

CRYONICS

1st Qtr, 1995

A PUBLICATION OF THE ALCOR LIFE EXTENSION FOUNDATION

Volume 16:1

Alcor President **Stephen Bridge** investigates

The Legal Status of Cryonics



Plus:

Part II of **"The Terminus
of the Self"** by Max More
and

Part II of **"Two Minds"**
an interview with the Founders
of Alcor **Fred and Linda Chamberlain**

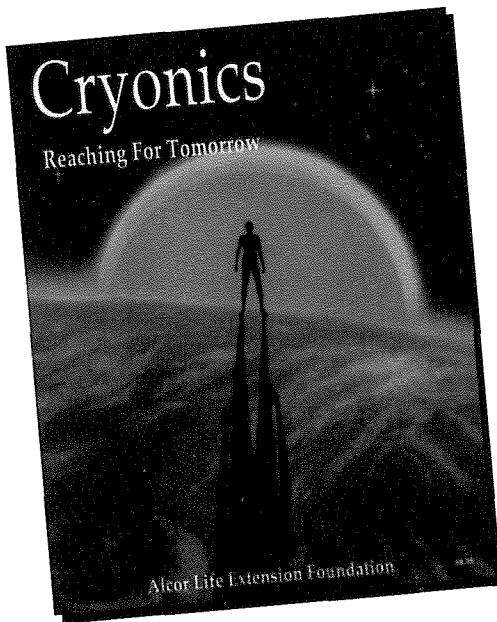
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“What is cryonics?”

Cryonics is the ultra-low-temperature preservation (biostasis) of terminal patients. The goal of biostasis and the technology of cryonics is the transport of today's terminal patients to a time in the future when cell and tissue repair technology will be available, and restoration to full function and health will be possible.

As human knowledge and medical technology continue to expand in scope, people considered beyond hope of restoration (by today's medical standards) will be restored to health. (This historical trend is very clear.) The coming control over living systems should allow fabrication of new organisms and sub-cell-sized devices. These molecular repair devices should be able to eliminate virtually all of today's diseases, including aging, and should allow for repair and revival of patients waiting in cryonic suspension. The challenge for cryonicists today is to devise techniques that will ensure the patients' survival.



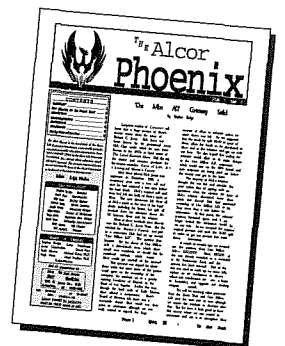
“How do I find out more?”

The best source of detailed introductory information about cryonics is *Cryonics: Reaching For Tomorrow*. Over 100 pages long, *Reaching For Tomorrow* presents a sweeping examination of the social, practical, and scientific arguments that support the continuing refinement of today's imperfect cryonic suspension techniques, in pursuit of a perfected “suspended animation” technology.

This new edition features an updated and lengthened chapter on revival, as well as the appendices “The Cryobiological Case for Cryonics” and “Suspension Pricing and the Cost of Patient Care.” Order your copy for \$7.95, or receive it FREE when you subscribe to *Cryonics* magazine for the first time. (See the Order Form on page 40 of this issue.)

For those considering Alcor Membership. . .

If you're intrigued enough with cryonics and Alcor that you're considering Membership, you might want to check out *The Alcor Phoenix*, Alcor's Membership newsletter. *The Phoenix* is a Membership benefit, so it's free to Members and Applicants, but anyone can receive it for \$20/year (\$25/year if you're overseas). It's released 8 times each year, on the “off months” of the quarterly *Cryonics* (February, March, May, June, August, September, November, and December). *The Phoenix* is shorter than *Cryonics*, but appears twice as often and is mailed First Class. Being a Membership newsletter, *The Phoenix* focuses on Membership issues such as financing cryonics, staff and management matters, developments in Patient Care and Emergency Response, etc. These issues will impact you directly if you decide to become a Member, and may help you make a more informed decision in the meantime.



Feature Articles

Algorithmic Feasibility of Molecular Repair of the Brain

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Two Minds: Chamberlain Interview, Part II

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LETTERS to the EDITOR

Dear Editor:

I've just read Tad Hogg's letter about my recent contribution to the discussion of revival. I actually agree with what he says on all but one crucial point—which was the real point of my article. My disagreement arises with his statement: "Fortunately, this... can wait until sufficiently sensitive measurement technology... becomes available." *No*, it cannot wait. Perhaps I didn't explain this point well enough, though.

I too have had a lot to do with software, NP problems, and heuristic solutions for them. I've actually implemented some of these, on a parallel computer too.

But with all such methods—simulated annealing, genetic algorithms, and heuristic repair—something is needed *besides* the algorithm. (The same is true for the cryptographic algorithm Ralph Merkle has proposed.) That something is some kind of guide or test that your current "best guess" solution is getting closer to the solution sought.

To really evaluate any of these methods for the specific problem of repairing a damaged brain, we have to come to grips with just what that measure of distance from a solution will be. To do that, we will inevitably be involved in the nitty-gritty of neurobiology... and neurobiology as it appears in a *damaged* brain. This point should be obvious, but there is more. It is also very clear that some kinds of damage simply won't be amenable to such algorithms: to look at an obvious counterexample, consider a brain that has been run through a Waring Blender. Yes, we can most certainly

record the location of every molecule in the mélange that results. But that mixture gives us no clue at all about whether our solution is near

or far from the desired one.

The existence of incredibly powerful computers, and the ability to deal with matter on a nanoscale, will not alone be sufficient to revive anybody. We're also going to need information about the structure which was disrupted; and we would need some way to judge that enough such information survives suspension before we could decide that these computers and algorithms will succeed.

One of the critical problems to suspension right now is that of cracking and motion of tissues in our brains. Different treatments affect brains differently. Moreover, many kinds of information we might garner from a damaged brain aren't even known to us, since we have a relatively scanty (but rapidly growing) understanding of the human brain and how it works. I wrote my original article because that key point—a serious discussion of whether enough information was actually available for any heuristic reconstruction algorithm to work—simply had not been made, by Ralph Merkle or by anyone. And if you lack that information, then you really *are* trying to solve a *very* large problem.

As a mathematician and a parallel software engineer, I find that I cannot honorably accept any proposal of a computer technique which omits any discussion of whether we have the information needed, now, or whether we will someday be able to have it. My own opin-

ion is that we will need more research and understanding, either of our brain or of how to improve our cryonic suspension processes, or of both at once, before we will get anywhere by bringing in algorithms and computers of any kind.

As a cryonicist, of course, *I hope* that enough is known already. And rather than simply hope, or try to construct algorithms in the air, I believe that the appropriate action is to do what you can to promote research towards improving our suspension processes. If we do that, the day will certainly come when we *will* have proof that enough information is preserved by our suspension techniques that we will be able to honestly offer to preserve our patients without doubt on that issue. That won't, of course, be the end of cryonics research: we want to have some way to *actually* bring back a patient rather than simply prove that the necessary information to do so remains.

That was the point of my original article. And naturally, I suggest that anyone who wants to be suspended should join in the effort of making our suspension techniques better than they are now. Many people may feel that it is asking too much to ask them to master an entirely new field and then do research in it; that's understandable. But even donation of money towards this aim provides enough for more steps in that research. And yes, certainly, the day will come when very large and fast computers will be used to carry out reconstruction of damaged patients, and so, if only we understand very clearly that such efforts are theory only, discussion in more detail of algorithms that might work makes sense. There is much to do for anyone who does not want to simply wait with folded hands.

Long long life,
Thomas Donaldson

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Letters not intended for publication should be clearly marked as such.

Alcor Member Paul Genteman Suspended

On January 3, 1995, Alcor Life Extension Foundation placed former Director Paul Genteman into cryonic suspension. Paul was 47 years old and, along with his wife, Maureen, had been actively involved in cryonics since the mid '70s. Alcor has only seven current members who have been signed up with Alcor longer than Paul. In addition, Paul was on Alcor's first Suspension Team with Jerry Leaf (also now in cryonic suspension), and served as Secretary, Vice-President, and Chairman of Alcor's Board of Directors.

Paul was in Phoenix, Arizona for scheduled intestinal surgery in late December, and deanimated several days following that surgery. Although his legal death was unexpected, the nearness of Alcor's facility lead to a rapid response by our Transport Team, and the suspension proceeded swiftly. Glycerol concentrations achieved were 6.6 Molar (venous) and 5.8 Molar (subdural). Details of the suspension will be published in the next issue.

Paul Genteman was one of the most respected and well-liked people in cryonics. We at Alcor want to express our deepest sympathy to Paul's family and to others who loved him. The world will be a poorer place without him.

We're planning a much larger appreciation of Paul (as well as the suspension report) in the 2nd quarter issue. If you would like to submit a letter with your thoughts or memories about Paul for inclusion in that issue, please e-mail your piece to Ralph Whelan (ralph@alcor.org) or mail it to the address shown on page 2.

Correction

Last issue, Thomas Donaldson's column "Science, Ciphers, and Sorcery in Cryonics" contained an error. On page 37, in the middle column:

"... work showing that pyramidal neurons had 3 different kinds of input on their dendrites (the parts of a neuron which send messages..."

should actually read:

"... work showing that pyramidal neurons had 3 different kinds of input on their dendrites (the parts of a neuron which *receive* messages..."

Up Front

By Ralph Whelan, Editor

Forty-eight weeks out of the year, working for a cryonics organization is inspiring and life-affirming (if a little, well, frantic). Four weeks out of the year, you are forced into a gritty confrontation with the very villain you are working so hard to eliminate. (Death, that is.)

Of course, it's not really "death" if the patient lives to tell about it. And that's the string that you cling to as you lower a friend into the nitrogen, reminding yourself that far worse is it to die and *not* be frozen. . . .

But far *better* is it to *not die*. Especially when the victim is a cryonicist, all of whom (despite being prepared for the worst) have displayed an obvious determination to live, and *especially* when the victim is Paul Genteman.

Without a doubt, Paul's departure will leave an empty spot in the hearts of everyone who has ever known him. But as the shock of his untimely suspension wears off, we will think less of what Paul is missing, and more of the experiences yet ahead of him, should we succeed in our goals. And that will be both our consolation and our motivation.

If you knew Paul, please consider taking a moment to write down your thoughts to or about him, and send them to us for publication in next issue's appreciation.

Until then, hunker down and enjoy some of *this issue's* mind food: Ralph Merkle is back with "Algorithmic Feasibility of Molecular Repair of the Brain," a short piece rebutting some of the points made by Thomas Donaldson in "It's Not At All So Easy" (3rd Qtr., 1994); Derek Ryan concludes his interview with Alcor founders Fred and Linda Chamberlain; Steve Bridge reports on the topics and events of the 2nd Annual Anti-Aging Medicine and Biomedical Technology Conference; Hugh Hixon introduces the latest technological approach to quantifying and understanding cracking phenomena in cryonic suspension patients; and Max More concludes his philosophical treatise on the "The Terminus of the Self."

PUBLICATION NOTES

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About the Cover

The cover of this issue was designed by Ralph Whelan, using Aldus Freehand™, Aldus Pagemaker™, Corel Gallery™, and some conceptual assistance from Derek Ryan, Tanya Jones, and Steve Bridge.



The Legal Status of Cryonics Patients

An Introduction

Why is there a legal question?

There are no state or federal laws in the United States today that are specifically aimed at cryonics or which mention it by name. That doesn't mean that no laws *apply* to cryonics. Because they work with legally dead human beings, cryonics organizations must be aware of—and often find ways to circumvent—laws intended to protect the public health from unburied or untreated bodies. Laws permitting anatomical donations have been beneficial to cryonics but pose their own set of problems. The funding of cryonic suspensions is often trapped in a tangle of laws concerning trusts, tax-exemption, and insurance policies. Eventually there *will* be laws which specifically regulate cryonic suspension and other forms of biostasis. Whether these laws are permissive or prohibitive will depend very much on our understanding of current laws and on our ability to cooperate with (or sometimes to out-think) elected and appointed government officials.

Legal status of patients

Today, cryonic suspension patients are legally dead. Not alive, not in-between, but DEAD. How we as cryonists think of our patients has absolutely no influence on this label. We have to remember it is “merely” a label, and labels can be changed. But until we can prove that cryonic suspension patients have a high likelihood of being revivable, we have to play the game from that viewpoint.

This label of “dead” creates both problems and opportunities for us.

One obvious advantage is that life insurance and various forms of trusts

can be used to fund cryonic suspensions, with the cryonics organization as beneficiary. This is standard law, and has been used successfully many times.

However, like most of the accommodations we make with the law today, the reliance on life insurance has a potential downside. Ironically, if cryonics research is successful and we can someday show that suspension patients should be labeled as “alive,” cryonic suspension companies would be in for years of chaos. How would life insurance work then? Would insurance companies pay off on the policy if no death certificate could be presented? I suspect that eventually ways would be

found around this payment problem by the more honest (or at least more creative) insurance companies, just as many companies already have found ways to give pre-mortem payments to terminal patients. Besides, if cryonics becomes popular (a good bet if we can show that it works), there will be a lot of new customers for some form of insurance funding.

Another advantage to the “dead” label for suspension patients is that it allows Alcor and other cryonics companies to use the Uniform Anatomical Gift Act (UAGA) to obtain legal custody of the patients’ “human remains.” Just as individuals are allowed to donate their

bodies after death to medical schools or their organs for transplant, they can also donate their bodies to Alcor for "medical research." When accomplished by a written pre-mortem declaration, this donation effectively removes the ability of family members to "dispose" of the individual in some other way.

The use of the UAGA has another benefit. Hospitals and medical personnel are used to the paperwork involved in whole body donations and to the requirement for rapid release of the body to the donee. Saying "we are taking custody of this dead person because he donated his body to us" still goes over better at the hospital than "you aren't good enough to understand that this person is still alive, so we are going to do your job for you by freezing him until some smarter doctors come along."

In addition, many states (including California and Arizona) have very clear legislation which requires the state and the family to respect individuals' choices as to disposition of their own remains. At least three court cases in California have affirmed that these laws protect an individual's right to choose cryonic suspension. In effect, this means "dead people" *do* have rights.

As with life insurance, future *disadvantages* are likely if we manage to persuade legal authorities that our patients are "alive." I doubt that you could donate your *living* body to Alcor; and the laws concerning individual choice on disposition of remains would no longer apply.

Of course, labeling a suspension patient "dead" today also creates a large number of problems. Agencies which regulate funeral homes, cemeteries, and mortuaries may not appreciate our semantic balancing act between life and death and may assume we fall under their regulation. Cryonics organizations in California were fortunate enough to escape this because of an Attorney General's opinion published in 1980.

But Alcor is currently facing a similar problem in Arizona (see below).

Dead bodies are considered by most people to be empty husks, only fit for discarding. The assumptions have always been that death is the reverse of life and that life cannot be reclaimed. While it seems clear to us that this is likely to be untrue, we are forced to deal with the reality that people whose minds may be closed to this idea are the ones in charge of society. One consequence of this attitude is that "dead bodies," whether belonging to cryonicists or not, can be autopsied with no thought of endangering a continued life.

Someday a special status and a new label for suspension patients (Don't-Know-Yets; The Undead; Metabolically Challenged; The Deani-Mates—especially popular in Australia) will be required; but before then we will need to produce more research showing why such a status is deserved.

The Individual Laws

Alcor was in California for almost 22 years. During that time, Alcor fought and won many legal actions to establish and protect the right of individuals to choose cryonic suspension. Along the way, we and our attorneys discovered several California laws which were useful to cryonicists. When we were investigating a possible move to Arizona, we looked for similar laws there. And in the past several months, I (along with some other people) have been comparing the laws of other states that might affect our members' suspensions.

Such legal research can be tricky. Each state may have individual quirks that would only be noticed by a local attorney or a judge, or by an official whose department was affected by that quirk. Legal indexes vary greatly in style and detail of indexing. Some statutes that on the surface appear to have

nothing to do with cryonics might be invoked against a cryonic suspension by someone especially "creative." Even the so-called "uniform" laws, which are supposedly the same from state to state, may be written or interpreted slightly differently, or may not have been passed in all states.

Citations are provided so the reader may find the laws in question. (Each state usually has several locations—such as law school libraries—where the laws of the fifty states are kept.)

If you find information different from what I have listed here, please let us know.

I. Uniform Anatomical Gift Act

California

California Health and Safety Code
7150-7157, original 1968, revised
1970, new Act 1988.

As explained above, this statute gives an individual the ability and the right to donate his body or organs for medical research or for transplant. While the law does not state anything about cryonic suspension, cryonic storage facilities depend on the following language to act:

"7150.5 (a) An individual who is at least 18 years of age may make an anatomical gift for any of the purposes stated in subdivision (a) of Section 7153, limit an anatomical gift to one or more of those purposes, or refuse to make an anatomical gift."

and:

"7153 (a) The following persons may become donees of anatomical gifts for the purposes stated: (1) a hospital, physician,

Note: This is a revised version of a paper presented November 5, 1994 at the Cryonics and Life Extension Conference, Ontario, California. I am not an attorney. This article is based on my research and on the experiences of my nearly 18 years of involvement in cryonics. I may have missed important laws or I may have misinterpreted what I have read. New laws may have been passed in your state in the past few months. You should consult your attorney or do your own research before assuming that my legal interpretations here apply to your particular situation in your state.

surgeon, or procurement organization, for transplantation, therapy, medical or dental education, research, or advancement of medical or dental sciences."

Alcor's purposes are research and the advancement of medical sciences.

The cryonics organization is the "procurement organization," which, under the definitions in the 1988 law, means "a person licensed, accredited, or approved under the laws of any state or by the State Department of Health Services for procurement, distribution, or storage of human bodies or parts."

This led to Alcor's great "Catch-22" problem in the *Roe v. Mitchell* case, where the California Department of Health Services told Alcor it was not an approved procurement organization. "So how do we apply for such approval?" we asked. "There is no procedure for approval," we were told. After several years of litigation, the California Court of Appeals, 4th District, agreed that such circular unreasoning could not be used to deny Alcor the ability to store patients.

Arizona

**Arizona Revised Statutes,
Public Health and Safety**
*36-841 et seq., 1970, amended
1986 and 1987.*

The language that applies to a cryonics facility is somewhat different from the California version, but still gives us plenty of room.

"36-843. The following persons may become donees of gifts of bodies or parts thereof for the purposes stated: 1. Any hospital, surgeon or physician ... 2. Any accredited medical or dental school ... 3. Any bank or storage facility, for medical or dental education, research, advancement of medical or dental science, therapy or transplantation."

