CRYONICS

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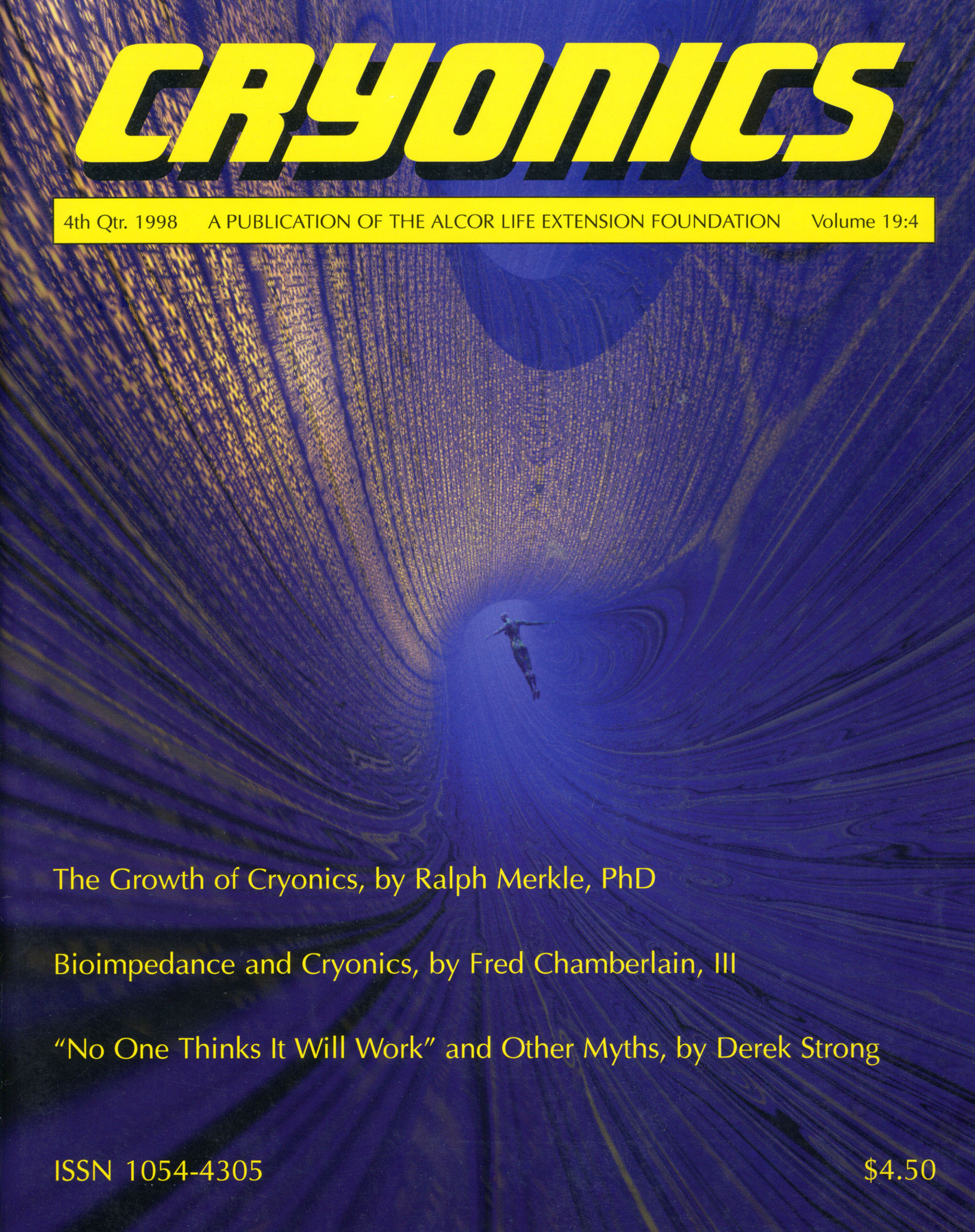

The Growth of Cryonics, by Ralph Merkle, PhD

Bioimpedance and Cryonics, by Fred Chamberlain, III

"No One Thinks It Will Work" and Other Myths, by Derek Strong

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Last quarter's "The Failure of Cryonics," by Saul Kent, drew a significant amount of mail, despite the fact that the entire text of this article had previously appeared on the CryoNet online mailing list, as well as in *The Immortalist*. Many letters seemed to agree that more cryonics research is necessary, though just as many expressed optimism about the chances of current cryonics techniques working. In one way or another, Mr. Kent's piece inspired three of our feature articles this time: "The Growth of Cryonics," by Ralph Merkle, "Bioimpedance and Cryonics," by Fred Chamberlain, and "No One Thinks It Will Work," by Derek Strong.

Clearly, controversy helps to focus our thinking. As you read this issue, ask yourself what specific questions in cryonics, life extension, or nanotechnology bother *you* the most. Write to us and get these concerns into the open. Perhaps your thoughts will form the basis of yet another quarter's issue of *Cryonics*.

letters to the Editor

The Failure of Cryonics

Dear Cryonics:

Saul Kent is certainly correct that it's in the cryonics movement's interest to have young people sign up. After all, it's in the interest of *any* industry to have a lot of customers who pay for a service over decades before they receive it! But was it a good sign that Alcor used to have a lot of young members? I don't think so.

I joined in my mid-twenties, convinced that the service Alcor was then providing wasn't worth the cost. I joined to support the movement, in hope that cryonics would be workable by the time I actually needed it. I was a true believer, as must be the case for anyone who'll lay out hard cash for a service they can't anticipate needing for decades. (Or work providing that service at sub-minimum wages!) Any movement needs true believers in its early years. But any movement which continues to rely on them is a failing movement, because it's a movement which isn't convincing people that its service is worth buying on its own merits.

Now, Saul would have us believe that the reason Alcor's membership is aging is that we represent the dying remnants of the people who joined up back then. Bunk! Alcor has more than four times the membership it had when I first joined, despite the fact that a large chunk of old membership jumped ship! The people who joined back then thus have little effect on today's membership statistics. Logically, the only reason our membership is aging is that we're attracting older people; not true believers, but customers! People are joining because they believe our service is worth the price *right now*. And I agree.

Lest this be read as a wholesale endorsement of Alcor's technological progress, let me say that this isn't because of improvements in Alcor's techniques. Not long after I joined Alcor, the progress screeched to a halt, for reasons beyond our control, and only recently resumed. You can lay credit for that perception of value on one man: Eric Drexler. He has provided technologically literate people with reason to believe that even the lousy suspensions we're providing (brain riddled with cracks, torn membranes, and all) might very well be worth the money. Because nanotechnology will be able to put you back together again, if you're not rotted or cremated! And the more plausible nanotechnology becomes, the more customers we will attract, for reasons largely beyond our own control. I really believe we're poised for another growth spurt in the next few years, exceeding anything we've experienced in the past.

The result will be an aging membership, much shorter times between sign-up and suspension, and the need for Alcor to start paying competitive wages and charging full costs, as there won't be enough true believers to carry the load. But that's not the death of cryonics, that's the birth! This long gestation is finally coming to an end.

Finally, don't read this as a suggestion that we place all our reliance on nanotechnology, and stop working to advance cryonics techniques! Even if nanotechnology were theoretically capable of fixing all the problems we have with current suspension (and that's probably not true except under ideal circumstances) we have to confront the very real possibility that there will never be enough cryonics suspendees to pay for the necessary development costs for such specialized technology. The less reliance we place on future capabilities, the better!

Brett P. Bellmore,
Capac, MI

The editor comments:

I hope you're right about that growth spurt and subsequent pay increase for cryonicists, Brett. I could certainly use a raise about now. <grin>

I agree with your attitude toward suspension members' ages. To put it another way: if every cryonicist were older than 70 and there were 50 suspensions per year, we'd be in no worse shape as long as 50 more septuagenarians per year signed up to fill the vacancies. The cryonics movement as a whole is doing much *better than that.*

* * *

Editor:

Saul Kent recently said ("The Failure of Cryonics," Cryonics, 3Q 1998) "...cryonics hasn't grown because nobody thinks it will work!" and "...major research advances leading to better and more credible cryonics services is the only hope we have...." Near the end he says "Anyone who wishes to be put on a waiting list to receive a 21CM Prospectus should send their name, phone number and postal address to...." and concludes with "...we should devote most of our attention, time and money to suspended animation research."

Under this strategy, signing up new members (among other crucial activities) is viewed as a drain on resources which could be better used to achieve "...major research advances...." This mono-strategy is a very poor one. Saul supports it with the enthusiasm of a salesman and unfortunately includes major inaccuracies and errors, a few of which are mentioned in the following paragraphs.

Saul's major contention that "...cryonics hasn't grown..." is contradicted

by the fact that Alcor (as Saul points out) was growing at a rate of about 30% per year for many years. He refers to this period as the "golden age of cryonics" and incorrectly attributes this phrase to me. Anyone acquainted with the small size and limited resources in cryonics would have to agree that we have never seen anything like a "golden age." The inaccurate phrase and incorrect attribution distract from the basic reality: Alcor was growing. Saul also points to the lack of growth and aging membership among the cryonics organizations with which he is affiliated. Other explanations for their lack of growth seem more plausible, including their policy of not recruiting people.

Saul said (cryonet message #9684) "... I believe that cryonics patients frozen today (under reasonably good conditions) have a much better chance of revival than of winning the lottery." Considering Saul's view that there is "...massive damage caused by the primitive freezing methods we employ...," that he is "desperate" and that "winning the lottery" is usually viewed as an extremely unlikely event, it is fair to conclude that Saul thinks present methods are unlikely to work.

However, the claim that "... nobody thinks it will work!" is obviously false. In conversations with a wide range of people I've found the "it doesn't work" argument is advanced no more frequently than any of the other (often charmingly absurd) arguments against cryonics. While it is certainly one of the arguments that must be countered, if this was the single argument that decisively influenced people's behavior cryonics would now be a vast movement numbering in the millions. My own experience with cryobiologists critical of cryonics is that they usually concede that preserving memories and related information in an information theoretic sense is not only plausible but even likely. They then attack other assumptions (e.g., that people in the future will revive people in suspension, that living a long and healthy life is a good thing, that nanotechnology is feasible, etc. See, for example, Cryonics, July/August 1993, pages 22-24 for critical comments by David Pegg).

There has been a recent shift: having learned there is a rhetorical advantage in claiming that current methods cause information loss, critics will sometimes make this claim. The validity of this criticism is undercut by their clear lack of understanding of "information loss." One critical cryobiologist (who will remain nameless) said "When a protein unfolds or when a bit of DNA is oxidized or when even a carbohydrate is broken up, INFORMATION is lost and there is no blue=print [sic] available to regain the information like there is for fixing a car. The information lost cannot NOT [sic] be replaced by a 'fix' of the structure alone."

Clearly, damage to DNA can (and in fact is) repaired. Future technology should be able to replace missing DNA by using redundant information from other cells. Proteins that unfold do not cause information loss, because each protein has one (or at most a few) functional configurations which they adopt spontaneously under appropriate conditions. The digestion of carbohydrates (e.g., sugars) does not seem to erase our memories of who we are.

This kind of statement clearly shows a major conceptual breakdown. The fact that computer scientists and programmers are more likely to become Alcor members is in part because they better understand the basic information theoretic issues, and can dismiss as erroneous the kind of "criticism" given above. Failure to understand such basic issues is not always confined to critics. For example, the "cracking problem" has caused much concern. At low temperatures, frozen tissue (and in particular frozen neural tissue) will crack. There is no reason to believe that this "damage" causes information theoretic death or even any significant information loss. Despite this, some people within the cryonics movement have expressed the deepest concerns about the "cracking problem," a level of concern which is unjustified given the available evidence.

Saul said "Until we have solid evidence that we can preserve the brain well enough to retain enough information to maintain our identities, it is inappropriate, I believe, for us to criticize cryobiologists over their opinion that future repair of today's frozen patients will be impossible." The anonymous cryobiologist quoted above expressed his critical opinion. I think criticism of his statements is entirely appropriate, and that we should in general criticize those who use faulty logic. This is particularly true when we are discussing matters of life and death, since the erroneous conclusion that a person is already dead can kill them. The burden of proof falls heavily on those who argue that cryonics does not work.

While Saul (and others) repeatedly talk about "...massive damage..." they provide no argument that this "damage" is likely to cause information theoretic death and hence no reason to believe their claims that current methods are unlikely to work. My own conclusions (see **http://www.merkle.com/cryo/techFeas.html** and **http://www.merkle.com/cryo/cryptoCryo.html**) are that information theoretic survival is likely when current methods are used under favorable conditions. Further serious analysis of this issue is worthwhile.

Finally, we have the question of the outcome of the proposed strategy, that "...we should devote most of our attention, time and money to suspended animation research."

Very broadly speaking, there are two major possible outcomes: success or failure. The successful development and demonstration of suspended animation would have a major favorable impact on cryonics (though exactly how favorable is still unclear). Unfortunately, there is a significant risk of failure. The human body is composed of many different tissue types, each with its own particular responses to different cryoprotectants, different cooling rates,

and other variables. Timely success is uncertain and, in my opinion, unlikely. Betting heavily on a single risky strategy is unwise.

Failure can be relative, however. It might be possible to cool an animal brain to some suitably low temperature (presumably near the glass transition temperature), rewarm it, and demonstrate at least temporary restoration of function by some relatively indirect methods (e.g., electroencephalograms showing a trained response to some stimulus, such as direct electrical activation of appropriate sensory neurons). While clearly unacceptable as a method for restoring a person to health, this would provide strong evidence in support of information theoretic survival. Unfortunately, the impact of such indirect evidence on the general public is likely to be modest. This result would be useful in the context of a healthy organization seeking to grow and prosper, but does not justify abandoning other approaches.

The growth of cryonics is a good goal, but the proposal that we follow a single approach to achieve this goal and abandon other approaches is a bad one. A balanced strategy is more robust and more likely to succeed, as discussed in "The Growth of Cryonics" in this issue.

Ralph Merkle

* * *

To the Editor:

On "The Failure of Cryonics" by Saul Kent.

The original title of this article, when it appeared on CryoNet, was "The Failure of the Cryonics Movement," which I think is more appropriate, though not the major issue here. In any case, Saul has written a powerful appeal for more effort to be spent on research to "improve the product" in cryonics. He contends that the reason there are so few cryonicists, even after more than three decades of promotion and publicity, is that so few people think it will work as intended, i.e. enable people frozen today to eventually be reanimated in a state of good health. It is worth noting that he does not focus on *whether* cryonics is likely to work, but on the *perception* people have of whether it will work. Some of his points can be challenged on various grounds, and have over the several months since his piece first appeared, late in April. (As one "for instance," membership statistics show the movement clearly is not dying, though growth in cryonics signups has slowed since the hectic pace of the early 1990s. Another "for instance" is that there are people who think cryonics has a good chance of working, such as scientist and science fiction writer Arthur C. Clarke, yet have not signed up. And Ralph Merkle denies that he referred to the '80s and early '90s as a "golden age" of cryonics, and has other objections.) Yet the fact remains that there is a pressing need for more research in cryonics, and our product could certainly stand improvement. There are some interesting obstacles I see.

One is a simple "catch-22." A strong belief in the likely success of a research effort may be necessary for the support that would engender that very success. A second, related problem is a credibility issue that mirrors the very problem with cryonics itself: is research going to "work"? As yet, we really don't know. A third problem I think comes from the very radical nature of what we want to accomplish: the elimination of death, which will lead to an other-than-human existence—humans after all are not immortal! Though this idea may have tremendous appeal to immortalists (as it does to me) I think it is a great turnoff to many.

None of these problems are reasons *not* to put serious efforts into research. We need the best techniques possible, and we need to make the strongest case we can that we have a method of saving lives, one that the world at large ought to take seriously. But I favor research *and* recruitment, i.e. we should be getting signups, *the more the better*, along with the support needed for the advancement and verification of our suspension procedures.

I don't share the pessimism some in cryonics have voiced about its workability, though certainly the case for it is not proved either. It boils down, mainly, to whether sufficient identity-critical information is preserved in the frozen brain tissue of a cryonics patient to restore that person, eventually, with memories intact. If memories can be restored it's a very good bet that everything else can too. Longterm memory seems to be stored in synaptic connections which are structures in the brain of larger than molecular dimensions. The sort of damage we are seeing with freezing, though extensive, does not suggest to me that these relatively large-scale structures are being completely obliterated or rendered uninferable. Thus I think probably nanotechnology of the future will make it possible to carry out the necessary repairs and restore a frozen human to a living, healthy state.

But, though I find ground for optimism, again the case isn't proved, and moreover, most people clearly are not ready to accept that signing up for cryonics is something *they* ought to be doing *now*. Life goes on much as it did before cryonics existed. Death is seen as inevitable. The legal system still uses flawed criteria for death based on function, not structure. As a consequence, cryonicists can't get premortem suspensions when they ought to have them to combat brain tumors and the like. Funerals, burials, cremations and autopsies still happen on schedule. Your relatives and mine, and almost everybody else, still die and are not frozen. Cryonicists are dismissed as cultists and kooks, and can only work in secret with mainstream research institutions, if that. All this would change if we could demonstrate a reversible technique for cryopreservation. We would be light

years ahead, even if present-day cryonics is already workable and we who are signed up are already immortal. So I am and remain a staunch proponent of research. But I think too that we must not relax our efforts to win people over to the movement even now, before the great breakthroughs we hope are coming.

Mike Perry

* * *

Editor:

Thank you for publishing Saul Kent's article on why cryonics will fail. The controversy and honesty of that article has been a long time coming. Too much of what is published by Alcor is boring, esoteric, "how many angels can dance on the head of a pin" arguing back and forth by the same member writers. To be honest, most of the time I toss the mailings in the trash after a quick glance but this article really caught my eye.

I absolutely agree with most of what he stated in the article. Sadly, it made me understand why I've become so ambivalent and uninterested in cryonics over the ten-plus years I've been a suspension member. I enrolled in the late 80s, ironically as a direct *result of* the the negative publicity surrounding the alleged "murder" and suspension of Dora Kent. My first impression incredibly was an Alcor magazine with the front cover showing the personnel being arrested in handcuffs and I thought, wow, they really must be committed to cryonics since they risked being arrested just to save that woman and here they're honest enough to publish the photo.

I had to laugh when I real Saul's list of cryonics myths because I grew up on them and heard them all. My ambivalence stems from the fact that I slowly realized that they *were* just myths and in my own eyes came to believe that Alcor or any other cryonics organization's sole purpose is to suspend us (something is better than nothing) and maintain our bodies until "science" as a whole invents the technology to hopefully revive us. This is simplistic, I know. Why more people don't enroll I don't know. I certainly did my share of proselytizing; I used to tell everyone I met about cryonics. My partner Peter is a suspension member because I insisted he join, not wanting a future without him.

I disagree here with Saul in that I think cryonics organizations will never be in a position to conduct the research needed to save our lives. To me, this is only another "myth of cryonics" chapter two. What I really understand now is the tragic, suicidal consequences of cryonics splitting itself from cryobiology. This, if anything, was our greatest undoing.

Nevertheless, any revival will come as an offshoot of cryobiology and as scientific knowledge progresses in this area there will be an interest in studying those of us frozen. Further, the best methods of suspension will likewise come as a bonus from cryobiology. If monies are to be donated anywhere, they need to go to cryobiology research. I think our lives depend upon working *with* them, not against them, and to certainly not continue separate, inferior research.

I'm sure I'm going to be ripped to shreds by responses to this letter but these are nonetheless the feelings of an aging Alcor suspension member, now 38.

Very sincerely,
Scott Toth

The editor replies:

Dear Scott,

I'm gratified that you're reading our magazine once again. Since the 2nd Quarter 1997 issue, I've diligently tried to look for contributors beyond Alcor's staff, directors, and regulars (though these individuals are more than welcome to submit articles, as always!). When I'm not publishing technical material, I've also made an effort to humanize discussions as much as possible, avoiding the dry abstractions of "angels and pinheads."

I also wanted to comment about "cryonics splitting itself from cryobiology." While certain old-school cryobiologists may still feel that cryonics rebelled from the academic field of cryobiology, I know of few cryonicists who wished such a divergence. The vast majority of cryonicists have profound respect for cryobiologists and great interest in the formal work of cryobiology. Happily, there are some indications (little more than hearsay and rumors, I admit) that a new generation of cryobiologists may feel less repulsed by what we're doing.

