ischemic glycerol perfusion of animals and during failed total body washout experiments. In contrast to the experimental situations where such edema has been observed, it appeared confined to the pancreas in P2. All three patients exhibited some degree of pulmonary edema.

The operation also had an element of human drama. Handling cryopreserved human patients with the equipment available was both difficult and dangerous, especially given that there was something that still needed to be preserved as well as possible, with minimum exposure to warm temperature and no damage. Jerry Leaf hurt his back while handling one of the patients (it was K.V.M.) and, though he adapted well afterward, he never fully recovered.[15]

Cold Agglutination Article and "Debate," 1984[16]

In the March 1984 *Cryonics* there is an article by Jerry Leaf with the title "Perfusion: Acute Vascular Obstructions and Cold Agglutinins." Filled with sage observations and recommendations, it makes the point that total body washout is an essential preliminary to avoid complications in cryoprotective perfusion. If you leave the blood intact a phenomenon known as "cold agglutination" will occur (the main substances responsible, known as "cold agglutinins," are identified) and there will be obstruction of the vascular system hindering or preventing a good perfusion:

> Agglutination is characterized by irregular clumps of red blood cells … Cold agglutination is of particular concern for suspension patients due to the various kinds of exposure to hypothermia, during both transport and perfusion protocols. … Virtually all human red blood cells will show cold agglutination at temperature between 0 to 5 degrees centigrade due to the normal presence of antibodies. Our greatest concern will be the cold agglutinins that have a temperature range, or thermal amplitude, between 5 and 15 degrees centigrade, which are the most common. In rarer cases the thermal amplitude can range as high as 31 or 32 degrees centigrade.

Cold agglutination can be prevented (reversed), Jerry notes, by keeping the patient warm (rewarming), but this has the unwanted complication of promoting ischemic damage. The best solution, when the patient is to be transported to a facility for further above-freezing interventions including cryoprotective perfusion, is total body washout:

> Every suspension patient requiring transport by commercial air carrier, packed in ice, should undergo total body washout with an appropriate intracellular-type flush solution. The alternative for these patients is rewarming to a temperature at which their particular cold agglutination will disaggregate, during support with a heart-lung machine. This is not without great danger of exacerbating an already ischemically injured body with an even greater reperfusion injury.
>
> Finally, every suspension patient should undergo total body washout with oxygenated perfusates in a temperature range of 17 to 20 degrees centigrade, to optimize considerations of both cold agglutination and metabolic requirements. After TBW, perfusate temperature can be reduced in accordance with the requirements for minimizing cryoprotective agent (CPA) toxicity and maximizing equilibration of CPA.

Much more is said in the article that will have to be omitted here. When it appeared, though, there was a critical response from Thomas Donaldson, who argued that, while TBW was desirable just as Jerry said, there were many situations where it could not be applied, and less sophisticated procedures must be used. Mainly, arrest might occur suddenly in a remote location where it was not practical to assemble the necessary equipment and personnel to do what was needed in a timely manner.

Jerry responded, in part:

> The purpose of the article on cold agglutinins was to inform those who are responsible for suspension patient care about what they could do to avoid cold agglutinins. It was not an article for those who cannot provide this care. Tom suggests that something useful might result if remotely located cryonicists operate at a technologically reduced level, say circa 1970. I find this to be less than our suspension patients need. The "good ole days" of cryonics are over, in that we know an uncontrolled perfusion with salt water/DMSO, or a mortician's plunging one of our patients into liquid nitrogen is not the way we should do things. Curtis Henderson said it all: "Cryonics used to be little more than Guerrilla Theatre, but now there is real capability to do suspensions." This is not to say we can always reach out and provide optimum care for every suspension patient. TBW is a relatively simple procedure and requires nothing complex.

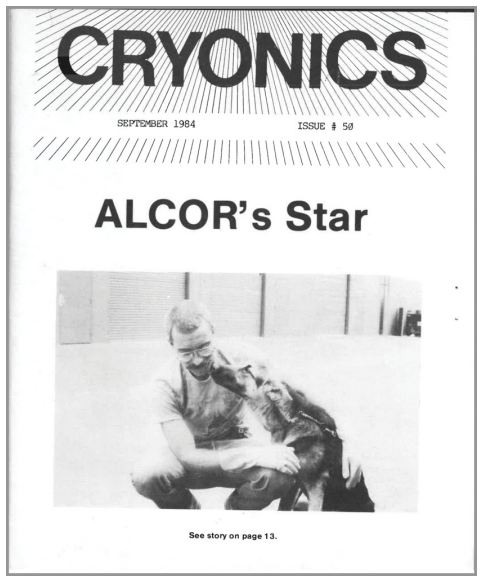
Landmark Canine Experiments, 1984-85[17]

By 1984 Jerry Leaf's and Cryovita's efforts were focused mainly on Alcor, which in fact was using the Cryovita location as its own headquarters. In July 1984 a series of experiments was launched to test a new base perfusate that had just been

developed at Alcor. The objective was to repeat more-or-less the procedure of seven years before, in which a dog would be cooled and subjected to total body washout (TBW) – its blood replaced by perfusate – then warmed and resupplied with fresh blood so that, if all went well, it would resume consciousness and full function. In fact, of the seven experimental subjects over the next several months, six would be long-term survivors. (The one failure, it was believed, did not result from poor technique or error but was "probably secondary to an undetected viral infection present before the experiment started.")

The first of these cases, done the weekend of July 21-22, had special significance because it was, in fact, the first successful experiment of its sort ever done by *cryonicists*. A large-sized mammal, a shepherd mix dog afterward named Star, was recovered from hypothermic TBW (temperature 4.2°C, hematocrit between 4 and 5) and cessation of heartbeat for an extended time. In other, more minor but still significant ways it could be called a "first ever, period," since the dog's blood was replaced with "a very 'alien,' nonphysiologic perfusate, perfus[ed] for one hour, and then successfully rewarm[ed]." The work was a delayed follow-up to the July 1977 experiment reported above; now the survival was gratifyingly complete. As the initial stage of the cryopreservation procedure, the success lent confidence to the premise that the whole cryopreservation would ultimately prove reversible, and moreover, that it might lead to improvements in techniques resulting in demonstrated, reversible cryopreservation of large mammals. (The latter has still not been realized, even for small mammals or other post-embryonic vertebrates. Though accomplishing it would be a great, game-changing event, it is not necessary for cryonics to work, since cryopreservation provides an indefinite time window for revival technology to be developed.)

For the first experiment the animal was bloodlessly perfused for 1 hour at 4°C as noted; for the remaining six cases the cold perfusion time was 4 hours. The last case in the series should have been a relatively easy exercise: "It was hoped that this final experiment would allow us to apply insights gained from the previous six in a way that would allow for even more rapid recovery of this animal, with fewer of the complications and less tissue injury than had been observed in some of the earlier experiments." An unusual complication developed, however, when dog blood used for the revival came from an animal that had been previously transfused and, it appears, was a source of red cell destroying (hemolytic) antibodies. The upshot was that the subject of the experiment, a husky mix given the name Nanook, experienced near-lethal loss of nearly two thirds of his blood's red cells. Heroic efforts, including use of a fluorocarbon-containing blood substitute, fluosol-43, saved the day and Nanook regained his red cell count and recovered, to provide a happy ending to this experiment and the whole series of seven.


CRYONICS

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ALCOR's Star

See story on page 13.

Cryonics cover Sep. 1984 showing Star, Alcor's first TBW survivor (one hour of bloodless hypothermia), with Mike Darwin.

Jerry Leaf with Nanook taking his first sips of water after 4-hour TBW.

Terri Cannon Cryopreservation, February 1985[18]

The 68-year-old Terri had a long history of lymphoma which, until about mid-1984, had been in remission. With the reactivation of her cancer, which had spread to her liver, Terri's health had taken a steep decline and it appeared likely she was soon going to lose her 12-year battle with the disease. Terri and her husband Joe had both long been cryonicists, and this was not their first brush with the possibility of Terri's arrest. Several times before they had taken the precaution of having personnel standing by.

Terri Cannon, about 1950

This time the situation seemed far worse. Joe contacted Alcor at 10 A.M. February 8, 1985. Terri was now in the ICU at the University of Wisconsin Hospital in Madison. By 2:50 P.M. Mike Darwin and Jerry Leaf were airborne, headed to a remote standby at the hospital. Once there, Mike and Jerry set to work, helped by Terri's rallying and temporary improvement. This gave them time to establish rapport with hospital staff and a local mortuary whose further assistance would be needed and to set up their equipment. Terri was also transferred out of the ICU to a more convenient location, the hematology floor, where Mike and Jerry explained cryonics to the nursing staff and the attending physician, all of whom were understanding and cooperative. For the next few days Jerry, Mike and Joe were in almost constant attendance, sometimes sleeping nearby. (Joe's presence was needed because Jerry and Mike were seen as having a potential conflict of interest as representatives of the organization that would benefit financially from the cryopreservation.) As the end (from a non-cryonics viewpoint) approached, Mike had these thoughts about Terri:

> I was struck immediately by her great warmth and gentle concern for everyone but herself. Understandably, Terri was very apprehensive about the well-being of her husband of 39 years and we ended our first meeting by her extracting a promise from me to see to it that he had a good lunch and got a little rest. She also joked with me and apologized for "not dying on schedule." She was genuinely more concerned about the welfare of Jerry and me than she was about her own situation. She seemed reassured by our presence and by the support she knew that we would provide Joe when the inevitable occurred. Her sense of humor and realism about her situation remained intact up to the bitter end. A few hours before deanimating she was remarking on the injustice of finally being able to fly out to California lying down ("first class") and not having any windows to look out of! Only a cryonicist could keep that kind of balance. …

Early on the morning of February 12, after some difficult moments and reassurances from sympathetic personnel, Terri arrested. Preliminary cooling and TBW was done at the hospital. It went well, with one complication caused by Terri's phlebitis in her right leg, which, unbeknownst to Jerry and Mike, had eliminated her right femoral vein entirely. The left vein was fine, though, and cannulation necessary to do the perfusion was done there. But Mike in his article makes the point that knowing the full medical history of the patient would have saved 45 extra minutes or more of precious time at above-freezing temperature. It is worth noting also that, in accordance with standard cryonics procedures then and now, the tissues were oxygenated during perfusion, under the belief that such metabolic support would reduce any possible deterioration while the patient was still above freezing.