The definitions in 36-841 include this: "'Bank or storage facility' means a facility licensed, accredited, or approved under the laws of any state for

storage of human bodies or parts thereof."

Arizona, like California, has no procedures to license human body storage facilities. But we didn't have to go to court for approval in Arizona. Since the California Department of Health Services had finally signed the disposition permits in Riverside, Arizona accepted that as evidence that we were approved "under the laws of any state."

Other States

All fifty states have passed one of two basic versions of this act, which makes it a dependable vehicle for cryonics companies to obtain legal custody of their members' remains. The variations in the two versions of the UAGA probably don't make much difference for custody of remains, although they may make a subtle difference in states where patients are stored. One advantage to the new form of the law is that it is simpler for people to donate their bodies at the last minute.

II. Right to Control Disposition of Remains

California

California Health and Safety Code
*7100 et seq., current version 1970,
amended 1988.*

This act is the cornerstone of the legal rights of suspension patients in California. It details the rights of a family to control disposition of remains, and the right of a decedent to direct that disposition prior to death. Several courts have held that this act applies to cryonic suspension.

"7100(a). The right to control the disposition of the remains of a deceased person, including the location and conditions of interment, unless other directions have been given by the decedent, vests in, and the duty of interment and the liability for the reasonable cost of interment

of the remains devolves upon the following in the order named:" [various relatives are listed.]

and

"7100(d)(1). A decedent, prior to his death, may direct the preparation for, type, or place of interment of his remains, either by oral or written instructions, but a written contract for funeral services may only be modified in writing. The person or persons otherwise entitled to control the disposition of the remains under the provisions of this section shall faithfully carry out the directions of the decedent subject only to the provisions of this chapter with respect to the duties of the coroner."

[It is notable that the list of "Law Review Commentaries" for this section includes "Cryonic Suspension and the Law" by Curtis Henderson and Robert C.W. Ettinger, *UCLA Law Review* (1968) 15:414.]

Arizona

Arizona has a similar statute, although not quite as powerfully worded. *Arizona Revised Statutes*, Public Health and Safety, 36-831.01, added 1990, amended 1991.

"36-831.01 A. If the person on whom the duty of burial is imposed pursuant to 36-831 is aware of the decedent's wishes regarding the disposition of his remains, that person shall comply with those wishes if they are reasonable and do not impose an economic or emotional hardship."

Since the "person on whom the duty of burial is imposed" would be Alcor, via the UAGA, I can safely say that Alcor would consider cryonic suspension to be reasonable, that it would not impose an emotional hardship, and that (assuming your arrangements are in place) it would not impose a financial hardship.

We have not tested this law's applicability to cryonics in Arizona courts; but we have pointed it out in our discussions

with the Arizona Department of Health Services and the Attorney General's Office. It seemed to make some impression.

Other States

I have not researched the statutes of many states for similar laws; but it appears that several states have included this right (I noticed both Arkansas and Oklahoma laws while looking for other things). The acts are far from uniform in wording, but the intent of free choice seems to be the same.

For instance: the "Arkansas Final Disposition Rights Act" (passed in 1991), *Arkansas Revised Statutes* 20-17-102.

"(b) An individual of sound mind and eighteen (18) or more years of age may execute at any time a declaration governing the

final disposition of their bodily remains at their death provided such is in accordance with existing laws, rules, and practices for disposing of human remains. The declaration shall be signed by the declarant, or another at the declarant's declaration, and shall be witnessed by two (2) individuals.

"(c) No person having possession, charge, or control of the declarant's human remains following the death of a person who has executed a declaration of final disposition shall knowingly dispose of the body in a manner inconsistent with such declaration."

It seems clear that Alcor's *Cryonic Suspension Agreement* and *Authorization of Anatomical Donation* fill the requirements of this Act. As I find time to

research this further, I hope to publish a list of similar statutes which exist in other states.

III. Avoiding Autopsy

We want to avoid the autopsy of suspension patients at all costs. A complete autopsy requires the detailed examination and dissection of all major organs, including the brain. Normally the brain is removed from the skull, divided into sections, and placed back into the *abdominal cavity* with the internal organs, possibly in a destructive stew of digestive juices. In some cases the brain is chemically investigated in greater detail, up to being liquified in a blender.

Even a limited autopsy which avoids dissection or examination of the brain can delay the onset of cryonic suspension procedures for half a day or more.

February 17-18, 1996
Scottsdale, Arizona

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CALL FOR PAPERS

Cryo-1

A Research Symposium on Advances in Biostasis, Life Extension, and Re-Entry Technologies

The purpose of the annual Cryo Symposia is to benefit all members of the life extension community by promoting and encouraging more research by individuals and cryonics organizations, and to help raise the standing of cryonics within the general cryobiological and scientific communities.

Although the emphasis is on research, relevant theoretical papers are also invited. All parties interested in making a presentation at Cryo-1 are invited to contact the Symposium Coordinators for more details.

In some cases of homicide or very strange diseases, bodies have been subjected to several autopsies over a period of weeks.

Most states give coroners or medical examiners wide authority to conduct autopsies and frequently require them to do so. For instance, sudden deaths of infants are usually required to be investigated, and this demand may often be extended to older children.

Fortunately for us, some state legislatures have moved toward restricting the power of the state to demand an autopsy. Some of these laws are discussed below. In addition, there may be state court decisions or Attorney General's published opinions which will assist us in protecting your brain from autopsy; but once we find out a member has died suddenly, time is limited and action is required immediately. Yes, attorneys are expensive; but acquiring this kind of knowledge for your state in advance might allow us to keep that good old brain in a lot better condition.

One good example is an Attorney General's opinion I found cited in a note to the Georgia statutes: "It would be unwise to undertake an examination of the head or other parts of the body without complete authority to do so, especially in those cases in which the autopsy is not necessary to discover the cause of death or it is definitely known that the cause of death arose from a condition existing in some part of the body other than the head."

In some circumstances we could use this to convince a coroner in Georgia to perform a limited autopsy—but only if we know about it in advance.

Of course, if cryonics researchers could ever make a convincing case that suspension patients were "alive," the autopsy question would be significantly changed. Autopsies are only performed on legally dead individuals.

Religious Objection to Autopsy

One statute which has been passed in five states (California, New Jersey, New York, Ohio, and Rhode Island) is the "Religious Objection to Autopsy." Simply, it gives people the right to prevent autopsy of their remains in most

circumstances by signing a certificate declaring that autopsy is contrary to their "religious belief."

It appears that the primary impetus for this law has been Orthodox Jews, whose religious beliefs forbid mutilation of the body after death. However, none of the laws require that objectors espouse any *particular* religion. Recent passage of this statute in Rhode Island and Ohio may indicate the existence of a nationally organized movement to propel such legislation. Please let me know if you locate or contact such an organization.

In those states which have passed a religious objection law, it may be the most effective way to prevent autopsies and to limit the scope of those which are performed. It has been reported that this law has prevented autopsies on two California cryonicists (not members of Alcor).

Alcor has certificates available for the five states which have passed this law. If you are a resident of one of these states or even spend a significant amount of time in one of them, we *strongly* urge you to sign the certificate immediately. Note that *younger* members are at the greatest risk of autopsy, since death at a young age is more likely to be the result of an accident, homicide, or sudden unexplained illness.

We are also working on a general form which *any* Alcor member can sign and which may be useful on Constitutional grounds or in a case where your state passes its own Religious Objection to Autopsy statute.

California

California Government Code,
27491.43. *Original 1984.*

This statute mandates that if the coroner is preparing to perform an autopsy or otherwise remove tissue from a decedent, and the coroner has "received a certificate of religious belief, executed by the decedent as provided in subdivision (b), that the procedure would be contrary to his or her religious belief, the coroner shall not perform that procedure on the body of the decedent."

If the coroner is told that such a document exists, it must be produced within 48 hours. Several rules are given for the form of the certificate. Then two exceptions:

"(c) Notwithstanding the existence of a certificate, the coroner may at any time perform an autopsy or any other procedure if he or she has a reasonable suspicion that the death was caused by the criminal act of another or by a contagious disease constituting a public health hazard."

(d, paraphrased:) A court may overrule the certificate if such action is in the public interest or if it is determined that the certificate was not properly executed.

If an autopsy is still required, the "least intrusive procedure consistent with the order of the court" must be used.

Other States

In a detailed search, I have found similar versions of this law in the following states:

New Jersey Statutes Annotated
52:17B-88.1 through 88.6.

New York Public Health Law
4210-c(1) *et seq.*

Ohio Code
313.131

Rhode Island Health and Safety Code
23-4-4.1

The language in these four states are nearly identical to each other, but somewhat different from the California law. The most important difference is that the non-California statutes do not require the objection to be in the form of a document. It may be provided verbally on behalf of the subject by a friend or family member. (It is certainly stronger with a signed form, however.)

Arizona does not have this law yet; but we hope to encourage such a movement among religious groups here. Such a law in all fifty states would prevent autopsies in many cryonic suspension

cases (heart attacks, as a common example). If you would like to work for passage of such a law in your home state, and you can't find the text cited above, we can send you a copy of it.

It also should be noted that Maryland law contains a very weak statement concerning religious objection to autopsy:

Maryland Health Code 5-310 (b)(2) "If the family of the deceased objects to an autopsy on religious grounds, the autopsy may not be performed unless authorized by the Chief Medical Examiner or by the Chief Medical Examiner's designee."

This Maryland law did not prevent an autopsy of an Jewish child in 1976, where the Court decided that "there were compelling State interests which outweighed the interest of the [boy's] father in his religious tenets." Still, it may provide protection in other cases, so we will also prepare an "objection to autopsy" document for Maryland residents.

One other intriguing idea has been put forward by Kevin Q. Brown on CryoNet (an electronic mailing list about cryonics), based on the passage by the United States Congress in 1994 of the "Religious Freedom Restoration Act" (Public Law 103-141). The Act nobly proclaims that "governments should not substantially burden religious exercise without compelling justification."

The central portion of the law states:

"(a) In General—Government shall not substantially burden a person's exercise of religion even if the burden results from a rule of general applicability, except as provided in subsection (b).

"(b) Exception—Government may substantially burden a person's exercise of religion only if it demonstrates that application of the burden to the person (1) is in furtherance of a compelling governmental interest; and (2) is the least restrictive means of furthering that compelling governmental interest."

Also important is the section on ap-

plicability:

"Sec. 6. Applicability. (a) In General—This Act applies to all Federal and State law, and the implementation of that law, whether statutory or otherwise, and whether adopted before or after the enactment of this Act."

This is intriguing; but it does not mention autopsies. Convincing coroners to apply such a law to autopsies of cryonicists is a long way from certain, and success would likely require a very expensive and time-consuming series of appeals up to the U.S. Supreme Court. But it doesn't hurt to mention it to coroners and other officials, so we will include a citation in the general "objection to autopsy" form we are designing.

IV. Living Wills and Health Care Directives

Most states now allow individuals to create some form of "Durable Power of Attorney for Health Care" or otherwise to appoint someone as a "Medical Surrogate," frequently in conjunction with a "Living Will." Either a Durable Power of Attorney for Health Care or a Living Will can be used to state what kind of medical care you want to receive or to refuse when you are in a terminal condition and unable to act for yourself. The Medical Surrogate is the person you appoint to make and carry out those decisions on your behalf.

If you have *not* appointed a Medical Surrogate or if the one you have appointed is no longer willing or capable of performing such a duty, call Alcor immediately to update your forms. If you have not appointed a Medical Surrogate, your family will be left to make the decisions regarding your health care, decisions which could also affect your cryonic suspension. Typical choices include whether or not to maintain a comatose patient on a respirator and whether to administer nourishment or fluids when the patient is unconscious and clearly terminal. You know your family better than we do, but do you *really* want your family to make those

decisions—especially without firm directions from you?

In some states, the Durable Power of Attorney for Health Care form expires after five years. This is true of the early California version of this form, which was signed by many Alcor suspension members. Please check your form to see if you need to prepare a new one.

Arizona

"Living Wills and Health Care Directives." **Arizona Revised Statutes, Public Health and Safety, 36-3201 et seq., added 1992.**

Arizona's recent addition of this law is fairly sweeping and should increase the ability of someone in Arizona to determine his own health care.

In addition to the typical decisions mentioned previously, the new law allows a person to state whether or not he consents to an autopsy. (This is very weak, though, since it does not limit the options of the coroner.) And there is one other interesting paragraph that spells out a situation that has been handled informally in many locales:

"36-3207 C. If a patient's death follows the withholding or withdrawing of any medical care pursuant to a surrogate's decision not expressly precluded by the patient's health care directive, that death does not constitute a homicide or a suicide and does not impair or invalidate an insurance policy, an annuity or any other contract that is conditioned on the life or death of the patient regardless of any terms of that contract."

Other States

I have not done any examination of the laws of other states in this regard. California and Indiana definitely have such laws, and we have forms available for those states, plus a generalized form that should work for most other states.

V. Funeral Practice

One of the more aggravating situations in Arizona has been an effort by the State Board of Funeral Directors and Embalmers to claim that cryonics is part of "embalming." Their justification for this is the definition in the Arizona Revised Statutes, Professions and Occupation, 32-1301, original 1945, amended various times since; but this term appears to be in the original.

"Definition 7. 'Embalming' means the disinfection, preservation, or attempted disinfection or preservation of a dead human body."

It's not a very precise definition, and it could be read to include cryonics. It seems a bit silly to us and ignores that cryonics uses different technology and chemistry to produce different effects and for a vastly different purpose. One can imagine bureaucrats in the 1950s taking laws specifying the fuel that must

be used in propeller airplanes and forcing them on jets, because "the damn things fly, don't they?"

Still, we have to operate in this state, so we are pursuing an understanding with the Funeral Board and the Attorney General's office. Our mission is to provide continuing education for the Funeral Board and to work this out co-operatively, without endangering suspensions or engaging in an expensive discussion in court. To this end, we have contracted with a local mortician to be present at Alcor suspensions as our "embalmer." (This does *not* mean Alcor is using embalming techniques or chemicals.)

This "embalming" issue is an example of how laws can come out of nowhere for any cryonics company. For instance, while California has no law defining "embalming" (that I could find), it does define "embalmer" as "one who is duly qualified to disinfect or pre-

serve dead human bodies by the injection or external application of antiseptics, disinfectants, or preservative fluids...." (California Business and Professions Code 7640, added 1939, amended 1943, 1955.)

This could be used to provide a de facto definition of embalming in California every bit as aggravating as the one in Arizona. Sometimes it is just the luck of the draw as to which official chooses to be annoyed at what time. If you're not from California or Arizona, you need to find out what variations on these laws could pose problems for you.

VI. Uniform Determination of Death Act

It is very important for us to know the criteria for pronouncement of death in each state. Thirty-one states have passed an act which attempts to

Where Cryonics is Outlawed by Ben Best

There are at least three legal jurisdictions in the world which have laws interfering with the practice of cryonics. These are the Canadian Province of British Columbia, the Colorado city of Nederland, and the country of France.

British Columbia, Canada

The June 1991 issue of *Cryonics* magazine contains my article describing the anti-cryonics law of British Columbia. This is Section 57 of the Cemetery and Funeral Services Act, which reads, "No person shall offer for sale or sell any arrangement for the preservation or storage of human remains based on cryonics, irradiation or any other means of preservation or storage, by whatever name called, that is offered or sold on the expectation of the resuscitation of human remains at a future time."

Appeals for this law to be reviewed have been flatly rejected by the current Minister of Consumer Services, Joan Smallwood, and by her predecessor, Moe Sihota. In rationalizing the law, British Columbia bureaucrats invariably state that they are pro-

tecting B.C. consumers from an unproven procedure. A recent letter from Joan Smallwood stresses that this is particularly important because "the death of a family member or friend may be a time of emotional turmoil."

Alcor Director Keith Henson says that he was invited to give a lecture on cryonics at a science fiction convention in British Columbia. He wrote to the RCMP asking if he would be violating the laws of BC by accepting the invitation. The RCMP advised him against giving the lecture.

Keith should have written to Mr. Paul Snikars, the Registrar of the Cemeteries and Funeral Services Branch. It is Mr. Snikars who is responsible for interpreting and enforcing the Act. I have asked Mr. Snikars whether in an emergency cryonists living or traveling in British Columbia could legally obtain the services of medical personnel, funeral directors or common carriers. He told me he didn't think it would be a problem, but he refuses to put this in writing (which could make it difficult to get co-operative help).

Early in 1994 Mr. Snikars told me that he was becoming irritated by Section 57 because at least once a month someone would phone him asking about it. He said that enough correspondence had been generated that he would recommend a review. A Consultation Group had been formed to review the Act with an eye towards requiring that funeral directors be licensed. I instigated a letter-writing campaign, but in August the Consultation Group refused to reconsider Section 57.

I still very much recommend that people write letters requesting that Section 57 be repealed. These letters are a source of concern to BC bureaucrats. In particular, I recommend writing to:

The Honorable Joan Smallwood, Ministry of Housing, Recreation, and Consumer Services, Parliament Buildings, Victoria, British Columbia V8V 1X4 CANADA

Tell her that forbidding a potentially life-saving procedure does not protect B.C. citizens. Tell her that family members are likely to be even more upset if technology for resuscitation of those currently frozen

define these criteria. Alabama instead has a *Uniform Brain Death Act*. I have not done research on either one of these acts; but that study will have to wait for another time.

VII. Regulations

Not all problems are caused by statutes (laws). Many can be created by obscure Department regulations or Regulatory Board rules which were added to support and enforce the statutes. These may be harder to find and understand. Alcor almost had a problem with this in Arizona, since one Department of Health Services regulation required dead bodies which had not been buried after 15 days to be placed in airtight containers. We informed the Attorney General that such a requirement would invalidate most of the UAGA, since medical research cannot normally be completed in 15 days nor

carried out in a sealed container. Fortunately, the Attorney General's Office agreed. Still, there is a big lesson here. If you're looking at doing cryonics transports or patient storage in another state, check the departmental regulations and regulatory board rules as well as the statutes.

VIII. Out of the U.S.

As far as I am aware, most other nations have nothing resembling the Uniform Anatomical Gift Act, although they must have some way to handle organs for transplant. It is hard to imagine the sort of regulations we will run into overseas as Alcor and cryonics spread into other countries. We invite members in other countries to write articles for us describing the legal situation where they live.

In the box below, Ben Best of the Cryonics Society of Canada discusses

some of the legal problems in Canada and other places, where cryonics has been declared illegal (or prohibited to some degree).