* * *

Dear Sirs,

Saul Kent's recent article in your magazine does point out a signficant shortcoming in the cryonics movement: lack of expected numerical growth. However, progress in many other areas is encouraging. 25 years ago doctors and hospitals feared liability if they cooperated in a cryonic suspension. Today the greater fear would be the liability from the failure to cooperate. There are now cryonics organizations with attractive, permanent facilities. Millions of dollars have been put into trust funds by those already deanimated, and many more millions are so designated by those still alive. The cryonics publications are of much better quality than those of the past.

As to Saul's present concern with research, we certainly have come a long way in that regard as well. I can remember Dr. Segall seeking another $25 to try another hamster experiment in his garage. Today his low-temperature experiments are underwritten by a multimillion dollar corporation. It is perhaps time to reemphasize membership recruitment. I would welcome the com-

ments of others on how this could best be achieved (in addition to improving the product).

Sincerely,
H. Jackson Zinn

TIpler's Physics

To the Editor:

David Pascal had a most interesting discussion last issue on Thomas Donaldson's review of Frank Tipler's book, *The Physics of Immortality*. This is a topic of special interest to me; for years I've been working on a book of my own, *Forever for All*, that tries to cover some of the same ground as Tipler, though also with emphasis on cryonics and other near-term approaches to immortalization or radically extending human lifespan. Tipler's book is "striking, significant, and profound," as David says, yet it also has shortcomings. One is, again, the lack of consideration of these near-term possibilities — apparently we have to wait 10^{19} years for the Omega Point to do it all for us, which is a bit of a wait, and has other problems. One is that Tipler's whole Omega Point Theory is rather heavily dependent on a collapsing universe which, as Thomas Donaldson is quick to point out, doesn't seem to be the kind of universe we are in. I also find Tipler's attempt to conjure a "God" out of relativistic, quantum cosmology a bit off-putting and ludicrous. (The universal wave function as the Holy Spirit? — give me a break!) You could just as well (more straightforwardly in fact) proclaim an atheist version of immortalism — as I do in my book. (I don't consider my atheism a bit shallow either — not all forms of atheism are equal and alike.)

But David in his letter makes additional points I think worth noting, one being that Tipler's ideas are complementary to those of cryonics, and even a necessary complement, and another, that Tipler is concerned with the extent to which religions may be technologically possible. Both of these, certainly, are worth considering in our drive toward immortalization. I do consider these and related ideas at length in the book, which I hope soon to have ready for review.

Mike Perry

Cryonics & Christianity

Re: Can a Christian Be a Cryonicist?" [*Cryonics, 2nd Qtr 1998 —ed.*]

Dear Cryonics:

Like Michel Laprade, I have been pondering the relationship between cryonics and orthodox Christianity, only I am struck by the dishonesty of arguing that the two are compatible. Consider the following facts:

(1) Christians didn't invent cryonics. The people who originated, developed, and popularized the cryonics proposal have openly acknowledged the role of scientific materialist philosophy in their thinking, starting with Robert Ettinger. Nothing in the orthodox Christian worldview implies an idea like cryonics.

(2) Christians aren't starting and running cryonics organizations now, though today's cryonics leadership comprises individuals from Christian and Jewish backgrounds who no longer profess the faith.

(3) Christians aren't signing up for suspension in large numbers, while the ones who do seem to offer heterodox rationalizations for their decision.

I don't have a problem with heterodox Christians who want to change their theology to allow for cryonics. Orthodox Christian theology is arbitrary to begin with, and anyone is free to invent a new theology.

However, I do have a problem with the attempt to paper over the difference between the scientific materialist assumptions behind cryonics and the "supernatural" assumptions behind orthodox Christianity. The two worldviews are just not "consilient" in any meaningful sense, and frankly, theology has nothing practical to contribute to our quest for radical life extension.

Long life,
Mark Plus

Michel Laprade replies:

I read, with some chagrin, the above letter regarding the "compatibility" of a Christian being a cryonicist. The author indicated that Christians didn't invent cryonics, don't run any cryonics organizations, aren't signing up in large numbers and that those who do are dishonest in rationalizing their decisions. It was also kind of hard to miss the thinly veiled attitude of "and the no good bums have no business being part of our club anyway."

The author correctly stated that "nothing in the orthodox Christian worldview implies an idea like cryonics." Of course nothing in any *orthodox worldview implies an idea like cryonics either! Since when is cryonics mainstream anything? Let me get this straight: by such baroque logic, if blacks didn't invent anything critical to cryonics, don't run any groups or sign up in numbers (who has?), should they be given the boot also?*

No one owns cryonics. It is not a

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Killer Instinct

by Brian Shock

August 8, 1995, a retired librarian named Mona Dick passed away in Burbank, California. Of course quite a number of people died on that day, as they do on any given day of the week, but only Mona Dick was an Alcor suspension member.

Coincidentally, I had just started working at Alcor on August 1, 1995, as the new Membership Administrator. I was nervous, energetic, enthusiastic, and almost completely without a clue about how best to handle my job. Little more than a week later, Mona Dick was declared legally dead, given a blood washout by Alcor's Transport Team, and flown to our facility for perfusion and freezing. Need I mention that I had even less of an idea how to deal with cryonic suspensions?

Mona arrived in a crate packed with ice, probably around 34 or 35 degrees Fahrenheit. As Tanya Jones, Hugh Hixon, and others uncovered Mona and gently placed her on the operating table, I was struck by bone-deep conviction: *this person was absolutely, inescapably, irretrievably dead.*

Dead bodies didn't faze me. Over many years of school I had dissected all of the standard zoological specimens, including humans. The presence of the corpse itself bothered me no more than the presence of a steak in the grocery store. What truly horrified me was that *I could only conceive of Mona Dick as a corpse, and not as a human being in critical condition.*

Although I was a newcomer to the Alcor facility, I'd been an Alcor suspension member for many years. I knew the rationale for cryonics by heart, I'd read *Engines of Creation*, and I'd even taken the Transport Training course the previous year. I fully understood that we would need an enormous amount of new medical technology to revive a cryonic suspension patient. Still, as Alcor's surgeon performed the cardiac bypass on Mona Dick and the perfusionist circulated cryoprotectant through her body, I couldn't shake the jarring conviction that they were simply ministering to an inert object. Instinct *insisted* to me that Mona Dick was never coming back from her final state.

In time, I graduated from disillusionment to healthy skepticism: *theoretically* speaking, I felt that we *might* someday develop the medical technology that could *possibly* return *some* cryonics patients to life. More than anything else, though, I learned to distrust my "instincts."

Do *Homo sapiens* in fact possess instincts in the strict ethological sense? Certainly infant humans have the well documented instinct to suckle, as well as a few other simple behaviors, but what about adults?

Although adult humans may or may not retain instinctive behaviors, we definitely respond to instinctive "releasers," internal or external signals that may activate or drive what we do. Higher primates such as chimpanzees are instinctively afraid of snakes, even if they have never before encountered them; some human children may react similarly. High-pitched noises (often the voices of women and children) may instinctively cause us emotional excitement — that is, annoyance or anger. Heterosexual adult human males may react to the hour-glass shape of human females with a very *different* type of emotional excitement. And then of course almost all of us have a very positive reaction to sugary foods — the sweeter it is, the more of it we tend to eat.

This particular example has been used *ad nauseam*, and so I won't bore you with it much further. When we think of our early primate ancestors living in a resource-poor environment, we can easily imagine the advantage of loading up on rare sugary food whenever possible. Now, when anyone can buy a box of Twinkies or a six-pack of Coke at

the corner store whenever he wishes, this unregulated instinct for sweets is causing a great deal of obesity.

If we return to these same early primate ancestors again, we also see the initial advantages of an instinct about death. Any empathic sense of mortality (*your* dead body implies *my* death) is probably a more recent function of the cerebral cortex, the highest level of our brains. However, even an unthinking organism needs to pay special attention to dead bodies: aside from the potential for infection, there is also a possibility that the cause of death (natural disaster, poisonous food, predator, etc.) may still be present. Indeed, humans clearly harbor a profound reaction to death, whether that reaction is instinctive or merely cultural.

But we're no longer simple primates grubbing out a bare existence on the plains of Africa. Just as our instinct for consuming sweet foods no longer serves us well, so too may our instinctive sense of death mislead us. Even if we can never revive current cryonic suspension patients, we can already observe how so much beneficial medical technology is counter-instinctive.

Consider routine surgery such as an appendectomy. If one of our low-tech ancestors could view this operation, how would he interpret it? First he might see a helpless victim (patient) suffocated (anesthetized) by a small hunting party (surgical team). The hunters would apparently stab this victim in the abdomen, and slice downward into his vital organs until finally extracting one tiny, inedible part. Inexplicably, the hunters would then stitch up the wound they had made, afterward abandoning their victim. Instinct would no doubt *insist* to our ancestor that the group of gowned and masked "hunters" had attacked their "victim" with murderous intent. When viewed in this instinctive fashion, more complex forms of surgery such as heart transplants seem downright *savage*, more like an Aztec sacrificial ceremony than any attempt at healing!

Finally, let's not forget hypothermic arrest surgery, where the medical team begins by cooling their patient down to about 68 degrees Fahrenheit and actually stopping his heart. Although I have never witnessed one of these operations, I suspect that I might experience precisely the same feeling I have with cryonic suspension patients. To any gross examination with human senses, *a hypothermic arrest patient is a corpse*. But against all instinct, after fifty minutes of death these "corpses" will be revived with little or no ill effect.

Instincts can *lie*. Feelings can *lie*. Ancient, beloved tenets of culture can *lie*. As cryonicists, we already know this to some degree, but our gut reactions to extreme situations can still confuse us. In times to come, when change assaults us from every direction and the going gets weird, remember your gut but lead with your head!

Letters to the Editor

Continued from page 7

philosophy for the pompous proprietorship of the "scientific materialists" elitists. The last time I checked my paperwork this was not listed as a requirement.

When you're in a life raft, it seems a little arrogant to complain that one of the people paddling is "one of those Jews." Or Christian. Or violinists or a three legged Arabian midget for that matter.

Imagine for a moment that the unthinkable should occur; that a Christian, after much prayer for divine guidance, should be the one who would "invent" the means by which we would be reanimated and brought back to health. Go on, raise your hand if you would feel that "theology has nothing practical to contribute to our quest for radical life extension." I suspect that some of the naysayers would suddenly be doing a tad bit of rationalizing of their own.

Cryonics is to life extension what a plane is to transportation or a phone is to communication. It is simply a tool, and a crude one at that. Cryonics is for all those with the ability to combine a bold vision with the necessary action to bring it about. What we need to do here is to get a life, stay focussed and keep our eye on the ball. While we are clearly motivated for different reasons, we all want to live. However, unless we encourage and welcome all those who share our common goal to join us, we diminish our own individual chances of survival.

Yes, I know that there are other people who are riled at the thought of Christians being cryonicists. But for the sake of those who work so darn hard on Alcor's membership growth, I just pray that the haughty attitude is not "catchy."

The Cryonics Choice

By Ralph C. Merkle

Given one grain of rice on the first square of a chess board, two on the second, four on the third, eight on the fourth etc. how much rice is on the chess board?

First posed by the Arabic mathematician Ibn Kallikan in 1256, what's remarkable about this problem is how bad we are at answering it. One author, who had asked both children and adults "How much rice do you think we had at the end?" said: "The kids were no worse than adults. They were usually off by miles. After working the problem the kids couldn't believe the results."

The answer is 2^{64}-1, or about 1.8 x 10^{19} grains of rice, or about 1.2 x 10^{15} kilograms of rice (assuming there are 15432.36 grains per kilogram), or enough rice to feed every man, woman and child alive today for over five centuries.

Compound interest produces the same remarkable result. Benjamin Franklin left two trusts when he died in 1790, one for Philadelphia and one for Boston, each to last for 200 years and each of 1,000 pounds sterling. The money was to be let out in small loans "so as not to exceed sixty pounds sterling to one person" for terms not exceeding ten years at five percent interest per annum. At 5% per year (a low rate of return by present standards, but it still illustrates the principle), 1,000 pounds sterling deposited in 1790 should have become over 17 million pounds sterling by 1990. Three fourths of the funds were disbursed in 1890, and the funds also encountered various unplanned exigencies, but still the two trusts combined held several million dollars in 1990.

Which brings us to cryonics. We are few in numbers and command modest resources, so we must make the best use of those resources. One use of resources is to grow. For a few years Alcor enjoyed a growth rate of about 28% annually (see picture). Though resulting in relatively low membership numbers, this growth rate implied a future strength that would let us deal with the many pressing concerns facing us. Had our growth continued at that rate, by the end of 1998 we could have boasted almost 1200 members. Unfortunately, this was not the case; we actually have under 500. Even including members of CryoCare (under 100), we muster little more than 500.

The damage that Alcor suffered during the split was a major factor in our reduced growth rate. Let's be clear about what we lost: if our growth were suddenly restored to 28% tomorrow, we would now and forever be smaller. The 1200 members we could have been is over twice as many as the under 500 we actually are. A decade from now the almost 14,000 we could have been will still be over twice as many as the 5,000 to 6,000 we would be if somehow we resumed our previous growth rate today. This is the harsh reality of a missed opportunity for exponential growth: it is not just missed for today, but for the entire future.

In "Growth and its Consequences" (Charles Platt, Cryonics Q3 1998) showed the immense impact of seemingly small changes in growth rate. A 10% annual growth rate (roughly Alcor's current growth

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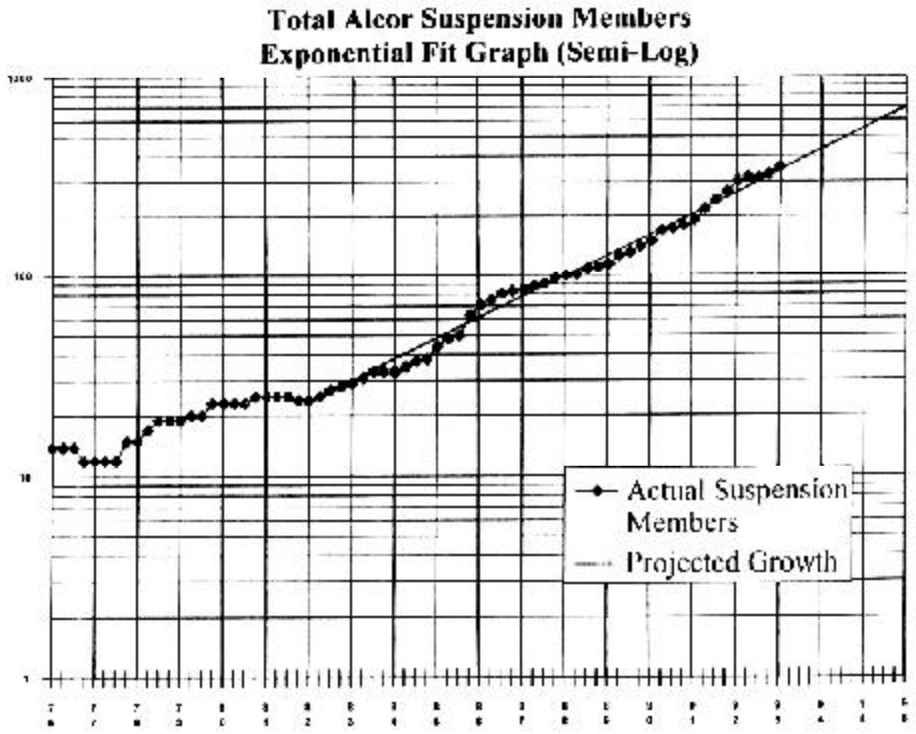

rate, though the data is sketchy) would give us 2,523 members in 20 years. Double the growth rate to 20%, and in 20 years we'll have 14,848 members. And if we could sustain a 30% annual growth rate, in 20 years we'd have 74,639 members. There's a reason the CEO's of major companies are obsessed with adding a few percentage points to the annual growth rate of their companies: over the long term these small differences have a phenomenal impact.

"Growth," for Lack of a Better Word, is Good!

Growth by itself will not solve all our problems, but it will give us the resources to *address* all these problems. Platt says in his article that 20% growth sustained for 40 years will result in a daunting 1,782 suspensions during the peak year (presumably during the last year or two of the simulation), or almost 5 suspensions every working day. At the same time, 1,782 neurosuspensions would produce (at our current price of $50,000 per neurosuspension, with about $33,000 going to the Patient Care Trust Fund and $17,000 in revenue for Alcor) a revenue stream of $30 million per year for Alcor and $59 million for the Patient Care Trust Fund. Allowing for some substantial percentage of whole body suspensions would increase this revenue stream. In 40 years at 20% growth, Alcor would have 524,448 members. At roughly $300 per person per year in dues, we would see an additional $150,000,000 per year from this source. These revenues would be sufficient to sustain the many full-time suspension teams necessary for dealing with that kind of load.

This compares rather sharply with today: we have to maintain at least one suspension team (and appropriate facilities) despite the fact that it is woefully underutilized (very roughly 2 or 3 suspensions per year). This leads to our current situation where revenues from ongoing operations (as distinct from the Patient Care Trust Fund, which provides more than sufficient funding to maintain patients in liquid nitrogen for the indefinite future) are insufficient to fully finance those operations: we make up the difference by a combination of donations and careful cost control. The small number of suspensions annually also reduces our ability to deal with peak load situations: the more suspensions we do, the better we will be able to deal with peak loads (statistically speaking).

Restoring Growth

How *do* we restore growth? Opinions about which factors are most important and what to do will vary (sometimes dramatically) from person to person. In "The Failure of Cryonics" (*Cryonics*, Q3 1998) Saul Kent suggested there was a single problem ("...cryonics hasn't grown because nobody thinks it will work!") and a single solution ("...major research advances leading to better and more credible cryonics services is the only hope we have..."). His article provides highly simplified (and often simply incorrect, see my letter in this issue) arguments in support of his claim.

Many people realize that signing up new members is helpful to growth. "Signing up new members" means that someone has to talk with prospective clients, discuss their concerns, deal with the particular arrangements that they wish to make, prepare the forms, and so forth. This ongoing interaction provides continuing feedback on the issues and concerns that actually influence their decision to sign up (see the article

by Derek Strong in this issue).

Many members signed up because their friends had previously made cryonics arrangements and told them about the experience. They might have learned that most cryonicists aren't rich and that cryonics is paid for with life insurance ("Oh! You mean I don't have to pay the $50,000 up front?"). They might have learned about the possibility that, through cryonic suspension, they could wake up healthy and happy in a world of almost boundless opportunity, not old and unhealthy and wretched in a world of ever-narrowing limits. Because word-of-mouth is so important, existing Alcor members are critical contributors to our growth. This also has a more immediate benefit to the individual member: the more people who know you're signed up, the faster Alcor will find out (when the time comes) that you need to be suspended. And relatives and friends told by strangers shortly after your legal death that you were signed up to be frozen can be much less cooperative (and even downright hostile) than if they learned earlier, directly from you, and had time to adjust to this new idea.

Tell your friends you're signed up: the life you save may be your own.

If your friends are interested, it helps if you have something to give them, such as an issue of *Cryonics*.

The Power of Growth

No discussion of a growing cryonics movement would be complete without mention of growth's advantages. What can a larger cryonics organization give us? What do we need?

We need a suspension team, with the right skills and the right training. We need a place to operate, and supplies to perform the operation: tubing and pumps, scalpels and clamps. We need an investment strategy, financial advisors, a fund that people trust. We need dewars, and someone to check the liquid nitrogen, and sensors and alarms in case something goes wrong, and a building to put them in. This can't be just any building, but a building that's safe from earthquakes, safe from fires, safe from floods and riots, safe from repossession. And we need much more. . . all of which takes thought, and time, and work, and most of all, *resources*. The larger the cryonics organization, the more resources it can provide.

A common complaint among non-cryonicists is, "You freeze dead people, don't you?" Before a cryonic suspension can begin, the patient must be declared legally dead. While the law and reality often go their separate ways, this still presents a major concern. The legalization of pre-mortem suspensions would both improve our own chances of survival and our credibility. We've tried to change the law once (in the Donaldson case); perhaps it is time to try again. The times are different, we learned much from our last try, and there is likely a certain random element in this process which might favor us in the next attempt. Would a case in Oregon seeking the right to pre-mortem suspension for a terminally ill patient succeed? After all, the Oregon Death with Dignity Act permits people to kill themselves; why not let them try to save themselves? The larger the cryonics organization, the more easily it could approach such a challenge.