With the TBW finished, Terri was packed in ice and, with the help of a local mortuary, air shipped to Cryovita's lab in California, where a near "textbook" cryoprotective perfusion was carried out, using glycerol which had now become standard. Terri and Joe had both elected neuropreservation. A new procedure was used from that of Ms. Rothacker in 1979:

> This was the first time that we were able to apply a new technique of perfusion which we had heretofore evaluated in animals and found to be superior to perfusion of the head via the carotids. Jerry went in though the chest as would be done for a whole-body perfusion, but then tied off all the vessels except the carotids and the vertebrals. This allowed us four points of perfusion for the brain, instead of the two available with just the carotids, and it also allowed us to stop the troublesome problem of "run-off" of perfusate down the vertebrals into the body. This shunting of perfusate away from the brain down a path of less resistance (the open vertebral arteries connect with the carotids via the Circle of Willis at the base of the brain) has been a serious barrier to good perfusion of the brain in the past. The use of the median sternotomy with aortic root perfusion eliminated this problem.

As for the choice of neuropreservation, Mike Darwin offers this commentary:

> Terri and Joe had both decided on neuropreservation as the most sensible course to follow. They could have afforded whole-body, but neither felt it a sensible thing. As Joe commented, "I'd thought about preserving just the brain years ago, but didn't dare open my mouth because I felt there would be such protests against it." Terri and Joe were quite open about going with the neuro option to the staff at the hospital, and we were all quite surprised to find that while there were many questions related to going "head only" there was little hostility and more than a few comments that it made

> more sense than taking along a broken-down body. One nurse commented to me that it helped her to better understand what we were after. She said that it forced her to realize that we weren't just counting on a cure for cancer, but that we expected complete control over life and that we obviously intended to settle for nothing less than a brand-new, healthy body.

Jerry Leaf for his part supported the right to choose neuropreservation, for those who desired it, and made major contributions to implementing it, as shown above with the procedures he was so instrumental in developing. He also thought it had research value. Yet at the personal level he remained staunchly committed to whole-body preservation, advocating this option when asked about it, and was cryopreserved as a whole body.[19]

Trans Time and Alcor[20]

Both Alcor and Trans Time benefited from Jerry Leaf's services through his company, Cryovita, as we have seen. And initially Alcor did not cryopreserve or store patients on its own but used Trans Time for both services. Over time, however, Alcor became independent and, through Cryovita, cryopreserved its patients independently of Trans Time, and also, provided its own storage. The contract between Trans Time and Cryovita meanwhile continued until, around mid-1985, it was terminated. Dissatisfaction had developed mainly, it appears, because Trans Time was in continual financial difficulties.

Service fees of Trans Time to Cryovita were often paid in stock rather than cash. Trans Time profited from media productions that sometimes used the Cryovita premises for videotaping but there was no trickle-down to Cryovita to cover Trans Time's outstanding debts. Trans Time had also released footage of operations done by Cryovita that was used in a movie, *Faces of Death*, showing scenes that permitted identification of a patient (Berkowitz), contrary to Cryovita's policies. Trans Time also owned the capsules it stored patients in (as did Alcor when later it handled patient storage) yet charged its customers explicitly for the same capsules. Trans Time allowed storage of patients for a finite time interval (one year) at a reduced rate then expected continued payments from whoever took responsibility for the patient (relatives usually). Alcor established a policy of a one-time payment for indefinite storage based on continuing, interest income.

In fact, after the two cases in 1980, there were no further Trans Time cases done by Cryovita, mainly because of a lull in cryonics cases overall. The Northern California organization, American Cryonics Society, originally Bay Area Cryonics Society, continued using Trans Time, with their own surgeon and other personnel. Both organizations still exist but have not handled new cases in nearly two decades, as far as the author is aware.[21]

Dora Kent Crisis and Afterward, 1987-1991[22]

The period of several years that began in late 1987 was not a great time for lovers of tranquility in cryonics, particularly at the Alcor/Cryovita location, then in Riverside, California. Dora, the ailing, 83-year-old mother of cryonics pioneer Saul Kent, was brought into the facility and arrested there on December 11. Her legal decease was witnessed by Jerry Leaf and Mike Darwin, two individuals who were competent in such matters, but neither of whom were MDs. Steve Harris, an Alcor member and an MD, signed the paperwork taking responsibility as the physician of record for the death certificate, and at first all seemed well. The local coroner, however, took exception to the unusual proceedings, and ultimately ruled the death a homicide. Alcor officials were guilty of murder, he said, inasmuch as Ms. Kent was still alive when her cryopreservation began, a finding that seemingly was reinforced by the discovery of cell metabolites in her torso which Alcor made available for autopsy.

Dora Kent was a neuro like Terri Cannon and a procedure largely similar was performed. Cephalic isolation or "saving the head" was carried out after both TBW and cryoprotective perfusion were complete (here done with surgical tools, not in the manner reported above for a frozen patient). The preliminary steps, including TBW, involved oxygenating the tissues as we noted above; such metabolic support could account for the presence of metabolites after legal decease, without assuming the patient was "alive." This was pointed out to the coroner, and in the end no charges were filed. Early on, though, the coroner demanded the head for autopsy, and sent officials to the Alcor facility to seize it. When they arrived, however, the item they were after had been moved and was then being stored off-site in a small container of liquid nitrogen. The whole story of what happened is a complex and still sensitive one that cannot be told here. Suffice it to say that Jerry Leaf was an important player. Dora Kent as a neuropatient remained in cryopreservation with no physical interrupt, and in due course a restraining order was obtained protecting her and the other patients at Alcor from interference by the coroner.

"Horatio Hornblower" and "Leaf's Paradox," 1991[23]

Meanwhile, work at Alcor/Cryovita continued. There were more cases, more dog experiments, and more struggles with officialdom. In the end cryonics was recognized as a lawful form of "disposition," in both its whole-body and neuro versions, and plans were developing for further research to improve cryopreservation techniques. Then suddenly, Jerry arrested and become a patient. In thus leaving us (though not totally) he also left one more article in the "pipeline" which appeared in the August 1991 *Cryonics*.

This last article is not about cryonics per se but a somewhat light-hearted, philosophical look at a more distant future when, along with cryonics revivals, there could be many other options not

possible today, including the ability to make copies of oneself. Jerry refers to recent discussions with a pseudonymous Horatio Hornblower, "an ex-Air Force officer and computer jock who has a copy-himself scheme." (Readers in the know will note an undeniable resemblance to Jerry's close friend and fellow cryonicist Hugh Hixon Jr.) But, Jerry says, all such schemes have a fundamental flaw.

> The person copying himself, (the "perpetrator") is trying to achieve some value for himself, such as sending his copies out to do the dirty, dangerous tasks, in order to avoid risks to himself. However, any exact "copy" will have the same knowledge and strive to gain the same value for the same reason as the perpetrator. Therefore, all copies will become perpetrators of copies in an infinite regress. As a consequence, not one erg of energy will be expended to achieve the original sought after value that was to be a benefit to the perpetrator. Further, the exponential propagation of copies would consume so much material and energy that the loss of natural resources will surely cause other humans to unite in an all-out effort to extinguish this ecological disaster.

Well, we could hope there would be some work-arounds, such as multiple copies, *along with the perpetrator*, "drawing straws" to see who would have to do "dirty work" and who could stay at home in comfort. As long as the perpetrator participated on an equal footing with the others, perhaps this would be acceptable to all, particularly if those staying home strongly outnumbered those going forth. But this too would have its complications, such as, in fact, generating a lot of copies all of whom would need living quarters, and so forth. Apparently, Horatio considered some less-equitable but more economical options such as having only one or a few copies and not telling them they are copies and withholding other information or means of acquiring it, in sending them forth, while the perpetrator with 100% probability stays home. If you alter the copies, though, they stop being copies even if still retaining some resemblance. In all, Jerry reasons that the idea of "achieving some value" for oneself in this way is highly dubious and concludes:

> Sorry, Horatio, but sometimes the only way to acquire the values you desire is by doing it the old-fashioned way: humping through the jungle and putting your life on the line. If you step beyond the edge of the envelope, Alcor will try to be there so you don't get sent home in a body bag.

Tributes

Jerry often received commendations for his work in cryonics. A few of these are collected here. The first is by Art Quaife, following the first dog experiment of 1977:[24]

> Undoubtedly the hero of the occasion was Jerry Leaf, who impressed us greatly in many ways. First, with his competence as a surgeon and scientist, having complete mastery of this complex operation. Next, with his calm and unflappable manner under fire, answering hundreds of questions from dozens of people, under the additional pressure of TV filming. Finally, with his iron man constitution in enduring hour after hour of difficult, demanding work. While Paul Segall, Kipp Grant, Jerome White, and I worked just about the same long hours that he did, Jerry had the additional responsibility of continually directing a whole crew who had never before participated in such an experiment.

The next tribute (unattributed) was likely or mainly by Mike Darwin, on the conclusion of the seven TBW dog experiments in 1985. The "recent suspension" is of Terri Cannon. (Though ostensibly a tribute to "Cryovita," Jerry who founded and ran this company is really the subject throughout.)

> **A Special Thank You to Cryovita[25]**
>
> The recent suspension of an Alcor member and the recent completion of the TBW series, whose success has outdistanced our wildest expectations, bring powerfully home the need to point up the role of our "quieter" partner and to offer thanks.
>
> Jerry Leaf, and Cryovita Laboratories of which he is president, has contributed at least as much, and being honest, maybe more, to the success we've experienced than our own efforts have. Frankly, we've been negligent by not acknowledging the role Cryovita has played in Alcor's development and growth. By allowing us to occupy space at Cryovita at a ridiculously low rent, and by providing, free of charge, his expertise and equipment, Jerry Leaf, more than any other man, past or present, has contributed to the growth and success of Alcor. His faith in us and his support is genuine and motivated only by a desire to see cryonics succeed and to see the research move forward. We can't thank Jerry and Cryovita enough.
>
> In this series of TBW experiments Cryovita has shared with us, as an equal (and sometimes unequally burdened) partner. Credit for our success needs to be redefined: the "our" here is Alcor and Cryovita.
>
> In the suspension we recently completed it was Cryovita's generosity which to a large extent allowed us to facilitate growth of our donor fund by keeping marginal costs and outside charges for perfusion to a bare minimum. While it is true that the Alcor staff provides services and benefits (by their presence) to Cryovita, they also inflict real liabilities (you should

see the utility bills these days!). In the two-way street of cooperation, it has clearly been Cryovita which has been logging the heaviest mileage.