Conclusion—Continuing Research

Obviously we have a lot more work to do in understanding laws which might apply to cryonics. I don't have the time or knowledge to do it all myself; and we can't afford a full-time attorney to work on it. However, attorney and cryonicist H. Jackson Zinn has begun work on a legal guide to cryonics that will try to compare the laws of the various states.

Already some Alcor members have volunteered to help with this effort. If you would also like to help, especially by looking at the laws in your own state, let us know and we'll put you in touch with Mr. Zinn.

is devised, and B.C. law had prevented their survival. I also recommend phoning Mr. Paul Snikars [(604) 387-9114] asking him to justify Section 57, and asking him to give a specific directive that medical personnel, funeral directors and common carriers can assist in a cryonics emergency without fear of prosecution.

France

In France, cryonics enjoyed a fair amount of publicity following the translation of Robert Ettinger's *The Prospect of Immortality* into French in 1967. In that same year a circular was issued by the Minister of Health which forbids any hypothermic procedure without 3 hours of flat EEG readings prior to cool-down. Cryonics is not mentioned explicitly in this circular. When I asked Cryonics Society of France President Anatole Dolinoff for an exact citation and wording of the law, he was unable to provide it for me, despite a lengthy dig through his archives. He has now requested the text of the law from the French bureaucrats, but has so far received no response.

In fact, the law has been broken at least twice with impunity. One person was maintained on dry ice in France for a full year before shipment to the Cryonics Institute

in Michigan for long-term liquid nitrogen storage. And Dr. Raymond Martineau, a retired professor of Medicine, has kept his deceased wife in an electric freezer at -55°C in his Loire Valley chateau since 1984.

Nederland, Colorado

In December, 1993 Trygve Bauge transferred his grandfather from liquid nitrogen storage at Trans Time to dry ice storage at his partially-completed home in Nederland, Colorado. Trygve's house was to be fire-proof, storm-proof, earthquake-proof and nuclear-war resistant. Trygve also had plans for a liquid nitrogen dewar by the summer of 1994. He obtained a contract to store a fellow from Chicago on dry ice. He planned to eventually have a cryonics business and life extension center. But in May of 1994 Trygve was deported back to Norway by the US immigration authorities. A media circus was created over the frozen corpses in Trygve's storage shed and the Nederland Mayor threatened to have them both cremated. City Council passed an Ordinance which changed the zoning laws to prohibit cryonics in Nederland, but the grandfather was "grandfathered." The city wants Trygve to sign an agreement that he can

store his grandfather so long as he refuses to store anyone else. Trygve refuses to sign and instead is circulating petitions against the Ordinance and against his deportation.

Comments

As the idea of cryonics spreads, many people who feel they can't or don't want to pay for liquid nitrogen storage with existing cryonics organizations are likely to take matters into their own freezers or try to start their own low-cost businesses. Although there is nothing immoral or criminal about these actions, they have a sensational character and are very likely to lead to sensational consequences—including anti-cryonics laws.

In my experience dealing with bureaucrats, I have found them to be incredibly hide-bound in their interpretation and support of existing law, but remarkably open to input concerning legislation in the process of formulation. My most ardent advice to cryonicists, therefore, is to remain aware of funeral legislation being revised in your jurisdictions—and to be in touch with those who are making revisions. When it comes to anti-cryonics laws, an ounce of prevention is worth a ton of cure.



Nanotechnology, Cryonics, and Bronze Restoration

Bronze restoration may not seem much related to the anticipated science of cryonic resuscitation. However, the technique I'm about to describe does involve reversal of interactions at the atomic level. Objects that have been badly damaged can sometimes be rendered in much more like their original condition, much as we hope to restore frozen, damaged tissue.

"How're you gonna bring them back?" is a question frequently asked by cryonics critics, particularly those with little exposure to the ideas of nanotechnology. So you launch into a discussion of the idea that atoms are little building blocks, that if necessary in the future we should be able to manipulate them pretty much *one at a time* (though very massively in parallel!), that people are just stacks of atoms, that to fix their problems you have to *rearrange* the atoms (or add or subtract them), etc. Little by little, you work up to the idea that, seen from the atomic perspective, a person is just a big machine made of many simple components, and ought to be fixable if you just do the right things with the components, which in principle you *can* do. When you finally get the ideas presented, though, many still just shrug them off as "science fiction," not to be taken seriously until something like the fine-scale control you are talking about really does come along. (Meanwhile the dead are buried or cremated the same as before, and lost to history.) Nanotechnology is still in large part a dream of the future, despite some impressive laboratory accomplishments. (One of the better known is the spelling of "IBM" in 35 xenon atoms a few years ago, though this trademarking nanofeat has been well

surpassed by now.) We are still some ways away from the controlled, atomic-scale manipulations that will probably be required to resuscitate a presently frozen human. Yet something at least a little like nanotechnology is already in use, and has been for decades—I'm not talking about biological systems that use their own, naturally evolved nanosystems—but a human technology familiar to art museums, the electrolytic decorroding of ancient bronze artifacts.

Bronze restoration may not at first seem much related to the anticipated science of cryonic resuscitation. However, the technique I'm about to describe does involve reversal of certain interactions at the atomic level, with the result that objects that have been badly damaged can sometimes be rendered in much more like their original condition, much as we hope someday to treat frozen, damaged tissue. In particular, details that seemed irretrievably lost are seen again. Though a person is far removed from a chunk of metal, we are dealing, fundamentally, with the same problem of information retrieval, which must underly the recovery of structure. So let's consider, then, what is involved in the existing techniques of bronze restoration.

Some ancient artifacts are recovered

in good condition and need little restorative work, particularly those buried in very dry climates. There are many more, though, that have suffered considerable damage, generally through the interactions of moisture and soil chemicals that convert the copper into various oxychlorides and oxycarbonates. (Similar chemical reactions occur with alloying ingredients such as tin, but since bronze is mostly copper, those relating to copper are the most important.) A repair process is badly needed—if it can be carried out. Thus many objects buried in even fairly dry locations for millennia will be covered with a thick green crust that obscures all but the roughest details. Formerly—before the twentieth century—methods of “restoration” were attempted that often did considerably more harm than good, the two favorite being removal of the crust with a hammer and chisel, and removal with a strong acid such as nitric or sulfuric. In either case the goal, more or less, was to strip off all the corrosion products leaving bare metal. It is easy to see why such an approach is no good in the case of a deeply mineralized specimen—much of the metal will have entered into chemical combination and will accordingly be lost in the cleaning process, even if the still-metallic core emerges unharmed. Many objects, in fact, have only a thin and fragile core remaining and would be reduced to pitiful ruins, if not destroyed outright.

So when, around the turn of the century, good studies of the process of corrosion were first made, it was realized that it is basically electrolytic in nature. Each copper atom gives up one or more electrons and enters into chemical union with a nonmetallic species such as oxygen or carbonate (CO_3). This suggested that, by resupplying electrons to the copper under the right conditions—using an electrolytic cell—the corrosion process might be reversed. In this way a copper compound would be reduced back to its chemical constituents, including the uncombined metal. The copper in turn might be expected to reattach itself to the parent object in a process similar to electroplating, which is easily done with this metal, using a closely related technique. Experiments were

done, and results dramatically confirmed these intuitions.

In a typical experiment, a partly mineralized bronze object was suspended, as a cathode, in a dilute aqueous solution of an electrolyte such as sodium hydroxide, along with anodes of iron. Low amperage direct current was applied for periods of days, weeks or months. (A waiting period was sometimes necessary for an appreciable current to start flowing, but usually this was short.) The mineralized copper was slowly reduced back to metal as the anodes underwent corresponding disintegration, iron combining with the non-metallic constituents that had formerly bonded to the copper, and precipitating them out of solution. Though the outcome depended on the extent and nature of the damage beforehand, it was indeed often possible to reverse the corrosion process and restore an artifact to a much improved appearance. This can be seen in the illustration, which shows a bronze statuette of the Egyptian goddess Isis, before and after treatment. A 1925 pamphlet of the New York Metropolitan Museum of Art, which carried out the restoration, had this to say:

“... The white spots in the “before” [photograph] are “diseased” regions consisting of copper carbonate plus chloride. The left hand of Isis was very badly corroded. The crust over the remaining portions of the body was hard and dark green in color. The statuette [11 in. high] was suspended in an earthenware tank containing 14 litres of 2 per cent. Na OH

solution. Electrical connections were made to various parts of the figure, without, however, cutting through the crust. In all of our work great pains were taken never to disturb the crust or patina before treatment. The current was 1.5 amperes and the first treatment lasted seven days. The second electrolytic treatment lasted fourteen days. The statuette was then washed in warm water and the loosely adhering particles of reduced metal and foreign material were brushed off. The details were revealed in a most striking fashion as is shown... Details of design such as the necklace, the hair and headdress, toe and fingernails, etc. were now distinctly revealed. ...”

It is a remarkable fact that, in such a case as this, details are preserved in the crust that are lost in the metallic core. These details in turn will be lost if the crust is simply removed, but can be re-



Statuette of Isis, before (left) and after bronze restoration.

Metropolitan Museum of Art

covered using the appropriate treatment, which approximately reverses the process of damage. The details recovered are macroscopic ones and it is unwise to press the analogy with cryonics too closely. Yet a parallel can be seen: we too hope to recover presently unreadable information—such as that stored in frozen brain tissue—and restore an “artifact”—in this case a human patient—as far as possible to a former condition—in this case a living, breathing, healthy state. It also goes without saying, I think, that the process of bronze restoration I’ve just described is far from the last word on the subject. Although only relatively minor refinements have been made in the decades since the work I’ve reported, we can expect much more improvement with the coming of full-blooded nanotechnology. (I should note in passing here, that interesting restorative work has also been done with non-bronze metallic objects—the bronzes however, are the most important in terms of their numbers and the need and the feasibility of restoration. Another thing I didn’t mention is that after the electrolytic process there is still work to be done in repatinating the bronze so it looks pleasingly “normal,” and in protecting it from further chemical attack.)

In fact it is an unfortunate consequence, in the application of a “good” restorative technique such as I’ve described here, that no doubt much information is *lost* that future technology could have recovered! However it is likely that many other artifacts will still be awaiting restoration when methods to be developed become available. (And how serious the loss of *significant* information will prove to be, is also unknown.) But in particular it should become possible to map the entire interior structure of an object of visible size, down to atomic dimensions. Starting, say, with a corroded bronze artifact, we can then “see” where every copper atom (and every other atom as well) has migrated and work on a “most plausible” theory of where it was originally. Once the theory is worked out, the atoms can be repositioned. No doubt this will result in a far better restoration than anything seen yet. (Actually, I suspect it will

turn out to be infeasible, computationally, to determine the mathematically optimal, “most plausible” theory, but, by analogy with certain combinatorial problems today, a close enough approximation of the optimal theory will be computable over a feasible time scale, using the resources then available.) Something of this sort should be doable with a frozen human too. That is, *we would start with the fundamental operation of mapping the interior structure*, to see what is there and what can be inferred about what ought to be there. I’ve suggested mapping all the way down to the level of individual atoms. Perhaps it will not be necessary to go that far (either for the person or other objects). In any case it seems a good bet that the structure of any stable, solid object can be mapped in this way, whether it is done at room temperature, or as with frozen tissue samples, under conditions of deep cold. It may not even be necessary to do a detailed 3-dimensional mapping to carry out many of the desired restorations; however the arguable feasibility of this approach speaks of the likelihood of *some* method being developed and used successfully.

People, I predict, are going to want some such method to be used. Today we like to go to museums and see beautiful relics from the past, carefully restored by the best methods now available. This trend should continue in the future, and I think, will be enhanced by the increase in leisure time and standards of living that should follow from full nanotechnology. I’ll go a little farther and predict a substantial increased interest in many sources of past information, including most importantly, older human beings, both living and dead. Today most people upon death are buried or burned. Future judgment should view this as a tragic loss, as a few of us do now, and the rare human freezings that survive from our time will be correspondingly valued. There will then be great interest in knowing what can be known from these remains, and in restoring the people who animated them to participate in the great future adventure.

I’ll close on a little lighter note. As one of the fringe benefits, the coming age of nanotechnology should be an

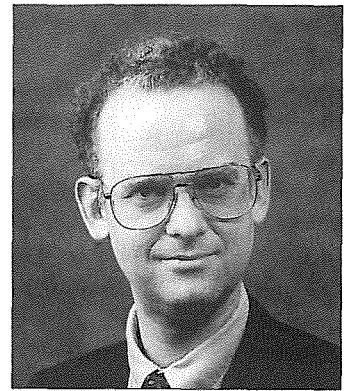
archeologist’s paradise. I’ve discussed one kind of restoration, where the atoms are, for the most part, still there and must only be freed of chemical entanglements and repositioned. In many cases though, parts of an object are missing but can reasonably be inferred and in principle, resupplied. This will be true, for instance, with many ancient buildings, and restoring them should be one of the relatively easy tasks of the new technology. The Athenian Acropolis thus could be made whole and gleaming as in the days of Pericles, and many other ancient wonders could similarly be healed and returned to their former splendor. It would, of course, be no ordinary restoration as we understand it today, but would extend down to the minutest particles. A broken column would not simply be fastened together with adhesive, but knitted at the molecular level, so no fracture could be seen even in the strongest microscope. Missing parts, where inferable, could be filled in, seamlessly and consistently, by assembling the necessary rock or metal. An invisible army of tiny devices could keep watch afterward, resisting further damage and making additional repairs when necessary. This could extend to other relics, including bronze art works, whose upkeep today, it turns out, poses some special problems. So, in a deeper sense than is now possible, the past would truly come alive.



References: “Bronze and brass ornamental work,” *Encyclopædia Britannica* 14th ed. (1948) 4, 250; Fink, C. and C. Eldridge, *The restoration of ancient bronzes and other alloys*, Metropolitan Museum of Art, New York, 1925. I also thank Hugh Hixon for consultations during writing of this article. —MP

Algorithmic Feasibility of Molecular Repair of the Brain

by Ralph Merkle, Ph.D.



A recent article by Thomas Donaldson ("Science, Ciphers, and Sorcery in Cryonics" *Cryonics*, 4th Qtr. 1994) is critical of my work showing a connection between cryptanalysis and cryonics, but it might understandably have left some readers rather baffled: the only reference Donaldson gives is to "The Molecular Repair of the Brain" (*Cryonics*, 1st and 2nd Qtr. 1994), which makes no reference at all to cryptanalysis (despite claims to the contrary by Donaldson). The only mention of the connection between cryonics and cryptanalysis in *Cryonics* to date was the sidebar in the 3rd Quarter 1994 issue on page 21. This sidebar (a single column of only four paragraphs) would hardly seem a sufficient cause for Donaldson's ire.

The mystery can perhaps be clarified by citing "Cryonics, Cryptography, and Maximum Likelihood Estimation" on page 129 of *Extro 1, the proceedings of the First Extropy Institute Conference on Transhumanist Thought*. With luck, this article has been reprinted in this issue of *Cryonics* and so I will not attempt to summarize it. [Unfortunately, we did not have space for the article in this issue; look for it next quarter. —Ed.]

Several years ago, in an article discussing the first publication of "Molecu-

lar Repair of the Brain," Donaldson said "A robot of molecular size astounds and amazes. But exactly what computations is it supposed to do? Without answers to that question, no one can even decide whether the approach is practical." (*Cryonics*, Vol. 11, No. 1, January 1990, page 31). More recently, in reference to "The Technical Feasibility of Cryonics" published in *Medical Hypotheses*, Donaldson said "Unfortunately his argument was then and remains utterly fallacious on this central point of the computer power required. Furthermore, depending on the kind of 'analysis' we ask of a data base, there is quite literally no amount of computer time required to do the analysis." ("It's Not At All So Easy," *Cryonics* 3rd Qtr. 1994, page 37).

Tad Hogg, a research scientist at Xerox PARC, said (*Cryonics*, 4th Qtr. 1994, page 3) in reference to "It's Not At All So Easy": "To summarize, Donaldson raises the important issue of computational aspects of repair, but there is no reason to expect the enormous number of possible arrangements will in fact require infeasibly enormous computations." Hogg cited many articles in the literature (several of which he authored or co-authored) to support his point. (See, for example, URL <ftp://ftp.parc.xerox.compub/dynamics/>

constraints.html. To quote from the cited URL: "Many studies of constraint satisfaction problems have demonstrated, both empirically and theoretically, that easily computed structural parameters of these problems can predict, on average, how hard the problems are to solve by a variety of search methods. A major result of this work is that hard instances of NP-complete problems are concentrated near an abrupt transition between under- and overconstrained problems. This transition is analogous to phase transitions seen in some physical systems.")

An interpretation of this statement in the context of cryonics would be that the computational problems of determining the healthy state of a frozen structure are likely to remain tractable until the damage approaches the point where actual information theoretic loss is sustained. As this transition is approached, computational tractability will rapidly deteriorate. Beyond this point, finding a solution consistent with the available data will again become easy because there are many possible solutions (and many differing people) whose brain structure would be consistent with the remaining frozen tissue. When all information is lost, any brain structure at all would be consistent with the frozen remains and the "search problem"

would become entirely trivial (and of debatable value).

"Cryonics, Cryptography, and Maximum Likelihood Estimation" suggests that maximum likelihood estimation can be adapted to provide an unusually powerful and robust algorithm for determining the healthy state of a cryonically suspended patient in the face of considerable damage, i.e., that this method would be able to approach the transition state more closely than most other methods.

"Science, Ciphers, and Sorcery in Cryonics" spends the first five paragraphs discussing God, Santa Claus, "...very intelligent people..." who become "deluded" by "fantasies," and the desirability of research (which, by implication, the very intelligent but deluded people must oppose; for the record, I think research is a good idea). In his closing paragraph, Donaldson refers to the "...fantasies of the ancient Egyptians."

I would encourage authors to avoid such overblown rhetoric, as it is readily dismissed by the discerning reader and obscures any substantive points the author might have made.

Donaldson does make some substantive claims: "...if we know the language in which the message has been sent, we can use information about the frequency of letters and small combinations of letters to discover the message. But the *prior information needed* to reach a solution remains crucial." Unfortunately, this particular claim is false. Cryptanalysis of a message in an unknown language is quite feasible. While it is helpful to know the language of the plaintext message (before it has been enciphered), it is by no means essential. And while it is also helpful to know the frequency of letters in the plaintext, this is also not essential. The only requirement when using simple first order statistics is that there be some significant deviation from a random distribution. We need not know the nature of the deviation a priori.

A type of logic which the committed cryonicist sometimes seems to use can be stated quite simply: it is assumed that cryonics is worthwhile, and therefore that all energies should be devoted to

increasing the probability that cryonic suspension, when used will be successful. Efforts aimed at analyzing the question "Is cryonics worthwhile today?" are viewed as, at best, a waste of time. After all, those who have spent a substantial part of their life devoted to cryonics *know* that it is worthwhile. The only significant issue (in their view) is reducing the risk of failure. This implies that all energy should be devoted to this problem.