If someone needs to be suspended, it helps if there are people nearby who know what to do. Is there someone who can contact the hospital? Will the hospital release the legally dead Alcor member to them? Where will the washout take place? Where are the supplies kept? Who will perform the procedure? All these questions and more must be answered. Local Alcor members need to know each other, have local meetings, and prepare now for their own future need. The larger the cryonics organization, the more territory it can cover.

And, of course, there is research. As part of a balanced portfolio of activities, research can make a major contribution to the growth of cryonics. Research, however, is not a fungible commodity. You can't buy a pound of research, just as you can't buy a pound of software. Research can be aimed at a better understanding of many different things. What will future medical capabilities be able to do? What kinds of changes take place in tissue during suspension with existing methods? What neuronal structures encode memory and personality? Given our current methods, is information theoretic death likely? Are there alternative suspension methods which are less likely to cause information theoretic death? The larger the cryonics organization, the more resources it can commit to such projects.

Conclusion

We need resources to grow, and growth brings resources that we can apply to all our problems, including *further* growth. A balanced deployment of our resources will give us exponential growth and a secure future.

Hamburger Helpers

by Charles Platt

Consider this science-fiction scenario:

Five hundred brave voyagers blast off in history's first interstellar space vehicle, hoping to colonize a new world. Unfortunately, their mission is doomed: Somewhere out beyond the orbit of Pluto, a catastrophic malfunction in their life support system threatens to terminate supplies of food, air, and water within a month. The voyagers contemplate three possible actions in response to this crisis.

1. They can broadcast messages in every conceivable format, on every waveband, hoping that some passing aliens will stop and help, or

2. Reconcile themselves to their fate, and enjoy their remaining days as well as they can, or

3. Work day and night to correct the malfunction, even though no one understands where the problem lies, and a fix may be impossible.

Perhaps option 3 seems most sensible — although it entails a risk. If the fault can't be fixed, the voyagers will have squandered the last month of their lives in a fruitless, exhausting effort instead of simply enjoying themselves in any way possible.

As cryonicists, we face a similar dilemma. All around us we see people pursuing transient pleasures on the assumption that death is inevitable. Clearly this is the realworld equivalent of Option 2 in the scenario above. We question that attitude and are more attracted to our version of Option 3: we spend some money, and maybe some time, trying to improve our chances of survival, even though we can't be certain that our efforts will pay off.

But how serious are we about this, really? I don't see many people spending substantial amounts of time or cash to tackle problems in cryonics. Rather, we contribute small sums in membership dues and insurance, and then hope for the best. In fact I suggest that most of us merely pay lip service to Option 3, while trying to avoid the sacrifices and drudgery that it entails. Our strongest commitment is to the cryo version of Option 1.

At first glance this seems ridiculous. None of us, after all, expects that our lives will be saved by aliens in UFOs. Still, we do expect unknown outsiders to solve our biggest problems, and these expectations may be less plausible than we are willing to admit.

The most basic expectation of cryonics is that benevolent strangers in the future will repair freezing damage, clone new bodies for neuropatients, and throw in some rejuvenation and longevity treatments as a bonus. This concept, first articulated by Robert Ettinger, seems reasonable to anyone who holds two truths to be self-evident: that progress in science will continue to the point where it acquires unimaginable powers, and scientists will have a natural interest in resuscitating people from the past, especially when the process becomes relatively cheap and simple.

I was persuaded by these arguments myself, when I first heard them. Subsequently, however, I had second thoughts. Maybe I was being too naive and idealistic; after all, many people — even in the sciences — are inhumane and exploitative. Instead of repairing, resuscitating, and rejuvenating us, Our Friends of the Future could perform hideously painful experiments, or sell off pieces of our wetware with the callous indifference of a junkyard owner stripping an abandoned automobile.

In fact there's a childlike element in our cherished vision of waking up in the future, where nice men in white coats will fix everything while asking little or nothing in return. It's like a kid's fantasy of waking up on Christmas Day to find his parents giving him the specific present that he always wanted. Moreover, most of us seem to assume that we're so inherently special, we don't have to do very much to deserve this. Just pay the minimum cost of liquid-nitrogen storage; that's all.

This naive faith in benevolent strangers also applies here and now, where many cryonicists insist on believing that some wealthy individual or corporation will provide us with resources to turn our tiny endeavor into a viable large-scale commercial enterprise, if we can just connect with "the right people."

Maybe this is true — yet I've seen

absolutely no evidence for it. In fact I have come to believe that Option 1, in my science-fiction scenario, is a fairly accurate metaphor for the behavior of cryonicists looking for help in solving the challenges that face us. Yes, we really could be as self-deluded as space travelers sending distress signals in the hope of being saved by a passing UFO.

A brief recap of early cryonics history explains the roots of my skepticism.

In 1931, when Robert Ettinger first conceived of preserving terminal patients in the hope that future science would find a way to revive them, he assumed that it was such an obvious idea, other people would think of it for themselves, soon enough. Since his own resources were limited, he also assumed that others would be better able to put up the money, do the research, and offer storage on a large scale. Therefore, he didn't try to promote his concept. He simply waited. [1] [2]

In 1947, he read that Jean Rostand had used glycerol as a cryoprotectant to reduce freezing damage. Here, perhaps, was a practical way to facilitate suspended animation. Still, no one made the seemingly obvious leap to the concept of cryonics, so Ettinger decided to make a small effort of his own. Knowing that scientists often read science fiction, he wrote his idea into a short story titled "The Penultimate Trump," which was published in 1948. [3] [4]

There was no response. So, once again, Ettinger returned to his original strategy: he waited. "I waited for many years," he wrote later, "momentarily expecting someone with better credentials and more prestige to introduce the Freezer Era." [5]

In the 1950s he took a conventional job as a physics teacher at Wayne State University in Detroit. [3] He was still haunted, though, by his radical concept, with its apparent potential to save millions of lives — including his own. Surely, if he could get his message through to "the right people," they would do what needed to be done.

In 1960 he went to the public library, picked out 200 names from *Who's Who in America,* and mailed to each of them a single page summarizing his idea. [5] As he later put it, "The response was very small, and it was clear that a much longer exposition was needed — mostly to counter the dead weight of cultural bias." He added, with a trace of bitterness, "A great many people have to be *coaxed* into admitting . . . that life is better than death, healthy is better than sick, smart is better than stupid, and immortality might be worth the trouble!" [1]

He wrote a book, *The Prospect of Immortality,* which he self-published in 1962. He sent a couple hundred copies to various people, including a science-fiction writer named Frederik Pohl. [5]

Most self-published books circulate among a few friends and then disappear without a trace, but Pohl was intrigued, and he connected Ettinger with the New York publishing industry. Two years later, Doubleday published a revised edition of *The Prospect of Immortality,* and the timing couldn't have been better. Change was in the air, "youth culture" was rebelling against traditional values, and people were getting into all kinds of strangeness such as astrology, transcendental meditation, macrobiotic food, and Kirlian photography. In this context, freezing people didn't seem so weird after all. [3] [5]

It was weird enough, though, to generate the wrong kind of publicity. When Ettinger hit the talk-show circuit, media people homed in on the wacky factor. He found himself sandwiched between guests like Buddy Hackett and Zsa Zsa Gabor while the host asked questions like, "Are you going to be frozen with your clothes on, or your clothes off?" [6]

Early cryobiologists such as Sir Alan Parkes and Audrey Smith had been extremely cautious, making modest claims and never discussing publicly the possibility of freezing human beings. But now that the idea of suspended animation was catapulted out of scientific journals, into *The National Enquirer,* cryobiologists were predictably dismayed. The Society for Cryobiology, which had been formed in 1958, [9] eventually added a new clause to its bylaws, threatening to expel anyone who dabbled in body-freezing:

> *2.04. Denial of membership and Discipline of Members*
>
> *Governors in office, the Board of Governors may refuse membership to applicants, or suspend or expel members (including both individual and institutional members),whose conduct is deemed detrimental to the Society, including ... any practice or application of freezing deceased persons in the anticipation of their reanimation. [7]*

Saul Kent has argued that if someone offered the cryobiologists enough money, they would have overcome their aversion to the embarrassing publicity and would have pursued research into human cryopreservation. [8] This may be true; but research wasn't the real problem. I think it was the idea of actually practicing cryonics, before the technique was perfected, that made scientists uneasy. When Ettinger talked to cryobiologists, he complained that "they all say the chance with present methods is small and the project premature."

Why "premature"? Because in science and medicine, *first* you prove that a technique works, and *then* you apply it. If you invert this sequence, you're not involved in orthodox science anymore; you're working speculatively, gambling on the future. This may help to explain why, when *The Prospect of Immortality* was reviewed in *Science* magazine, the reviewer described Ettinger as "an utterly confused optimist." [9]

Well — he certainly wasn't a pessimist! In an introduction to a later book, he wrote: "Pessimism is partly a matter of bad experiences or/and hormone shortages. These can be remedied, if you can hang on a while." [10]

And clearly "hanging on" was one of his great strengths. In fact, he still

wasn't ready to give up. Many readers of his book had sent him letters asking for more information. With relentless patience, he started telling them how to get in touch with each other. If "the right people" were too ignorant or perverse to propel humanity into the Freezer Era, a grass-roots movement might be the only way.

Eventually, this persistence paid off — or seemed to. In June, 1966, a biologist named James Bedford wrote to Robert Ettinger offering to fund cryopreservation research. Bedford wasn't the millionaire that Ettinger had been hoping for; he had a more personal interest, having been diagnosed with liver cancer, which had spread to both lungs. He wanted to have himself frozen. [9]

His wish was granted. In *Life* magazine and elsewhere, the case was hailed literally as a milestone in human history. Robert Ettinger announced that "the world will never be the same," [11] and appeared on nationally-networked TV. Surely this was the moment he had dreamed of: His idea had emerged from obscurity and penetrated almost every home in the nation. And yet, most people *still* didn't respond. Despite massive exposure, as the year drew to a close, probably no more than 200 Americans were members of cryonics organizations, and still no one was willing to invest serious money. [12]

These early beginnings established a pattern from which we have barely deviated during four decades. I draw three lessons:

Lesson 1. The rift between cryonicists and cryobiologists is rooted in a fundamental difference of philosophy, training, and attitude toward science. This incompatibility will not be resolved merely by reiterating the seeming logic of our desire to freeze-now-fix-later, no matter how well we justify it (as in Ralph Merkle's resourceful arguments for the potential of nanotechnology).

Lesson 2. I see no indication that "the right people" will ever recognize cryonics and transform it into a profitable business, so long as it remains a speculative procedure. Once in a while, in the decades since James Bedford was frozen, wealthy individuals have signed up, but none of them has implemented the ambitious program that Ettinger assumed was inevitable. The only exceptions are Saul Kent and Bill Faloon, currently putting more than $1.5 million a year into research at 21st Century Medicine. But when they first became interested in cryonics, neither Kent nor Faloon was wealthy. They were not outside benefactors; they are fellow travelers, in the same predicament as the rest of us, and trying to improve their own chances of survival.

Likewise, the largest sums of money received by cryonics organizations have been postmortem bequests from people who were already members and wanted to insure the financial integrity of their organizations for purely personal reasons. Bearing this in mind, perhaps we should stop searching for "the right people" outside our field, since this quest has achieved zero success after more than four decades. Instead, we should recognize that something about cryonics makes it unappealing not only to scientists, but to venture capitalists. Maybe we should ask ourselves why.

Lesson 3. Cryonics also remains unacceptable to 99.995 percent of Americans, even though the concept has received free publicity on a vast scale that other businesses would die for. After hundreds of magazine articles, dozens of TV shows, several movies, and scores of radio talk shows, we find ourselves still an underfunded, overworked, tiny special-interest group. Even when celebrities such as Arthur C. Clarke, William Shatner, or Stanley Kubrick have endorsed cryonics, this has not triggered substantial growth—perhaps because most people don't see the sense of spending $100,000 or more on a procedure with totally unpredictable chances of success. Consumers generally expect to get solid value for money. They want a product that works.

We should pay attention to the path followed by all other radically new technologies, from powered flight to personal computers. First, while the idea is being developed, only a few visionaries and eccentrics take it seriously. Then some demonstrations are staged — and are received usually with great skepticism. Finally some early adopters buy the product, and respected authorities endorse it. At this point news reports shift from being dismissive to cautiously enthusiastic. From this point onward, if the product or service is genuinely useful and reasonably priced, it is accepted by consumers — though the process may take two or three decades.

In the misguided belief that we are a "special case," we've tried to abbreviate this tiresome process. We're still at the stage where our product is in development, appealing only to visionaries and eccentrics. We can't stage a demonstration. We haven't even reached the early adopters. Yet we cling to the idea that some wealthy patron is going to sell our idea, somehow, to the great mass of consumers.

This is not going to happen. It's wishful thinking; an evasion of our responsibility to prove ourselves.

I see a similar lack of realism in our hopes for future resuscitation. True, if we're lucky, some cryonics associations may still exist 100 years from now, staffed by people who share our interest in rescuing patients from the frozen state. Thus, we may not need to rely on "outsiders." Even so, Our Friends in the Future won't necessarily possess unlimited resources. Therefore, it seems downright stupid to make their task harder than it needs to be.

Nanomachines most likely will become dirt cheap (literally); but programming them to rebuild the horrendously complex three-dimensional structure of a human brain will be nontrivial, to say the least. This task will be more daunt-

ing, and presumably more expensive, if severe damage has occurred. Therefore, if we want to increase our chances of resuscitation, obviously we should do what we can to minimize the damage.

Again, this is a matter of accepting responsibility for our own welfare instead of assuming that other people will solve all our problems, no matter how difficult we make them. This means, for instance, we should all learn the techniques of standby, transport, and perfusion, so that we may help other cryonicists quickly and effectively, to minimize their ischemic time. Also, we should face the need for research to improve our cryopreservation techniques.

The history of cryonics research is dismal. It has been sparse, poorly funded, slow, and largely unsuccessful. But now, finally, there is some good news. Earlier this year, at the annual conference sponsored by the Society for Cryobiology, presentations from researchers at 21st Century Medicine were well received, probably because they described solid lab work investigating solutions for known problems associated with freezing tissue. The people from 21st did not attempt to defend cryonics as it is currently practiced; nor did they speculate about nanomachines that can't be built yet, or techniques for cell repair that cannot be tested. Rather, they communicated verifiable results in a manner that orthodox scientists could respect and understand.

At a special seminar scheduled for November 8th, details of these results will be released to the general public. We will learn about powerful new techniques to achieve vitrification (low-temperature storage without ice damage), while minimizing toxicity. The importance of these developments cannot be overstated. At this point I believe we really do have a shot at fixing our own life-support system, instead of waiting for other people to do it for us. Since some of the research also has broad commercial applications outside cryonics, 21st Century Medicine even has a shot at making some money.

If you're reading this before November 8th, you can still make arrangements to attend the seminar which will be presented in Ontario, California (about one hour's drive from Los Angeles). In addition, lab tours will be available. Call 1-877-277-0322 (toll free) for details.

Cryobiologist Arthur Rowe once suggested that reviving cryonics patients is as implausible as turning hamburger back into a cow. This notorious statement, which may have been made with deliberate malice, has provoked anger in our community ever since—with good reason. Injury caused by freezing is not directly comparable to the structural disruption caused by a meat grinder.

I do believe, however, that we shouldn't just dismiss this kind of criticism. It represents the views of an entrenched opposition, which must be addressed and refuted if we want a real chance of achieving widespread acceptance. This means doing the hard work and/or spending the money to develop demonstrations which will force even extreme skeptics to change their minds.

I believe we can demolish the "hamburger" metaphor conclusively and permanently — if we're willing to shoulder this responsibility, instead of reposing in the smug but misguided belief that if we just wait long enough, "hamburger helpers" will rescue us from our narcissistic complacency.

Abbreviated References

1. *The Prospect of Immortality,* Foreword to the 1987 edition published by The Immortalist Society.

2. "The Immortality Myth, Resurrection, and Technology," a paper by Steven B. Harris MD, 1992.

3. *The Immortalist* by Alan Harrington, Random House, 1969.

4. Personal correspondence from Robert Ettinger, June 26, 1992.

5. "Report on the Slow Freeze" by Robert Ettinger, Worlds of Tomorrow magazine, November 1966.

6. Personal interviews with Saul Kent and Curtis Henderson.

7. Society for Cryobiology web page.

8. Personal conversation with Saul Kent.

9. *Suspended Animation,* Robert W. Prehoda, Chilton Book Company, 1969.

10. *Man into Superman* by Robert Ettinger, St. Martin's Press, 1972.

11. *Life* magazine, January 27th, 1967.

12. Membership guesstimates supplied informally by Curtis Henderson and Mike Darwin.

Bioimpedance and Cryonics

by Fred Chamberlain

Bioimpedance as a possible indicator of cellular integrity for evaluation of transport protocols and the assessment of quality in biostasis procedures; an overview and plan for investigation.

Abstract. A basic assumption in all bioimpedance models is that electrical capacitive effects in tissue are attributable to cell membranes (1). Lessening of these properties, which is detectable as a reduction of bioimpedance, appears to be strongly correlated with risk of mortality or vulnerability to illness (2). This paper reviews the relevant literature and known properties of cell membrane and tissue capacitance. It discusses the limitations of current analytical models, and explores how measurements useful in cryonics may overlap with those needed for medical research. Plans are outlined to apply bioimpedance in evaluating cryonics protocols as well as in assessing damage to molecular structure during actual cryonic suspensions.

1. Background.

The recent technical advocacy of cryonics has largely been based on hypotheses of the reparability of damaged biological tissue by molecular scale repair machines (3), as proposed in K. Eric Drexler's *Engines of Creation* (4). Such mechanisms were suggested earlier as "robot surgeons" in *The Prospect of Immortality* by Robert C. W. Ettinger (5). Criticisms have been voiced (and disputed) that such hypotheses are not well supported by observational evidence (6,7,8), and that cell membranes may be dissolved by present cryoprotectants. These debates persist in the face of arguments, published earlier, that substantial cellular structure exists for periods of many hours after clinical and legal death, even under adverse conditions of warm ischemia and freezing without cryoprotection (9). Recent literature supports the idea that even 4-8 hours of ischemia does not necessarily render neurons non-viable (10).

No systematic, well-funded program exists to explore these controversies in depth and resolve them. Cryonics research up to this time has focused on raising the standards of the best procedures, rather than on evaluating lesser, (relatively speaking) "compromised" suspensions often necessitated by circumstances or other limitations. It is apparent that an urgent need exists for thorough evaluation of the wide range of these lesser technologies, which are certain to be used in an increasing number of cases.

There, we expect to find a spectrum of molecular preservation corresponding to a range of parameters (rapidity of response, choice of medications, methods of cooling or other stabilization, etc.) Real-time correlation of bioimpedance measurements with markers of molecular preservation may help us more rapidly and realistically evaluate protocols for cryonic suspension, as well as monitor and control actual procedures. This is the context for our investigation.

2. Introduction and Overview.

For several years, bioimpedance had been discussed by the staff at Alcor for measurement of cryoprotective levels during cryonic suspensions. Hugh Hixon and Steve Van Sickle reasoned, based on the use of bioimpedance for such purposes as monitoring of dialysis patients (11), that non-conductive cryoprotectants should produce a drop in tissue conductivity. More recently, in reviewing technologies for combating ischemia, we began to see that bioimpedance might have more general use, as a way to assess tissue viability (cell membrane integrity).

Bioimpedance measurements can differentiate intracellular from extracellular water (12), a consequence of the electrical capacitance of cell membranes. A reference on biomedical engineering (13) roughly places cell membrane capacitance at one microfarad per square centimeter. This is a uniform property of living organisms, their organs, tissues and elementary biological materials. In vegetables, for example, there is a total loss of capacitance upon boiling or freezing (14). May we not also expect to see such effects with animal tissues, specifically those of humans? Would such data help guide the development of cryoprotectants, cooling rates, or other parameters associated with cryonic suspensions?

As discussed in more detail below,

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bioimpedance is under vigorous use and development by the medical community. Cryonics applications will benefit from this widespread effort. Also, we might develop applications (particularly in resuscitation medicine) of clinical value. In deep hypothermia for neurosurgery, as another example, there is likely to be a strong overlap of our goals to preserve tissue integrity and the needs of surgical teams to recover patients to an uninjured, living state. If we need measurement validation by means of animal work, we may find opportunities for collaboration with medical research teams. If our instrumentation or data processing strategies have commercial value, this will add to the resources available for furthering cryonics research.