Direct ways of repaying Cryovita are hard to come by in these early days. Mostly, what we have to offer is our thanks and our promise to keep up the pace of progress and to concentrate our resources, as we have in the past, on expanding our understanding of cryonics/cryobiology. We hope to have Cryovita with us every step of the way, hopefully as a less abused partner in the future! In the meantime: THANKS! WHAT WOULD WE DO WITHOUT YOU?!

P.S. Please don't answer that question.

Then, in 1991, when Jerry became a patient, a special issue of *Cryonics* was devoted to him and his contributions to cryonics. Several of us contributed essays and I can't do justice to all that was said but will start with the moving tribute of Ralph Whelan. Ralph was then the young (early 20s) editor of *Cryonics* and had been working about a year at Alcor, after a tour of military duty in Germany. (He was also "M-60, M-16, and 40mm grenade launcher qualified," and "well-versed in hand-to-hand combat."[26]) Though his time with Jerry was brief, Ralph came to know him well and wrote a lengthy article in elegy which is excerpted here, starting with some pertinent observations.[27]

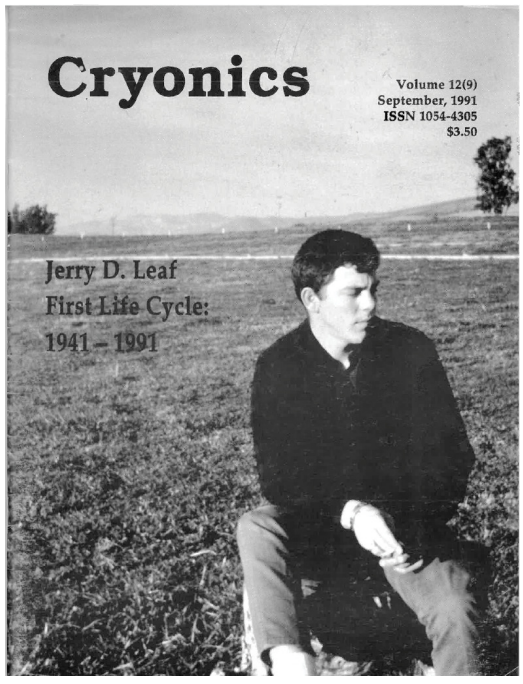
The life and times of Jerry Leaf may never be properly told. He was a quiet and stoic man – by no means shy, but reserved and meticulous. What you heard about Jerry Leaf is what he thought you ought to know. When he talked about himself you listened, and took mental notes. He was the sort of man who never shouted, not because he couldn't but because he didn't have to. If anyone had a story worth telling and a lesson worth learning it was Jerry. …

After some further remarks Ralph quotes Joe Hovey, a long-time Alcor employee now retired, who had known Jerry for several years:

I knew him to be a first-rate scientist, but I discovered that he was also a philosopher who could quote chapter and verse from Plato and Aristotle to Freud and Rand. In addition, he believed fiercely in individual rights, and opposed strongly any attempt by any governmental body to suppress any individual or group activity which did not harm others.

Ralph continues:

That description of Jerry was as evident to me on the day I first met him as it is today. As I write this, I have been working and living as an Alcor employee for one year to the day. My involvement is so brief, historically,



Jerry Leaf, Cryonics *memorial issue, September 1991*

and yet total immersion has its benefits. In my one year of involvement with cryonics and more specifically Jerry, I came to respect and care for him as much as I've ever cared for anybody. How could one person be so much to so many people? When I'd been here for scarcely a week, I contracted a very serious case of food poisoning. Jerry, barely knowing my name, took me to the hospital, half-carrying me most of the way, stood by my side in the emergency room for hours, and even held my hand as I slipped in and out of consciousness in hyperventilation. I barely remember anything of that day, and yet I'll never forget his support.

Jerry was more things to more people than anyone I've ever known. He was on any given day my co-worker, my teacher, my confidant, my doctor, my small-arms instructor, my fellow soldier, my commander, and my drinking buddy. For others around here he was all those things and more, being the voice of reason and very often the unifying factor for Board and staff meetings. He was respected in some capacity by all I ever heard speak of him, within and outside of Alcor. His integrity and veracity as a man and as a cryonicist were attested to by all who knew him, and this in an environment that could best be described as "unforgiving."

(Tragically, Ralph would later drop out of cryonics due to financial hardship, postpone signing up again when financially secure, die of an unexpected heart attack, and be buried at age 46, four years younger than Jerry when he arrested.[28])

Steve Bridge in the same issue has some appropriate comments, referring, among other things, to Jerry's role as a "decision maker" (in this case, director) of Alcor.[29]

> … Jerry was the first person with a medical background to devote himself to cryonics. Along with a very small number of other people, he transmuted cryonics from the realm of mortuary science to the realm of heart-lung machines, medicine, and high technology.
>
> Jerry is the first true technical leader in cryonics to go into suspension and the first Alcor decision maker to do so. In many ways, Jerry is the most important person ever placed into cryonic suspension. Others were better known in the general public; others were more involved in the very beginnings of cryonics; the suspension of others made more news. But no one else currently in suspension ever contributed as many ideas, techniques, time, money, and emotional energy as Jerry Leaf.

Mike Darwin in turn reported being struck speechless on hearing the news about Jerry:[30]

> Mike Darwin at a loss for words. Jerry would've liked that a lot. I hardly know where to begin. The hardest thing for me to realize about Jerry's deanimation and his suspension is that it would have happened at all. The man was like gravity, like a force of nature. What do you think when you wake up one morning to find everything floating around the room: that gravity has disappeared in the night? … Oh Jerry, I'm going to miss you so much. … Words will never tell.

In closing, I can report that I knew Jerry for several years prior to his becoming a patient, and what others report about him I can largely only echo. We had our disagreements, as on the issue of neuro versus whole body, but I had only respect for his integrity and sincere dedication to a cause that is, on one hand, not one of the popular ones, but on the other, seems vital and necessary to those of us who are involved. And he was a close friend. So, Jerry: rest in peace for now, we hope to see and hear from you again! ■

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5. Nerve cells in dog's brain: LG, 60.
6. Subject of the experiment: AA.
7. At the Berkowitz suspension: JL2, 33.
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10. Jerry Leaf with Nanook: AA.
11. Terri Cannon: AA.

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Interview

Interview with Jerry Leaf, Part 1, *Cryonics* 7(7) (Jul. 1986) 26-32; Part 2 Cryonics 7(8) (Aug. 1986) 21-28; Part 3 (Sep. 1986) 23-29.

CRYO-82, THE BIG FREEZE

By Jerry D. Leaf

This originally appeared in Cryonics *#28 (Nov. 1982), 5-10, 24. The portion beginning "The Following was sent" (letter to the Society for Cryobiology Members) has been moved from its original location following "direct mailing to members of the Society for Cryobiology." to form a separate, stand-alone article I have also done minor editing in both articles, correcting spelling errors, harmonizing capitalization and, in one instance, changing "parliamentarian" to "parliamentary"* – RMP.

While reading the last issue of *Cryonics*, I discovered that I am to write a "report" on my experiences at the meeting of the Society for Cryobiology, Cryo-82, held in Houston, Texas. In the same *Cryonics*, I am referred to as "one of the few public cryonicists who is a member of the Society for Cryobiology." That this should be noteworthy, or somehow remarkable, is one of the reasons I had to attend Cryo-82.

I did not go to Cryo-82 as an outsider, or merely as a cryonicist, but as a long-standing member of the Society for Cryobiology, who is concerned about the stability and purposes of this valuable organization. I am concerned that the current Board of Governors are detracting from the legitimate purposes of the Society to satisfy their own personal goals. I will relate some of my experiences at Cryo-82, but I would also like to address some of the issues involved.

The problem is *not* that some cryobiologists do not like the idea of cryonics. This is to be expected since cryonics is *not* a widely accepted idea in the general populace. Cryobiologists probably have the usual range of ideas about death and dying, represent various religious faiths, and have a normal diversity of social and political views. A problem *does* arise when members of a scientific society, operating under the special advantages of a non-profit society, begin to operate outside that public trust, to satisfy the non-scientific prejudices of a portion of its membership. The purpose of the Society for Cryobiology is to "promote research in low temperature biology and medicine." When a special interest group within the Society subverts the power of their elected offices to serve their personal views instead of the advancement of scientific research, it is time for an objection to be raised. One of the reasons I went to Cryo-82 was to raise this objection.

In 1964 cryobiology became a formal scientific discipline, with the creation of the Society for Cryobiology. In the same year, 1964, cryonics became a public issue, with the publication of *The Prospect of Immortality*. Some cryobiologists became cryonicists and some cryonicists became cryobiologists. It was a naturally incestuous relationship, and it has remained so to this day. In 1970 I became a member of the Society for Cryobiology while I was a graduate student working on a special study for a degree in cryobiology. My interest in low temperature biology, especially suspended animation, was stimulated by a college lecture given by the Cryonics Society of California in 1967. A few influential members of the Society for Cryobiology, such as Dr. Harold T. Meryman, began creating an "unofficial policy" that cryobiologists who wanted to participate in the Society for Cryobiology should not associate with cryonics organizations. When such inducements ultimately failed, they were later escalated to threats against jobs and careers. However, as you can well imagine, these kinds of activities were strictly "unofficial." Now the inducements have been escalated by Meryman, et al, attempting to make related "policy" on an "official" level in the Society for Cryobiology. From whence Meryman's views arise, we may never know, but he is clear about his feelings on the subject, as presented in a brief communication concerning the establishment of a National Institute of Low Temperature Biology:

> I am quite unsympathetic with the goals of preserving human beings through freezing. I find the proposition mischievous in the extreme and fear that like some other scientific "breakthroughs" that one might mention, the end result would be impossible to control and far more damaging than beneficial to society.