This point of view, however, is inadequate for those who are evaluating cryonics for the first time or are examining it in light of alternative strategies (e.g., devoting greater effort to more conventional methods of extending life or increasing the amount of time spent on completely divergent activities, such as partying). It is not necessarily obvious, a priori, that cryonics is worthwhile. A major motivation for writing "The Molecular Repair of the Brain" was to answer the question: are current suspension methods likely to work?

This is independent of the question: will *future* suspension methods work? If one concludes that current suspension methods don't work, but that future suspension methods are likely to work, then one would delay making suspension arrangements until after those future methods had been developed. Thus, the relevant question in deciding whether or not to make suspension arrangements is whether current suspension methods provide a sufficient chance of success to be worthwhile. If some future developments might alter the chances of success, the question can be periodically revisited until (a) suspension methods have improved sufficiently that signing up appears worthwhile, or (b) you're dead.

The conclusion I reached, which I felt was surprising, was that current suspension methods are likely to work. This is based on my assessment of current (imperfect) suspension technologies, an assessment of our current (imperfect) knowledge of the human brain, and estimates of the capabilities of future technologies. The reasons for this conclusion have been given in "Molecular Repair of the Brain," "Cryonics, Cryptography, and Maximum Likelihood Esti-

mation," and elsewhere.

It has been argued by some that this conclusion implies that research to improve future suspension methods is not worthwhile. This is profoundly false. Firstly, it assumes that a person views (say) a 10% chance of being killed during a good suspension as "acceptable."

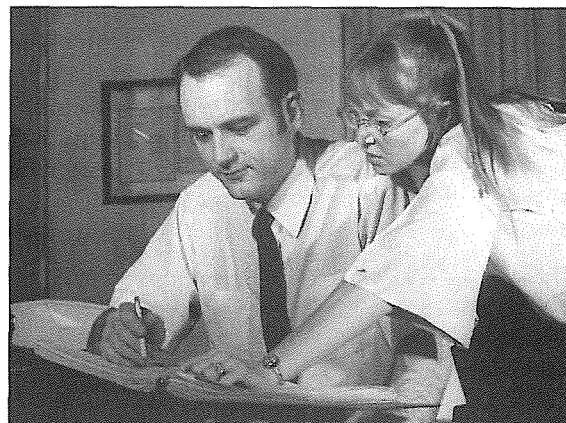
Secondly, and of even greater significance, is that current suspensions are often carried out under conditions that are far from perfect. This is sometimes unavoidable, but in too many cases today poor quality suspensions are caused by grossly inappropriate behavior on the part of doctors, coroners, emergency medical technicians, police, and other members of society who play a role in our medical care system. The largest contributing factor to this unhappy state of affairs is the general assumption in society at large and in the medical community in particular that cryonics is unlikely to work and therefore that a dying patient should be prevented (despite entreaties and pleas from the patient) from pursuing it until after all other avenues have been tried, exhausted, tried again, exhausted again, and then tried one or two last times just for good measure. While the Oregon Death with Dignity Act provides a major improvement in this rather loathsome attitude, it seems unlikely that the medical community will substantially change its practices until there is at least some acceptance that cryonics is reasonable and offers a non-negligible chance of success. The approach that seems most likely to achieve this objective is a pincer movement: on the one hand improving suspension methods to the point where the patient could be revived with only modest advances in current technology, and on the other hand making it clear that future technologies will be able to reverse even major damage.

Research in both areas would appear worthwhile.



An afternoon in the company of...

Two Minds



Derek Ryan concludes his interview with Alcor Founders

Fred and Linda Chamberlain

Part 2 of 2

Cryonics: *If you can, describe for me the series of events that kind of tied all the California cryonicists together in the late seventies.*

Fred: When CSC (Cryonics Society of California) declared they were defunct, BACS (Bay Area Cryonics Society) and Alcor became embroiled in competition over signing up those cryonicists and how to service them. This led to competitive problems that just were not realistic with the numbers of members involved.

The underlying corporations, Manrise (Alcor) and Trans Time (BACS), were being supported (contractually) by dues from the nonprofit organizations. The obvious solution to ending this competitive problem was to merge Manrise into Trans Time. Then both non-profits could concentrate on signing up members in their areas, and Trans Time would do all of the actual suspensions. At that time, Jerry Leaf was forming Cryovita to do research. He contracted with Cryovita to train all of the Alcor and BACS people as a

Cryovita suspension team. As an incentive, Trans Time stock was given to those who participated in the training.

Linda and I moved to northern California in '79 with the anticipation that Linda, as a director of Trans Time, could attend the monthly meetings in the Bay Area (of Trans Time and BACS). Laurence Gale was then Trans Time's southern California representative, and the link with Jerry Leaf's Cryovita, the suspension contractor service arm. This looked like it would end the competitive problems and create a smooth running machine.

My head hurts. (Both laugh.) Okay, when was the first Lake Tahoe Life Extension Festival?

Linda: The first Festival was in September of 1979, but it was actually very informal. Once we were living in Tahoe, we would go down to the Bay Area every month for the BACS and Trans Time meetings. The first year we were up there, the Bay Area folks said, "On Labor Day, why don't we go

up to Lake Tahoe and hold the BACS and Trans Time meetings up there?" The word got out, and 20 or 30 people came from different parts of the country. The next year, I think, Hugh Hixon suggested that we should start presenting the results of research being done by Cryovita and the various cryonics organizations, with a slide projector and formal presentations, the whole works. It became an annual affair from then on, and over the course of nearly a decade or so, the Festivals served as a useful platform for some good scientific dialogue in cryonics.

Fred: Also, the Festivals were interesting because for many of the people who would come to them, this was the first time they had been in the presence of more than two or three cryonicists. Rather than feeling like a tiny group hiding in the shadows, now suddenly they were immersed in 40 or 50 people, all of whom were cryonicists, having a good time, going out to the casinos, and filling up a whole corner of a restaurant. Suddenly, it felt like we were in the ma-



jority. It was both novel and exciting. It restored the big "Annual Get-Together" for cryonicists, which had been missing since the BACS conference in 1971.

When did you stop holding the Festivals?

Fred: Well, the last conference was sponsored by Life Pact and it was held at Asilomar...

Linda: ...just south of San Francisco...

Fred: ...where the first genetic engineering concerns—about the dangers of it—arose. We called it "A Conference on Biostasis and Reentry." That one was held in August of 1990, just after Arlene [Arlene Fried—Linda's mother] was suspended in June. In fact one of the main presentations at that conference was a talk by a prominent cryobiologist about how great the histology was on Arlene's [frozen] kidney. That was the last formal cryonics research conference, the last Life Extension Festival.

Weren't you publishing a little magazine called "Lifequest" about that time?

Linda: Right, we thought it might help people understand cryonics better if there were more positive fiction about the subject.

Fred: We thought we'd write novels, but first we needed to cut our teeth on

some short stories.

Linda: *Cryonics* magazine published a few of our short stories, and one came out in the *Venturist Monthly News*, but then we started publishing a small collection of them twice a year.

Fred: At the end, we might have had a couple of dozen subscribers, but when Linda's mom was suspended and we decided to sell our business and go back to school, it was impractical to keep it going.

Linda: There was some talk about continuing it via e-mail, and John de Rivaz (in the UK) is still toying with the idea of publishing a large group of these stories as a single volume, but nothing has really happened with Lifequest since we left Tahoe.

Okay, so what was "Life Pact?"

Linda: Life Pact was an organization that grew out of our incorporation of The Lake Tahoe Life Extension Festival. At the time (that was the mid to late '80s) we were trying to address some of the shortcomings that still exist with cryonics. There had been a lot of progress on suspension capabilities, and Alcor's organizational structure was vastly stronger, but not much was being done to address the area of reanimation and reentry.

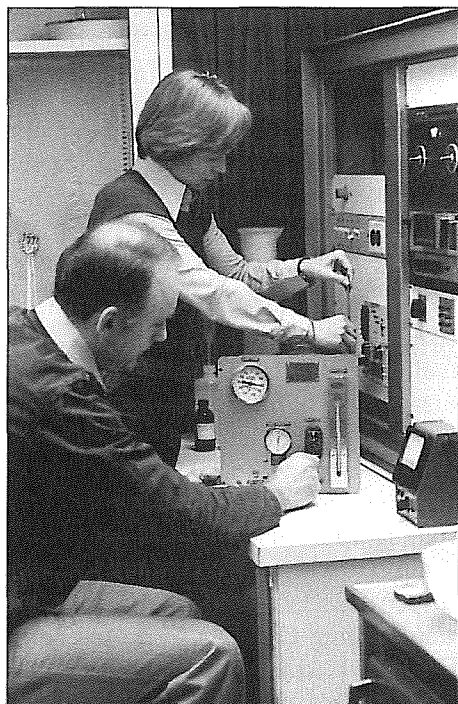
Fred: No cryonics organization, for understandable reasons, has yet addressed this issue. It still remains one of the main problems with cryonics. Nobody really has any idea what reanimation will cost. Far beyond that, nobody has any idea of what kind of energy, effort, time, or dollars will be required to rehabilitate a revived suspension patient, to get them caught up with the world, and able to function in society at a level which they will find acceptable.

One of the main ideas with Life Pact was that a person ought to have an understanding that a great deal might be required of them at the other end and that they may make things easier for themselves, or improve their chances for an early reanimation, if they make a commitment to pay back certain costs, whether it be education, rehabilitation, or even reanimation itself. We thought that a video interview where the mem-

ber states that they understand this idea, would make it much more likely that a reanimation organization, looking at this data, would have greater confidence in proceeding with reanimation for these people, especially if resources are scarce, and if they had to be selective about whom to revive first.

Linda: Another aspect of the Life Pact video interview is to let your reanimation preferences be known. For example, reanimation scientists of the future might say to themselves, "We don't know anything about Mrs. 'A' over here, but we know that Mrs. 'B' was quite old when she was suspended. And we know that Mrs. 'B' made this videotape where she tells us in her own words, 'I wouldn't feel comfortable being rejuvenated before I'm revived. I'd rather wake up old, just as I am today. Otherwise, I might not know it was me.'" Those scientists viewing her video might decide that Mrs. 'B' isn't a "cutting edge" kind of person, and if they brought her back into some kind of cyberspace, it might blow a few fuses for her. ("But on the other hand, this Linda Chamberlain patient over here, she'll go for anything!") (Laughs.)

So the thrust of Life Pact then, was to address some of these revival issues that cryonics organizations aren't addressing?



Fred: Yes. Most people have a fairly simplistic view of what will be involved with reanimation. It may turn out that they are right, and that the benevolent scientists of the future will take care of everything for us. But I don't think we can or should count on that. There are things we can do now that might make our reentry easier for us as well as those who revive us, and therefore make it more likely that we'll be revived in the first place. I don't think it's going to be a simplistic procedure where we come walking out of this time tunnel, somebody hands us a glass of champagne, and we take off in our rocketships. It's not going to be that easy.

Linda: There's another central idea about Life Pact that I think is important to mention. People have always been concerned about who will bring us back. Why will "they" want to bring us back? One of the most popular answers to this is that the people of the future will see us more or less as oddities, and that they'll want to bring us back because we're interesting.

It looks good on paper.

Linda: Right. We want a little more assurance than that, though. By making Life Pacts with other people, "we" can become those people of the future. At one point we referred to Life Pact as



"Helping Hands Across Time." For example, I make a commitment to help get Fred back, and he makes the same commitment to me. If I am reanimated first, (for instance, if he suffered more ischemia during his suspension than I did in mine) then I have a Lifepact with Fred to do whatever I can to see that he is reanimated as soon and as well as possible.

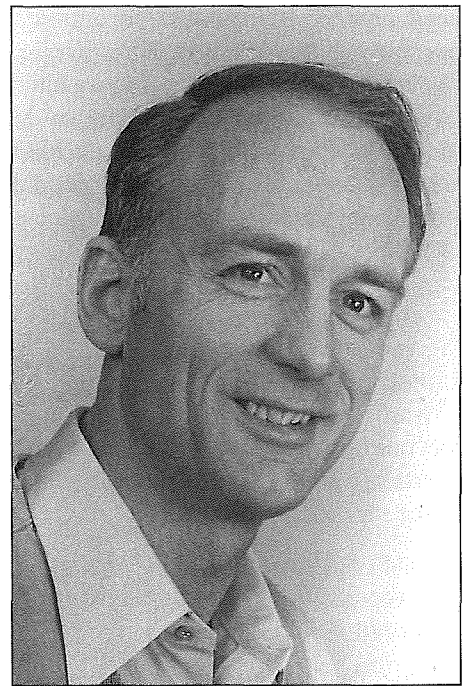
And, if each one of us makes as many of these Lifepact agreements with other cryonicists as possible, then we form a sort of chain across time. This way, the reanimation of any one person makes the reentry of many others much more likely. Of course, none of us knows when we'll need to be suspended, so it's in everyone's interest to make these kinds of links with as many people as possible.

Fred: It's almost like getting married. You make a deal with another person, that on the other end of the time tunnel, whichever of you needs the other can count on his or her help. We're all at risk when and if we're in suspension, and so any one of us might conceivably need help getting out.

Linda: And at some point, there will be people who have made these Lifepacts with others, who themselves never actually have to be suspended. They'll be the ones to get the chain of reanimations started.

Fred: Things were a lot different in Alcor and the cryonics community in general back when we were first working on these ideas in the late 80s. That had a lot to do with why we were pursuing them separately from Alcor, why we weren't able to keep pushing to see these kinds of issues addressed. Now, though, it might be the right time for Alcor to start taking on some of these projects itself, such as the videotape interviewing of members, and the fostering of Lifepact commitments between cryonicists. There is still much that we can do to improve our chances, both with research for improving our procedures on this end, and with things like making Lifepacts, which may indeed help us on the other end.

Fast-forwarding a bit now, Linda, your mother [Arlene Fried] was frozen in 1990. My understanding is that she



knew about cryonics for a number of years before she actually decided to sign up.

Linda: That's right. For a long time, she just thought of it as Linda's latest "thing" or fad, but after a couple of decades it became clear to her that this wasn't just a passing fancy. I think it just took a long time for the idea to grow on her. Even when she did finally decide to sign up, I think she did it mostly for me, though her motivation certainly changed later.

To get her to sign up, I basically gave her an Alcor membership as a gift. I gave her a card saying, more or less, "You gave me the gift of life, for which I'm very thankful. Now I'd like to return the favor." I offered to pay her first two years' worth of dues and insurance, and she just couldn't resist. It really seemed to move her. Our hope in giving it to her as a gift was that at the end of the two years, she would keep it up. And she did, making the insurance and dues payments on her own after that.

But cryonics still wasn't a really big interest of hers until the latter part of 1989, when she found out that she had lung cancer, and that she had only about six months to live. That changed everything.

Fred: Once Arlene became fully adjusted to the idea that she wasn't going to make it, and that she was going to

need cryonic suspension, her attitude became very constructive. For example, she knew it was important that we have an arrangement with a mortuary to do the full body washout. So she decided she really wanted to meet the people from the mortuary. When the mortician came, even though Arlene was obviously terminal and in not in very good physical condition, she said, "I'm so happy to meet you!"

Linda: And the mortician told me, afterwards, "That's the first time I've ever met one of my clients before hand. And I certainly didn't expect her to be happy to see me."

Didn't Arlene ultimately elect to minimize the duration of the end stages of her cancer by dehydrating?

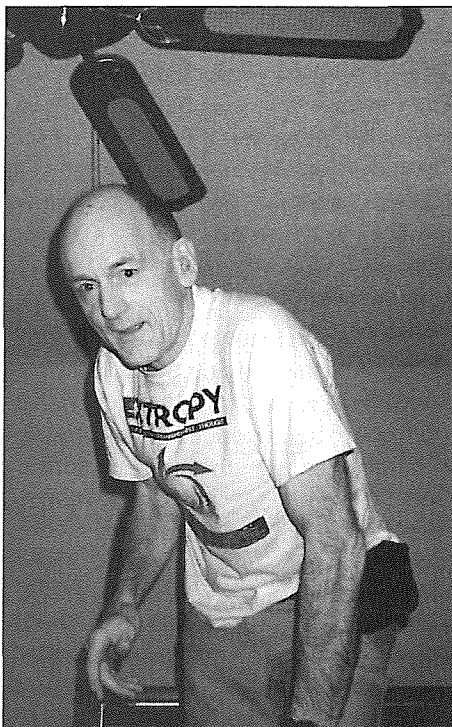
Linda: Yes. She was not happy with her quality of life at that point. She knew that there was no way around her deanimation, and she didn't want to just sit there prolonging the pain for no reason. She had undergone chemotherapy and radiation, to little or no effect. She had lost weight (from 160 down to 98 pounds), she had no energy, and no appetite. She understood that the only way to hasten things (without risking autopsy) was by refusing food and fluids, and she was determined to do it. (The doctors and nurses who were helping out spent a lot of time with her individually just to insure that it was her decision, and she remained steadfastly resolved to it all throughout.)

For a variety of reasons beyond our control, it ended up taking about 10 days, which is probably longer than normal. This extra time ended up being to her advantage in terms of her suspension quality, because we needed it to make some last minute arrangements. (Things we had already arranged, but which fell through at the last minute.) Also, because of the extra time, she probably had more Alcor staff and Suspension Team Members present at the time of her deanimation than any remote member has ever had. She got a very good suspension as a result.

When did the two of you decide to go back to school full time?

Fred: We made that decision very soon after Arlene was suspended. Up until that time, we had been discussing the possibility of selling our business in Tahoe and doing something different, but hadn't done anything about it. Arlene's suspension really brought home for us how short life is, and how suddenly you can find that you're out of time.

At the time, we didn't feel that circumstances in Alcor were such that we could be intimately involved in its operations, but we knew that there is always a need for people who have education, skills, and training in certain key research areas such as neurobiology. So



we decided to go back to school to pursue that education. Unfortunately, a number of things happened in our first year back at school to change our plans yet again.

Such as?

Fred: For starters, things were really starting to heat up politically in Alcor, about the impending move of Alcor's facilities, among other things. With both of us having a parent in suspension, it was very important to us to see that they got out of the earthquake zone safely.

The way things were, it seemed clear that we would have to get personally involved, and do some work. So we moved down to Southern California (in our RV—the "Star Cruiser") to help out until we got it done.

Why did you then move to Arizona along with Alcor?