3. Breadth of Application.

Bioimpedance has been extensively used for determining "body composition" (15,16), but it has a rapidly growing range of other applications in medicine. One research group states (17): "Altered cellular membrane function is a common feature of the septic patient and has been systematically associated with a significant low X_c/R and phi" [*low tissue capacitance*]." This group further states, "Some authors have demonstrated that this relation X_c/R is highly correlated with mortality and could be used for staging of critically ill patients throughout their stay in the ICU." In another study (18): "registration of thoracic electrical bioimpedance was used for early detection of acute rejection after heart transplantation." For burn victims, cell membrane capacitance seems to be highly significant. Investigators state (19), "The phase angle (BIA) indicative of cellular membrane effects of burn and sepsis had its lowest values at day 1.5, and stayed significantly low until day 4. Interestingly, the phase angle was lowest in the two cases that died subsequently." (Phase angle is a measure of the degree of capacitance vs. resistance in the tissues.)

Extensive surveys of BIA for medical purposes have recently been published [Critical Reviews in Biomedical Engineering, V24/4-6 with over 1200 references]. Special issues of certain periodicals have focused on it [Physiological Measurement, 5/98:V19/N2 and The American Journal of Clinical Nutrition, 9/96:V64/N3(S)]. Its usefulness has been shown in areas ranging from regulating dosages of Human Growth Hormone (20) to the prediction of mortality in risk in asymptomatic, HIV-infected patients (2).

4. Principles and Basic Bioelectrical Impedance Models.

Bioimpedance is a measure of the passive electrical properties of the bulk tissues of the body (vs. 'skin resistance' as commonly used in polygraphs for lie detection or active measures of body-generated electrical signals such as in electrocardiography or electromyography). Body tissues exhibit both resistance and capacitance. The vector sum of these, "impedance," is a measurement of the response to very small outside electric currents introduced into the body.

Electric current moves through the body both by ionic conduction and by charge accumulation on cell membranes. At frequencies of interest for medical assessment, a significant portion of the conduction takes place "through" as opposed to "around" the cells (typically, single frequency instruments operate at 50 kHz). If cell membranes are intact and cells are tightly coupled to one another, electrical capacitance is high. If cells are perforated or very loosely coupled to each other, the capacitance is less.

Skin resistance created problems with good measurements until the development of a now universal four terminal or "quadrapole" system. In this technique, electric current flows through the body between two electrodes, and the level of current (in microamperes) is measured. Close to each of the "current injection" electrodes, a second "voltage measurement" electrode is placed. Between these two inner probes, the actual voltage developed through bulk tissue can be accurately measured (with very high input impedance, to eliminate the skin resistance effect). Due to the capacitance effects of the tissue, the measured voltage and current will be not be perfectly synchronized (*i.e.* "in phase"). The degree of asynchronism ("phase angle" for sinusoidal stimuli) is a measure of cell capacitance.

4.1 Early Observations and Models of Biological Specimens.

In a recent review paper (21), Boone et al. talk of 19th century researchers observing the decrease in electrical resistance as the frequency was raised. One of them (Bernstein) suggested a "'membrane hypothesis'; that tissue consisted of conductive cells enclosed in an insulating membrane, and surrounded by a conductive *interstitium*." In 1910, Hober (22), "found a large decrease in the resistivity of a sample of blood after disruption of the red cell membranes." This, he suggested, al-

lowed the intracellular fluid to play a part in conduction, where previously it had been isolated by the cell membranes.

Electrical models developed in the early part of this century (21) are shown in Figures 1 and 2, attributed to Lapique (in 1907), Philippson (in 1921) and Fricke and Morse (in 1925). Capacitances (C) are shown with subscripts "m" for "membrane"; intracellular resistance is indicated by "i." Subscript "x" means extracellular resistance.

Figure 1 does not provide for extracellular resistance, but "works" because R_i and R_m (in combination) emulate this. Figure 2 does not account for membrane resistance, but this can be conceived as a component of R_x. These "lumped constants" are more easily analyzed, but do not realistically correspond to biologically related values. More complex models are plausible, but lead to less manageable mathematics. In all cases, notwithstanding these difficulties and simplifications of models, electrical capacitance is always there. Every investigator takes it into account, one way or another. Tissue without capacitance (cell membranes) is not "alive," by any existing standard.

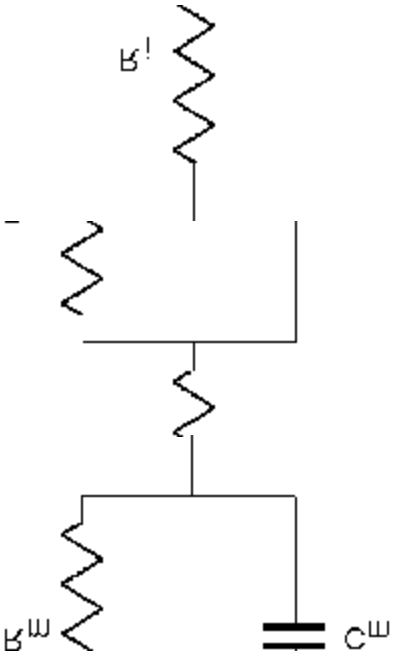


Figure 1.

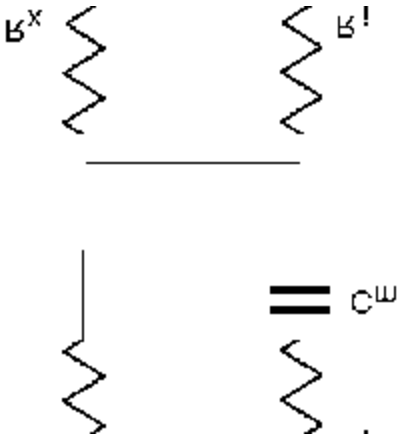


Figure 2.

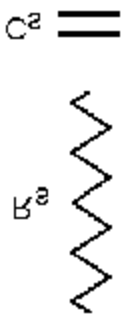


Figure 3.

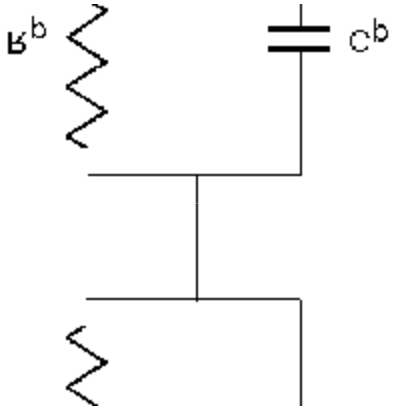


Figure 4.

4.2 Theoretical Models and Their Limitations.

In 1941, Cole and Cole (1) measured the electrical properties of dielectric solids and liquids, including (interestingly) glycerol at temperatures of -40ºC to -60ºC. After a long series of measurements in which they found many departures from elementary theory, they devised a model based on "pseudo-capacitances" with "constant phase angles" (CPAs). Their work appears as the foundation reference for most models of bioelectric impedance.

In the fifty years since its publication, the Cole-Cole model has not been rendered obsolete. Boone et al. (above) say, "although it is possible to choose parameters so that it accurately represents most tissues, the physical interpretation of a (Coles') 'constant phase angle' element remains elusive." Comparisons based on multiple frequency approaches have not shown other analytical methods to be clearly superior (23).

It is not surprising that biological tissue exhibits non-linear electrical behaviors, making modeling of it difficult. A source cited earlier describes "bioelectric current loops" (specific to small groups of cells) as follows: "Intense current loops often are contained within a millimeter or less, although loops of weaker intensity may extend throughout the whole body volume. Current loops involve potential differences of about 100mV between extremes." There are in excess of 10^{10} cells in the body. Most are non-spherical, and they preferentially conduct current in longitudinal vs. transverse directions (along the longest interior pathways of the cell). Membrane voltages of up to 0.1 volt exist from interiors of cells to their exteriors, and (thus) cells store electrical energy to begin with. Any flows of ions (and they flow all the time) cause shifts to these voltages.

This complexity has made the development of realistic models difficult,

Perspectives.

During the first quarter of 1998, Alcor and BioTransport, Inc. had been anticipating the imminent formation of a close working relationship with Twenty First Century Medicine, Inc. and BioPreservation, Inc., both of which are closely associated with CryoCare Foundation. Under the scenarios proposed, BioTransport would have focused almost exclusively on the structuring of programs for cryonics service delivery, based primarily on methods and technologies provided by 21st CM and BPI (Twenty First Century Medicine and BioPreservation).

During the second quarter of the year, differences of approach arose which (now) take us in divergent directions. For several years, at minimum, developing a cryonics service business along the lines advocated by 21st CM and BPI would have meant focusing almost exclusively on methods which require the ideal situation of advance notice and deeply cooperative hospital staff and family. Such cases are important, but infrequent. Our obligations to the general Alcor Membership do not permit us to discontinue programs for training and equipping local groups for response to a full range of rescue scenarios. We are hopeful that at some future time, 21st CM and BPI will offer to license their technologies to Alcor and BioTransport.

Alcor and BioTransport have signed a contract to pursue capabilities independent of 21st CM and BPI. This will include (a) improvement of protocols, (b) research of new ways to compare and evaluate protocols, and (c) raising capital for local rescue team support through a Direct Public Offering (DPO). As part of the research effort, an intensive examination of bioimpedance as a promising source of new data is underway. The paper which follows is the first of many which will appear in support of this effort.

and it has frustrated investigators who try to compare instruments for purposes of standardization and reliability. As one investigator put it, trying to explain his model (24):

> "The most likely cause of phase shift at higher frequencies in bioimpedance spectroscopy is the interaction between subject stray capacitance and the measuring characteristics of the instrument. If this hypothesis is correct, T_d (an arbitrary time delay necessary to make the model 'work') has no biological significance and is an artefact of the measuring system. For all practical purposes, the T_d effect can be largely modelled out by using either $\exp(jwT_d)$ or $1/(1+jwT_d)$ as additional products in the Cole-Cole model, although the latter is likely to be theoretically more appropriate."

5. Bioimpedance and Cryonics.

Despite the limitations of models, the underlying reality is that biological tissues possess capacitance; it seems to be a measure of cell membrane quality. Electric current flows through extracellular pathways at low frequencies. At higher frequencies, it penetrates cell membranes as a result of capacitance. If cell membranes are damaged, capacitance vanishes and overall resistance drops (at all frequencies). In light of this, we expect useful results from bioimpedance measurements in cryonics. If we later develop improved models in which subcomponents of bioimpedance can be tied to definable elements of the cellular ultrastructure, so much the better.

5.1 Evidence of Potential Usefulness.

In a recent paper on whole body impedance (25) the authors comment that sources of data are highly variable. This is intended to be an observation on the unreliability of the literature for research purposes, but the implication for cryonics is quite different. The statement is made that:

> "Another potential source of variability is the change in tissue properties after death. Many data in the literature were obtained from excised tissues that were far removed from in vivo conditions. Twofold increases in resistivity were reported within a few minutes after blood flow ceased, apparently because of swelling of cells as the result of ischemia." (25) [The cited basis of this comment is a Scandinavian paper published in 1951 (26)].

Although not so clearly stated in other literature, the implication is that profound changes in bioimpedance take place immediately after the onset of clinical death. Yet, so far as the present review of the literature has revealed, there is no indication that post-mortem bioimpedance changes per se have been studied as the primary focus. This implies the potential for doing useful, original work.

It also implies substantial potential for important measurement of changes to bioimpedance in persons who are being medicated and cooled in an attempt to prevent the dissolution of their cellular structure. Are there other investigators who might have parallel interests to ours, in this respect? Almost certainly.

5.2 Possibilities for Collaboration.

A study of cat brain ischemia (27) for up 120 minutes at 37°C, with subsequent fixation and study of neural ultrastructure, would be of interest in itself. If bioimpedance measurements had been made, the value to our work would be greater still. The same is true of rat brains stored at both 4°C and 25°C for up to 72 hours and then evaluated for biochemistries (28). In one case, freeze-fracture vs. thin section electron microscopy of tissue was made after 1-48 hours of autolysis at 20°C (29). As with the cat brain work, bioimpedance measurements might have been of great interest to the investigators, as well as ourselves. Other studies like this should be sought out,

with the goal of finding work in progress which might offer opportunities for collaboration on our part.

Much interest exists in differentiating apoptosis from necrosis (30,31). Some of these investigators might have interests in adding bioimpedance to the parameters they are recording. The same is true of those concerned with lysosomes as active agents in neuronal cell death (32). The role of calcium ions in killing cells of the central nervous system is of intense interest (33,34,35), as investigators search for ways to limit damage in strokes. If bioimpedance turns out to be a useful research tool in evaluating the effects of medications in these studies (as well as in cryonics), might there not be substantial opportunities for our participation, if we were to furnish data acquisition and logging equipment on a loan basis (in exchange for the data)?

Forensic and pathologic studies of brains (36,37,38) might benefit from bioimpedance measurements. Even studies to characterize changes in surface tissues after death (39) could be useful, if we had bioimpedance correlation for the other data. Taking the point of view of forensic medicine and forensic analysis, for a moment, it could be that the studies we are commencing could lead to applications in which bioimpedance becomes a standard part of all procedures in which "time of death determination" is a priority.

Finally, we should be interested in related technologies, particularly where they might have potential for use in cryonics. Mike Darwin has developed a method named "CryoVent" for rapid cooling, first described as (40), "A proprietary working fluid that results in long term survival of animals ventilated with it," preceded by the statement, "We then looked to perflurodecalin and mixtures of other flurocarbons such as FX-80, the breathing medium used by Leland Clark and his associates in the late 1960's." This will no doubt be an option for cryonics transport in the future, depending on its availability under license. Accordingly, it makes sense for us to follow this work, along with parallels under study by other investigators (41).

Along with the use of fluorocarbon class compounds for ventilation, we need to track the use of perfluorocarbons used as artificial bloods, such as those shown to enhance brain oxygenation during cardiopulmonary bypass (42). Would the use of bioimpedance measurements during the administration of these compounds add to our knowledge of their usefulness? They might, and we should find ways to work with those who are using these compounds, wherever possible.

6. Plan for Investigation.

A database of reference material is being gathered for use by both Alcor and BioTransport in generating proposals for putting bioimpedance to work in cryonics. In conjunction with that, (a) a program of measurements will be planned, (b) candidate hardware systems will be identified, and (c) correlative data will be identified. ("Correlative data" means those measurements or observations we need, along with bioimpedance, to tie the bioimpedance data to the state of molecular preservation in tissue — electron micrographs and biochemical markers, principally.) As results are obtained, (d) cryonics applications will be proposed, to include specific performance goals.

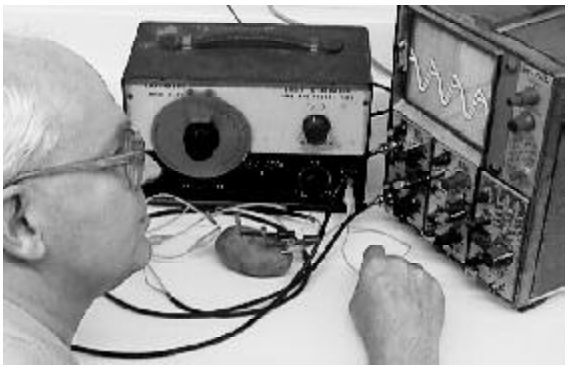


Fig. 5. Hugh Hixon's BIA Demo Setup.

As mentioned earlier, efforts will be made to locate ongoing research which can benefit from bioimpedance measurements, and participate. This means looking for programs with animal models and data types we would like, per (a) and (c) above.

It may be important for us to look for situations where data logging and analytical platforms are compatible. [For example, if most investigators doing work of interest to us ran a package like LabView BioBench, our contribution might be limited to compatible signal acquisition hardware and (our own) software. The hardware could range from OEM instruments with existing drivers to "front ends" we develop on our own. The latter might be both less expensive and more suitable.]

A contrary view to integration with others' platforms might be the relative ease (to them) of getting a stand-alone system from us, and later receiving the data in a reduced form. Under that perspective, we would want to supply a system which required only that they "turn it on and properly place the bioimpedance leads on/into their experimental model."

6.1 Short Range Goals.

We need to determine that we can make useful measurements and use them reliably for evaluating protocols and stabilization procedures. For that, we need to plan, construct and make use of basic apparatus for fundamental measurements, in which ischemic tissue characteristics are mapped. We must also, if we can, develop improved models on which realistic bioimpedance interpretations can be based. Do we have, even now, some early results supporting these goals?

6.2 Preliminary Laboratory Activities.

Figure 5 shows the phase angle effect obtained by applying a 10 KHz sine wave voltage to a potato, using four surgical needles for the electrode array. With an oscilliscope and an audio gen-

Fig. 6. Bioimpedance Scale Adaptation.

erator, available in most laboratories, Hugh Hixon (of Alcor) readily reproduced the phenomena discussed in reference 14. This indicates the straightforward manner in which one can demonstrate the existence of cell membranes in living materials, using bioimpedance.

In Figure 6, a consumer scale measuring percentage of body fat (via bioimpedance) has been modified with external circuitry to simulate the presence of a person standing on the device

Fig. 7a. Impedance Bridge Breadboard

(electrical currents passing up one leg, through the abdomen and down the other leg.) Electrodes at each heel measure the voltage developed by current entering and leaving through the ball of the foot.) The external circuitry will also permit demonstating and (later) measuring bioimpedance phase shifts of people, in parallel with the internal bioimpedance data processing.

Fig. 7b. Fred Chamberlain, Arjen Kamphuis, and Berrie Staring Discuss Bioimpedance.

Figure 7(a) shows an experimental assembly with which more sensitive differences of phase shift can be detected. In Figure 7(b), visitors Berrie Staring and Arjen Kamphuis from the Netherlands (see website : www.transcedo.org) discuss potential for use in commercial as well as cryonics applications.

Over the next several months, extensive measurements will be performed in support of proposals for Alcor and BioTransport, Inc. to jointly develop such applications. An important near term goal will be a capability to measure bioimpedance during cryonic suspensions, if initial studies indicate that this data could help characterize the quality of the procedure.

6.3 Preliminary Analytical Work.

Figure 8 shows a composite circuit, combining the functional features of Figures 1 and 2, above. At this point, it is still too simple to accurately model in-vivo bioimpedance response, but will serve to illustrate one of the analytical approaches under consideration. By a technique similar to that used in the optimization of other systems (non-electrical), the response of this circuit to square waves (or sinusoidal stimuli with phase shifts) can be projected. Figure 9 shows the response of this circuit to imposed square wave voltages, and Figure 10 reflects the injection of square "current waves" of alternate polarity, as measured at the junction of R_l with R_m and C_m.

In each case, the analytical modeling results in rapid convergence of the response waveform. The technique can be applied to far more complex circuits, for the purpose of emulating the response of in-vivo data. Figure 11 represents a circuit for this purpose (24), and is an example of the direction which can be taken with this analysis.

6.4 Long Range Goals.

The following specifications give an idea of what might suit our needs in the longer term, bearing in mind that they are (presently) hypothetical. The idea is to have a sense of where we are

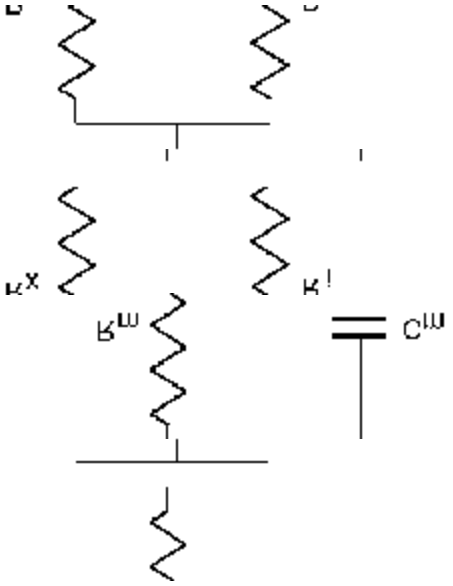


Figure 8.

headed. These goals might lie years away, if only low level funding is provided. Conversely, with capitalization of the kind to be sought by BioTransport, they might be achieved far more quickly.