Meryman is so determined to do what he can for his cause, that he has even influenced the manufacturer of cryogenic containers to refuse further sales of custom designed dewars for cryonics use. I do not want to single out Meryman as the only person involved, but he has been the most aggressive and visible of his like-minded associates.

Cryo-82 was to provide Meryman and his associates on the Board of Governors the final recourse afforded them as office holders in the Society. They drafted a Statement of Policy claiming that, "The act of freezing a dead body and storing it indefinitely on the chance that some future generation may restore it to life is an act of faith, not science." Just "freezing" something "dead" may not be science. However, if you are doing research into the techniques involved in perfusion, designing cryoprotective perfusates, developing methods of controlled rate cooling, working on safe storage systems involving high vacuum technology and collecting data relevant to evaluating your effort, then you're damned right, I

call it *science*. As far as working with "dead" things is concerned, I am working with several organ systems at once, whereas most cryobiologists work with only one organ system in isolation. The organ systems I work with are as biologically "alive" as the isolated organs experimented with in simpler models. The use of the word "dead" in the Policy Statement clearly refers to "clinical" death, not "biological" death. Reanimation after "clinical death" is achieved in medical practice today. Meryman's laboratory is trying to develop the ability to freeze and store cadaver kidneys. Would Meryman accept my statement if I said, "The act of freezing a dead kidney and storing it indefinitely on the chance that some future generation may restore it to life is an act of faith, not science"?

It is now a matter of public record that I do not support this Policy Statement. Another goal of the Meryman Board is to change the Bylaws of the Society for Cryobiology so that the Board of Governors is empowered to expel any member of the Society who does not support Society Policy. This means that any cryobiologist may be expelled from the Society if he is also involved in cryonics. Meryman will thusly have achieved his longed-for goal of separating cryobiology and cryonics.

So off I went to Cryo-82, for the scientific papers I would hear, and to have my say concerning "Policy Statements" and "Bylaws." The Cryo-82 meeting was held at the Hilton Hotel, located on the campus of the University of Houston. The campus is a modern edifice, typical of today's wealthy Houston scene. The slate of scientific papers presented in four days totaled over 100, covering most areas in low temperature biology and medicine. The meeting was well organized and reasonably scheduled, for my interests, except the Business Meeting. The Business Meeting was scheduled on the eleventh hour of the last day, causing me to stay an extra night to ensure that I could make my flight connections at the Houston Airport 35 miles away.

The last day of the meetings I proceeded to the vicinity of the *rooms* where the Business Meeting was scheduled to take place. I say *rooms*, because the Cryo-82 program had the Business Meeting scheduled to take place in two different locations until I found where members of the Board of Governors were beginning to seat themselves. It was evident that most of the membership had already left for the Houston Airport. Dr. Meryman, President of the Society, entered and made a quick headcount. He asked someone to check the hallways for needed members. I rose from my seat and suggested they check the other room, since the program had the meeting scheduled in two places at the same time. My suggestion resulted in another 5 to 6 members. A quorum required 40 members, but they failed to materialize. Meryman remarked that it looked like we had a quorum. Having studied up on my *Robert's Rules of Order*, which govern Society meetings under our current Bylaws, I rose from my seat on a "point of information," requesting a headcount to ensure a quorum was present. We were still six short of a quorum. Meryman said he was only joking about declaring a quorum. I was not amused. He then turned to me and asked what I suggested we do, since I seemed well versed in parliamentary procedures. I told them they could wait until next year's meeting or put any motions to a ballot vote by mail. At this time we could only have an informal discussion of the issues. They chose the ballot by mail. It was agreed that minutes would be prepared containing our discussion. By the time the proposed Bylaws came up for discussion, two of the Board members again sought to have a vote taken without a quorum. I again rose to a "point of order," informing them that they would not be able to vote on any proposed changes in the Bylaws of the Society, even if a quorum were present, since the Board of Governors had failed to give proper "notice" as required by our current Bylaws. They asked if I had a copy of *Robert's Rules*, which I held up. The appropriate pages were marked, but an actual examination was deferred. We continued with an informal discussion of the proposed new Bylaws. I seemed to be the only member present who had a multiplicity of questions about the changes being proposed. At one point in the discussion David Pegg and John Baust made comments to the effect that I was obstructing the will of the Board. I replied that I was protecting the rights of the membership and that I resented any implication that I was in any way out of order. Pegg retracted this implication but Baust remained silent. John Baust was hosting the Cryo-82 meeting, so I imagine he felt I was ruining an otherwise very successful week in Houston.

At the beginning of the meeting I identified myself as Jerry Leaf, from the UCLA Medical Center. When the minutes were published, I was also identified as the President of the Institute for Cryobiological Extension. The minutes were inaccurate, having material added and deleted to suit whoever was responsible for their publication. Furthermore, I did not think the issues were clearly presented. None of the discussion concerning the Policy Statement on cryonics was presented. Therefore, I assembled material containing my thoughts on the most relevant issues, with some documentation, and made a direct mailing to members of the Society for Cryobiology.

The results of the mail ballot are not yet known. Whatever the outcome, the important thing has been done. They were denied the silence and sanction of the victims.

I wish to thank Betty Leaf for her computer work that made the Society mailing possible, as well as this paper; Mike Federowicz for his usual tireless efforts in orchestrating the actual mailing to the membership and Hugh Hixon and Al Lopp for helping Mike prepare the mailing.

Jerry D. Leaf
Research Associate, UCLA
President, I.C.E.
Director, Trans Time Suspension Team
Member, Society for Cryobiology

The following is one part of the material sent out to the membership, and deals with the "Policy Statement" on cryonics.

Dear Society for Cryobiology Members:

I am writing to you because important issues will be decided by you that will affect the character of our Society for many years. But first, I would like to introduce myself. I have been a member of the Society for Cryobiology since 1970. I am currently working at the UCLA School of Medicine, Dept. of Surgery Div. of Thoracic Surgery as a Research Associate in Dr. Gerald Buckburg's laboratory, well known for its studies in myocardial protection and development of blood cardioplegia. I also own a private research laboratory, Cryovita Laboratories, dedicated to studies in low temperature biology and medicine.

As members of the Society we will be asked to vote on a completely new set of Bylaws. There are substantial issues involved in the proposed new Bylaws; however, I would like to address one particular area affected by these changes, the power of the Board of Governors to make "policy" and issue "policy statements," as provided in Section 4.14, part (a). This new power to make "policy," without approval of the membership, can only be appreciated by noting that support of "policy" is a new requirement for membership, Sec. 2.01, part (a) and (b). If a member should disagree with, i.e., not support, some future "policy" of the Board, then such a member would no longer satisfy the requirements of membership. The Board then has grounds for Discipline, Sec. 2.03, e.g., the Board may expel such a member.

Your first, and last, chance to openly disapprove a "policy" is now before you. The "Policy Statement" about cryonics, freezing clinically dead humans, is the first "policy" to come down to us from the Board. If you approve the new Bylaws you will never again have a chance to cast your vote for or against a Board "policy." The Board should be anxious for the membership to approve this "policy statement," as it will disqualify from membership several current members of the Society who will not support this "policy." If the Board seeks to expel these cryobiologists, the result may be lawsuits against the Board for loss of income. The possibility of such litigation perhaps accounts for Sec. 10.01, Indemnification, also a new addition to our Bylaws, if they are approved.

Why do we need a "policy" toward cryonics? It is apparent that Dr. Harold Meryman has deeply held negative feelings toward cryonics, based on his social views.

The Board of Governors has complained about receiving inquiries concerning cryonics. Since the Board knows nothing about cryonics, they should disregard such inquiries as beyond their field of expertise, or respond within the limit of their knowledge as cryobiologists. I don't see what their problem is, unless they are simply looking for an excuse to make a policy statement about cryonics from more obscure motives. I receive much unsolicited mail, as we all do. It would be absurd of me if I were to make a public policy statement about Ford Motor Company simply because I receive unwanted inquiries from them concerning my knowledge of their latest products or my opinion of their performance.

The first principle of good science is observation, and whereas Dr. Meryman has never observed the perfusion and freezing of a human, I cannot see how he can make any scientific judgment about its value scientifically. Since I have observed such procedures, have in fact directed the most technically advanced of these procedures, I can state unequivocally that scientific knowledge has been gained by doing "cryonic suspensions" or "clinical cryostasis," as such procedures are called. I am compiling data that should have the opportunity to be presented to those most knowledgeable in low temperature biology and medicine, cryobiologists. If we allow Dr. Meryman and/or our Board of Governors to decide for us what is or is not knowledge, why should we travel to meetings? They can simply mail the "truth" to us in a series of Policy Statements.

I am also pursuing research at Cryovita Laboratories using animal models for experiments in both organ and whole animal preservation at low temperatures. I expect to be allowed, as a member of the Society for Cryobiology, to present my findings, for your judgment, at future meetings of the Society for Cryobiology. This is the normal and proper function of a scientific society and its membership.

Cryonics involves the experimental application of cryogenics, cryobiology, and medicine. I have made arrangements for funding and donation of my body, after clinical death, to be used for such an experiment. I have done this because I think experiments with humans can provide advanced knowledge, along with animal research, that will result in the eventual development of suspended animation. Suspended animation, as a clinical modality, could extend the period of time available to pursue therapy for some patients designated "terminally ill," thus saving human life. I fully understand the experimental nature of today's cryonic suspension.

The science of cryobiology seeks to gain scientific knowledge of the effects of cold on living systems. The literature of cryobiology is represented by material on both plant and animal life, on living systems as small as a single cell and as large as whole mammals. While much low temperature research involved in the freezing and thawing of biological systems, a considerable effort has been made to achieve more specific technological goals, i.e., organ preservation. The work on organ preservation has as its goal the preservation of human cadaver organs for transplantation. The desired result will be the saving of human life. I recognize the value of this kind of research, as does Dr. Meryman, since his laboratory has been and is involved in organ preservation studies. I am also interested in preserving human life, if possible, and I do not think a case can be made for the part being more valuable than the whole, in this instance.