Fred: We had already decided to come out here for a couple of months (again, in our RV) to help Alcor get settled in.

Linda: The idea being that we would go back afterwards, and resume our plans for long term education. But our "break" from school ended up serving as an important opportunity to reevaluate things, like whether we could really afford to go without earning income for 10 years.

Fred: And because of the way things evolved with Alcor's staff and board, we found that the possibilities for once again working closely with Alcor were much greater than we might have anticipated a few years earlier.

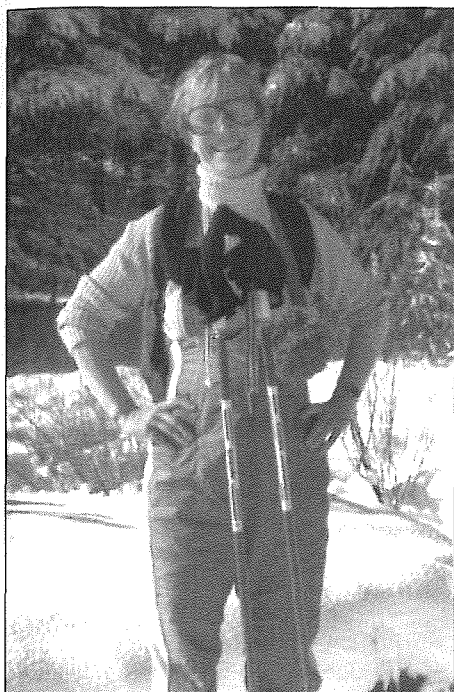
I know that you [Fred] found out in the summer of 1993 that you have early stage prostate cancer. How did that affect all of this?

Fred: Well, it certainly reinforced our growing conviction that we didn't necessarily have all the time we would need to pursue the neuroscience education. And it further emphasized the need to do everything we could to insure that Alcor is in good shape.

Linda: We certainly hope that Fred has more than the 10 plus years required to do all the schooling and move on to the pursuit of important research, but we know it's not a given.

So what is your prognosis at this point?

Fred: Well, that's a really complicated question to answer. And it depends very much on what kinds of treatment approaches we try, and whether they prove to be effective. We are considering a few different promising options right now, but the simplest way to answer your question is that 50% of patients in my condition live longer than 10 years. How much we can influence that remains to



be determined, but based on our own research, we are hopeful.

How did this change things for you, Linda?

Linda: Well, it made me suddenly realize. . . again. . . that we're mortal. I've confronted this more than once, but it seems like every time you get over the hurdle, something comes up to remind you again, and it shocks you. It suddenly hit me between the eyes that, maybe Fred would have to be frozen. Maybe I'll have to spend some number of years without him before I join him, or before we're reunited in the future.

Having to confront that as something more than just an idea, more than just some intellectual concept not really related to me personally, really affected me. I was actually the one who first proposed to Fred that we might want to put off going back to school indefinitely, and to get really involved in Alcor again. It matters now more than ever.

How about you, Fred?

Fred: It changed my priorities quite a bit. Suddenly I had a new topic about which it was very important to educate myself, and I ended up in medical libraries for many hours during the first few months after I was diagnosed.

It felt very much like the judge had

brought down the gavel, and said, "You're sentenced to death." The only question was when the sentence would be carried out. Having been a cryonicist all these years, I've always known that this sentence hangs over my head, but this really shortened the horizon for how soon I might have to pay up.

Fortunately, things have been going fairly well for me since the diagnosis, and some of the important biological markers even indicate a regression of the cancer. We just can't know what will happen, but that doesn't mean we can't be hopeful about in the meantime, and do everything we can to fight it.

Who knows? Ten years is a long time in medicine these days, and many promising therapies are in development as we speak. As long as I've got my cryonics arrangements in case things don't progress as we hope, there's no reason to stop and brood about it now. I've got a lot of living left to do.

So what do you see for Alcor in the near future?

Linda: I feel very good about Alcor these days. We've undergone a lot of important changes and transitioning recently, and we're now set to really start seeing some important progress. We're starting to build some important momentum, we're assembling a team that's really capable of making a difference in research, and it's just a matter of time and money before all of this starts to pay off. We certainly intend to play an important part, and we have great confidence in those around us.

Fred: I feel the same. I would add that I will be rather surprised if, five or so years from now, Alcor hasn't achieved some *startling* results in the area of research.

Linda, as we bring this interview to a close, I'd

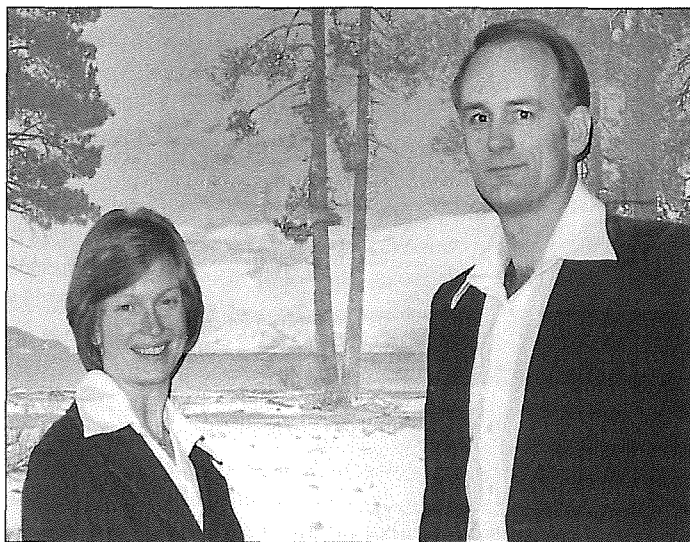
like to mention your wonderful habit of signing all of your writings and messages with some variation on the notion of "boundlessness." (E.g., Boundless Life, Boundless Fun, etc.) Why the emphasis on that theme?

Linda: We humans have always been enslaved by our ignorance, our mortality, and our physical limitations. The main thrust of cryonics has always been to expand the time that we have available to us, and not just time, but health as well. Once you begin thinking about expanding these things, you begin to think about other things as well.

Wouldn't it be neat if I could be smarter? Wouldn't it be neat if I could read faster? Wouldn't it be neat if I could remember more? Wouldn't it be neat if I could upload myself into more of *me*, so that I could go more places, do more things, live more life?

Pretty soon you begin to think in terms of boundlessness; throwing off the chains; improving yourself physically, mentally, in every way. Why have *any* limits on what you can do, what you can experience, what you can enjoy? More is just better, in general. *[Laughs.]* I want to remove all of the boundaries in my life that hold me back, and that's what I want for everyone else I care about as well.

No more limits!



2nd Annual Conference on Anti-Aging Medicine and Biomedical Technology

by Stephen Bridge, with Ralph Whelan

Over 1,500 physicians, scientists, and lay people from around the world convened at the Alexis Park Resort in Las Vegas December 4-6 to attend the *2nd Annual Conference on Anti-Aging Medicine and Biomedical Technology*. Several Alcor Members and Staffers made the trip, and heard presentations from over 100 anti-aging researchers. Topics ranged from promising therapies for debilitating diseases such as cancer and Alzheimer's to innovative laser treatments for facial rejuvenation to the plethora of new drugs evincing significant youth-restoring potential, like melatonin, human growth hormone, and DHEA.

Most of the people attending had become part of an uncontrolled research project with themselves as guinea pigs.

They were on various regimens of drugs, diet, and exercise which they hoped would lessen their aging and lengthen their life spans. Each person there was probably using a different combination of these items. Some will probably work; some won't. (And if I were doing a talk on cryonics to these people, I would explain that these experimental subjects need a back-up plan.)

One of my thoughts during the presentations was that 50% of what we heard was almost certainly wrong. Unfortunately, there is no way to know which 50% for at least another decade.

The conference opened late with an optimistic welcome by Ronald Klatz, D.O. (Dr. of Osteopathy), the President of A⁴M (American Academy of Anti-Aging Medicine). We don't have room to cover all of the presentations, so we'll focus on the highpoints.

Sunday

- ◆ Robert Morin discussed atherosclerosis, using some dramatic slides to show the differences between people with high HDL's and low HDL's. He pointed out several drugs that have a major effect on raising HDL levels, especially niacin, which is inexpensive and generally available.

There appears to be a lot of evidence that Vitamin E is very important in lowering

atherosclerosis, though it may not work for smokers.

Reducing the level of homocysteine in the blood is an effective way to reduce atherosclerosis. Folic Acid, Vitamin B₁₆, and Vitamin B₁₂ are especially good at this.

Morin was one of several to point out the potential for the hormone DHEA (dehydroepiandrosterone) in reducing circulatory disease.

He feels confident that aspirin is important, but the dose is still a question. Also, some people increase their risk of stroke by taking aspirin. He recommends taking regular aspirin, not timed release, if you decide to pursue this course of action.

Finally, he said that the studies of fish oils appear to be finding positive effects on heart disease.

- ◆ Dharma Singh Khalsa, is an MD (anesthesiologist) at University of Arizona. He was a traditional American doctor until getting involved with various non-western traditions in the 60s and 70s. He has changed his name to reflect his beliefs. He now places a lot of emphasis on Eastern techniques (such as meditation) to reduce stress and improve memory. He finds these especially useful in early Alzheimer's patients.
- ◆ A Sunday evening symposium was basically a panel of various doctors who actually try to practice anti-aging medicine with their clients. Several have had FDA problems; but all per-



Richard Cutler, Ph.D. (left), molecular biologist with the National Institute on Aging, receives the A⁴M Infinity Award, for outstanding Contributions in education and research, from A⁴M President Dr. Ronald Klatz.

sist because they believe it is important. Many audience members asked detailed questions about which drugs and techniques the panelists personally used.

Monday

- ◆ Arthur Valen pointed out that aging and disease are not the same. Studies have shown that eliminating all occurrences of cancer in the population would only increase the average lifespan by about two years. Eliminating all occurrences of heart disease and stroke would only increase the average lifespan by about 7 to 9 years.

He emphasizes that the problem of aging will never be appropriately addressed until it is addressed in and of itself.

- ◆ Dr. Richard Cutler explained that more oxidation damage occurs in children, as opposed to the adult body. Perhaps initiating an antioxidant regimen during childhood will provide more protective benefits as a person ages.

- ◆ Samuel Bogoch reported on an important new test for cancer, which allows cancer to be detected much earlier than previous methods. This is "Anti-Malignin Antibody in Serum Test (AMAS-registered trademark)." Apparently there is a particular antibody for many types of cancer which can be tested for in a fairly simple test. The accuracy of this test is high.

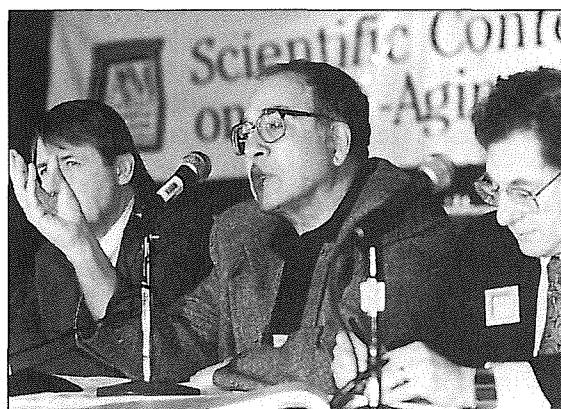
- ◆ Chithan Kandaswami gave a talk on nutrition. His view was that eating a large number of fresh fruits and vegetables might really be more important than taking vitamins, because so many hundred other chemicals have now been found in these foods that appear to have beneficial effects.

- ◆ Robert Goldman, D.O., President of the National Academy of Sports Medicine, gave a humorous talk on the kinds of exercise, especially weight training, that will keep people healthy well into older age. He had several pictures of older athletes to show this.

- ◆ One of the major talks which we were there to see was unfortunately cut short because the session was running late. Dr. Klatz is part of a group working on a brain cooling helmet, especially for Paramedics to treat trauma victims.

The helmet is intended to supplement CPR because CPR does not work fast enough. Though it does revive the heart about fifty percent of the time, less than five percent of the survivors remain physically and/or mentally "intact." A recent study showed only one out of 163 unwitnessed arrest victims survived. In 95% of all cases, brain damage is too severe to sustain life despite the fifty percent heart resuscitation rate.

The BCD (Brain Cooling Device) uses CO₂ for cooling and includes injection of fluids through the carotid



Stephen Sinatra, M.D., F.A.C.C. (left), William Regelson, M.D., and Arthur Balin, M.D., Ph.D., F.A.C.P. (right), discuss clinical interventions for the "Realities of Practicing Anti-Aging Medicine."

to flush the stagnant blood from the brain. This fluid also contains chemicals known as "lazeroids" (from the biblical "Lazerus") which protect the brain from ischemic injury. Lazaroids have been shown to reverse early brain damage for up to 35 minutes.

By lowering the brain temperature to 18°C, the heart can be stopped for up to 90 minutes without brain damage.

The research in this area is very exciting and we are watching closely to see if Alcor may eventually wish to use this system or one like it.

An afternoon panel on "Communicating Anti-Aging Medical Information"

was interesting and useful, up to a point. The panel included Carol Kahn, writer for *Longevity Magazine* and co-author of cryonicist Paul Segall's book *Living Longer, Growing Younger*; Emmy-winning television producer Suzanne Mangione, who previously interviewed Steve Bridge for a documentary on life extension; and cryonicist William Faloon, President of the Life Extension Foundation. Carol and Suzanne were especially informative about how to get your news out to the public through the media. #1 hint: "News" means "something new." Make your approach when you have something new to say.

- ◆ The Coenzyme Q₁₀ presentation by L. Stephen Coles of Cal Tech and well-known cryonicist Steve Harris of UCLA was not new information to many of us; but was obviously impressive to most of the audience. Animals receiving supplements of Q₁₀ have much higher energy levels at all ages and live longer on average. No extension in *maximum* lifespan was seen in their studies.

- ◆ Stuart Rich gave an interesting presentation on using the new "Ultrafast" CT scanners to spot plaque deposits in arteries much earlier than other methods. The CT scans for the presence of calcium in the vessels. Early tests showed no false positives. If the scanner found it, other tests found it—but much later.

- ◆ Vincent Giampapa and the A⁴M are beginning an elaborate study of aging biomarkers in New Jersey. This is necessary because we cannot wait for decades to test regimens to see if aging is reduced. We need to find better clues to aging that can be tested short term.

Roy Walford of UCLA, M.D. and famous researcher on calorie restriction effects on lifespan of UCLA was the after-banquet speaker. Walford primarily concentrated on discussing his two-year stint in the Biosphere, where the eight-person crew was forced to practice involuntary calorie restriction in order to complete the two years. They couldn't raise as much food as they

thought they could, so they all lost a lot of weight. In Walford's pictures, the team appeared to be near starvation. Yet they all worked 65 hours a week to keep the place running, and none came down with infections. Even though the average body fat dropped as low as 7-8%, none of the women missed menstrual periods. Based on previous studies of female athletes, this was quite surprising, and led Walford to assume that a weight-loss diet by an athlete may be quite different than the low-calorie, high-nutrition diet practiced by the Biospherians.

One other major change he saw was a drop in average cholesterol levels from 220-140 at the beginning of the "mission" to 140-120 by the end. Interestingly, most of the crew's cholesterol and body fats went back to pre-experiment levels within a few weeks of the time they were released into the big world.

Tuesday

◆ Cryobiologist Greg Fahy gave an entertaining presentation in which he described the progress toward successful vitrification of whole organs. He broke the topic down into three basic steps. To successfully vitrify, one must 1) Learn how to add cryoprotectant to tissue without injury, 2) Learn how to cool without injury, and 3) Learn how to warm rapidly and uniformly.

Steps one and two have been accomplished, and sufficient technology for step three is believed to exist already. Fahy's team is gearing up to implement this technology.

◆ Barry Datlof of the American Red Cross gave a presentation on using natural fibrin to form clots wherever you want them. This is sort of a natural glue and sealant, already in use for bone sealing in surgery. But there are many new possibilities, since it is naturally biodegradable and can be adjusted for how fast the physician wants it to biodegrade. It may also be used as a specialized drug delivery system.

◆ Richard Hochschild reported on several years of testing he has done on various biological markers of aging. He presented fascinating evidence

that certain life styles not only make people live longer but keep them biologically younger as well. Some of these are obvious: smoking and large amounts of red meat are bad; low-fat diets and regular exercise are good. Some are not so obvious, though.

Excessive exercise is negative ("negative" means high correlation with faster aging; positive means correlation with slower aging; neutral means no correlation found). Coffee consumption is neutral. Heavy alcohol or no alcohol consumption tested worse than moderate alcohol consumption (one drink per day, especially wine). Fat consumption is more detrimental to men than to women. Sleep deprivation is worse for women than for men.

Geographical differences reported for lifespan (e.g., Mississippi has shorter average lifespan, Utah is much longer than average) match very closely with biomeasures of aging. Persons in so-called "long-lived states" tested 2-3 years younger than persons of the same age in "short-lived" states.

Among non-smokers, highly educated people had better lung function. (He had no idea where that came from. We talk more and exercise our lungs?)

High blood levels of anti-oxidants were positive. (Smoking results in low levels of antioxidants.) High iron levels were negative. (Free iron in the blood creates some of the most harmful free radicals. Other statistical studies have shown that men who give blood have a longer average lifespan, similar to that of women—who lose blood once a month for much of their lives). Hochschild's study showed that men who donated blood three times per year had an iron level similar to that of menstruating females. In families with a history of heart disease, even young teen-age men have low blood levels of anti-oxidants and high levels of iron. Maybe there was something to the old "bleeding" cures after all. Where are my leeches?

Seriously, Hochschild suggested that the most important things you

can do for your lifespan and health (especially if you are a man) are quit smoking, take anti-oxidants, and give blood three times a year.

◆ Ralph Merkle gave his usual fine presentation on nanotechnology and how such a technology might be used to extend life span and cure disease. I was amazed that this topic was brand new to a very large percentage of the audience.

◆ William Regelson took us up to (and past) lunch with his discussion of the several dozen projects he is working on, especially new work on DHEA, a hormone which appears to have powerful effects in a number of areas. Some conditions shown to benefit from DHEA therapy so far are lupus (very important since so few drugs are effective), Cushing's Syndrome, and many viral diseases. It also is effective as an anxiolytic (anti-anxiety drug) and anti-fatigue medication.

Regelson had an important warning for self-experimenters, though. In testing DHEA on himself, he overdosed and came down with something that his own physician diagnosed as digitalis intoxication. Apparently the DHEA has potent effects on the circulatory system. Remember, this is a hormone and will have many effects. Don't go using this without a great deal of caution. The same goes for other drugs.