(A) ***Field Portability.*** All equipment should fit within one piece of carry-on luggage and weigh no more than fifty pounds.

(B) ***Data logging and display/analysis.*** These should be automated and easy to learn, so that intelligent lay persons can operate the system.

(C) ***Price.*** This should be less than $10,000.00 and should include training, consulting and warranty repair (parts and labor) for three years after delivery.

(D) ***Performance.*** The system should

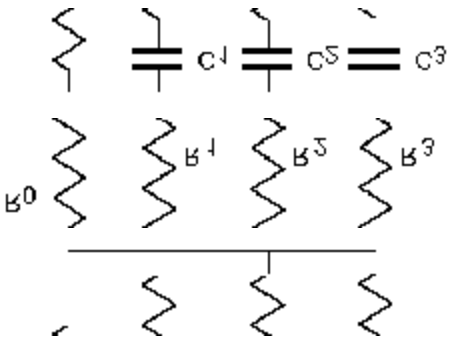
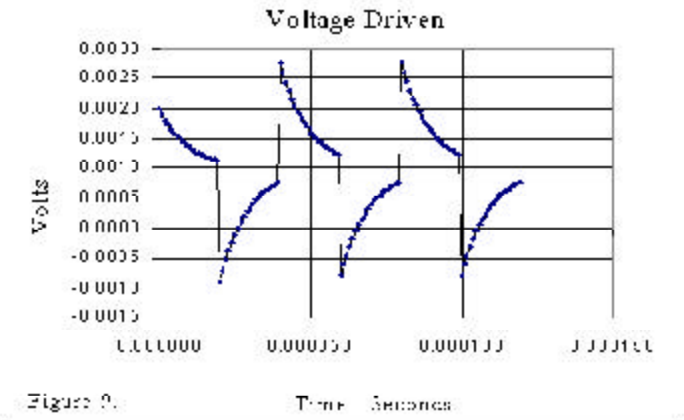


Figure 11.



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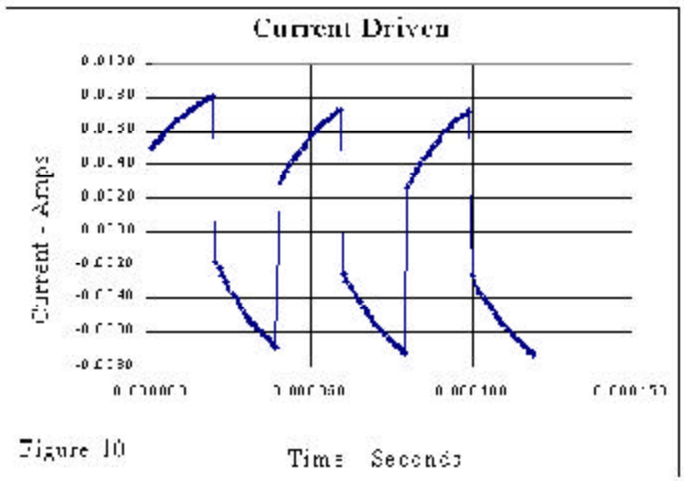

Figure 10

report the absolute value of impedance and phase angle with a resolution of one percent or better, and be highly stable.

(E) ***Sensible "Make or Buy" Tradeoff.*** The choice of making or buying hardware should be based on minimizing manpower and other dollar costs.

(F) ***Compatibility with Collaborative Work.*** (A) through (E) above should be important to those we work with. In addition, we must minimize the degree to which integrating our measurements into their work is a burden.

7. Summary and Acknowledgements.

Bioimpedance measurements are considered to be a potentially valuable source of additional data for cryonics purposes. The medical literature suggests a high level of interest and development, which may offer the potential for collaborative intersection with medical research, thus saving Alcor and BioTransport substantial funding in developing this approach. By obtaining electron micrographs and biochemical marker data, along with bioimpedance results, in connection with such collaboration, we expect to develop means of far better assessing both our methods and the results of actual suspensions. Apologies to those whose relevant publications were not cited, particularly in the area of repair for suspended patients by way of nanotechnology. Thanks especially to Hugh Hixon and Steven Van Sickle, without whose initial interest the present work might not have begun.

(Postscript)

A vast literature of investigation and clinical application of bioimpedance is taking shape. In planning Alcor and BioTransport research, we will explore it thoroughly. Readers of Cryonics who are familiar with or engaged in bioimpedance work are encouraged to contact Alcor and/or BioTransport. There is plenty of work to do (email: fred@alcor.org or fred@biotransport.com; both of these will remain active addresses.)

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"No One Thinks it Will Work" . . . and Other Myths

by Derek B. Strong (fka Derek Ryan)

Once, while attending the wedding reception of some dear friends of mine, I got into an interesting conversation with a couple of very interesting people. The topic of conversation was cryonics, of course, and the two people were a very active and well-respected biological researcher (let's call him "Bob") and his very intelligent son (we'll call him "Bob's son"). Though I had often spoken with these two at previous parties, this was the first time we'd actually broached the topic of cryonics.

We went on and on that night, exploring many facets of the technology, its potential social impact, all the usual stuff. Finally, we focused in on the simple question of whether cryonics (as practiced today) had any hope of working. Bob had obviously looked into the issue somewhat, and he held serious doubts that memory and identity could survive the kind of cellular damage inflicted by the freezing process (even under optimal circumstances). We explored this issue for a good while, until we finally convinced ourselves that we weren't going to convince each other. On the basic issue of damage, we found much to agree about. But on the possibility that this damage might be repaired, we had very different outlooks.

This conversation etched itself in my memory for a number of reasons. For one, it was by far the most I have been challenged to defend cryonics from a scientific point of view before or since. That was invigorating! On the other hand, my apparent inability to change his mind left me feeling disappointed, and we always seem to remember our disappointments more clearly than our successes. The main reason my conversation with Bob comes to mind right now, though, is that, out of the *thousands* of folks with whom I have discussed cryonics this decade, he is the one and only I can remember talking to whose one and only stated reason for not joining a cryonics organization was his firm belief that the technology would not work.

This contrasts sharply with Saul Kent's recent statement (in his article, "The Failure of Cryonics", published in last quarter's *Cryonics* magazine):

"To put it in a nutshell: cryonics hasn't grown because nobody thinks it will work!"

Let me state for the record here that I am not a trained scientist. I have no degree in the field of "Cryonics Psychology," and even if I did, well... I guess I couldn't have one of those under any circumstances, could I? No such field of scientific inquiry exists today. The closest analog we have is the field of "Death & Dying Psychology," and its applicability to cryonics seems to be limited at best.

What's more, the study of human motivation is known to be quite problematical. We can ask people why they do what they do, including "anonymously" using a medium such as the Internet. We can phrase our questions in ways that trick them into revealing more than they mean to about what's going on in their heads. We can poke them, prod them, and measure various aspects of their brain activity and neurochemistry when they carry out the actions whose motivations we are trying to determine. But except in rare circumstances, our conclusions as to why people do what they do are often nothing more than educated guesses. People are complex. What they say, what they mean, and most importantly, what they *do*, are often unrelated to each other at all. This is all we know for certain.

None of us really has the kind of

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understanding of why people do and don't sign up that would compare with, say, Dr. Greg Fahy's understanding of cryobiology, or Dr. Mike Perry's understanding of mathematics. It's still too early in the game, with too few players, and no real study so far. Anyone can tell you anything about why new cryonicists aren't "beating down our doors," and no true authority can aid you in deciding what to believe.

So where does that leave us? Well, the best we can offer are those folks who have spent significant time talking to people, trying to convince them to sign up, and listening to what they say (and what they seem to mean). Saul Kent is certainly one such person, having been doing this for many decades. And though I am a latecomer by comparison, I would count myself in that group. During my time as an Alcor member (9 years), volunteer (2 years), Membership Administrator (3 years), Advisor (2 years), and Director, I have spoken with hundreds of individuals who were carefully considering the prospect of cryonic suspension membership. I personally signed up nearly a quarter of Alcor's current membership, and worked closely with another 75+ or so who entered the signup process at one point but never finished. I have given tours, speeches, presentations, and interviews to literally thousands of others, speaking with a tremendous number of them at length on every issue they could imagine in regard to the desirability of cryonics.

So what do I think?

First and foremost, let me offer my firm agreement with what I think Saul Kent and others usually *mean* when they speak about the failure of cryonics. That is, I believe, as they do, that cryonics won't really acquire the kind of widespread acceptance we all want until and unless we can demonstrate a fully reversible procedure. This seems so clear I have difficulty imagining disagreement about it. No amount of reasoning and argument will ever touch people on an emotional level (the way they *need* to be touched to change their minds on something as fundamental as this) the way that the sight of a living, breathing, healthy cryonics revivee will.

But will this be sufficient? I don't think so.

Interestingly enough, an alarming number of people think cryonics *already has worked*. One of the most common questions I heard while manning the phones at Alcor during my days as a staffer there was this:

"So... what ever happened to that dog that was frozen and revived?"

Most cryonicists will know that this refers to the famous case of Miles the Beagle and Paul Segall at Trans Time, Inc. Most of you will also know that Miles was not actually frozen. He simply underwent (and survived) approximately an hour of asanguineous hypothermic perfusion, meaning that he had his blood washed out and his body temperature lowered to just above freezing, then had the process reversed and survived to bark about it later. For whatever strange set of reasons, *many* people think Miles was frozen and successfully revived.

And let's not even talk about the worldwide confusion about Walt Disney here! Suffice it to say that a surprisingly large number of people already think cryonics works or has worked. But let's leave aside these people. For the most part, they probably aren't the sharpest cookies in the terran cookie jar, and wouldn't probably be our best targets for new members, anyway.

But what about the rest of the world? Or narrowing down to a more approachable audience for our current purposes, what about the rest of America and other Western-influenced societies? Why don't they sign up? Do they think cryonics will work?

Thanks primarily to the intelligent efforts of former Alcor President Steve Bridge, we just happen to have some surveys on file that asked people exactly that. During 1995 and 1996, Steve, Brian Shock, and I conducted tours of Alcor's Scottsdale facility for a number of different "Death and Dying" classes from nearby Mesa Community College. MCC happened to have an instructor at that time who himself found cryonics to be very interesting, and who wanted his students to hear unusual perspectives. We gave these folks the whole rundown: a tour of the facility, a description of our procedures, and all the time they wanted in which to ask questions. After the first couple of tours (during which I was still helping), Steve got the brilliant idea of creating and offering a survey designed to let the students tell us (anonymously) about their thoughts on what they had seen and the notion of cryonics in general. In the end, Steve, Brian, and I surveyed five different classes, for a total of 67 unique surveys.

Besides the standard "feedback" questions designed to help us improve as speakers ("Was the subject explained in an understandable manner?" "Were your questions answered to your satisfaction?" etc.), Steve asked three really critical questions on the survey. Taken as a group, these turned out to give us a *lot* of insight into what the average person really thought about cryonics once they'd heard our side of the story. Indeed, looking back at the completed surveys today, I am more impressed than ever with just how useful those questions turned out to be. From the 11 questions, here are questions 8, 9, and 10:

8) Do you think cryonics might work?

9) What are your feelings about cryonics in general now? A good idea, a bad idea, other?

10) If you felt that you could afford cryonic suspension, would you sign up for it?

Before I get into specifics, I should mention that the demographics of these classes are a big part of why I find them to be as close to "scientific" as such surveys can get. First of all, Phoenix is

well known as one of the more diverse cities in America in terms of cultures. It has grown dramatically in the last 30 years, with most of the new residents coming from all over the States (and other places). Its ability to get folks to emigrate there makes it a true melting pot, and these classes reflected that. You could hear southern accents, eastern accents, midwestern accents, and of course you could clearly see the diversity in terms of race, with African-Americans, Latino-Americans, and a variety of other minorities being well represented. (It is no accident that Phoenix is one of the primary locations for sneak previews and screenings conducted by the motion picture industry. That Phoenix represents a broad cross-section of American culture is a clearly accepted fact.)

Another reason I like the demographics of Death and Dying classes is the distribution of ages and careers. To the best of my knowledge, these classes were all night courses. As such, they tended to attract a disproportionate number of so-called "returning students," meaning adults well past the "normal" age for attending college. The ages of these students therefore ranged from 18 to 40 and beyond, with a relatively even distribution. This means that to a certain extent we can discount the expected problems with surveys from college students being biased toward the views of the "younger generation."

In retrospect, I regret that we didn't ask for information about age, race, and career, since those numbers would tend to bolster the validity of our results. Nevertheless, I do believe that the location and time of the classes helped us in getting a broad set of demographics.

Questions	Feasibility	Good Idea/Bad Idea?	Would you sign up?
Generalized Response	*Yes, it might work.*	*It's a good idea.*	*Yes, I might sign up.*
Specific Responses	"Yes, but would have much better odds if you could freeze while still alive."	"Like many early scientific ideas (like airplanes) someday it will seem commonplace."	
		"I think it is a great idea. Definitely a need for research funding."	

Questions	Feasibility	Good Idea/Bad Idea?	Would you sign up?
Generalized Response	*Yes, it might work.*	*It's a good idea.*	*No, I won't sign up.*
Specific Responses			"No, I do not think I would want to be alive, when all my loved ones are dead."
		"Good idea, very interesting. But would like to see a live (well) creature frozen then brought back."	"Not personally. A body is just another thing to carry around. Also would possibly wake up a loon."
			"No. I think my body is temporary only for this life."

Questions	Feasibility	Good Idea/Bad Idea?	Would you sign up?
Generalized Response	*Yes, it might work.*	*My feelings about cryonics are [other].*	*No, I won't sign up*
Specific Responses		"I don't know. But if it ends up working I'll sign up."	

First, I'll talk about raw numbers. For questions 8, 9, and 10, the responses can be grouped under four major categories. Questions 8 and 10 elicited responses of "Yes," "No," "Maybe," and "Unsure." (I count all responses resembling "I would say the odds of that are non-zero" as "Maybe," and all the responses resembling "I wouldn't know how to assess the odds of that" as "Unsure.") Question 9 elicited responses of "Good Idea," "Bad Idea," "Other," and again, "Unsure." I tried to be very strict in my assessment of the occasionally vague answers we received. You can see examples of exactly what was said below to get a feel for this process.

8) Do you think cryonics might work?

Unsure	No	Maybe	Yes
5	11	26	25

9) What are your feelings about cryonics in general now? A good idea, a bad idea, other?

Unsure	Bad Idea	Good Idea	Other
3	7	31	26

10) If you felt that you could afford cryonic suspension, would you sign up for it?

Unsure	No	Maybe	Yes
8	38	14	7

Questions	Feasibility	Good Idea/Bad Idea?	Would you sign up?
Generalized Response	*Maybe it might work.*	*It's a good idea.*	*No, I won't sign up.*
Specific Responses		"I think that if people want to try this and they have the money then more power to them. But no, I don't believe I would ever want to do this."	
			"Live today, not tomorrow."

Questions	Feasibility	Good Idea/Bad Idea?	Would you sign up?
Generalized Response	*Yes, it might work.*	*My feelings about cryonics are [other].*	*No, I won't sign up.*
Specific Responses		"I think there are a lot of ethical issues we should deal with first."	
	"Maybe somewhere down the line. Too many issues to be solved and overcome yet."	"Personally, I would not be interested in being 'brought back.' Frivolous."	
		"I think other medical concerns should have higher priority."	"No, even though I think this is 'it' to life (no heaven, no reincarnation, etc.), when I die, I will have done enough in this life."
		"I feel very neutral. I have no desire to live forever, but for those who feel the desire, I hope it does work."	"No. I feel a need to be able to move on I don't want to hang in limbo for an indeterminate time."
		"For those who joined, I hope it works. I hope that someday it will be possible to bring these people back."	

Certain things jump right out at me in these numbers. For one, of the folks in this data sample, 25 out of 67 said, "Yes cryonics might work," and 26 said, "Maybe cryonics might work." Combined, that means 76% or our respondents give cryonics some chance of working. As I said above, this contrasts sharply with the assertion that "No one thinks it will work." One might argue that the question is not worded perfectly, since we asked them "Do you think it *might* work?" as opposed to "Do you think it *will* work?" However, I don't consider that much of a criticism; I (and I suspect nearly all cryonicists) would answer "Do you think it might work?" with "Yes" and "Do you think it will work?" with "Maybe."

76% thought it might work. That's astounding. And that is the main point of this article. Despite how few people are actually signed up for cryonics today, a surprising percentage of our random sample seemed to think it might work. Though creating a fully reversible procedure will definitely help us advance our cause, clearly the lack of such a procedure is not the *only* reason people aren't signing up today. To answer that question, we'll need to look deeper.

The next set of information that interests me is the relatively high number of respondents who said they felt cryonics was a good idea (31), the relatively low number who were willing to say it was a bad idea outright (7), and the relatively low number of respondents (7 — not the same 7 as previously) who would sign up for cryonics if they felt they could afford it.

Combined with the previous results, I would infer the following statement

from our respondents: "It might work, it's a good idea, but I probably won't sign up."

What's going on here?

The comments that go along with these raw numbers tell the tale. As I said above, this block of three questions seems to work well as a group. By correlating the answers to each of the three questions, we get slightly more complex patterns that people tend to fall into. For example, no respondent answered "unsure" to all three questions. There were a small number who all agreed that they didn't think it would work, that it was a bad idea, and that they wouldn't sign up for it, and slightly fewer who said they think it might work, that it is a good idea, and that they'd probably sign up. Most respondents fall into the mixed categories.

In the diagrams from page 27 through page 30, I list most of the comments that reveal something about the person's thoughts on cryonics, organizing them into groups based on the general answers given to each of the three questions. We start with the most pro-cryonics groups, and work our way down to the most anti-cryonics.

As you can see, we get the full range of comments here. In deference to Saul Kent, I note first that three different people do mention wanting to see the procedure work before they have any interest in signing up. (One person wants to see a demonstration, another just says "if it works" they'll sign up, and one is still "doubtful about the unthawing part.") Some people clearly do consider the technical feasibility a big issue preventing them from embracing current cryonics technology. These individuals are clearly in the minority.

In the most positive group, we see comments that match the beliefs of many cryonicists: our procedures would certainly be more effective if clinical death were not a prerequisite to suspension, and more research would help cryonics become commonplace over the long term.

To me, the most interesting group is the second one. They think it'll work, and they even think it's a good idea, but it's just not for them. Fear of separation from loved ones comes up, as does the desire for confirmation that the procedure works, familiar religious questions, and concern for the mental capacity of reanimated patients. These comments

Questions	Feasibility	Good Idea/Bad Idea?	Would you sign up?
Generalized Response	*Maybe it might work.*	*It's a bad idea.*	*No, I won't sign up.*
Specific Responses	"Possibly, but I don't think you can take souls."	"Again, I feel it's wrong ethically."	
		"I'm not for it because of religious beliefs."	

Questions	Feasibility	Good Idea/Bad Idea?	Would you sign up?
Generalized Response	*Unsure whether it might work.*	*My feelings about cryonics are [other].*	*No, I won't sign up*
Specific Responses		"I'm not real sure. We were put here to live one life. If too many people do this and it works it may overpopulate the earth even more."	

Questions	Feasibility	Good Idea/Bad Idea?	Would you sign up?
Generalized Response	*No, it might work.*	*My feelings about cryonics are [other].*	*No, I won't sign up.*
Specific Responses		"The concept is good but I'm still doubtful about the unthawing part."	
	"I think only God can create a new body for the new patients, not man."	"I think it is interesting."	
		"No interested. I'll take my chances with eternal life."	
		"None, except it does seem a little self centered on the part of the patient."	"No. I am not afraid to die."

all match what we've been hearing from people for decades.

Even in the other groups, we never really see any novel issues. Based on these surveys, as well as my experience with the public, let me suggest four of the most common, general reasons people don't feel cryonics is for them (in no particular order):

1) Fear of separation from their time, peers, and loved ones.
2) Concerns about technical feasibility.
3) Religious issues.
4) "Ethical" issues.

Certainly solutions to any of these problems will have an effect on overcoming the others, but I don't believe that any one solution would eliminate *all* of them. A reversible procedure would bolster our case, but would it dissipate our fears centered around religion and the ethics of reviving apparently dead people? More importantly, would the certainty of reanimation reduce our fear of being lost and alone in a strange future?

Consider the climate of fear surrounding human cloning. Demonstrating that it can be done has not caused people to be less afraid of it. To the contrary, more people are thinking about cloning (and finding themselves afraid of it) than ever before, exactly *because* it might work. Why should cryonics encounter *less* fear and opposition in a similar situation?