While Dr. Meryman's organ research is greatly supported by public funds, all cryonic suspensions are supported by private money, freely donated by choice after an "informed consent." As for my own animal research, I do not accept public tax money, but only private donations. Dr. Meryman believes a "massive infusion of money" could lead to "an orgy of empirical experimentation" resulting in a "waste of resources." Apparently organ preservation research in Dr. Meryman's laboratory results in scientific experimentation, but if others, not on his approved list, do organ preservation research it results in an "orgy of empirical experimentation." If Dr. Meryman gets an "infusion of money" from the public cash box it's money well spent, but if others, not on his approved list, receive money, it is a "waste of resources."

The value of any scientific society or scientific publication is the sharing of information. I expect this is the reason most of us are members of the Society for Cryobiology and subscribe to the *Journal of Cryobiology*. It is a function of scientists to hear and see all sides of an issue. This is what distinguishes science from less rational endeavors. The presentation of data for examination and criticism is the most reliable road to truth, not policy statements by demigods. There are other members of the Society for Cryobiology that are involved in cryonics, but have been told they would be excluded from their chosen profession, cryobiology, if this became public knowledge. So they have remained silent, some under direct threat to their jobs. I do not accept irrational limitations imposed on my thoughts, my research, or my associations with others. I hope you will not accept unfounded and grossly unjust limitations on yours. I will vote against any limitations of my activities that are legal and, therefore, my right to pursue. I will also vote against any policy statement that attempts to detract from the pursuit of scientific knowledge and its communication to other scientists. I hope you will join me in this action. Thank you.

Sincerely yours,

Jerry D. Leaf
President
Cryovita Laboratories

Fight Aging!

Reports From the Front Line in the Fight Against Aging

Reported by Reason

Fight Aging! exists to help ensure that initiatives with a good shot at greatly extending healthy human longevity become well known, supported, and accepted throughout the world. To this end, Fight Aging! publishes material intended to publicize, educate, and raise awareness of progress in longevity science, as well as the potential offered by future research. These are activities that form a vital step on the road towards far healthier, far longer lives for all.

Transcriptomic Analysis of Microglia in Mice Shows Greater Inflammatory Activity with Advancing Age

April, 2020

Microglia are innate immune cells of the brain, akin to macrophages elsewhere in the body, but equipped to undertake an additional set of tasks relating to neural function. A range of evidence strongly suggests that the progression of neurodegenerative conditions is strongly driven by greater inflammatory activity in the microglia of older individuals. This is perhaps largely due to cellular senescence, perhaps largely due to greater adoption of the aggressive M1 phenotype. Underlying causes include greater leakage of the blood-brain barrier due to the molecular damage of aging, allowing unwanted compounds and cells into the brain that will rouse an inflammatory response.

Accordingly, there is greater interest nowadays in strategies that might reduce inflammation in the brain, whether senolytic drugs targeting senescent cells, small molecules that might force microglia into the more helpful M2 phenotype, or other approaches to selectively sabotaging mechanisms of the immune response. Repair of underlying damage beyond cellular senescence that causes the chronic inflammation of aging is still a fairly low priority in the research community, alas.

Aging and Alzheimer's disease (AD) are both associated with diminished blood-brain barrier (BBB) integrity and an opening for T cell migration into the central nervous system (CNS). In the parenchyma, bidirectional crosstalk occurs between the infiltrating cells and the resident glial cells; activated microglia impair BBB function by releasing several inflammatory modulators and thus lead to hyperpermeability; and the resulting T cell infiltration, in turn, favors increased microglial activation by secreting proinflammatory cytokines or acting in a protective manner toward senescent microglia.

We performed RNA-seq analyses on microglia and astrocytes freshly isolated from wild-type and APP-PS1 (AD) mouse brains at five time points to elucidate their age-related gene-expression profiles. Our results showed that from 4 months onward, a set of age-related genes in microglia and astrocytes exhibited consistent upregulation or downregulation (termed "age-up"/"age-down" genes) relative to their expression at the young-adult stage (2 months). Most age-up genes were more highly expressed in AD mice at the same time points. Bioinformatic analyses revealed that the age-up genes in microglia were associated with the inflammatory response, whereas these genes in astrocytes included widely recognized AD risk genes, genes associated with synaptic transmission or elimination, and peptidase-inhibitor genes.

The results of this study indicate that microglia exhibit an increase in responsiveness to inflammation stimuli with age, which is reflected by the consistently elevated expression of inflammatory-response genes, whereas astrocytes appear to function as "preservers" of inflammation, which is reflected by the upregulation of peptidase-inhibitor genes upon aging.

Link: https://doi.org/10.1186/s12974-020-01774-9

Elevated Brain Amyloid-β Levels Correlate with Worse Cognitive Performance in Clinically Normal Old People

April, 2020

It seems reasonable to believe, based on the evidence, that amyloid-β aggregation is associated with the onset of Alzheimer's disease, but the question has always been whether it was a suitable target to reverse the condition. The failure of reductions in brain amyloid-β via immunotherapy to produce meaningful clinical success has brought other views of the condition to the

forefront. For example, raised amyloid-β may be a side-effect of persistent infections that produce chronic inflammation, and it is the inflammation that is important. Or amyloid-β may provoke sufficient inflammation and cellular senescence in supporting cells of the brain for it to become self-sustaining as the core of the condition, even once the amyloid is removed.

A logical next step at the present time would be to test senolytic therapies that can pass the blood-brain barrier, as this should both clear senescent cells and reduce the chronic inflammation in the brain that results from senescent cell signaling. If this produces results in humans that are as promising as those in mice, that might be a good indication that the primary driving mechanism of Alzheimer's disease (and perhaps many other neurodegenerative conditions) is chronic inflammation.

The Anti-Amyloid Treatment in Asymptomatic Alzheimer's disease (A4) Study is an ongoing prevention trial in clinically normal older individuals with evidence of elevated brain amyloid. The large number of participants screened with amyloid positron emission tomography (PET) and standardized assessments provides an unprecedented opportunity to evaluate factors associated with elevated brain amyloid.

This cross-sectional study included screening data in the A4 Study collected from April 2014 to December 2017 and classified by amyloid status. Data were was analyzed from 2018 to 2019 across 67 sites in the US, Canada, Australia, and Japan and included 4486 older individuals (age 65-85 years) who were eligible for amyloid PET, clinically normal, and cognitively unimpaired.

Amyloid PET results were acquired for 4486 participants (71.29 ± 4.67 years; 2647 women), with 1323 (29.5%) classified as amyloid-β (Aβ)+. Aβ+ participants were slightly older than Aβ-, with no observed differences in sex, education, marital or retirement status, or any self-reported lifestyle factors. Aβ+ participants were more likely to have a family history of dementia (3320 Aβ+ [74%] vs 3050 Aβ- [68%]) and at least 1 APOE ε4 allele (2602 Aβ+ [58%] vs 1122 Aβ- [25%]). Aβ+ participants demonstrated worse performance on screening Preclinical Alzheimer Cognitive Composite results and reported higher change scores on the Cognitive Function Index.

In conclusion, elevated brain amyloid was associated with family history and APOE ε4 allele but not with multiple other previously reported risk factors for AD. Elevated amyloid was associated with lower test performance results and increased reports of subtle recent declines in daily cognitive function. These results support the hypothesis that elevated amyloid represents an early stage in the Alzheimer's continuum.

Link: https://doi.org/10.1001/jamaneurol.2020.0387

Many People Aged 40 to 50 Exhibit Rapid Progression of Preclinical Atherosclerosis

April, 2020

Researchers here show that many people in their 40s have measurable signs of preclinical atherosclerosis, the early stages of the development of fatty lesions that narrow and weaken blood vessels. The data shows that these early lesions also progress more rapidly than was expected at this time of life. In its later stages, atherosclerosis results in stroke or heart attack as important vessels rupture or are blocked by debris from a fragmented lesion. At present there is little that can be done to meaningfully reverse existing lesions: lowering blood cholesterol levels only slows progression somewhat. Despite considerable interest in the research community in achieving reversal of established lesions, there has been little practical progress towards viable therapies in recent decades.

The PESA ('Progression of early subclinical atherosclerosis') study has been monitoring 4200 healthy middle-aged men and women with noninvasive imaging technology and omics biomarkers for more than 10 years. The use of noninvasive imaging technologies "allows us to identify the progression of the disease earlier than is possible with classical markers, such as the presence of coronary calcium detected by computed tomography (CT), thus allowing us to identify individuals at higher risk who could benefit from early intervention. The results show that ultrasound of the peripheral arteries is a more efficient method for detecting atherosclerosis progression than the study of coronary calcium by CT."

Atherosclerosis is characterized by the accumulation of fatty deposits in the artery walls. The disease is normally detected at an advanced stage, when it has already caused clinical events such as a heart attack or stroke. Treatment of the disease at this symptomatic stage is of limited effectiveness, and most patients experience a decline in quality of life. The treatment of these patients, moreover, places a significant burden on health care resources.

"This study is the first to analyze the progression of atherosclerosis at frequent intervals. The previous view was that the disease progressed very slowly throughout life. However, the new results show that the disease progressed very rapidly in 40% of the individuals analyzed. Future data from the PESA study will show whether this progression is associated with subsequent cardiovascular events. Until now, the speed of atherosclerosis progression has not been a factor in assessing individual risk."

"The key finding of the study is that over a short follow-up of just 3 years, 40% of individuals aged between 40 and 50

years showed major progression of atherosclerosis in distinct locations, including the carotid, femoral, and coronary arteries. This rapid disease progression could make these individuals more vulnerable to developing symptoms or having clinical events such as a heart attack or stroke." The researchers conclude that the findings, while they await validation from the occurrence of events in the PESA cohort in the future, will be of great value for the identification of strategies to stall the epidemic of cardiovascular disease.