◆ Don Kleinsek gave a "Ten Year Forecast" of the field of genetic therapy. He explained that existing gene therapy is transient, requiring reintroduction of desired alterations, and that eventually we should be able to make permanent changes to the genome.

There are three types of genetic diseases: Classical (single gene), Acquired (viral genes), and Complex (multiple genes). Genetic abnormalities can cause disease through alterations in a critical gene, abnormalities in regulatory genes, abnormalities in cell-surface proteins or their associated intracellular pathways, abnormalities in cellular growth control genes, abnormalities in the DNA repair process, and abnormalities in

intercellular communication.

Identification of disease genes is accomplished through molecular cloning (Functional, Protein, Gene Probe, Positional, Gene linkage, Gene probes, or Sequencing).

In *ex vivo* genetic therapy, the genes are introduced into some delivery vehicle, then transplanted into removed cells, which are then reintroduced to the body. In *in vivo* therapy, the gene is again put into a gene delivery vehicle, then injected into the body, reaching the target cells (depending on the nature of the delivery vehicle).

◆ Gwen Ivy had some new updates on deprenyl in prevention of aging. The mouse evidence had always been good; but a new study showed very strong effects in dogs, including prevention of malignant tumors in breeds of dogs particularly susceptible to them. She also noted that Deprenyl appears to slow aging at least partially by rescuing dying neurons.

◆ James Wilson of the University of Arizona spoke of immune stimulation effects of thymus extracts. Maybe I should call that immune "normalization" effects, since it has been used effectively to treat auto-immune diseases such as arthritis, lupus, scleroderma, and some allergies, along with some viral infections.

◆ K. Kitani reported on lifespan studies with Japanese farmers and fisherman. Japan currently has the fastest growing average increase in lifespan of any country. Because of the statistical interruption of WWII deaths and the radiation and cancer deaths for years after, Kitani considers the recent growth to be a return to pre-war levels. Interestingly, he pointed out, the people who say that this lifespan is because of the healthful effects of fish or rice are positively wrong. Fisherman, who have that for a primary diet, have the lowest lifespans of any commercial group in Japan. The farmers are much longer lived. their diet consists mostly of fruits, vegetables, and a variety of grains, with very little meat. The longest lived are the Okinowans, who combine a healthy diet with a low stress lifestyle.

The conference ended with predictions by Klatz, Merkle, Kitani, and Greg Fahy about how anti-aging medicine might progress in the next decade or two. All were optimistic (surprise!).

I was surprised at how many people present, including many physicians, had never spoken with a cryonicist or read any cryonics literature. It was as bad as any general audience. Some thought we were people who somehow believed that freezing itself was a magic cure for aging and cancer. Many wondered if we had successfully thawed people yet. Questions like this show a huge gap in understanding that we need to overcome. Fortunately, the audience also contained at least 25 members of cryonics organizations, including 13 Alcor members, and several people who are likely to be signed up in the next few months. We'll be back next year, which will also be in Las Vegas, it appears.

Cryonicists are interested in life extension and aging prevention in general, not merely in freezing. Those of us who attended this conference may well look back on it one day as a seminal event in the battle against aging and death. The enthusiasm level seemed to grow each day of the conference. I hope the participants and others can all keep it going and channel that into practical results.

Part of the future growth of cryonics is dependent on a general increase in understanding that aging and death are preventable and that this is perhaps the most important and neglected area of medical research. Conferences like this are critical to that change in public perception.

Alcor staff attendees were Dave Pizer, Ralph Whelan, Tanya Jones, and Steve Bridge. Volunteers

Trudy Pizer and Judy Muhlestein came with us from Arizona.

Alcor had a booth at the Conference, with effective displays created by Ralph Whelan. We were a bit disappointed that the Exhibit area was so poorly marked and that Conference organizers didn't do a better job guiding attendees to the area. Conference Staff promise this will be much improved next year.

Overall, I would say that many people had their awareness of cryonics substantially increased over the three days.

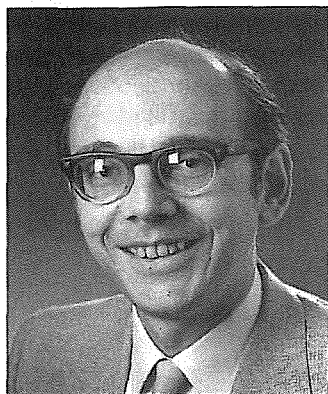


Membership Status

Alcor has 360 Suspension Members, 608 Associate Members (includes 71 in the process of becoming Suspension Members), and 28 patients in suspension. These numbers are broken down by country below.



Country	Members	Applicants	Subscribers	Country	Members	Applicants	Subscribers
Andorra	0	0	1	Ireland	0	1	2
Argentina	1	0	1	Italy	0	2	3
Austria	1	0	1	Japan	1	0	3
Australia	12	1	7	Lithuania	0	0	2
Brazil	0	0	1	New Zealand	0	0	2
Canada	10	3	46	Russia	0	0	5
Costa Rica	0	0	1	Spain	6	0	0
Denmark	0	0	1	Sri Lanka	0	0	1
Estonia	0	0	1	Sweden	0	0	5
Finland	0	0	2	Switzerland	0	0	1
France	0	0	2	U.K.	16	4	9
Germany	1	1	1	U.S.A.	312	59	436
Holland	0	0	2	Ukraine	0	0	1
				TOTALS	360	71	537



Yet One More Idea for Recruiting

We have all tried to work out just how people become involved with cryonics. Some strong arguments exist that we need not convert a high percentage of people to cryonics for our own suspensions to succeed. Still, belonging to one of the smallest minorities on Earth makes many cryonicists uncomfortable. Just like other cryonicists, I too have thought about this issue. I've done so basically trying to generalize from my own history. In my own case, as best I can reconstruct it, I think that my very first interests in suspended animation, and from there in cryonics, came most of all from an early feeling that one lifetime could never be enough to do all that I wanted to do.

When I was a boy I was very curious, and did several different things. In late elementary school I put out a neighborhood newspaper for a while, on a hectograph (an old copying technique, now obsolete). I tried making an animated movie (again by old techniques, snapping one frame at a time). It wasn't long, but it did show the animation: a stick man walking to a rock and picking it up. I was voraciously interested in science of all kinds. My mother was an artist, though when I was young she spent her time raising a family (she took up art again later but is now old and paints no longer). She tried to turn me on to art. (I probably had some talent, but other than for appreciation I've never cultivated it and do not think of myself as someone who could do that now). And of course I read lots of science fiction, the science fiction classics, though no one thought of them as classics then: Stapledon, Heinlein, Simak, Asimov, Brown, Bester.... As I grew older (but hardly old as adults measure it) what I most noticed was not the presence of death but the fact that I must make a choice among all those things that interested me. I would need to study some subject to work and "make a living" in it (I did not come from a wealthy family). I felt that to be a restric-

tion, that I must choose *one* thing and spend the rest of my life on it. I hadn't yet even reached the age of 20. Old age and death seemed so far away that they almost did not matter... except that they meant that I would never see the 22nd Century, or the 23rd, or the 30th, which even then I thought would be fascinating. When Heinlein published his *The Door Into Summer* (1957) I was quite taken with the idea, and became even more interested when Herman Kahn, in *The Year 2000* (1967), suggested that such a technology might even exist by then. "I could see the future!", I remember thinking.

It was not until I got to college that I finally chose a profession, and that choice happened almost by chance. I studied much more than one subject in college: anthropology, philosophy, even literature, and mathematics. Mathematics was taught "Texas method," which meant that the students were *not* supposed to read about the subject. The teacher gave all the students a list of definitions and theorems to prove; the course consisted of the students proving those theorems virtually on their own, and presenting their proofs before the class. I turned out to be good at that, and so in the end went into mathematics. I recall being bored in physics classes, which seemed to be done entirely by rote. So did chemistry. And, dear reader, computer science as a subject did not exist then (I learned Fortran in grad school, and how to punch out the Fortran statements on punched cards). I could very easily have chosen some other subject, if the teachers had set me afire, but it was math that caught me then.

And from there I got a doctorate. In 1969 I finished, then found a job in Australia. (I wanted to see the world, and besides, it was the middle of the Vietnam War and I found people so depressed that their depression was infectious.) One subject that had interested me was anthropology, about which I read a good deal... including Malinowski's books. For a long time I thought that I would

never see any "primitive people" firsthand (too bad! one more limit); but right after settling in Australia, I went off to New Guinea in the summer break, and camped on a hill in Chimbu territory for a month. (Math can be done with a pen and a pad of paper: all the time I was there I was working on math.) I had known a bit about cryonics before then, but when I returned I felt as if on fire: what would it be like to see the year 3000... 10,000... ?!! The day will come when we will seem as primitive as the Chimbos look to us.

Not only that, but I had grown up by then. I knew that I would die (failing any new discoveries), and so would never see that future, whether it was bright or dark. And so I started, in Australia, to look for a cryonics society I could join.

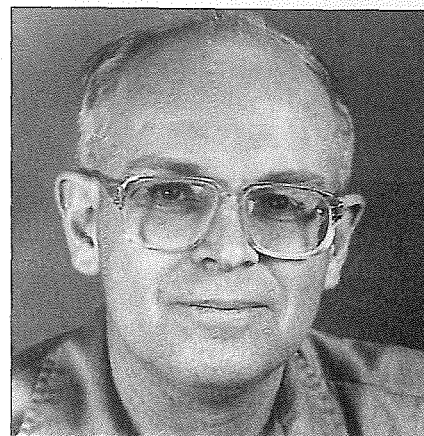
The common thread I point out here is that sense of limitation, that I knew I was forced to make choices among many alternatives, all of which attracted me. Some people seem to slip into their lives as if into a shoe specially designed for their foot, and settle into that life so happily that they never think of wanting another. That is certainly not what happened to me.

Does this lead to any suggestions? (Naturally I'd like to know if many readers feel and felt the same way!) Try ads in travel magazines, especially the ones that don't offer set tours. Or (maybe better!) international airline magazines, for those who are already travelling to places they have chosen themselves. Look for people with multiple interests: perhaps by combining a mailing list for photographers (say) and another one for English speakers with an interest in classical Greek (say) to find people in both. Or cooking and cosmology... or any other combination of strong interests (the interests should not be light) in disparate subjects.



Exploring Cracking Phenomena

by Hugh L. Hixon



On September 28, Alcor conducted its first animal experiment since January, 1993, combining training, tests of technical improvements, and research pilot studies. Two dogs underwent total body washout in close sequence; one of them was perfused to 9.4M with glycerol (venous effluent concentration), and the other was

retained as a control.

The principal motivation for the experiment was research, but in the interests of economy, the agenda was expanded to include animal handling procedures, the familiarization of new and local people, a general checkout of suspension procedures, experimenting

with improving surgical procedures, a checkout of the total body washout portion of Alcor's new suspension cart, testing our ability to handle two patients at once, a faster method of making burrholes, and seeing how high we could push the cryoprotectant concentration. The list of proposed things to try was

considerably longer, but was pruned vigorously in the interests of reality, as was the list of research projects. The research items were a pilot study to determine glycerol concentration in the brain, and a pilot study to see if we could detect cracking in the brain by listening for the cracking events. Speaking generally, the training and familiarization portions of the experiment went pretty much according to the experimental plan. One animal underwent total body washout in Alcor's new suspension cart, without any surprises. We put two dogs on femoral-femoral bypass and washed them out in the space of about six hours, including considerable time spent with surgical training of four people. This last included one Phoenix-area surgical nurse who has become interested in cryonics. Making burrholes was speeded up a lot by discarding the brace-and-bit method and chucking the bits in an electric drill. Two burrholes were made in less than 15 minutes, with a lot less effort and fuss, and a great deal more control. A light touch was used with frequent stops



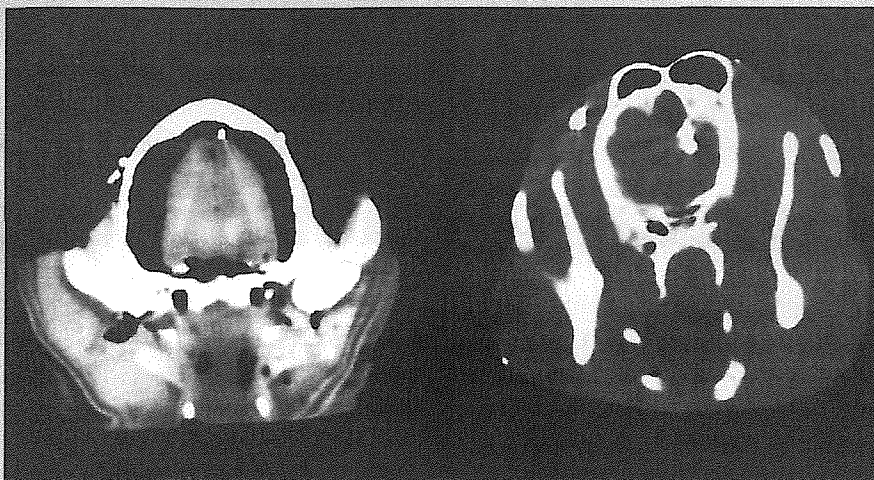
MRI images of the glycerolized and control heads.

CAT image of the glycerolized (left) and control heads at dry ice temperature (-78°C).

The void between the glycerolized brain and the skull shows a brain shrinkage of nearly 50% in volume.

There is very little contrast between regions in the 9.4 M glycerolized brain, but what contrast there is is distributed symmetrically, indicating even perfusion and differences in uptake (or degree of dehydration) in the various regions of the brain. Where contrast is visible in the control brain (not shown), it is comparable to that in the glycerolized brain.

The distribution of density differences is not the same between glycerolized and control, however. The stellations in the brains of the control and glycerolized animals are scattering from crackphone elements and wires.



to evaluate progress, and in general, making burrholes this way is a lot more pleasant than it has been when using a brace and bit. Finally, a combination of low mixing reservoir volume and 30 liters of 10.5M glycerol perfusate allowed us to push the venous concentration to 9.4M whole body in a 50 lb. dog. High

glycerol concentrations were recommended to us by our cryobiology consultant, and were also useful for the pilot CAT/MRI and cracking experiments.

CAT/MRI Pilot Study

There has always been a hidden as-

sumption in cryoprotective perfusion, that the concentration of cryoprotectant in the tissues is the same as it is in the venous effluent. The CAT (X-ray) and MRI portions of the experiment are an attempt to determine the truth of the matter by a means that does not involve destruction of tissue.

Box 1: Observations at an Autopsy

In 1983, I was present at the autopsies of the bodies of three cryonic suspension patients who had been converted to neuropreservation due to insufficient funding. (Federowicz, Hixon, and Leaf, *Cryonics*, #50, 16 (Sept, 1984))

I have since observed another autopsy performed by a pathologist on a suspension patient. As yet, I have not seen the pathologist's autopsy report.

Autopsy patient number four had been in suspension for four years. The cause of death was metastasized cancer. The time between pronouncement and washout was 21 hours. No clotting or agglutination of blood was observed on washout (the lungs appeared to be filled with blood). Cryoprotective perfusion took 2.5 hours, and the final glycerol concentrations were: venous, 3.65M; burrhole, 3.37M. Perfusion was stopped because of increased vascular resistance and protrusion of the brain into the burrhole. Considering the long ischemic period and the resulting edema, the perfusion was considered good.

Cooling rates were roughly as follows: -

1° to -2°C per hour from final perfusion temperature to -50°C; -4°C per hour from -50°C to -78°C; -10°C per hour from -78°C to -100°C; -20°C per hour from -100°C to -160°C; -5°C per hour from -160°C to -170°C; and more slowly to LN₂ temperature. This cooling profile was deliberate.

Rewarming for patient number four was manually controlled. The patient was initially placed in a cooled-down dewar and allowed to warm as shown in the graph at right. Temperatures are at the brain surface. The body was warmed separately at the end because of its greater mass.

In 1983, we had observed cracking of the skin and subcutaneous fat, on backs of hands, tops of feet, shins, thighs, etc., and this time was much the same.

In 1983, we observed shattering of the major vessels, and major and minor fractures of all the internal organs. This was not the case this time. I had expected to see internal fractures, and when I did not, I made a very careful scrutiny of all the organs as the autopsy proceeded.

To summarize a great deal of the history

of the 1983 patients, in 1974, patient P₁ was perfused with 2.11M dimethyl sulfoxide (DMSO) (no colloid) after approximately 24 hours of ischemia. On autopsy the fluid in the aorta contained 40mM DMSO. P₁'s thermal history was complicated, as he was stored on dry ice for several months in 1982. Warmup was uncontrolled, and took 21 hours from LN₂ to -47°C.

P₂ was perfused in 1978 with 2.11M DMSO (PVP-40 colloid) after approximately 72 hours of ischemia. On autopsy, the DMSO concentration in the aorta was 760mM. P₂'s thermal history was complicated. Warmup was uncontrolled, and took 21 hours from LN₂ to -47°C.

P₃ was perfused in 1980, with glycerol, to a final venous concentration of 2.85M (PVP-40 colloid). On autopsy, fluid from the femoral artery contained 1.97M glycerol. Cooling to dry ice temperature was at about -2°C per hour. Cooling to LN₂ temperature was by the slow-fill method, and the rate varied from approximately -10°C per hour in the early phase to -0.3°C near LN₂ temperature. Warmup was uncontrolled, and was approximately 90°C in the first 24 hours, and 10°C in the last five days.

With P₃, we excavated the top 20 cm of the spinal cord. The cord was found to have



MRI longitudinal section through the glycerolized and control heads at 0°C.

The glycerol shows as brighter areas. The very bright areas around the shrunken brain, in the ventricles inside the brain, and in the left sinus are liquid perfusate. The dark areas in the brain are the perfused (dehydrated?) brain tissue. Note that the vitreous humor of the eyes has a substantial amount of glycerol.

The truth of the matter is that there are complications to using these methods. One such complication is *shrinkage*. Very roughly, tissues are about 60% replaceable water and 40% insoluble solids. If the volume of a brain is osmotically reduced by 50% (which we did in this perfusion), the only thing that can

leave is the fluid component, which means that the proportion of solids goes to 80% of the volume of the organ! If we assume that the remaining fluid in the tissue is in equilibrium with the components of the venous effluent (and it very well may not be), a 9.4M glycerol concentration in the venous effluent may

amount of shrinkage may be important. Up to this point, it has been ignored.