Even when we have achieved the reversible suspended animation that Saul and I both want, the widespread acceptance of biostasis will *still* require us to overcome many issues. Given that likelihood, why should we focus on a single issue to the exclusion of all others? Shouldn't we also be attacking the other reasons that may prevent people from embracing life extension in general and cryonics in particular? Indeed, if we can make some progress in those other areas, increasing public interest in cryonics, won't we also garner more potential donors and investors for our precious research projects?

In particular, besides research aimed at a fully reversible procedure, I believe we need to continue to work on growth, and on emphasizing the "community" in "cryonics community." All available evidence tells us that people are more likely to sign up when there are others around them who have also signed up. The disproportionate growth in areas of high cryonics activity, combined with the complete lack of members in entire *states* of the U.S. highlights the value of having cryonicists around for interaction with new prospects. (A confession: contrary to my statement at the beginning of the article, "Bob" is not the only person I can remember who claimed technical unfeasibility was his only reason for not signing up. The other person? His son, of course. What does this tell us about how people form their decisions?)

The long-term goal in growth and community building is to solve the problem of people feeling displaced from "their time." The more of our loved ones and peers who will take the ride with us, more comfortable we can expect to feel when we come back. Growth and community-building create a positive feedback loop that can only help us. We must capitalize where things are good and cryonicists are relatively plentiful, continue making our case to those who aren't so lucky in terms of geographic location, and continue trying to have an effect on the cultural values and mores that give people the idea that radical life extension is somehow bad.

I appreciate what Saul is doing at 21st Century Medicine, and I support his efforts fully. I just don't agree that an all-or-nothing strategy is what's best for the cryonics movement, "at this point in history," or any time in the near future. We've got a lot to do. Let's all keep doing it in the best way we know how, playing to our strengths, diversifying according to our various interests and aptitudes. *That* is the best strategy for turning "The Failure of the Cryonics Movement" into "The Success of the Cryonics Movement."

Questions	Feasibility	Good Idea/Bad Idea?	Would you sign up?
Generalized Response	*No, it might work.*	*It's a bad idea.*	*No, I won't sign up.*
Specific Responses		"I feel there are too many ethical issues that are raised."	
		"I would not want to be frozen and have no desire to be brought back to life after death."	
		"I believe in the immediate ascension of the soul and eternal life -- this 'science' goes against my value system. This is the ultimate form of denial."	

A Bibliography of Cryonics Fiction

by Brian Shock

I could start by suggesting that science fiction may help us explore, understand, and adapt to the future, but do I really have to commit such an obvious rationalization?

I simply enjoy reading science fiction, and I believe that many readers of Cryonics share this enthusiasm. Therefore, for the benefit of this group, I have tried to assemble a comprehensive list of novels that employ some form of cryonics or suspended animation as a major plot point.

Please note:

1) I have focused on novels alone. Although several short stories are listed, the vast number of relevant candidates were beyond my current ability to compile. If I missed one of your favorites, please let me know.

2) Although countless novels mention cryonics, many (such as TekWar*, by William Shatner,* Neverness*, by David Zindell, and* The Silicon Man*, by Charles Platt) use it only peripherally. For purely arbitrary reasons I have omitted them from this bibliography. (Sorry, Charles.)*

3) The brief synopses after each title contain only as much information as I could glean on the fly. In most cases I actually read the novel, but I may have forgotten much of the plot or had little patience with a perfunctory storyline. And of course there were many for which I had to make guesses based on Grolier's Online Encyclopedia of Science Fiction, cover blurbs, and the hearsay of acquaintances.

4) Thanks to Steve Jackson for motivating me to finish this project (which had remained at the bottom of my list for countless years), and thanks to Steve Bridge for his priceless library research.

Memoirs of the Year Two Thousand Five Hundred, by L.S. Mercier (1772) — Suspended animation sends someone to a utopian future.

Three Hundred Years Hence, by Mary Griffith (1836) — Suspended animation sends someone to a utopian future.

The Frozen Pirate, by W. Clark Russell (1887) — A pirate accidentally entombed in ice and revived years later.

Looking Backward, 2000-1887, by Edward Bellamy (1888) — Suspended animation sends someone to a utopian future.

Dix mille ans dans un bloc de glace ("10,000 Years in a Block of Ice"), by Louis Boussenard (1889) — a contemporary man visits the future after being accidentally frozen and revived.

"The Jameson Satellite" (short story) by Neil R. Jones (1931).

The Resurrection of Jimber Jaw, by Edgar Rice Burroughs (1937) — A satirical account of the revival of a prehistoric man and his experiences in the civilized world.

"The Penultimate Trump" (short story) by Robert CW Ettinger (1948).

A Door into Summer, by Robert Heinlein (1957) — An inventor is shanghaied into suspended animation by unscrupulous business associates.

Why Call Them Back From Heaven? by Clifford D. Simak (1967) — Imagines a time when a person can be

tried for delaying the freezing of a corpse, permitting "ultimate death," and the financial estates of the frozen have become a political power-bloc, inviting criminal manipulation.

Zapiski iz budushchego ("Notes from the Future"), by Nikolai Amosov (1967) — A fictional examination of cryonics.

Bug Jack Barron, by Norman Spinrad (1969) — Set in a future where cryonics is taken for granted and millions of people are stored at the Rocky Mountain Freezer Complex.

Frysepunktet ("Freezing Point" or "Freezing Down"), Anders Bodelsen (1969) — A fictional examination of cryonics.

The Age of the Pussy Foot, by Fred Pohl (1969) — A man is frozen intentionally and revived in the future.

Vital Parts, by Thomas Berger (1970) — Berger is a mainstream novelist (*Little Big Man*, among other novels); a cryonicist is apparently a major character in this novel.

The Gods of Foxcroft, by David Levy (1970) — The cover blurb reads "Frozen alive of their own free will, they were reborn into an unimaginable future."

Absolute Zero, by Ernest Tidyman (1971) — About a financier who builds up a vast cryonics industry.

The Ice People (Originally published in France, 1968) by Rene Barjavel (1971) — Frozen people from a "superior civilization that existed 900,000 years ago" wake up. Was a best seller of the time.

"Ozymandias" (short story) by Terry Carr (1972) — People who take to the cryonic vaults in order to avoid a war fall victim, like the mummified pharaohs of ancient Egypt before them, to professional "tomb-robbers."

Looking Backward, by Mack Reynolds (1973) — A man is frozen intentionally and revived in a utopian future.

"The Defenseless Dead" (short story), by Larry Niven (1973) — Points out that the living have all the votes and that the dead might be an exploitable resource; it was Niven who first used in print Frederick Pohl's term "corpsicles" to denote cryonics patients.

The Dream Millenium, by James White (1974) — Explores hypothetical psychological effects of long-term freezing.

"Doing Lennon" (short story) by Gregory Benford (1975) — An unfrozen John Lennon turns out not to be what he appears or aspires to be. (Obviously this one doesn't make much sense anymore.)

The Long Sleep, by John Hill (1975) — A man awakes from suspended animation (which presumably involved freezing) and discovers he has lost his memories and identity.

Deep Freeze, by H. Walter Whyte (1977) — A standard revival tale where the hero must find his way in a world where he is not appreciated.

The Far Arena, by Richard Ben Sapir (1978) — A Roman gladiator is frozen accidentally and revived in modern times.

The Worthing Saga, by Orson Scott Card (1978) — A family's patriarch is frozen and later revived after many generations to see the future he created.

The Forever Formula, by Frank Bonham (1979) — A truly disgusting, immoral juvenile novel in which the protagonist realizes that immortality is immoral and so thaws out a room full of cryonics patients (after rescuing his girlfriend, who was suspended "before her time").

Sleeping Beauty, by L.L. Greene (Larry Levine and Steven Greene) (1982) — A newswoman has had her life saved by cryonics. She is the first successful revival — but something has gone terribly wrong.

Sun's End, by Richard Lupoff (1984) — A far future story of suspended animation.

Between the Strokes of Night, by Charles Sheffield (1985) — Takes the notion of suspended animation to its logical extreme.

". . . And He not Busy Being Born" (short story) by Brian M. Stableford (1987) — A bold entrepreneur who succeeds against the odds in delivering himself into a world of immortals finds that he still cannot evade his destiny

Freeze, by William Raynor and Myles Wilder (1988) — The cover blurb reads: "Freeze a human body? To what purpose? To what end? Read this shattering, shocking tale and find out."

The Death of Sleep, by Anne McCaffrey and Jody Lynn Nye (1990) — A woman keeps getting frozen during space accidents, and subsequently spends all of her time adjusting to new societies.

The World at the End of Time, by Frederik Pohl (1991) — On a distant planet, the protagonist is dragged in and out of cryonic suspension numerous times, allowing him to see the rise and fall of various civilizations.

Chiller, by Sterling Blake (Gregory Benford) (1993) — Comprehensively (and very sympathetically) describes a near-future cryonics movement under threat from a serial killer.

Gun, with Occasional Music, by Jonathan Lethem (1995) — A Chandleresque private detective story set in a future where criminals are placed in cryonic suspension.

Tech Heaven, by Linda Nagata (1995) — (Reviewed in *Cryonics*, 1st Qtr 1996) — Told from the unique viewpoint of a woman who suspends her husband in the contemporary era, then fights many decades into the future to maintain his suspension and eventually reanimate him.

Tomorrow and Tomorrow, by Charles Sheffield (1997) — (Reviewed in *Cryonics*, 3rd Qtr 1997) A man places his terminally ill wife into cryonic suspension and then follows her. Initially, a retelling of the Orpheus myth.

The First Immortal, by James Halperin (1998) — (Excerpts printed in *Cryonics*, 1st Qtr 1998) If you don't know about this one, you haven't been paying attention.

"The Psychology of Death" by Michael Laprade

(Experiences of a Guest Lecturer)

I am a long-time, rather low-profile member of Alcor. I am a counselor in a California state prison by vocation and a performing Illusionist by avocation.

What I am *not* is an official spokesman for Alcor or any other cryonics organization; never have been and don't expect I ever will. I've never been interviewed regarding my involvement with cryonics, nor written any articles for newspapers or other publications on the subject. But several years ago I was reading the class synopsis in our local University's catalog and happened upon a class described as "The Psychology of Death." The class was to discuss not only how we handle the loss of those around us but also to explore the various options we face in the disposition of our remains.

I didn't want to be presumptuous, but I had a feeling that not *all* options were being adequately represented, if you know what I mean. So I picked up the phone and offered to give the class a layman's view of why I thought cryonics was a more than viable option worth considering. Somewhat to my surprise, the instructor enthusiastically accepted. Thus began my odyssey as a guest lecturer.

Obviously, I wanted to have my act together prior to showing up for this gig. I began to assemble my thoughts and my materials with the nagging fear that I might be setting myself up for an intellectual slaughter. I anticipated fierce resistance, snickering, and perhaps even outright ridicule. Nevertheless, I passionately believed in my subject matter and I was determined to present it to the best of my ability. If there were any "holes" in my position, I wanted to know about them.

On the appointed day, I showed up dressed casual/chic (upscale to look serious but not a retentive business look), and began with a short history of the subject. I then laid into the meat of the matter and covered what in my experience were the most common objections. I was not judgmental about others choosing to avoid participation in our great adventure, nor apologetic about my choice either. I didn't mince words or sugar coat anything. I didn't try to impress anyone with gory details that would only serve to inflame those who were ready to capitalize on anything that could provide them an excuse for hysteria. I also made a point to allow plenty of time for questions and went to great pains to leave an impression of a guy who was "normal," had a sense of humor, and a life outside of cryonics; I didn't want them to think they had just meet the local "Heaven's Gate" rep.

By and large, their questions were of the garden variety that anyone who has shared with the uninitiated would find all too familiar. No problem here; I felt that I not only handled these questions very well but that I was in reasonable control of the situation. But then, to my surprise and chagrin, at least one of the students was familiar enough with the subject to ask about the neurosuspension option.

I explained that I was a whole body donor myself and didn't personally subscribe to that option. I went on to say that to me, cryonics was a big enough stretch without adding the additional complications that neurosuspension would entail.

Don't get me wrong, I didn't downplay this option. I simply took the position that, much like whole body donors were "way out in front" of those who weren't even signed up, "neuros" were "way out in front" of whole body donors. Basically I said that I thought neuro proponents were simply willing to place their bets on technological capabilities that were just too premature for my comfort level. I added that while I didn't doubt the theoretical feasibility of the option, I just chose to go with what I felt was the least demanding projection of an unproven technology.

Overall, it went extremely well. I reemphasized that I was not recruiting for new members but only wished to make them aware of cryonics; what they did with this awareness was *their* choice. I closed the presentation by leaving my name and phone number and offered myself as a resource if any additional information was needed on the subject. I also left Alcor's number if someone was interested in any literature. The instructor was quite pleased, and I have been invited back every quarter to address a new class.

Cryonics is an extremely bold undertaking with (as yet) but a small chance of succeeding in my life cycle. I do not feel that I am part of any "lunatic fringe," though, and I know that I can effectively communicate this feeling to those with whom I speak. People need to be able to identify with our members if they are going to seriously consider taking such a bold step themselves. These ongoing lectures are the perfect tool for me.

Over the years, I have read many times about how we should all try to initiate those around us regarding our chosen option. I agree. I do think, however, that we need to find a format where we can be comfortable and identify with our chosen audience. For some, this will take the form of media interviews. For others it will involve talking to co-workers. Others still will discover their own unique circumstances for an opportunity to share our vision. I know that I found it important for *me* to articulate my position and to stand up and be counted.

The Seekers of Immortality:

A Listing of Cryonics Patients with some Remarks on Growth of the Movement.

by R. Michael Perry, Ph.D.

Twice before in this magazine I've done a listing of all persons up to that time who were frozen for possible reanimation. (Though most of these are still frozen, a significant number, particularly from the early years of cryonics, did not stay frozen.) The first report (*Cryonics*, October 1990) listed 52 patients, though 4 minimally attested and doubtful cases were later dropped. The second report (*Cryonics*, July 1992) listed 63 patients. As of this writing, some 6 years later, 43 more names are added to the list, to bring the total to 106. (I've made no new discoveries of people suspended on or before June 1, 1992, as covered in the last report, nor have any more people been dropped; I did, however, find a little more information on a few of the earlier cases. It is of course possible that other freezings occurred that I haven't recorded, or, probably less likely, some are still recorded that didn't really happen. I've made the best judgments I could from the data I have, and corrections and emendations are of course welcome.) I should remark here too that I've included everybody I have records of who was preserved in some manner, generally involving low temperature storage, with arguably the purpose in mind of returning them to life in this world someday, if it becomes possible. Most of these cases involve storage of the deanimated human, whole body or head only (neuro), in liquid nitrogen, but I've included permafrost and freezer storage too, the deciding factor being the intent that is involved (restoring someone to life in the future), rather than the likelihood of success. (Even here there are one or two marginal cases, e.g. Ms. Martinot in France, that I've given the benefit of the doubt and included.)

Cryonics is our lifeboat, and we are concerned about its future. We wonder in particular if the movement is growing or possibly destined to "deanimate" itself, before aging is conquered and biological immortality is achieved. So we study statistics of membership growth and the like to see what prevailing trends, if any, can be discerned. One source of data of this type, which does not seem to have been tapped and is clearly relevant, is simply the rate at which people are entering suspension. In fact some interesting statistics on the rate of suspensions are obtainable from the listing of patients included here. In one study I chose the 5-year interval from Jan. 1966 through Dec. 1970 as a baseline to compare with other intervals. There were 14 suspensions during this time. In the next 5 years, from 1971 through 1975, there were 8 more, to total 22. On average then, in each of the five years from '71 through '75 there was an increase by a factor of $(22/14)^{1/5}$, for an annual percentage increase of 9.5. Similarly, we can determine an average, annual percent increase over other time intervals by comparing the number of suspensions that had occurred by the start of the interval with the number that had occurred by the end of the interval. Results are shown in Table 1.

Start of Interval	Total Previous Suspensions	End of Interval	Total Suspensions by end of interval	Avg. % increase per annum
1 Jan. 1971	14	31 Dec. 1975	22	9.5
1 Jan. 1976	22	31 Dec. 1980	30	6.4
1 Jan. 1981	30	31 Dec. 1985	34	2.5
1 Jan. 1986	34	31 Dec. 1990	52	8.9
1 Jan. 1991	52	31 Dec. 1995	89	11.3
1 Jan. 1996	89	31 Aug. 1998	106	6.8
1 Jan. 1971	14	31 Aug. 1998	106	7.6

Table 1. Average % increase in number of suspensions per year, using 5-year baselines.

We see then that overall, since 1971, the number of

James Bedford:
The first controlled freezing.

Genevieve de la Poterie:
Frozen at 8.

Stanley Penksa:
Frozen at 99-1/2.

people suspended each year has been around 8% of the number that had *already* been suspended up to that point. During particular 5-year intervals this percentage, restricted to the interval in question, has fluctuated somewhat as would be expected. There was a low point in the early '80s, possibly influenced by the Chatsworth disaster. (Nine patients of the Cryonics Society of California who were stored in a cemetery vault in this Los Angeles suburb were thawed and lost in the 1970s; the case came to trial in 1981.) After this came some "highs," and more recently the rate seems to have settled back to roughly its average value.

In view of the small number of cryonicists and suspensions, the annual increase in suspensions is quite modest. To get an idea of what it might add up to over time, suppose it continued unchanged for 100 years, from Jan. 1971 through Dec. 2070. At this rate, by then there will have been 21,080 suspensions, impressive enough by our meager standards but insignificant compared to the world population. Unless the rate can be boosted considerably, cryonics is not likely to have much impact in terms of alleviating death worldwide. Even at the highest rate shown in the table (11.3%), which yielded an increase from 52 to 89 over 5 years, in 100 years we would have only 651,420 suspensions, still not much compared to the world population. Without major and unprecedented changes in human thinking, it seems the world must pass us by—in its headlong rush to oblivion. Of course, forecasting of this sort is hazardous. Among other possibilities, many positive things could happen to change the picture, everything from reversible suspended animation to antiaging treatments that really work. Some of these we may hope will not be too long in coming, though as usual there are few guarantees. (One guarantee, however, is that the harder you work for and support efforts to bring about something you want, the more likely you will get it.)

We've been considering our suspendees in bulk, but cryonics patients are people too, not just statistics, and we must not forget the human dimension. Unfortunately, it will not be possible to do justice to this subject here, but the pictures included with this article suggest a few highlights. In looking at these generally happy faces, we must not lose sight of the gravity of the issue cryonics confronts, and the fact that it doesn't always work out, even short term. (Two of the people shown, in fact, did not stay frozen, as the table will verify.)

Suspension Patients

To turn now to the table of suspension patients, a few words of explanation will be useful. For the type of suspension, W is whole body, N is neuro (head only), B is brain only. (Cryonicists who do not choose the whole body option generally expect to have their bodies rebuilt by cloning-related or other procedures in the future.) WF is whole body with storage at freezer temperature, above that of dry ice (–78°C or –109°F) . WP is whole body permafrost storage.