Link: https://www.eurekalert.org/pub_releases/2020-04/cndi-apr040620.php

Complement C5 Protein is a Biomarker of Preclinical Atherosclerosis

April, 2020

At some point in the years ahead, the research community will develop effective means of reversing atherosclerotic lesions, the fatty, inflammatory deposits that build up in blood vessel walls to ultimately cause stroke or heart attack. Those therapies will be best applied in a preventative manner, not used in the late stage of the condition when lesions are large, complex, and greatly distort and weaken blood vessels. That in turn means that a reliable, low cost test to assess progression of preclinical atherosclerosis is required. Researchers here propose complement C5 protein levels in a blood sample as such a test, based on recent human data.

The purpose of this study was to analyze the temporal and topologically resolved protein changes taking place in human aortas with early atherosclerosis to find new potential diagnostic and/or therapeutic targets. The protein composition of healthy aortas (media layer) or with early atheroma (fatty streak and fibrolipidic, media, and intima layers) was analyzed by deep quantitative multiplexed proteomics. Plasma levels of complement C5 were analyzed in relation to the presence of generalized (more than 2 plaques) or incipient (0 to 2 plaques) subclinical atherosclerosis in 2 independent clinical cohorts, PESA (Progression of Early Subclinical Atherosclerosis) and NEFRONA (National Observatory of Atherosclerosis in Nephrology).

Proteins involved in lipid transport, complement system, immunoglobulin superfamily, and hemostasis are increased in early plaques. Components from the complement activation pathway were predominantly increased in the intima of fibrolipidic plaques. Among them, increased C5 protein levels were further confirmed by Western blot, enzyme-linked immunosorbent assay, and immunohistochemistry, and associated with in situ complement activation. Plasma C5 was significantly increased in individuals with generalized subclinical atherosclerosis in both PESA and NEFRONA cohorts, independently of risk factors. Moreover, in the PESA study, C5 plasma levels positively correlated with global plaque volume and coronary calcification.

In conclusion, activation of the complement system is a major alteration in early atherosclerotic plaques and is reflected by increased C5 plasma levels, which have promising value as a novel circulating biomarker of subclinical atherosclerosis.

Link: https://doi.org/10.1016/j.jacc.2020.02.058

Reducing Neuroinflammation Slows Onset of Neurodegeneration in Animal Models

May, 2020

Alzheimer's disease is strongly driven by chronic inflammation in brain tissue. Studies in which senescent, inflammatory microglia are removed from the brain strongly suggests this to be the case in the later stages of the condition. Here, researchers use animal models to demonstrate that it may also be the case in the early stages, prior to onset of obvious symptoms of cognitive decline. A view of Alzheimer's disease in which inflammation is the dominant mechanism – resulting from some combination of exposure to pathogens, accumulation of senescent cells, and dysregulation of immune cells due to amyloid-β aggregates – is gathering support these days.

In a new animal study examining Alzheimer's disease, researchers found that disease progression could be slowed by decreasing neuroinflammation in the brain before memory problems and cognitive impairment were apparent. The new findings point to the importance of developing therapies that target very early stages of the disease. In 2011, the National Institute on Aging updated the diagnostic criteria for Alzheimer's disease to reflect its progressive nature. The criteria added a preclinical stage during which brain changes are taking place, but the person is still asymptomatic and, therefore, unaware of his condition. Biomarker profiles could eventually be used to identify people in the disease's early stages who might benefit from early treatments.

"Starting an intervention at the earliest stage of the disease, when cellular and molecular alterations have already been triggered but major damage to the brain has not yet occurred, could offer a way to reduce the number of people who go on to develop full Alzheimer's dementia. However, there have been few studies in animals examining therapeutic strategies that target timepoints before symptoms can be seen."

The researchers designed an animal study to gain a deeper understanding of the role of neuroinflammation in Alzheimer's disease during the pre-symptomatic stage of the disease, which

might represent the best time for therapeutic intervention. The study results suggest that rebalancing neuroinflammation in animals that show altered neuroinflammatory parameters could be beneficial. "Our results help demonstrate that neuroinflammation in Alzheimer's disease is an extremely complex phenomenon that can change over the disease's progression and varies based on factors such as affected brain area. We hope that these findings will prompt scientists to further investigate neuroinflammation at the earliest stages of the disease, which may represent an important pharmacological target."

Link: https://www.eurekalert.org/pub_releases/2020-04/eb-reb042220.php

In Search of Very Rare Genetic Variants with Large Effects on Longevity

May, 2020

Genetic studies of the past twenty years have quite effectively ruled out the idea that genetic variation has a meaningful impact on life span in the overwhelming majority of people. To a first approximation, there are no longevity genes. Rather there is a mosaic of tens of thousands of tiny, situational, interacting effects, that in aggregate produce an outcome on health that is far smaller than the results of personal choice in health and lifestyle. Near the entirety of the effects that your parents have on your health and life span stems from their influence on the important choices - whether you smoke, whether you get fat, whether you exercise.

But this is not to say that there are no longevity genes. It only constrains our expectations on their rarity, just as human demographics constrains our expectations on how large an effect size is plausible. Big databases and modern data mining can still miss rare variants and mutations. There is the example of the single family of PAI-1 loss of function mutants who might live seven years longer than their peers - possibly as a result of the influence of PAI-1 on the burden of cellular senescence. One might also suspect that the exceptional familial longevity of some ashkanazi Jews is simply too much for good lifestyle choice to explain, though there no single variant really stands out after many years of assessment.

The commentary here notes recent research into rare variants and life span that, once again, fails to find a sizable contribution to longevity or its inheritance. At some point, we must accept that genetics is most likely not a direct and easy path to enhanced human longevity. It is an important tool in the toolkit, enabling therapies for a range of uses, but the goal of a modest adjustment to a few genes that produces an altered metabolism that yields significant gains in longevity (with minimal side-effects) may be a mirage. Time will tell.

Aging: Searching for the genetic key to a long and healthy life

For centuries scientists have been attempting to understand why some people live longer than others. Individuals who live to an exceptional old age – defined as belonging to the top 10% survivors of their birth cohort – are likely to pass on their longevity to future generations as an inherited genetic trait. However, recent studies suggest that genetics only accounts for a small fraction (~10%) of our lifespan. One way to unravel the genetic component of longevity is to carry out genome-wide association studies (GWAS) which explore the genome for genetic variants that appear more or less frequently in individuals who live to an exceptional old age compared to individuals who live to an average age. However, the relatively small sample sizes of these studies has made it difficult to identify variants that are associated with longevity.

The emergence of the UK Biobank – a cohort that contains a wide range of health and medical information (including genetic information) on about 500,000 individuals – has made it easier to investigate the relationship between genetics and longevity. Although it is not yet possible to study longevity directly with the data in the UK Biobank, several GWAS have used these data to study alternative lifespan-related traits, such as the parental lifespan and healthspan of individuals (defined as the number of years lived in the absence of major chronic diseases). These studies have been reasonably successful in identifying new genetic variants that influence human lifespan, but these variants can only explain ~5% of the heritability of the lifespan-related traits.

The GWAS have only focused on relatively common genetic variants (which have minor allele frequencies (MAFs) of ≥1%), and it is possible that rare variants might be able to explain what is sometimes called the 'missing heritability'. Now researchers report how they analyzed data from the UK Biobank and the UK Brain Bank Network (which stores and provides brain tissue for researchers) to investigate how rare genetic variants affect lifespan and healthspan.

One type of rare genetic variant, called a protein-truncating variant, can dramatically impact gene expression by disrupting the open reading frame and shortening the genetic sequence coding for a protein. The team calculated how many of these rare protein-truncating variants, also known as PTVs, were present in the genome of each individual, and found ultra-rare PTVs (which have MAFs of less than 0.01%) to be negatively associated with lifespan and healthspan. This suggests that individuals with a small number of ultra-rare PTVs are more likely to have longer, healthier lives. This work is the first to show that rare genetic variants play a role in lifespan-related traits, which is in line with previous studies showing rare PTVs to be linked to a variety of diseases. However, these variants only have a relatively small effect on human lifespan and cannot fully explain how longevity is genetically passed down to future generations.

Send email to Reason at Fight Aging!: **reason@fightaging.org**

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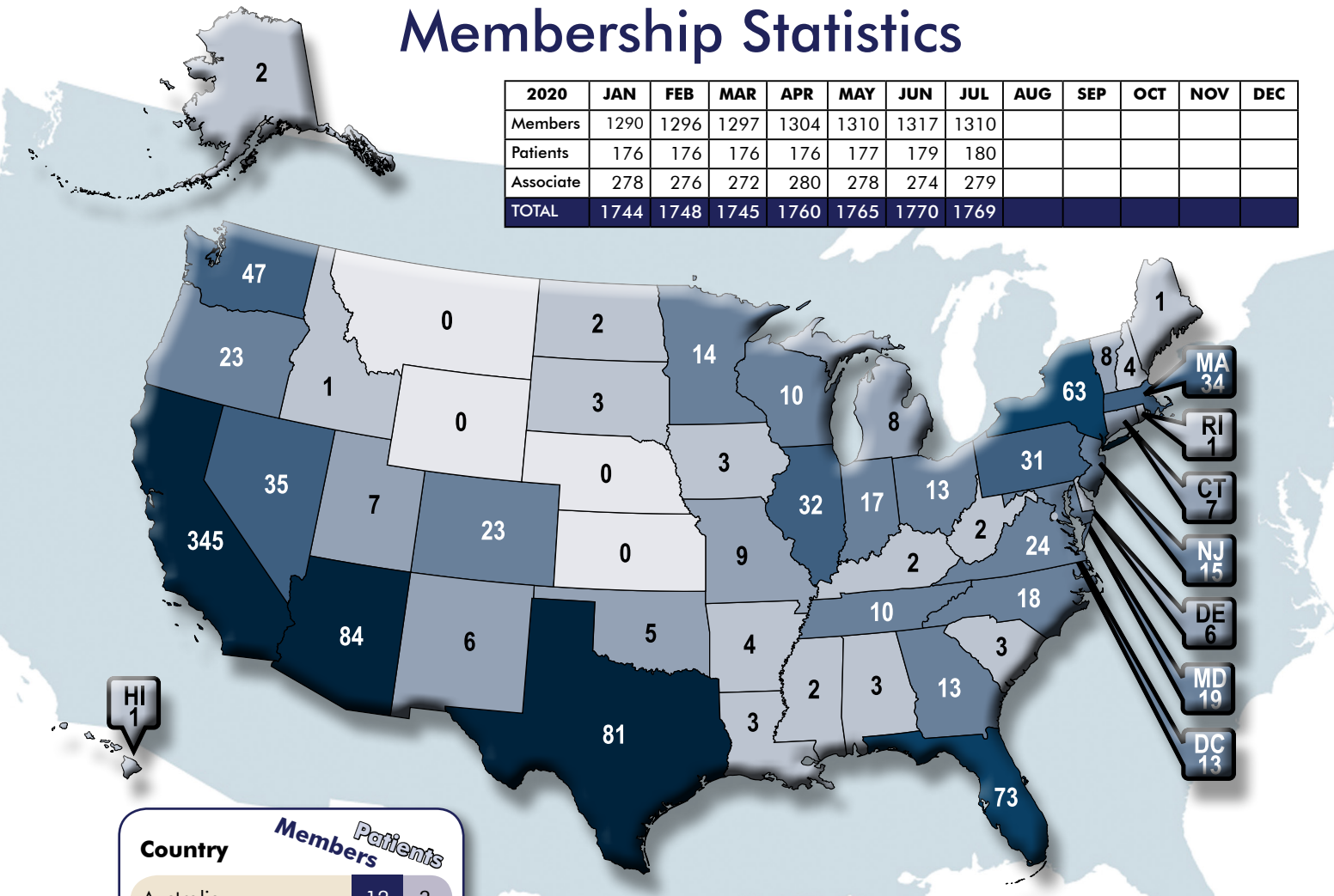
Membership Statistics