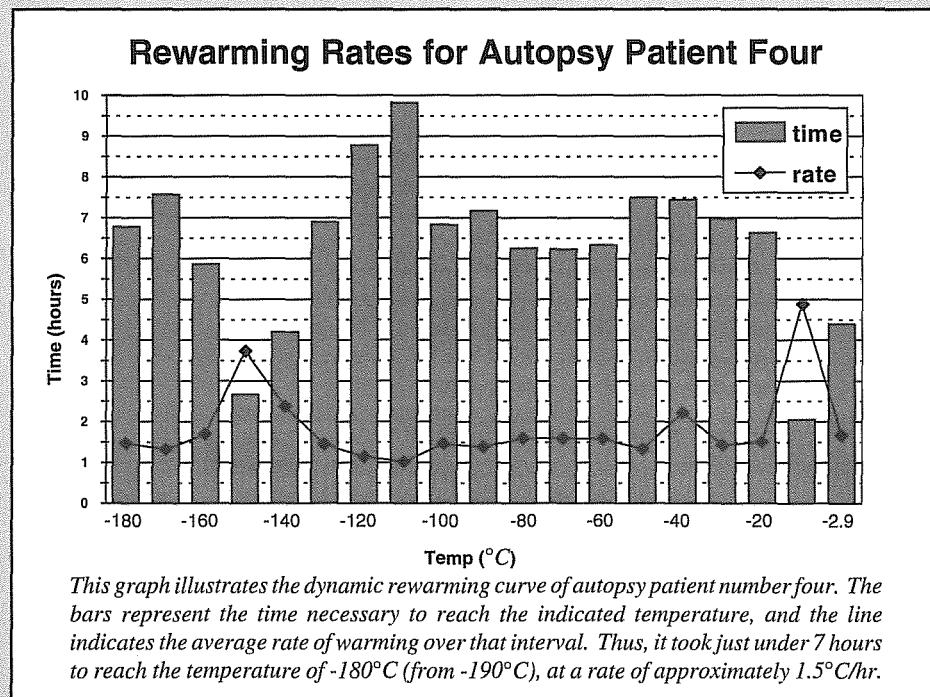
CAT—One might think that since glycerol has a higher density than water (1.24 g/ml), it will be considerably denser to X-rays. This is not the case. X-ray absorption/scattering actually depends roughly on the *fourth*

a clean glass-rod fracture about every 6 cm over its exposed length. Except for the autopsy described in this article, this is the only examination of human neural tissue following cryonic suspension that has ever been done.

P₄'s brain (the most recent autopsy) was in five major pieces: cerebellum (cracks at spinal cord and pons), the two hemispheres of the cerebrum (crack along the corpus callosum), and the frontal lobes. (Approximately the first third of each hemisphere of the cerebrum. Transverse, symmetrical, and along no recognizable anatomical feature.) The tip of one of the temporal lobes was fractured transversely. No other cracks were noted.

I expected to see cracking of the brain. The real question was, on what scale? The abdominal and thoracic organs in the 1983 autopsies were fractured in no particular pattern. Animal organs (including the brain) frozen at Alcor by Mike Darwin ten years ago cracked extensively on a scale of about a centimeter, and my nightmare was to find a skull full of popcorn. Happily, this was not the case.

I expect that a number of people, on reading this account, will step forward with conclusive guesses as to the meaning of it



all. My personal opinion is that there is now insufficient evidence for any conclusion. The examples at hand are contradictory. Useful answers await new experimentation. One major problem of relating any animal experimental evidence to humans is that of scale.

I am of the opinion that the sheer size of the human brain compared to that of any easily obtained animal creates difficult scaling problems. Also note: current cooling of cryonics patients is done at a rate slower than that used for patient P₄.

Box 2: High Temperature Storage of Suspension Patients

Since the observation of cracking in cryopreserved organs over a decade ago, and the subsequent attempts to achieve vitrification, a number of schemes have been put forth for storage of patients at some higher temperature, such as above T_g , the glass transition temperature for a cryoprotectant-water combination. The logic here is that above T_g , the strains caused by cooling will be relieved by distortion of the still (slightly) fluid cryoprotectant mixture, rather than discontinuously (by cracking) at some lower temperature. For glycerol-water combinations, this is in the range approximately -90°C to -130°C . There is probably some chemical activity in this range, but the increasing viscosity as the temperature is lowered would tend to reduce this.

The storage temperature used now is -196°C , the boiling point of liquid nitrogen at atmospheric pressure. LN_2 is cheap and nontoxic, and because the system operates at a phase transition, storage at this temperature is simple and robust. All the systems that have been proposed for storage at some higher temperature are more expensive, and more complicated, and therefore more prone to error. Arguably, there is a tradeoff between security on the scale of a

century and some level of cracking, and of course the cost. A patient in liquid nitrogen may have cracks in the brain and other organs, but given dewar integrity and reasonably reliable LN_2 supply, chemical reactions are completely halted, and no further cracking is going to occur. A patient stored at some higher temperature requiring some degree of active regulation is poised on a knife-edge between higher reaction rates and cracking for (perhaps) a somewhat lesser period.

The problems involved can be divided roughly into two categories: fundamental, and practical. Among the fundamental questions are:

- What is the temperature at which cracking begins?
- Does this temperature vary with cryoprotectant concentration?
- Is this temperature the same for different cryoprotectants?
- Does this temperature vary by organ?

At this time we are unable to answer any of these questions on any but theoretical grounds. The recent completion of a computer-controlled cooldown and data record-

ing system at Alcor, and the beginnings of a method for determining the actual cracking temperatures, may give some answers to these questions.

If it turns out these temperatures vary considerably, as seems reasonable, then a compromise will have to be made as to the appropriate storage temperature, not only for individuals, but in the limit even for their separate organs. For example: if the cracking temperature (and therefore the "safe" storage temperature) varies with cryoprotectant concentration, and if the widely varying conditions of suspension continue to result in patients with different brain concentrations of cryoprotectant, do you store each patient at a different "best" temperature?; if a brain is unevenly perfused with cryoprotectant (which may occur for a number of reasons), what temperature will be selected?; if someone is perfused with a new and better cryoprotectant that can accommodate a lower storage temperature, and all that is available is a single mass storage unit, what temperature will they be stored at?; if the liver cracks at a higher temperature than the brain, do you store at the brain temperature and let the liver crack, or do you bet on a short time until revival is possible

power of the atomic weight of the individual atoms in a molecule, and the lower atomic weight of the carbon atoms in the glycerol balances out rather closely the higher mass density. The 12-bit intensity resolution of CAT scanners allows some distinction to be made out between water and glycerol, but it's not particularly dramatic or useful. CAT can probably distinguish uneven perfusion in an organ. Our dog brains showed no observable variation in CAT density within each brain, which would tend to indicate even perfusion (or dehydration). The shrinkage problem pretty well forestalls any further conclusions or measurements.

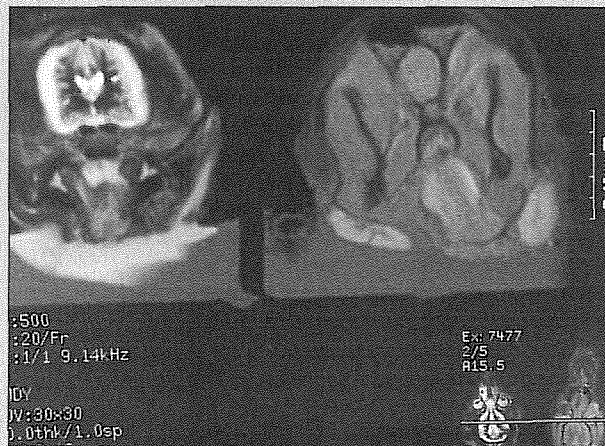
MRI — Clinical MRI systems respond somewhat selectively to the water or the fat in tissues. There is also spectroscopic MRI, but this type of instrument is almost entirely restricted to research institutions. Our access is presently limited to a clinical machine, and we looked only at the water distribution in this pilot study. Hence, when we observed glycerol, it

was indirectly, by the absence of water. The contrast between the 9.4M fluid surrounding the shrunken brain, and penetrating the fissures in the brain's outer surface, is quite dramatic; but whether it dramatizes dehydration or lack of penetration of glycerol into the brain (or both) is the

question. Hopefully this will be cleared up when the 9.4M brain is analyzed for glycerol content after the pilot cracking study is completed.

There are several ways that this problem may be developed into a more usable research system. One is to get access to a spectroscopic MRI system.

MRI cross-section through the glycerolized and control brains, at 0°C , in front of the burr holes. Here, the dura is still attached to the skull, and the perfusate fills it. Again, the bright penetrations into the shrunken brain are the perfusate in the fissures of the brain, and the ventricles are filled with perfusate. Note the little thumbnail locator cross-section in the lower right corner.



and store at a temperature where the brain may undergo deterioration?; etc. There could be some rather interesting contortions in the process of figuring out who decides, and who pays.

Once the above answers are approximated, the practical questions must be answered. These include:

- **Mass storage vs. small units.** I have tended toward a system based on the Alcor "bigfoot" design, which would accommodate four whole bodies, or 54 neuros, or some combination thereof. Last year on Cryonet, Brian Wowk (with input from several others) proposed an ingenious mass-storage system that would require a relatively small amount of active regulation. How will this affect the ability to "customize" storage conditions (see above)? In order to get high per-patient efficiency, will you have to build a large unit that will not be filled for a long time, and eat the cost of running it for just a few patients until then? Is it possible to construct a "modular, expandable" mass storage unit that is both refrigeration and volume efficient in its early stages?
- **Mechanical refrigeration vs. LN₂ refrigeration.** This mostly revolves around reliability and survivability of the system,

both with respect to mechanical problems and the supporting commercial infrastructure. There are *small* mechanical systems used in laboratories that can go as low as -150°C. Are they efficient, or merely convenient in their current application? Can they be scaled up? Since sooner or later, the mechanical system will fail, how expensive is it to replace? How easy is it to replace? If it's expensive and hard to replace, can you afford two of them? If the power goes out, do you have an emergency generator for backup? (If you back up with LN₂, as the lab units do, why bother with the higher temperature storage in the first place?) How big an LN₂ reservoir will you need to cover a once-a-century LN₂ supply problem?

- **Materials.** Superinsulation or foam? If foam, how do you seal the cracks? Small foam units and modular units will be mostly insulation; how expensive is floor space? Can you afford the high initial cost of superinsulation containers? Can you get superinsulation containers serviced and reworked economically? How do you deal with the problem of sealing the joints between blocks of foam, while allowing for the contraction it undergoes? Do you use more cheap foam or less of

the better, expensive stuff?

- **Interactions with the environment.** How do you defrost? Will you have to put the whole thing in a sealed room with an industrial-size dehumidifier? What kind of access is best; walk-in or top-loading?
- **Engineering skill.** How many design cycles (i.e., system defects and even outright failures) do you go through to achieve a reliable, economical system? Can you afford the services of an engineer who has designed freezer plants?
- **Backup.** If the system fails, what's the alternative? The failure of a small unit poses many fewer problems than failure of a mass-storage system.

At the moment, we have a system that, except for the cracking problem, works pretty well. As I have attempted to indicate, storage at higher temperature will bring a new, and very likely larger, set of problems, and those will probably impose additional costs, including potential loss of life. A number of fundamental questions need to be answered, and if those answers are acceptable, a lot of tradeoffs will need to be made. Alcor is currently conducting a pilot experiment to determine at least some of the fundamental questions concerning cracking, and will proceed from there.

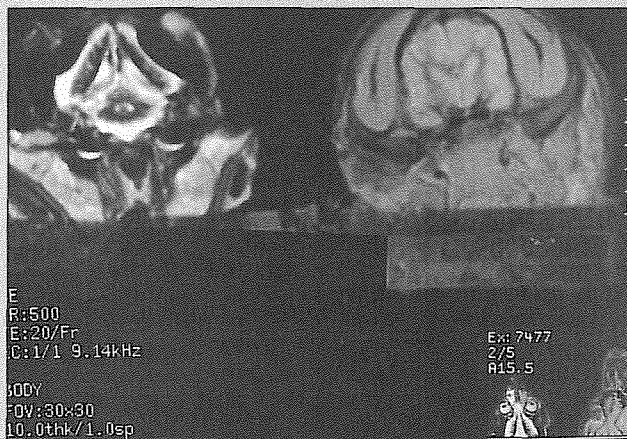
Another is to use an odd property of MRI; the MRI signature disappears in solid materials. We have done CATs and MRIs at both 0°C and -78°C, and as was expected, the brains had no MRI image at -78°C. Brian Wowk has pointed out that this can be used to determine a "freezing point", watching the image

appear as the brain is slowly warmed up, and noting the temperatures as it does. The appearance temperature is an indication of the glycerol/water ratio at each point of the brain, independent of the degree of dehydration. If spectroscopic MRI is simultaneously available, it may be also be possible to directly deter-

mine the absolute glycerol concentration at each point. Unfortunately, this would take a great deal of expensive machine time (we are paying \$50 per quarter-hour) which is probably not available locally in any event. (However, Brian, who is working in this field, has late-night time available, and has offered to make a series of runs. Whether we will be able to take advantage of this offer requires the solution to several other problems, however.)

A final note: Because of size, logistical problems, and cost, CAT and MRI are unlikely to be used much in human suspensions. These are multimillion-dollar fixed or semi-fixed installations that must be served by a trained organization that is usually interested in getting their investment back as soon as possible. Further, once a few basic research questions are answered, like glycerol/water ratios and distribution, they don't appear at this time to have any further utility. And finally, it may be possible to answer the cryoprotectant distribution question by simpler methods, but not as easily.

MRI cross-section through the glycerolized and control brains, at 0°C, at the line of the burr holes in the skull. Here, the brighter



liquid perfusate is contained under the dura, which has sagged down over the shrunken brain. The bright penetrations into the brain tissue are the perfusate in the surface fissures of the brain; the ventricles are filled with perfusate.

Cracking Pilot Study

We have known about cracking since a group of autopsies performed by Alcor in 1983. (See **Box 1**.) The result has been to propose storage at some higher temperature, balanced between the highest temperature at which cracking is observed and some acceptable rate of deterioration due to the higher temperature. A number of things have prevented us from attempting this.

To determine the condition(s) at which organs (particularly the brain) crack, I have devised a recorder that listens for the sound of a crack, and records some of the details of the event. Passing over a great deal of technical detail, four microphone elements were

imbedded in the brains of both the control and the 9.4M dog. (The hope was that the data collection rate would be high enough to actually locate the crack, but between the data collection rate, the speed of sound in the material, and the size of a dog's brain, this didn't pan out, by at least an order of magnitude.) The sound of an event triggers data collection, and time-stamps it. (Unfortunately, so do other things, like switching open and closed the LN2 solenoid valve of the temperature descent controller. The details are another story, but I want to thank Stephen Van Sickle for tips on practical noise suppression and the idea of a channel that records electrical noise only. It was invaluable.) My identifica-

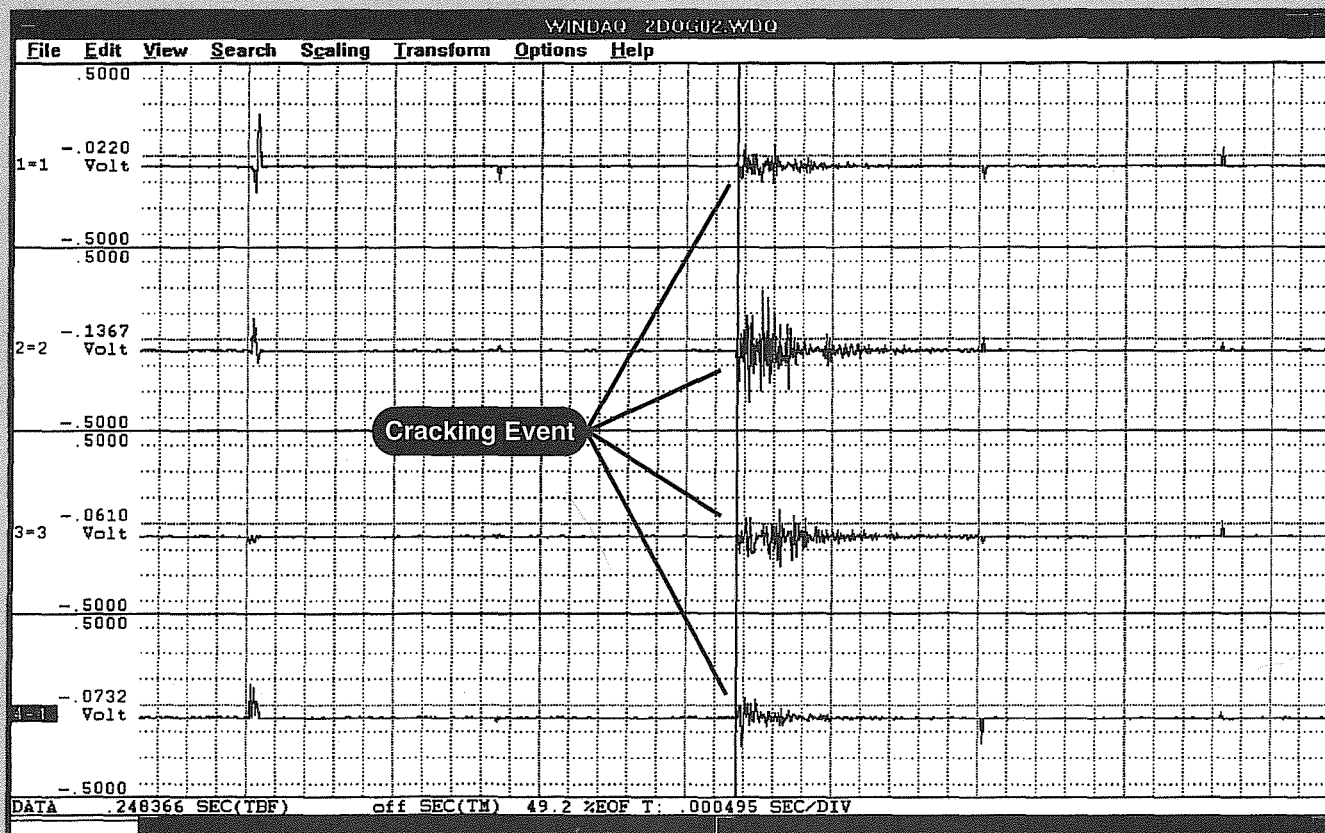
tion of what constitutes a cracking sound is not complete yet, but I was able to identify 53 events in the 9.4M dog and 13 events in the control dog in the interval from -78°C to -196°C that are likely candidates (see recordings). The first event in the 9.4M dog occurred at about -99°C ! (See graphic below.) If this is verified by future experiments, it will be a major blow to the concept of high temperature storage (See **Box 2**).

But that is why we are asking these questions. This is only the beginning of studying the cracking problem.