The different storage and suspension organizations are: AL—Alcor Foundation (suspension and storage); BPI—BioPreservation Institute (suspension), CC—Cryocare Equipment Corp. (suspension [straight freeze only] and storage, active 1960s); CI—Cryonics Institute (suspension and storage); CS—CryoSpan (storage); CSC—Cryonics Society of California (suspension and storage,

CASE #	DEANIMATION DATE	NAME/IDENTIFICATION	SEX	AGE	SUSPENSION	CURRENT STATUS	SOURCES
1	22 APR 1966[1]	*[L.A. AREA]	F	60s	W/CC	t(c. Early 1967)	WFFM, C1, FWR.66.MAY
2	12 JAN 1967	BEDFORD, JAMES H.	M	73	W/CSC	W/AL	WFFM, FWR.67.JAN
3	27 AUG 1967	PHELPS-SWEET, MARIE (MRS. RUSS VAN NORDEN)	F	74	W/CSC	t(c. 1971)	CR.67.SEP.1, SA.119
4	07 SEP 1967	NISCO, LOUIS T.	M	78	W/CC	t(c. 1971)	FWR.68.FEB.1 DNM.69.JUL 13, LAT(81.JUN 14?)
5	28 JAN 1968	SCHULMAN, EVA	F	ELD	W/CC	t(c. 1971)	FWR.68.MAY.5, O.70.DEC.4, C2
6	14 MAY 1968	KLINE, HELEN	F	*	W/CSC	t(c. 1971)	CR.68.JUN.120, NA, C2
7	JUL 1968	KESTER, DONALD (SR.)	M	ELD	W/CC	t(c. OCT 1969)	CR.68.SEP.166, CFDA.69.NOV-DEC.2
8	28 JUL 1968	MANDELL, STEVEN JAY	M	24	W/CSNY	t(c. OCT 1974)	CR.68.SEP.162, NA, SAI, MSM, C2
9	06 SEP 1968	STANLEY, C. RUSSELL	M	*	W/CSC	t(c. 1971)	CR.68.OCT.190, NA, C2
10	20 NOV 1968	MIHOK, ANDREW F.	M	48	W/CSNY	t(within hrs)	CR.69.JAN.4
11	04 JAN 1969	DEBLASIO, ANN	F	43	W/CSNY	t(c. 1980)	CR.69.FEB.2, BR(90.AUG 12)
12	14 MAR 1969	HURST, PAUL M. (SR.)	M	62	W/CSNY	t(c. FEB 1974)	CR.69.MAR.6, C.98.3Q.41
13	MAY 1970	GREENBERG, HERMANN	M	42	W/CSNY	t(c. FEB 1974)	O.70.DEC.4, TIC, C.98.2Q.16, C.98.3Q.41
14	20 SEP 1970	HARRIS, MILDRED E.	F	55	W/CSC	t(c. OCT 1974)	O.70.OCT.1, TIC, NA, SAI, MSM
15	25 JAN 1972	DE LA POTERIE, GENEVIEVE	F	8	W/CSC	t(c. OCT 1974)	O.72.FEB.1, NA, MSM
16	13 NOV 1972	*	F	51	W/CSC	t(c. 1980)	O.72.NOV, O.72.DEC, O.73.JAN, C.81.MAR.4
17	10 DEC 1972	DOSTAL, CLARA	F	60	W/CSNY	t(1973)	O.72.DEC, O.73.MAY, CDR, SB.81(JUN 06)D(3?)
18	04 FEB 1974	DEMAR, MARY J.	F	75	W/TT	W/CI	O.74.MAR, RE
19	09 FEB 1974	*	M	65	W/TT	N/AL	O.74.MAR, C.81.SEP.11f
20	10 APR 1974	BABURKA, MICHAEL (SR.)	M	64	W/CSNY/ PR	t(c. 1974)	I.77.NOV.2, C.81.JUN.2, C2
21	11 OCT 1974	*	M	abt. 7	W/CSC	t(02 APR 1979)	O.74.NOV.1, VMN.95.
22	28 SEP 1975[2]	LEDESMA, PEDRO	M	62	W/CSC	t(02 APR 1979)	OMP, C2
23	16 JUL 1976	CHAMBERLAIN, FRED II	M	79	N/AL	N/AL	I.76.SEP, MP
24	02 OCT 1976	WILSON, PATRICIA LUNA	F	15	B/TT	B/TT	LER.307, LEM.77.MAR.18
25	23 SEP 1976	ETTINGER, RHEA CHALOFF	F	78	W/CI	W/CI	CI BROCHURE, RE
26	14 JUL 1978	BERKOWITZ, SAMUEL	M	76	W/TT	t(late 1983)	LLM.79.SEP.30, C.83.DEC.1
27	02 NOV 1978	*	F	65	W/TT	N/AL	LLM.79.SEP.71, C86.APR.24
28	22 JAN 1979	ROTHACKER, LUCILLE	F	76	N/TT	N/CS	TC.79.MAR, C.81.NOV.21, C2
29	15 JAN 1980	DEMAR, WILFRED J.	M	79	W/TT	W/CI	C.85.NOV.13, RE
30	17 JAN 1980	FOOTE, JANICE	F	36	W/TT	N/CS	SB.80.unk, C.84.SEP.16, C.85.NOV.13, C2, PW
31	02 FEB 1981	HIXON, HUGH L. (SR.)	M	71	N/TT	N/AL	MP
32	1982	*	M	ELD	B/PR	*	I.83.MAY.3
33	25 FEB 1984	MARTINOT, MONIQUE[3]	F	49	WF/PR	WF/PR	C.84.JUL.1, C.84.SEP, MP
34	12 FEB 1985	CANNON, THERESA M.	F	68	N/AL	N/AL	C.86.FEB.17, SWB
35	08 JUN 1987	ROBERTSON, RANDALL B.	M	29	N/AL	N/AL	C.87.AUG.14, MP
36	10 NOV 1987	ETTINGER, ELAINE	F	65	W/CI	W/CI	C.87.DEC.1, I.87.DEC, RE
37	11 DEC 1987	KENT, DORA	F	83	N/AL	N/AL	C.88.JAN.1, MP
38	12 MAR 1988	JONES, VIOLET	F	87	W/TT	W/CS	C.88.APR.1, I.88.JUN, C.88. JUL.5, PW
39	Late MAR 1988	*	M	85	WP/CSCN	WP	I.88.JUL, C2
40	08 MAY 1988	BINKOWSKI, ROBERT	M	72	W/AL	W/AL	C.88.JUN.2
41	07 OCT 1988	SCHWARZ, ALICE M.	F	78	N/AL	N/AL	C.88.NOV.15, MP
42	12 DEC 1988	JONES, RICHARD CLAIR	M	57	W/AL	W/AL	C.89.JAN.2
43	21 MAR 1989	DONOVAN, EUGENE T.	M	71	N/AL	N/AL	C.89.APR.1, MP
44	18 AUG 1989	*	M	78	W/TT	W/CS	ACSJ.89.JUN, C2, PW
45	19 AUG 1989	COMOS, CRISTINA	F	21	W/AL	W/AL	C.89.NOV.20, MP
46	06 NOV 1989	MORSTOEL, BREDO	M	89	W/PR	W/PR	C.90.MAY.15, TB
47	09 MAY 1990	*	F	60	W/AL	t(MAY 1994)[4]	SWB, MP
48	09 JUN 1990	FRIED, ARLENE F.	F	68	N/AL	N/AL	SWB, MP
49	22 JUN 1990	SCHIAVELLO, ROCCO ("ROY")	M	30	W/AL	W/AL	SWB, MP
50	29 SEP 1990	*	F	76	W/PR	W/CI	TB, RE

CASE #	DEANIMATION DATE	NAME/IDENTIFICATION	SEX	AGE	SUSPENSION	CURRENT STATUS	SOURCES
51	22 DEC 1990	*	F	97	W/PR	W/CI	TB, RE
52	31 DEC 1990	*	F	88	W/AL	W/AL	MP
53	13 MAR 1991	SHERRILL, FRED	M	61	W/CI	W/CI	RE
54	JUN 1991	*	F	ELD	WP/CSCN	WP	I.91.NOV, C2
55	10 JUL 1991	LEAF, JERRY D.	M	50	W/AL	W/AL	MP
56	02 AUG 1991	*	F	62	N/AL	N/AL	MP
57	07 OCT 1991	RUNKEL, WALTER	M	75	W/CI	W/CI	I.91.OCT, I.91.NOV
58	29 NOV 1991	*	F	80	W/TT	W/CS	C2, PW
59	12 DEC 1991	SALIN, PHILIP	M	41	N/AL	N/AL	MP
60	07 JAN 1992	WHITE, SUSAN	F	73	B/TT	B/CS	I.92.APR.5, I.92.MAY.8, PW
61	10 MAR 1992	*, CAROL	F	42	W/TT	W/CI	C2, I.92.APR.7, RE
62	19 MAR 1992	*	M	39	N/AL	N/AL	MP
63	01 JUN 1992	FRIEDMAN, MICHAEL L.	M	38	W/AL	W/AL	MP
64	19 JUN 1992	*	M	64	W/AL	W/AL	MP
65	24 JUN 1992	HOURIHAN, JAMES J.	M	28	N/AL	N/AL	MP
66	24 AUG 1992	*	F	50	W/CI	W/CI	RE
67	25 AUG 1992	MARSH, LYNNE	F	70	W/TT	W/CI	RE
68	09 SEP 1992	ERFURT, JOHN C.	M	58	W/CI	W/CI	RE
69	Abt. NOV 1992	*	F	ELD	B/TT	B/TT	I.92.DEC.6
70	30 NOV 1992	AMLIN, CHARLES	M	94	W/CI	W/CI	RE
71	01 FEB 1993	*	M	48	B/AL	B/AL	MP
72	11 APR 1993	*	M	37	N/AL	N/AL	MP
73	Late 1993	*	M	ELD	B/*	B/*	MP
74	05 FEB 1994	WHITE, JEROME B.	M	55	N/BPI	N/CS	I.94.APR.5
75	30 APR 1994	STEINBERG, LILLIAN	F	91	W/AL	W/AL	I.94.JUN.2
76	06 MAY 1994	MARSH, RICHARD	M	81	W/BPI	W/CI	I.94.JUL.9
77	13 SEP 1994	*	F	75	W/CI	W/CI	RE
78	16 DEC 1994	FREDERICKSSON, HELMER	M	71	W/CI	W/CI	RE
79	03 JAN 1995	GENTEMAN, PAUL F.	M	47	N/AL	N/AL	I.95.APR5, MP
80	09 JAN 1995	BRADSHAW, MARGARET	F	50	N/BPI	N/CS	I.95.MAR.4, PW
81	Abt FEB 1995	*	F	Child	B/BPI	B/CS	I.95.APR.5
82	12 JUN 1995	EPSTEIN, ANATOL	M	66	W/AL	W/AL	MP
83	08 AUG 1995	DICK, MONA K.	F	72	N/AL	N/AL	MP
84	Late AUG 1995	*	M	*	B/PR	B/CS	I.95.OCT.9
85	Abt SEP 1995	*	*	*	B/BPI	B/CS	I.95.NOV.4
86	06 OCT 1995	FOOTE, ANDREA	F	54	W/CI	W/CI	RE
87	03 NOV 1995	*	F	100	W/CI	W/CI	RE
88	26 NOV 1995	PENKSA, STANLEY	M	99	W/AL	W/AL	MP
89	12 DEC 1995	GALLAGHER, JAMES L.	M	55	N/BPI	N/CS	CP
90	28 JAN 1996	*	F	46	W/CI	W/CI	RE
91	05 MAR 1996	*	M	48	W/AL	W/AL	MP
92	08 MAR 1996	*	F	86	W/CI	W/CI	RE
93	17 APR 1996	*	M	75	W/CI	W/CI	RE
94	16 MAY 1996	POPPER, HENRIETTA	F	80	N/BPI	N/CS	CP
95	02 AUG 1996	CORNELIUS, WALTER	M	74	W/CI	W/CI	RE
96	19 OCT 1996	*	F	82	N/AL	N/AL	MP
97	08 FEB 1997	KUHRT, EDWARD	M	65	N/AL	N/AL	MP
98	20 FEB 1997	CANNON, JOSEPH G.	M	81	N/AL	N/AL	MP
99	04 MAR 1997	DEMAR, ERIC S.	M	72	W/CI	W/CI	RE
100	14 DEC 1997	*	F	38	W/PR	*	MP
101	29 DEC 1997	GRUENLER, HORST	M	92	W/CI	W/CI	RE
102	24 MAR 1998	*	F	83	W/CI	W/CI	RE
103	07 MAY 1998	*	M	53	W/CI	W/CI	RE
104	29 MAY 1998	*	F	54	W/CI	W/CI	RE
105	04 JUN 1998	MATIC, NATASHA	F	88	W/CI	W/CI	RE
106	1998	*	*	*	*	*	CP

active 1960s-'70s); CSCN—Cryonics Society of Canada; CSNY (suspension and storage,active 1960s-'70s); TT—Trans Time (suspension and storage). Other cryonics-related organizations that do not practice either suspension or storage are not included, e.g. American Cryonics Society and the modern CryoCare. Actually there are some simplifications here in the interest of clarity. CSC didn't practice suspension or storage, but only its sister organization Cryonic Interment (same initials as Cryonics Institute). For CSNY it was its sister organization Cryo Span that did the actual suspensions and storage (a different organization from the more recent and currently active CryoSpan). When a suspension has terminated, usually through simple thawing and burial, this is signified by "t" with the approximate date in parentheses. Unavailable or missing data is signified by an asterisk (*). Sources of information and other notes are given at the end. For their help in assembling the information on more recent cases I would especially like to thank Robert Ettinger, Charles Platt, Christopher Rasch, and Paul Wakfer.

NOTES:

[1]Date of freezing in this case.

[2]Freezing did not occur until about 26 Jul. 1976.

[3]Monique Martinot (France) is still being maintained, apparently, by her husband Dr. Raymond Martinot..

[4]Her will, upheld in the California courts, stipulated that she not be "cremated or frozen."

Sources: (1) Books: LER = *The Life Extension Revolution* by Saul Kent: SA = *Suspended Animation* by Robert Prehoda: WFFM =*We Froze the First Man* by Robert F. Nelson and Sandra Stanley. (2) Article: TIC = *The Iceman Cometh* by Clifton D. Bryand and William E. Snizek. *Society* Nov.-Dec. 73. 3) Periodicals: ACSJ = *American Cryonics Society Journal*; C = *Cryonics:* CFDA = California Funeral Directors' Association Newsbulletin; CR = *Cryonics Reports*; DNM = *Detroit News Magazine*. FWR = *Freeze-Wait-Reanimate*; I = *The Immortalist*; LEM = *Life Extension Magazine*; LLM = *Long Life Magazine*; O = *The Outlook*; TC = *The Cryonicist*; VMN = *Venturist Monthly News.* (4) Newspapers: BR = *The Berqen Record:* LAT = *Los Angeles Times; SB = The Sacramento Bee.* (5) Court Documents: CDR = Complaint for Declarative Relief. Halpert et al. v. Nelson et al. Los Angeles Superior Court Case C-161229, 18 May 1976; N.A = Appellant Robert F. Nelson's Settled Statement on Appeal. 2nd Civil no. 63721 (for Superior Court Case C-161229. Los Angeles County), 20 May 1982; SAI = Supplemental Answers to Interrogatories. Los Angeles Superior Case C-161229, 22 Jul. 1980, p. 14. (6) Persons: TB = Trvgve Bauge; SWB = Steve Bridge: MP = Mike Perry: CP = Charles Platt; PW = Paul Wakfer (7) Misc.: C1 = Memo trom Ted Kraver C2 = confidential sources: MSM = Minutes of special meeting of board of directors of Cryonics Society of California, 11 Oct. 1974. OMP = Cemetery records of Oakwood Memorial Park, Chatsworth, Calif.

Photo credits. Ann Deblasio: *Immortality*, Apr. 1970 4; Genevieve de la Poterie: *The Outlook*, Aug. 1971 cover; the rest: Alcor Foundation.

Ann DeBlasio:
A priest consecrated her capsule.

Terri and Joe Cannon. Not the only married couple who have chosen cryonics.

Jerry Leaf: Soldier of fortune who became a pioneering, life-extension scientist.

Eve of Destruction:
Prophecies, Theories, and Preparations for the End of the World

by Eva Shaw, Contemporary Books, Chicago 1996

Reviewed by Thomas Donaldson, PhD

More and more frequently we may notice individuals who stand on street corners (metaphorically speaking) and proclaim loudly that the End of the World is near, if only because we are at the end of another millenium. From time to time, we may also hear cryonicists named as kin to such crackpots.

I myself am partially guilty of making this accusation, when I compare beliefs by some cryonicists about nanotechnology (without capitals) to millenarian ideas, and refer to it as a belief in Nanotechnology (capitalized). Since I've never looked closely into millenarianism, I decided to read a bit more about it. The book named above was my introduction to that area.

Basically Shaw goes through all the different cults, Christian and non-Christian, which have at one time or another claimed that the world would soon end and we must prepare ourselves for the coming of that end. Although she does make a few bows to non-European traditions, her discussions center mainly on Christian beliefs and (more recently) New Age beliefs, both of which are European. Her book also gives a nice summary of these predictions in its final chapter, starting with AD 156 and ending with AD 2050.

Claims that the End was near have occurred regularly for the last 2000 years. Some cults leave their claim at that, with no date; others have leaders who dare to name a particular date. It's interesting that usually, when that date passes, the leaders of these latter cults merely provide another date, giving various excuses for their mistake. Their followers often believe them and continue to wait.

Apparently the early Christians believed widely that the End of the World would come soon after Christ's crucifixion. Just as with other later cults, when this didn't happen, believers continued to believe, simply rewording their predictions. This was done by putting the date further into the future, or as many establishment denominations have done since, by interpreting the End in more symbolic terms.

End of the World myths usually include more than simply an end to the world. Often there is a period of grace and happiness which lasts for various lengths of time: the chosen ones live on into this era, which ends with the passage of all to Heaven. The judgment and damnation of *non*-chosen ones may occur at any time in this sequence, depending on the cult in question.

I would hardly claim that believers in Nanotechnology are Christians. Other than in a symbolic sense, no cryonicist believes that we will see the End of the World. However, Shaw also discusses another class of such beliefs, those directed toward a New Age. Many prophets, clairvoyants, numerologists, and UFO worshippers don't believe in an End of the World either. Instead, they believe that we are approaching a special threshold time, one in which humanity will go through an evolutionary leap to a new stage. This idea sounds a good deal more familiar, though the instances Shaw discusses don't look familiar at all: a Moira Timms who believes that UFOs have come on a heroic mission to save us from ourselves, Baird Wallace, who claims to have been channeling information about our future evolution from the Space Brothers, and others. It's critical here that the change occur *suddenly*. The notion that at some near future instant we will *all* change *suddenly* into a new form of humanity, with enhanced mental and physical powers, begins to sound like some of the less insightful ideas about Nanotechnology.

The other side of a cultish belief in sudden transformation is the idea that changes we see today have little relation to the "true" change to come, or may actually *distract* us from it.

Relating back to nanotechnology, note that we already have significant abilities to work with matter on nanolevels: such abilities have grown floridly in biotechnology, and scientists working with semiconductors are already thinking seriously about how to make future nanosized circuits. Some members of the cryonics community, however, ignore these developments and preach a future major (and *sudden*) advance in technology that will bring sudden changes in society, beliefs, and the human condition. Naturally the aforementioned precursor developments do not merit the name "nanotechnology"; only full-blown nanomachines (with nano-sized gears, gear shafts, and the like) truly deserve this title.

So, does Eva Shaw's book tell us something about (at least some of) ourselves? You must decide for yourself.

Review: Nonfiction

The Garden in the Machine:
The Emerging Science of Artificial Life
by Claus Emmeche, transl. Steven Sampson
Princeton University Press, 1994

Reviewed by Thomas Donaldson, PhD

Many cryonicists are professional computer scientists or have other close connections to computers. They will have heard about artificial life and genetic programming, two major subjects discussed in this book. Cryonicists who have not will learn at least what these subjects are about when they read it. The book (translated from Danish) does not deal with the details involved in either Conway's Game of Life (the first version of artificial life produced) or other related questions. Instead it deals with the broader issues raised by Artificial Life (AL) and other such technologies.

The Game of Life is not really a game between players, but a system designed to show some of the attributes of life in a universe stripped to essentials. Basically, we have an infinite checkerboard starting with pieces placed on various squares. The player (or rather, programmer) establishes laws by which each successive stage of the game is found. A position on the checkerboard is either *on* or *off* (*on* positions have a piece placed on them, *off* positions are bare). A position is turned *on* if three adjacent positions are *on*. It remains *on* until two or more adjacent positions are turned off. We think of these rules as the "chemical laws" of an artificial universe. Amazingly, such simple rules produce a very wide variety of behavior, quite unpredictable at first. Various placements make systems which die out, or end up in a repetitive loop. Other ways of placing pieces create self-reproducing systems which persist indefinitely.