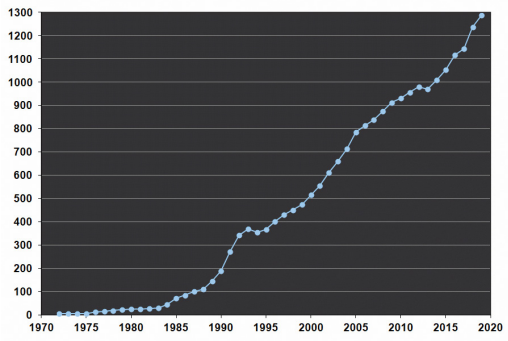
2020	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Members	1290	1296	1297	1304	1310	1317	1310					
Patients	176	176	176	176	177	179	180					
Associate	278	276	272	280	278	274	279					
TOTAL	1744	1748	1745	1760	1765	1770	1769					



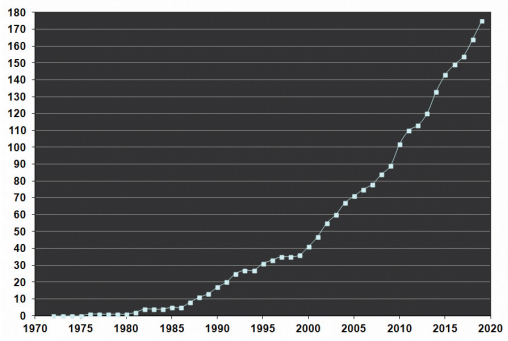
International Members & Patients

Country	Members	Patients
Australia	12	3
Austria	1	0
Belgium	1	0
Brazil	1	0
Bulgaria	1	0
Canada	63	4
China	0	1
Finland	1	0
France	1	1
Germany	20	0
Hong Kong	2	0
Hungary	1	0
Israel	1	1
Italy	2	0
Japan	4	0
Luxembourg	1	0
Malaysia	1	0
Mexico	5	0
Monaco	1	0
Netherlands	1	0
New Zealand	1	0
Norway	2	0
Portugal	4	1
Puerto Rico	1	0
Spain	5	1
Sweden	1	0
Taiwan	1	0
Thailand	3	1
United Kingdom	40	3
TOTAL	178	16

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



Number of Alcor members



Number of Alcor patients

Alcor Associate Membership

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:

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- **Discounts on Alcor conferences**
- **Access to post in the Alcor Member Forums**
- **Access to local Alcor meetings and training events**

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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 cryo-preserved 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.

Revival Update

Scientific Developments Supporting Revival Technologies

Reported by R. Michael Perry, Ph.D.

Development of a Neural Interface for High-Definition, Long-Term Recording in Rodents and Nonhuman Primates

Chia-Han Chiang, Sang Min Won, Amy L. Orsborn, Ki Jun Yu, Michael Trumpis, Brinnae Bent, Charles Wang, Yeguang Xue, Seunghwan Min, Virginia Woods, Chunxiu Yu, Bong Hoon Kim, Sung Bong Kim, Rizwan Huq, Jinghua Li, Kyung Jin Seo, Flavia Vitale, Andrew Richardson, Hui Fang, Yonggang Huang, Kenneth Shepard, Bijan Pesaran, John A. Rogers, Jonathan Viventi

Science Translational Medicine 08 Apr 2020: 12(538), eaay4682, https://stm.sciencemag.org/content/12/538/eaay4682, accessed 08 May 2020.

Abstract

Long-lasting, high-resolution neural interfaces that are ultrathin and flexible are essential for precise brain mapping and high-performance neuroprosthetic systems. Scaling to sample thousands of sites across large brain regions requires integrating powered electronics to multiplex many electrodes to a few external wires. However, existing multiplexed electrode arrays rely on encapsulation strategies that have limited implant lifetimes. Here, we developed a flexible, multiplexed electrode array, called "Neural Matrix," that provides stable in vivo neural recordings in rodents and nonhuman primates. Neural Matrix lasts over a year and samples a centimeter-scale brain region using over a thousand channels. The long-lasting encapsulation (projected to last at least 6 years), scalable device design, and iterative in vivo optimization described here are essential components to overcoming current hurdles facing next-generation neural technologies.

From: Protecting Thin, Flexible Brain Interfaces from the Human Body, (unattributed), Duke University via Eurekalert, 08 Apr 2020, https://www.eurekalert.org/pub_releases/2020-04/du-ptf040320.php, accessed 08 May 2020.

Researchers have demonstrated the ability to implant an ultrathin, flexible neural interface with thousands of electrodes into the brain with a projected lifetime of more than six years. Protected from the ravaging environment of internal biological processes by less than a micrometer of material, the achievement is an important step toward creating high-resolution neural interfaces that can persist within a human body for an entire lifetime.

The results, appearing online April 8 in the journal *Science Translational Medicine*, were published by a team of researchers led by Jonathan Viventi, assistant professor of biomedical engineering at Duke University; John Rogers, the Louis Simpson and Kimberly Querrey Professor of Materials Science and Engineering, Biomedical Engineering and Neurological Surgery at Northwestern University; and Bijan Pesaran, professor of neural science at New York University.

"Trying to get these sensors to work in the brain is like tossing your foldable, flexible smartphone in the ocean and expecting it to work for 70 years," said Viventi. "Except we're making devices that are much thinner and much more flexible than the phones currently on the market. That's the challenge."

The human body is an unforgiving place to live if you're an uninvited guest – especially if you're made of polymers or metal. Besides attacks from the surrounding tissues and immune system, foreign objects must be able to stand up to a corrosive, salty environment.

Engineering electrical devices that can withstand this assault is an even more daunting prospect. Current long-term implantable devices are almost universally hermetically sealed within a laser-welded titanium casing. Think of a pacemaker, for example.

"Building water-tight, bulk enclosures for such types of implants represents one level of engineering challenge," Rogers said. "We're reporting here the successful development of materials that provide similar levels of isolation, but with thin, flexible membranes that are one hundred times thinner than a sheet of paper." …

"You need to move the electronics to the sensors themselves and develop local intelligence that can handle multiple incoming signals," said Viventi. "This is how digital cameras work. You can have tens of millions of pixels without tens of millions of wires because many pixels share the same data channels." …

In the new paper, Viventi, Rogers, Pesaran and their colleagues demonstrate that a thermally grown layer of silicon dioxide less than a micrometer thick can ward off the hostile environment within the brain, degrading at a rate of only 0.46 nanometers per day. And because this form of glass is biocompatible, any

trace amount that dissolves into the body should not create any problems of its own.

They also show that, even though the glass encapsulation is not conductive, the device's electrodes can detect neural activity through capacitive sensing. This is the same sort of technology that can detect the movements of a finger on a smartphone's touchscreen. They implanted a 64-electrode neural interface into a rat for over a year and a 1,008-electrode neural interface into the motor cortex of a monkey reaching to a touchscreen.

Temporal Circuit of Macroscale Dynamic Brain Activity Supports Human Consciousness

Zirui Huang, Jun Zhang, Jinsong Wu, George A. Mashour, Anthony G. Hudetz

Science Advances 11 Mar 2020: 6(11), eaaz0087, https://advances.sciencemag.org/content/6/11/eaaz0087, accessed 08 May 2020.

Abstract

The ongoing stream of human consciousness relies on two distinct cortical systems, the default mode network and the dorsal attention network, which alternate their activity in an anticorrelated manner. We examined how the two systems are regulated in the conscious brain and how they are disrupted when consciousness is diminished. We provide evidence for a "temporal circuit" characterized by a set of trajectories along which dynamic brain activity occurs. We demonstrate that the transitions between default mode and dorsal attention networks are embedded in this temporal circuit, in which a balanced reciprocal accessibility of brain states is characteristic of consciousness. Conversely, isolation of the default mode and dorsal attention networks from the temporal circuit is associated with unresponsiveness of diverse etiologies. These findings advance the foundational understanding of the functional role of anticorrelated systems in consciousness.

From: Scientists Just Proved These Two Brain Networks Are Key to Consciousness, Vanessa Bates Ramirez, SingularityHub, 12 Mar, 2020, https://singularityhub.com/2020/03/12/these-two-brain-networks-arent-active-at-the-same-time-but-theyre-both-key-to-consciousness/, accessed 08 May 2020

Consciousness is one of the greatest mysteries of the human species. Where and how does it originate? Why do we have it? Is it even real, or just an illusion?

These questions aren't just hard to answer – even *looking* for answers is difficult. But scientists are slowly chipping away at them, with teams all over the world carrying out studies on the brain aimed at cracking the consciousness code.

One of the most recent studies showed a clear relationship between two brain networks critical to consciousness. In a paper published this week in *Science Advances*, a team from the University of Michigan described their finding that the default mode network (DMN) and the dorsal attention network (DAT) are anti-correlated, meaning that when one is active, the other is suppressed. The team also found that neither network was highly active in people who were unconscious.

These findings suggest that the interplay of the DMN and the DAT support consciousness by allowing us to interact with our surroundings then to quickly internalize those interactions, essentially turning our experiences into thoughts and memories. …

The team used functional magnetic resonance imaging (fMRI), which measures brain activity by detecting changes in blood flow, to study the brains of 98 participants. Some of the participants were awake, while others were mildly sedated or generally anesthetized, and some suffered from brain disorders of consciousness.

The team built a machine learning model to analyze when different parts of participants' brains were in use at the same time. Many previous studies of these patterns used fMRI data averaged over several minutes, but the Michigan team took second-to-second images of brain activity. …

They observed eight primary brain networks–from higher-level processing to visual processing and the activity of the whole brain – in addition to the aforementioned DAT and DMN. Using the first 98 participants, the team created a model of the activity patterns of these networks, including which ones were activated simultaneously, for how long, and which network activated subsequently.

Once they had a reliable model, the team further evaluated their results in an additional group of 248 participants, all of whom were conscious but some of whom had psychiatric disorders that could alter the functioning of their brain networks. …

The researchers saw that the brain quickly transitions from one network to another in regular patterns, and the *conscious* brain cycles through a structured pattern of states over time, including frequent transitions to the default mode and dorsal attention networks.

But in patients who were unconscious – whether they'd been sedated or they suffered from brain disorders – transitions to the DMN and DAT were much less frequent.

This is key: though the experiences of unresponsive patients would have differed depending on how they became unconscious – their brain networks would have been impacted and reorganized in different ways – they all shared the same isolation of the DMN and DAT networks.

In people who are conscious, turning off the DMN (which is what happens when you take psychedelics) results in an inability to deeply self-reflect. Turning off the DAT, on the other hand, would result in an inability to be aware of and respond to one's surroundings. It's the switching between these two networks that allows us to be engaged, aware, self-reflective humans–conscious beings, you could say.

"We wanted to pinpoint which networks are related to consciousness," said Huang. "By suppressing consciousness, we developed a better sense of which networks are important for consciousness by process of elimination."

Multifunctional Surface Microrollers for Targeted Cargo Delivery in Physiological Blood Flow

Yunus Alapan, Ugur Bozuyuk, Pelin Erkoc, Alp Can Karacakol, Metin Sitti

Science Robotics 5(42), 20 May 2020, https://robotics.sciencemag.org/content/5/42/eaba5726, accessed 25 Aug. 2020.

Abstract

Mobile microrobots offer great promise for minimally invasive targeted medical theranostic applications at hard-to-access regions inside the human body. The circulatory system represents the ideal route for navigation; however, blood flow impairs propulsion of microrobots especially for the ones with overall sizes less than 10 micrometers. Moreover, cell- and tissue-specific targeting is required for efficient recognition of disease sites and long-term preservation of microrobots under dynamic flow conditions. Here, we report cell-sized multifunctional surface microrollers with ~3.0 and ~7.8-micrometer diameters, inspired by leukocytes in the circulatory system, for targeted drug delivery into specific cells and controlled navigation inside blood flow. The leukocyte-inspired spherical microrollers are composed of magnetically responsive Janus microparticles functionalized with targeting antibodies against cancer cells (anti-HER2) and light-cleavable cancer drug molecules (doxorubicin). Magnetic propulsion and steering of the microrollers resulted in translational motion speeds up to 600 micrometers per second, around 76 body lengths per second. Targeting cancer cells among a heterogeneous cell population was demonstrated by active propulsion and steering of the microrollers over the cell monolayers. The multifunctional microrollers were propelled against physiologically relevant blood flow (up to 2.5 dynes per square centimeter) on planar and endothelialized microchannels. Furthermore, the microrollers generated sufficient upstream propulsion to locomote on inclined three-dimensional surfaces in physiologically relevant blood flow. The multifunctional microroller platform described here presents a bioinspired approach toward in vivo controlled propulsion, navigation, and targeted active cargo delivery in the circulatory system.

From: Microrobots Roll Along Blood Vessel Walls to Deliver Drugs (unattributed), Medgadget, 04 Jun. 2020, https://www.medgadget.com/2020/06/microrobots-roll-along-blood-vessel-walls-to-deliver-drugs.html, accessed 25 Aug. 2020.

Precise delivery of therapeutic drugs into diseased tissue remains a challenge in a variety of cases. Tumors can be hard to seed with chemo agents, particularly when the blood flow is not favorable for delivery. Now, researchers at the Max Planck Institute for Intelligent Systems in Germany have developed microscopic drug delivery devices that can travel against the flow of blood.

The new microrobots were inspired by leukocytes (white blood cells) that are naturally able to roll along the interior walls of blood vessels, and even move against the flow of the surrounding blood. However, while leukocytes are self-powered, the new devices rely on an external magnetic field to get them to their target.

Having about the same size, shape, and locomotion capabilities as leukocytes, the microrobots feature a chamber that can be loaded with drugs and a surface to which antibodies can be attached. While a magnetic field can push the microrobots toward their destination, the antibodies help to bring each device precisely to where it is needed.

Having built the microrobots, the researchers successfully tested them on mimics of blood vessels, using a magnetic field to roll them along the interior walls. Moreover, the team was also able to use the antibodies attached to the microrobots to guide the devices toward individual cancer cells where they dropped off their therapeutic cargo.

Alloying Conducting Channels for Reliable Neuromorphic Computing

Hanwool Yeon, Peng Lin, Chanyeol Choi, Scott H. Tan, Yongmo Park, Doyoon Lee, Jaeyong Lee, Feng Xu, Bin Gao, Huaqiang Wu, He Qian, Yifan Nie, Seyoung Kim, and Jeehwan Kim

Nature Nanotechnology 15, 574–579 (08 Jun. 2020; updated 23 Jun. 2020), https://www.nature.com/articles/s41565-020-0694-5, accessed 24 Aug. 2020.

Abstract

A memristor has been proposed as an artificial synapse for emerging neuromorphic computing applications. To train a neural network in memristor arrays, changes in weight values in the form of device conductance should be distinct and uniform. An electrochemical metallization (ECM) memory, typically based on silicon (Si), has demonstrated a good analogue

switching capability owing to the high mobility of metal ions in the Si switching medium. However, the large stochasticity of the ion movement results in switching variability. Here we demonstrate a Si memristor with alloyed conduction channels that shows a stable and controllable device operation, which enables the large-scale implementation of crossbar arrays. The conduction channel is formed by conventional silver (Ag) as a primary mobile metal alloyed with silicidable copper (Cu) that stabilizes switching. In an optimal alloying ratio, Cu effectively regulates the Ag movement, which contributes to a substantial improvement in the spatial/temporal switching uniformity, a stable data retention over a large conductance range and a substantially enhanced programmed symmetry in analogue conductance states. This alloyed memristor allows the fabrication of large-scale crossbar arrays that feature a high device yield and accurate analogue programming capability. Thus, our discovery of an alloyed memristor is a key step paving the way beyond von Neumann computing.

From: Engineers Put Tens of Thousands of Artificial Brain Synapses on a Single Chip

Jennifer Chu, MIT News Office, 08 Jun. 2020, https://news.mit.edu/2020/thousands-artificial-brain-synapses-single-chip-0608, accessed 24 Aug. 2020.

MIT engineers have designed a "brain-on-a-chip," smaller than a piece of confetti, that is made from tens of thousands of artificial brain synapses known as memristors – silicon-based components that mimic the information-transmitting synapses in the human brain.

The researchers borrowed from principles of metallurgy to fabricate each memristor from alloys of silver and copper, along with silicon. When they ran the chip through several visual tasks, the chip was able to "remember" stored images and reproduce them many times over, in versions that were crisper and cleaner compared with existing memristor designs made with unalloyed elements.

Their results, published today in the journal *Nature Nanotechnology*, demonstrate a promising new memristor design for neuromorphic devices – electronics that are based on a new type of circuit that processes information in a way that mimics the brain's neural architecture. Such brain-inspired circuits could be built into small, portable devices, and would carry out complex computational tasks that only today's supercomputers can handle.

"So far, artificial synapse networks exist as software. We're trying to build real neural network hardware for portable artificial intelligence systems," says Jeehwan Kim, associate professor of mechanical engineering at MIT. "Imagine connecting a neuromorphic device to a camera on your car, and having it recognize lights and objects and make a decision immediately, without having to connect to the internet. We hope to use energy-efficient memristors to do those tasks on-site, in real-time."

Memristors, or memory transistors, are an essential element in neuromorphic computing. In a neuromorphic device, a memristor would serve as the transistor in a circuit, though its workings would more closely resemble a brain synapse – the junction between two neurons. The synapse receives signals from one neuron, in the form of ions, and sends a corresponding signal to the next neuron.

A transistor in a conventional circuit transmits information by switching between one of only two values, 0 and 1, and doing so only when the signal it receives, in the form of an electric current, is of a particular strength. In contrast, a memristor would work along a gradient, much like a synapse in the brain. The signal it produces would vary depending on the strength of the signal that it receives. This would enable a single memristor to have many values, and therefore carry out a far wider range of operations than binary transistors.

Like a brain synapse, a memristor would also be able to "remember" the value associated with a given current strength, and produce the exact same signal the next time it receives a similar current. This could ensure that the answer to a complex equation, or the visual classification of an object, is reliable – a feat that normally involves multiple transistors and capacitors.

Ultimately, scientists envision that memristors would require far less chip real estate than conventional transistors, enabling powerful, portable computing devices that do not rely on supercomputers, or even connections to the Internet.

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.

Ralph C Merkle, "**Revival of Alcor Patients**," *Cryonics*, 39(4) & 39(5) (May-June & July-August 2018): 10-19, 10-15.

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
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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.

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- 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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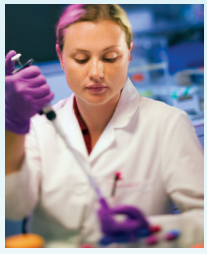

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