And from this comes the very first question: is a self-reproducing setup of this kind to be considered *alive*? Proponents claim that they have created a true form of life; others dissent from that idea. Emmeche discusses both opinions*****. On the side against the idea that some of these creations are "alive" comes the simple observation that they are en-

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* My own opinion is that computer viruses *do* satisfy any reasonable test for life, because they occur in real computers. Creatures in Conway's Game of Life and other such systems remain simulations only — which does not impugn their value for understanding life forms.

tirely digital; their interaction is entirely symbolic. On the other hand, even the simplest physical living creatures must deal with the real world and respond to it in *nonsymbolic* ways. What's the difference? A real living creature might move its legs, while a computer version of that creature (with lots of graphics software) could only produce an *image* of something moving its legs. (Note here that there is no claim that "real living creatures" must have the same metabolism as any present earthly creature.) One major feature of AL is its reproduction (Emmeche points out that so far we have not produced *one* self-reproducing machine in the real world). Self reproduction can involve many different steps. Besides using the Game of Life, Emmeche also discusses the original plans of von Neumann himself for a self-reproducing machine, the first detailed plans for cellular automata (CAs). (Von Neumann's original plans were finished by another researcher, Arthur Burks, after Von Neumann's death. Burks also showed that these cellular automata could be implemented on a computer, again not with real reproduction but computer-simulated reproduction). Of interest is the stated belief of von Neumann himself about his creation: his design may well have ignored some of the major features of real living creatures.

Unlike von Neumann's machine, we and other living creatures do not have a system able to produce whatever creature is exactly specified by our genes. In virtually all cases, animals grow into their particular forms as the result of complex interactions between many gene products, with no genes dictating the form itself. We grew into human beings not because we had the complete *explicit* plans for a human being in our genes, but because our genes happened to produce a human being as a consequence of their actions.

This process is easier to understand when we think of all the ways in which different forms may come not from direct plans but by interaction. For instance, crystals form in a particular pattern because of their environment, not because they somehow store plans of their final shape within themselves. Emmeche considers this process in life forms as quite unknown and unstudied. I must add here that all the extensive work on such issues as the growth and development of fruit flies has by now resulted in much increased understanding of these processes in living creatures. (We may come to understand even the growth and development of human beings relatively soon.) Even so, the major point — that our genes do not contain an explicit plan for us — remains valid. In this sense, von Neumann's machine misses one major feature of most present life forms.

Intellectually it's easy to separate the "blueprints" for a creature from the processes creating it. The actual construction of living creatures, however, mixes up blueprints and construction. In light of this, we can definitely state that living creatures at all like us (perhaps even living creatures *at all*) could easily form from arbitrary materials. When we speak of simulations in a machine, the validity of the term "alive" is far from a trivial question.

Emmeche's book also describes "genetic programming," using evolutionary processes to find programs that solve hard problems (for which no polynomial algorithm exists). To do this, we first set up a form of selection between programs, retaining those which do best on a given problem, and then producing several generations of programs along these successful lines. In each generation, programs doing the best are preserved and even combined (the genetic word for this is "crossing over"), after which they go through another round of selection. This process turns out to be quite efficient in generating good solutions to specific problems.

Emmeche also discusses several other programming approaches, each of which uses ideas in the construction of life forms either to explain the behavior of living things or reproduce it. One such program, for instance, shows how flocking might arise in birds. Others look at evolution in an array of artificial creatures. Such programs show many patterns noticed in the evolution of real living things.

The book never gives any firm answer as to whether the Game of Life actually involves "living creatures" in any sense; it merely describes many different strands of programming that orbit around the behavior of life forms. Since even the simplest life forms (not to mention human beings) have much more complexity than any computer program to date, relatively accessible artificial systems may teach us a good deal — either new ways to solve our computer problems, or new understanding of why life forms behave as they do.

Cheating Death:
The Promise and the Future Impact of Trying to Live Forever

by Marvin Cetron and Owen Davies

St. Martin's, New York 1998.

Reviewed by Mike Perry, PhD

This book attempts a sober forecast of the near-term future, based on a premise that will be familiar and welcome to immortalists but has been ignored by most others: that significant extension of the human lifespan is just around the corner. The authors estimate that by 2015 at the latest, treatments will be available to lengthen our healthy, productive years by several decades, so that today's Boomer generation can expect to stay active until at least age 110 or so. The extra time, moreover, will open the possibility of further advances in understanding and preventing the aging process, so we could find our lives extended indefinitely. Though certainly the overall prospects are optimistic, life extension will create a host of problems.

One problem is simply that we have, up to now, ordered our lives around the inevitability and predictability of our deaths. Some people could find it quite disturbing that this is no longer so. (This should not apply to a true cryonicist, of course, but then we are a small minority.) Two other staples of life, birth and procreation, lose much of their relevance without death. As the authors maintain, we will need a whole new set of values. Meanwhile, we can expect some difficult adjustments along with the evident benefits.

One difficult adjustment may follow because the labor force will swell with life-extended persons who did not die or retire "on schedule" as with former generations. In fact, people are already living longer than was anticipated when such programs as Social Security were put into effect in the early part of this century. Even now there are more and more people approaching the age of benefits, and relatively fewer to pay the taxes that will support them. This trend can only continue, and with the advent of life extension, it will accelerate considerably. If you aren't going to reach retirement age by 2010, say the authors, you will probably never collect on Social Security. Similarly, other retirement programs are not going to prove adequate, so people will continue working into their eighties and nineties, and may never find the opportunity to retire.

Such problems do, of course, have a considerable silver lining, in that the ancient scourge of aging will diminish and, one hopes, disappear altogether. Health costs will increase for a while, then decline — and keep on declining. Older people, in unprecedented good health, should be able to acquire new skills and knowledge, and will meanwhile have special value for their greater expertise and experience. Among the significant changes in work habits, visible in present trends, will be an increasing number of self-employed individuals who use computers and work out of their homes.

For all the optimism of their basic premise, the authors also respect the gravity of their subject, and remind the reader early on that "the claim that we will soon gain something approaching immortality requires firm support if it is to be taken seriously" (p.2). A major part of the "firm support," scientific evidence as to the cause and possible cure of aging, is examined in Chapter 1. And here, I think, a significant error is made, with a claim that research with melatonin has achieved "a crucial breakthrough" in understanding the aging process. Mice, it's true, live longer in better health on melatonin, but it's not clear that they experience any reversal of aging at the molecular level. Seen in context, this problem is minor. The more important point noted by the authors is that we are learning more about aging all the time, and the day is probably not too far off when we will control and reverse its effects in a major way.

Again, this could occur as soon as 2015 or earlier, arriving in time to save many of us in cryonics. This is just fine if it happens, of course, but meanwhile, why not arrange for freezing in case it takes longer, or you die sooner? Cryonics is one part of life extension that is not mentioned at all in the book. Though one might wish otherwise, in a way this is actually reassuring, since it shows that interest in life extension is percolating outside of cryonics as well as within our small movement. We may hope this trend will grow along with other progress.

Cryonics, Immortality, and Social Disruption

by Thomas Donaldson, Ph.D.

Some cryonicists quite plainly believe that the advent of fully perfected means for cryonic suspension will cause lots of social disruption: mobs hunting for scapegoats in the street, legislation against cryonics by various law-making bodies, police crackdowns, etc. Such events will provide ample scope for those who wish to exercise their traditional heroism: the brave cryonicist holding off police for long enough to hide a carefully suspended member; ringing statements in court proceedings; and countless dramatic events of the kind we see in many contemporary films.

However, a strong case exists that neither cryonics nor immortality will cause much social disruption (of this kind) at all. Certainly they will cause lots of rethinking and changes, but that will happen over a period long in terms of present human lifespan. (Yes, a historian looking back might see it as sudden, but historians even now happily collapse centuries into a single period such as "the Middle Ages" or "Classical Times").

Most social disruption of the violent kind happens because of sudden changes. As much as we'd like to get both cryonics and immortality *tomorrow* (if not sooner), by their nature neither can arrive suddenly.

Immortality provides the easiest example. Let us suppose for a moment that some laboratory discovers a treatment which totally abolishes and reverses aging. A cartoon in *The American Scientist* several years ago illustrated this well: one scientist turns to another and says, "Well, maybe this formula will bring immortality, but we'll need forever to test it!"

The first indications of such an "immortality" treatment would come from people who seemed to rejuvenate. Even so, laymen and scientists alike would probably conclude the effect of that treatment was merely cosmetic. After all, actors right now use various operations to look younger, and no one believes those operations have more than a cosmetic effect. If rejuvenated immortals appeared tomorrow, the public might still take as much as 30 years to realize that our hypothetical immortality treatment actually worked on aging.

The second indication of such an immortality treatment would be people who did not age at all. Of course aging, again, is a relatively slow process. If our test subjects took their treatments at a young age, 50 years might pass before anyone were convinced that the treatments' effects are more than cosmetic.

The argument above also makes a strong assumption: that a single treatment is discovered which does the whole job. Technology rarely works that way. Instead, we are far more likely to see better and better treatments that eventually *end* with agelessness. Along the way, individuals taking the treatments look better than those who do not, but many of those treated may still die of old age. True, they might die at higher ages, but only careful statistical studies would show this.

Then too, immortality treatments will not obtain consent for tests from the authorities for many years, if not many decades. The US FDA, for instance, has very rigid ideas about what must be done to test a new drug. If a drug was designed only to act on aging, the tests required would take 30 years; if it acted on other conditions, then its effect on aging would remain problematic. This does exclude the possibility of someone obtaining and using such treatments; they would simply do so without the umbrella of authority (complicating statistical analysis of the treatments' efficacy).

I actually believe this process has already begun. Those interested in drugs which may work against aging will have to decide to take them even though *no* legal authorities have agreed that they work. Such a slow, undocumented process is simply not the sort of thing that leads to film heroics.

Cryonics has similar problems. (Since most readers of *Cryonics* believe in the ability of technology to solve many problems currently thought unsolvable, some of you may not see this immediately.) Cryonics depends not just on the ability to freeze and revive a seriously ill patient, but also the ability to cure the patient's illness. However, there is a widespread public belief that some illnesses are simply *not* curable. This belief may not disappear suddenly. Even if one patient *is* revived and cured,

there will remain many others in suspension with conditions which the medicine of that time will not know how to cure. Those few revived can easily be shrugged off as "very lucky but very unusual."

And remember that agelessness is one of the primary aims of those suspended. The previously discussed problems with immortality treatments extend to cryonics patients as well. Even with fully perfected suspension, 50 years or more might pass before we could offer permanently effective life-extension treatments to cryonics patients; many of these individuals might prefer to remain in suspension until then.

Bob Ettinger has spoken of one cryobiologist, an opponent of cryonics, who believes that cryonic suspension will not become medically acceptable until "someone has been frozen, revived, *and made immortal*" (my italics). Ettinger (rightly!) considers such an attitude insane. It's easy to forget that this cryobiologist is simply stating the requirements the FDA makes on *any* medical treatment. Even with fully perfected suspension, for a very long time we may still find ourselves working only with patients who have been declared "dead." (If you are a cryonicist, you will know that the Declaration of Death is a quasi-religious ceremony which says nothing, *even now*, about whether or not the patient can be revived — but if you are not, then you will notice little change.)

By their nature, both immortality and cryonics will creep up on us, rather than arriving suddenly with brass bands roaring out an anthem. Both will be revolutions, but revolutions of a gradual, subtle kind. Such changes very rarely cause much coherent opposition until they are complete . . . and by then, no one would even think of opposing them.

This and That

by Stephen J. Van Sickle

How to Uncook an Egg

Proteins are the very stuff of life, and I personally like it when mine continue working properly. A lot can happen to a protein, though, and it doesn't take much (heat, chemicals, or even just shaking) to cause them to unravel and clump together in a tangled mess. This is what happens when an egg is cooked; the protein rich whites link together into a firm, white mass. Not suprisingly, much the same sort of thing happens during cerebral ischemia and exposure to cryoprotectants, so it would be nice to be able to "uncook" an egg. Well, John Glover and Susan Lindquist of the University of Chicago may have a way. In their experiments, these researchers worked with the protein luciferase — the stuff that makes fireflys glow. They unravelled the protein, and exposed it to various combinations of "heat shock" proteins from yeast. (Cells try to protect themselves from damage by producing these types of proteins.) Glover and Lindquist discovered that Heat Shock Protein 104, in combination with HSP 70 and HSP 40, not only prevented tangles, but also unknotted them and helped them fold normally. Now if only they'd turn that hamburger back into cow.... (*New Scientist*, 18 July 1998 and Cell, Vol. 94, p. 73.)

Nanotechnology

The nanomachine approach to nanotechnology is based on the notion of atomically sized and precise machines not too different from the ones around us in our daily life. Wheels, axles, and rotating bearings are indispensible parts of these machines. Some biological systems use rotating systems (such as flagellar motors in microorganisms), but these are relatively large and complex. Now, however, scientists at IBM's Zurich Research Laboratory have succeeded in creating a single-molecule rotor rotating within a bearing. The single molcule, composed of only a few dozen hydrogen and carbon atoms, was demonstrated by scanning tunneling microscope to rotate freely, driven by thermal energy at room temperature. (*Science*, Vol. 281, p. 531).

There are two ways to build a nanomachine. One way is by building it bit by bit. The other is by being extremely clever and designing it so that the parts, as they are randomly jostled around, assemble themselves. This latter method is how life does things, and so a great deal of attention has been given to using DNA to design and build machine and computer parts. Researchers at the California Institute of Technology and New York University have succeeded in designing and growing periodic DNA crystals on a two dimensional surface in two distinct striped patterns. Since it is relatively easy to "program" DNA molecules with a specific sequence, this points the way towards being able to specifically design shape and pattern of the DNA on a surface, perhaps as computer components or scaffolding for other structures. (*Nature*, Vol. 394, p. 539)

Growing Ice Crystals in Electric Fields

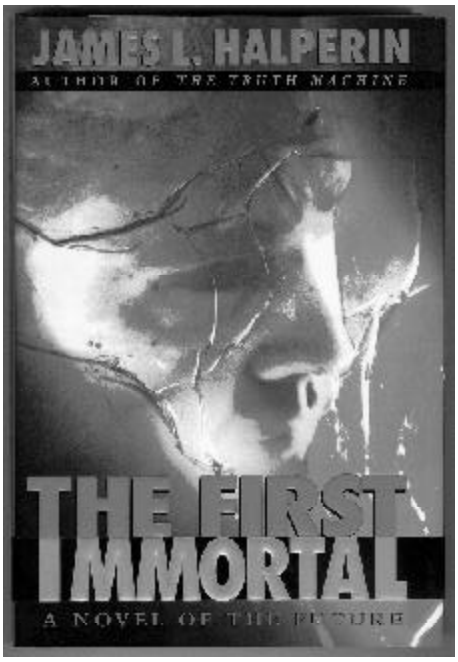
Everyone knows what an ice crystal looks like — even in the South you've at least seen a picture of a snowflake. One can say these crystals are a cryonicist's enemy; the whole point of cryoprotectants is to reduce their numbers and the damage they cause. Well, it is a good thing to know one's enemy, and a team at the California Institute of Technology has come up with an interesting tool for studying ice crystal growth systematically.

A strong electric field created by the tip of a charged needle has resulted in long, smooth, needle-like crystals that grow up to ten times as fast. Varying the field strength changes the growth in a predictable manner. Yes, yes, "smooth" and "needlelike" are not necessarily the adjectives cryonicists might want to use for describing ice crystals, but the researchers feel that this new technique will lead to a better understanding of the basic process of crystal growth. It also leads to the wild speculation on my part that some combination of electric and magnetic fields could effect crystal growth in a fashion beneficial to us. Well, maybe not. (*Science News*, Vol. 154, p. 23 *and Physical Review Letters*, July 6, 1998)

Rotary Rocket Begins Construction

The Roton, a revolutionary (pun intended) new single-stage-to-orbit spacecraft designed by the Rotary Rocket Company and mentioned in an earlier column, has begun construction at the facilities of Scaled Composites in Mohave, California. Kerosine tanks have already come out of the molds, and the molds for an oxygen tank and airframe are almost finished. Ground testing of components for the new rotating rocket engine, including live firings of the main thrusters and attitude control rockets, are well underway. This is starting to look less and less like a paper bird and more like the Real Thing. Now the question is: can Alcor's CryoTransport Team come get me on the Moon?

This column consists of items that I happen to run across and personally find interesting. If you'd like to help, you can give me more interesting news items by email to sjvan@uwm.edu.



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Directions: Take the 10 to the 17 Northbound, exit Thunderbird Road heading East. Thunderbird will turn into Cactus St, stay on Cactus until you turn left on Tatum, and then right on Thunderbird (which will turn into Redfield in about 3 miles), then (after a quarter mile on Redfield) left on 76th Place. 76th Place turns into Acoma Drive; Alcor is on the right at 7895 Acoma Dr., Suite 110.

Bay Area

Alcor Northern California meetings are held the second Sunday of each month at 4:00 PM, followed by a potluck supper and socializing. All members and guests are welcome to attend. For meeting information, call Alcor at 1-602-922-9013

Boston

There is a cryonics discussion group in the Boston area meeting on the second Sunday each month. Further information may be obtained by contacting Tony Reno at (508) 433-5574 (home), (617) 345-2625 (work), 90 Harbor St., Pepperell, MA 01463, or reno@tfn.com (email). Information can also be obtained from David Greenstein at (508) 879-3234 or (617) 323-3338 or 71774.741@compuserve.com (email).

District of Columbia

Life Extension Society, Inc. is a cryonics and life extension group with members from Washington, D.C., Virginia, and Maryland. Meetings are held monthly. Call Mark Mugler at (703) 534-7277 (home), or write him at 990 N. Powhatan St.; Arlington, VA 22205.

Florida

Austin and Glen Tupler, two Alcor members living in Florida, are interested in revitalizing Alcor's local group in their state. For more information about local meetings and organization, please contact them at 954-583-0801.

Los Angeles Area

For more information about local meetings in this area, call Alcor Director Michael Riskin at (714) 879-3994.

Indiana

Alcor's former president, Steve Bridge, has returned to his home state and plans on organizing local meetings. If you would live in the Midwest U.S. and would like to meet other cryonicists in your area, call Steve at 317-375-0968.

San Diego

Alcor's Medical Director, Dr. Thomas Munson, lives in the San Diego area and wishes to get a local Alcor group started. If you would like to get in touch with Dr. Munson, call 619-454-2321.

England

There is an Alcor chapter in England, with a full suspension and laboratory facility south of London. Its members are working to build an emergency response, transport, and suspension capability.Meetings are held on the second Sunday of the month at the Alcor UK facility, and may include classes and tours. The meeting commences at 11:00 A.M., and ends late afternoon. The address of the facility is: 18 Potts Marsh Industrial Estate, Westham, Pevensey, E. Sussex BN24 5NA Tel: (01323) 460 257

If you're coming to an Alcor UK meeting, phone ahead; meetings are sometimes rescheduled. Call Garret Smyth on (0181)789 1045 or send email: Garret@TheOffice.net. You may also contact Mike Price on (0181) 845 0203, or Alan Sinclair on (01273) 612 071.

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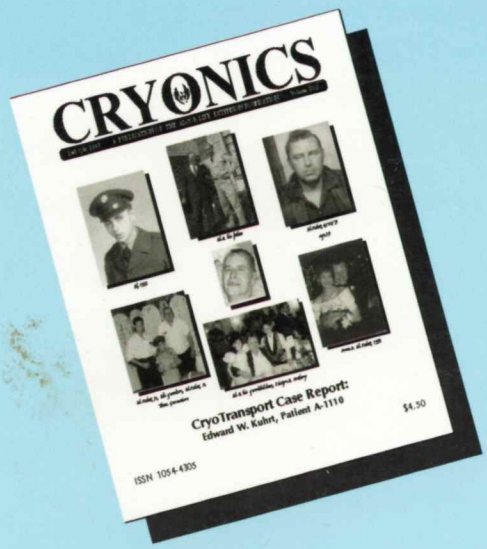

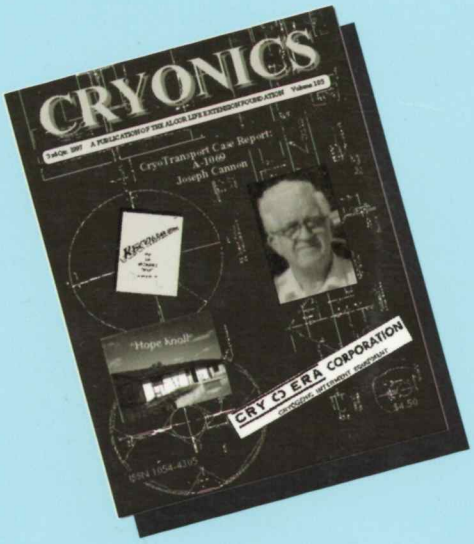

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