Crackphone output

An event from the crackphone, seen on all four recording channels. This particular event is in the 9.4 M glycerolized head, and took place at about -99°C . Its profile is typical of the 53 events tentatively identified as cracks that took place between -99°C and -196°C . The major variations between events are in amplitude and decay time. The two blips on either side of the acoustic event are electrical noise.

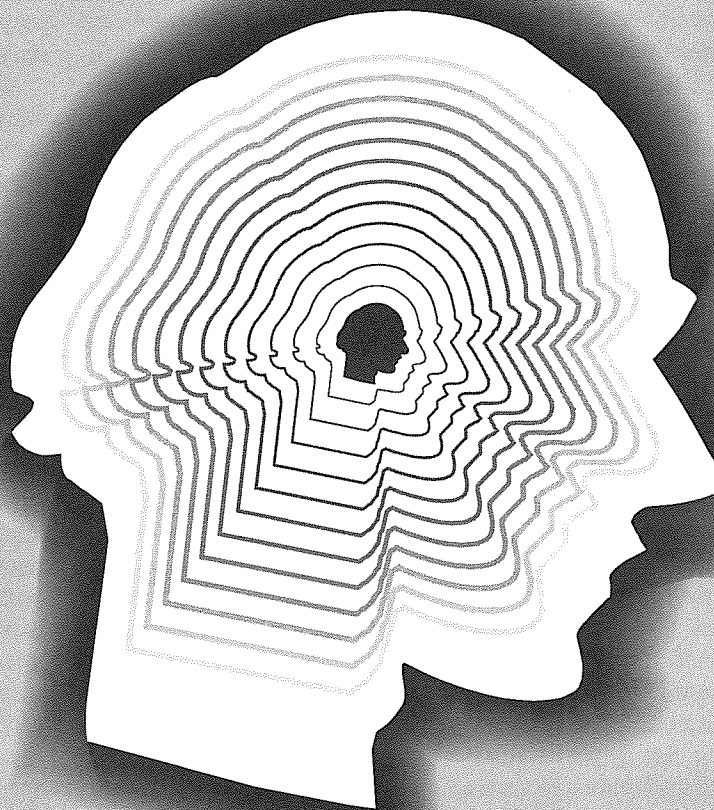


The Terminus of the Self

Part 2 of 2

By Max More

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In the first half of this essay, I criticized the standard (cardiac and/or brain) criteria for death, offering in their place an alternative. I argued that a correct criterion must be based on the destruction of personality rather than on bodily death. At the core of what matters in our survival is the persistence of our personality, not the persistence of our particular body or even brain. I noted an ambiguity in the concept of "dead": it sometimes implies a reversible state, and sometimes a final, irreversible state. I argued that true, final death involves irreversible (rather than "permanent," ie. simply "unreversed") loss of continuity of personality, and not continuity of structure or brain function. A person can, in principle, survive brain death, so long as their personality can be reconstructed from existing information.

Deanimate

We have seen that a person is not dead immediately following cessation of whole brain or neocortical function. Now I will argue that a person is not properly described as dead, at least in the theoretical sense, while they are incapable of consciousness but where their brain (or replacement hardware) retains the structure allowing possible restoration of that capacity. Going a step further, I will show that a person is not dead while they exist only in the form of information lacking a functioning embodiment. Though they are not dead, we may not be comfortable describing them as *alive*. Indeed, it would be inaccurate to describe them as alive. We need a new category to describe these cases—that of *deanimate*; I will divide this category into the subcategories *deteriorating*, *biostatic* and *inactivate*.

On the theoretical view, and more ambiguously on the standard view, absence of life is not co-extensive with death. We can see this by attending to the differing ideas of continuity defined above and by a better understanding of the nature of life and death. By “death” I mean the end point of the gradual dissolution of a living system. Dying is the process that takes an organism from life to death, from a *process* of living to a *state* of death. We should reserve the term “death” for the *result* of the process of dying, otherwise we will have no term to make that reference. If we were to say that death had claimed someone as soon as their heart stopped beating, or their brain ceased functioning, we would no longer be able to clearly differentiate very different conditions—those of various kinds of biological and neurological cessation of function from those of loss of any present or future possibilities for restoring function. Death is therefore the state a person is in

when they are theoretically dead.

Almost no one seems willing to venture a definition of life. According to Prigogine and Stengers¹, a living organism is an open system in which matter and energy are exchanged with the environment. A living organism is a dissipative structure: a dynamic state of matter which originates in far-from-equilibrium conditions and involves a close association between order and structure on one hand and dissipation or waste on the other. Living creatures keep internal entropy at bay.² When they fail to do this they cease coherent functioning and proceed down the necrotic path of increasing dissolution. Death is the end result of this entropic process. This dying process may be arrested and reversed at some stages; how far along the process arrest and reversal can be achieved depends both on how much critical information remains or can be reconstructed and on the level of technology.

Since there is a large gap between cessation of function (whether cardiac or neurological) and loss of all structure and structure-critical information, we need a term to refer to that part of the spectrum in which the person potentially is fully or mostly recoverable.³ *Deanimate* can fulfill this need. It connotes absence of movement, cessation of life, leaving us the term “dead” (in our theoretical sense) to exclusively refer to an organism that has reached a state of death, without connoting further decay. When someone’s heart stops beating, or their brainstem ceases to integrate bodily functions, that person becomes *deanimate*. They lose consciousness and cannot spontaneously recover. When they become *deanimate*, the dying process will continue until they are dead, unless other persons intervene. Such intervention may consist of cardiopulmonary resuscitation, if deanimation has occurred in the last few sec-

onds up to something under an hour,⁴ or it may take the form of biostasis (cryonics, vitrification, or advanced suspended animation).

In the case of biostasis, the *deanimate* person’s physical embodiment is stabilized, by locking their constituent molecules in place at extremely low temperatures or by chemical fixation. Biostasis is thus a sub-category of *deanimate*; *biostatic* persons are *deanimate* persons whose dissolution has been arrested (before reaching a critical stage). If the technology becomes available to repair the life-threatening condition causing deanimation, and to reverse the changes caused by the biostasis technique (which may itself add further injury), the *biostatic-deanimate* person may be restored to life.

Both *biostatic* and *inactivate* fall under the category of *deanimate*, but they may usefully be distinguished. In the previous section I described a hypothetical scanning procedure that gathers thorough structural information about the brain. This information might be stored on an inactive, non-biological medium for a period prior to reembodiment of the information in a working brain. In that case, the person would be *deanimate* and *inactivate* but not *biostatic*. *Inactivate* persons will be thought of as further from being alive than will *biostatic* persons. There are two related reasons for this: First, while both *biostatic* and *inactivate* persons lack the capacity for consciousness, the former exist in their standard embodiment, though in static form. But *inactivate* persons persist only as information instantiated in a form radically different from that of their standard body. Technology capable of resuscitating *biostatic* individuals probably is less remote than technology capable of re-embodiment of individuals from their identity-critical information. Second, these differences in form and temporal remoteness are likely to generate differing attitudes in us. On the permanence view of death, we are more likely to regard an *inactivate* person as dead than a *biostatic* person. We will find it harder to regard someone as not dead who persists only as nonbiologically-embodied information, and whose revival we think only remotely likely. This difference makes

¹Prigogine and Stengers (1984). Dawkins (1976, 2nd ed. 1989).

²This characteristic may be shared by non-biological entities, or “artificial life.” A-Life researchers therefore suggest that we understand life in terms of certain formal characteristics rather than as essentially carbon-based chemistry. This way of conceiving of life clearly accords with functionalist views of mental states. For an overview of current work in A-Life see Kelly (1991).

³See next section for cases where someone might be said to be *partially* dead.

⁴The 3-5 minutes rule for “brain-death” is no longer an impenetrable barrier. People have been recovered from many minutes of ischemia at low temperatures with the help of calcium channel blocking drugs.

it worthwhile distinguishing biostatic from inactivate within the general category of deanimate.

We can apply the category of deanimate on both the theoretical or the permanence views of death, though its extension will differ between the two. In the theoretical view, when a person ceases living and loses the spontaneous capacity for consciousness, they become deanimate. They will continue to die until they are dead, unless they are put into biostasis or otherwise preserved. So, in this view the person is first alive, then deanimate and degenerating, then deanimate and static, and later, possibly, alive again. The permanence view differs in that when life ends, if we believe the person will never be returned to life, then we will say that the person goes immediately from being alive to being dead. This allows no room for a period describable as deanimate. The permanence view will agree with the theoretical view in allowing for a period of deanimation only where we believe that the person will eventually be restored to life. So, deanimation is compatible with the permanence view but only where cessation of life is thought to be temporary.

For some, it will be difficult to shake the feeling that someone who remains only as inactively stored information is dead. I think the feeling of oddness felt by some in thinking of an inactivate person as not dead is largely generated by the entrenched standard belief that not-dead = alive. Since an inactivate person, even more than a biostatic person, is far from alive, the temptation to think of them as dead can be strong. The feeling of oddness should be dispelled by keeping the third category of deanimate in mind. With that category in place, it will seem even more odd to think of inactivate persons as dead. Inactivate persons and dead (ex-) persons differ in important ways. In the former case, a great deal about the living person is being preserved; all the information specifying their psychology and its physical embodiment persists, and *ex hypothesi* that information could eventually be used to restore the person to life. All the knowledge and experience of the original person remains, though as potentiality rather than actuality. The fact that

the person experiences a break in continuity of consciousness is not a reason to say that they died and will be replaced by a different person if the information is re-embodied. If we were to say this, we would also have to say that persons who go into a coma and later are revived have died and been replaced.

Why not think of the situation as the person's death and replacement? First, we need to remember that if we believe someone to be inactivate it means that we believe it to be empirically possible, now or in the future, to restore them to consciousness. Regarding them as dead has a number of effects: We will cease to think of them as involved in our lives in the future. We will make no efforts to

"When someone's heart stops beating—or brainstem ceases to integrate bodily functions—that person becomes deanimate. They lose consciousness and cannot spontaneously recover. When they become deanimate, the dying process will continue until they are dead, unless other persons intervene."

return them to life, instead treating their inactivate form as equivalent to the ashes of cremation. We will withdraw all their rights and disregard their interests in continuing life in the future. The pre-inactivate person may have made plans for the post-reactivation stage of their life, but our regarding them as dead will destroy their plans far more completely than if someone were to destroy all of another person's assets. There is no obvious difference between treating an inactivate person this way and disconnecting a comatose patient from life support when it is believed that they could be brought out of the coma with treat-

ments to become available in the future.

If we believe that the inactivate person will never be restored to life, perhaps because they did not provide the funding to do so and no one else will be willing to bear the expense, then we will correctly regard the person as permanently dead, even though their condition is potentially reversible and so they are not theoretically dead. This kind of situation helps to explain intuitions to the effect that inactivate persons are dead. Inactivate persons who will never again be alive can indeed be regarded as dead—as permanently but not theoretically dead. Maintaining the distinction between the theoretical/reversible and permanence conditions will distinguish the two classes of inactivate persons, those who are dead in the permanent sense and those who are not dead in either sense, and thereby helps dissolve any intuitions about the deadness of inactivate persons as a class.

Partial Death

Although the concept of death has now been defined more precisely by distinguishing it from deanimation, an indeterminacy remains due to the psychological reductionist theory underlying these distinctions. We may expect it always to be simple to tell when someone is dead, at least in principle. If death is put in the context of psychological reductionism, this clarity evaporates as soon as we realize that such continuity is a matter of degree. The R-relation includes both psychological continuity and connectedness. The same person continues only if a person-stage has enough psychological connections to the preceding person-stage. There is psychological continuity between person-stages, i.e., the person survives, if those stages are strongly connected. Parfit stipulates that strong connectedness requires the persistence of at least 50% of the usual number of psychological connections over the course of a day.

However, as Parfit notes, this limit is entirely arbitrary, adopted only for the sake of convenience. We could just as easily claim that 60% connectedness over a day (or a week) meant that the original person has been destroyed and replaced by a new person. The fact is

that the previous person-stage has 60% survived over the specified interval. Beyond that fact it is a matter of decision and linguistic convention whether we say the same person continues, or whether the original person retains their identity. Our decision will be influenced by the personal, legal, and cultural con-

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sequences of placing the strong connectedness requirement at a particular level. This indeterminacy is worsened by the problems involved in trying to weigh the relative contributions of different components of psychological connectedness. Are memories more or less important than skills? Are dispositions more or less important than intentions? Exactly what kinds and degrees of psychological changes would add up to a 40% or 50% reduction in connectedness?

We can accurately say that someone—some person-stage—suffering significant brain damage has partly died. This is just to say that the remaining person-stage has a significantly reduced degree of psychological connectedness with the previous person-stage associated with that body. Speaking of a person's partial death is not merely a manner of speaking; it is a reflection of a real weakening in the strands that constitute the continuity of the person. As more of these strands are removed at a time, less of the pre-existing person continues. We may usefully think of a person's survival or continuity this way: If my friend came out of a car accident with brain damage resulting in loss of some of his personality or with alteration in personality, I would mourn for the loss of part of the person he was. I would miss the person-stage whom I knew and would have to acquaint myself with the new person-stage. At the same time, I am sorry for what has happened to my friend, the same person who continues to exist. So long as the damage done to him does not exceed the critical threshold beyond which strong psychological connectedness is lost (wherever we set that threshold), he is the same person, not qualitatively, but in the logical sense of personal identity. The same person persists, though a new person-stage has peremptorily replaced the former stage of the person.

Though we can think of death as a matter of degree, the legal system is not good at handling spectra. The law regards persons as either dead or alive, just as it regards people as either above or below an age of consent. It may therefore be practically necessary to decide on an line—arbitrary within broad limits—sorting cases of damage to a person

that result in their death from those that do not. If someone is *too* damaged then, although their body may continue to function and some behaviors or responses may persist, we can say that the person has died, changing their legal status, and setting in motion activities such as disposal of the body and distribution of the estate. (The body would not be disposed of if the person to whom it had belonged had signed a living will directing that their body be maintained in such a situation, and had provided funding for this purpose.) A plausible candidate for the standard of being *too* damaged is the point (or range) where someone loses the characteristics of personhood. These characteristics include the capacity for consciousness and self-awareness, rationality, responsibility, and an ability to communicate. These characteristics are, to be sure, a matter of degree, but there will be some cases where it is clear that personhood has been lost.

Let us imagine a man, Jones, who is a normal, adult human being, possessing all the familiar characteristics of personhood, displaying a robust intelligence, and enjoying diverse relationships. One unfortunate day, Jones is involved in a serious auto accident. His friends and family, gathering at the hospital, are told that Jones has suffered a devastating head injury, but that he will live. However, though he breathes unaided and shows some awareness of the environment—moving away from loud noises and towards the smell of food—he cannot recognize anyone. Despite repeated attempts no one is able to evoke any sign of recognition from him. Let's call this individual Jones-B, and the pre-accident person Jones-A. Jones-B has not only lost his memories of Jones-A's life, he displays none of Jones-A's wit, insightfulness, ability to form complex and satisfying relationships, nor can he even carry out a conversation. His brain has been damaged to such an extent that he has to be fed, he does not recognize friends and relatives of the past, and he cannot engage in any of the activities that Jones-A could. On any remotely plausible measure of connectedness, the remaining psychological links between Jones-B and Jones-A are too tenuous to amount to strong con-

nectedness: Jones-A and Jones-B are not psychologically continuous. I hold that Jones-B is not the same person as Jones-A; the two together do not form one longer lived individual, though they consecutively share a single continuous body; Jones-A no longer exists; Jones-A is dead.

In cases like that of Jones, we can say that a normal person, who is suddenly damaged so badly that they lose the qualities of personhood, ceases to exist. The massive and discontinuous loss of psychological connectedness means that personal continuity has been broken, and that person's life has been terminated. If the damage is less, we will say that the same person lives on, though diminished, even if many of their memories are gone, their personality undergoes some changes, and their cognitive and communicative abilities are lessened. The point here is not that personhood is essential to a person's remaining alive; personhood is simply a plausible marker for the minimum retention of connectedness required for a person's survival. My underlying claim, based on psychological reductionism, is that death of a person necessarily results from an excessive severing of connectedness; it is *not* that loss of personhood necessarily results in the death of a human in all cases. We can see the distinctness of these claims by considering a different kind of case.

Smith is a healthy woman, her cognitive and communicative abilities, her capacity to form relationships, and her ability to reason and to take responsibility being comparable to those of Jones-A in my former example. Smith starts off in a condition much like that of Jones-A, and she ends up as diminished as Jones-B, but she goes from one state to the other differently. Whereas Jones-A was replaced discontinuously and immediately by Jones-B, Smith undergoes a gradual, years-long deterioration resulting from (let us posit) the growth of

inoperable cancer in her brain. Comparing Smith at an advanced stage of her deterioration with her former healthy self, we see few psychological connections—as few as connected Jones-A and Jones-B. Smith differs from Jones in that at no time do we find a discontinuity remotely like that resulting from

though not a person, Jones-B possesses a capacity for consciousness of a limited kind and survives so long as that continues. However, we differ in the case of Jones-A where, according to Gervais, Jones-A continues to live after the accident (being identical with Jones-B).

In criticizing the view of Green and Wikler who, like me, employ a psychological continuity conception of death, Gervais raises anencephalic infants as supposedly being a problem. Gervais thinks that the cases of anencephalic infants and cases like Jones should be treated alike: "If the anencephalic are obviously not dead, then Jones is obviously not dead either."

"Embodying the category of deanimate in the law would have several beneficial results. Recognizing the category of deanimate persons, and the potential for expanding that category, would spur research in neocortical preservation and repair. Common practice would gradually move from disposal and dissolution of persons when they are not theoretically dead to a situation where the possibilities for maintenance and revival were affirmed and acted upon."

Jones' accident. Comparing her condition between any two adjacent days, or even months, we find only minor changes. Month by month her memories slowly fade, her concentration weakens and dissolves, her confusion increases, and her capacity to reason, communicate, and engage in complex behavior attenuates. Since Smith's loss of connectedness is cumulative rather than acute, psychological continuity is maintained. Even though the deterioration eventually robs her of the characteristics of personhood, the gradualness of the loss means that, unlike Jones-A, she has not perished.

As it stands, the law holds that a person, after falling below the threshold for personhood, has not died regardless of whether this occurred gradually or discontinuously. Despite her defense of the neocortical criterion, Gervais appears to agree with the current legal view. According to Gervais, a person (and not just a biological organism) continues to exist—personal identity is maintained—despite total loss of personhood, so long as the capacity for consciousness remains. We can agree in Smith's case, where I also hold that Smith survives past the loss of personhood. We can also agree in the case of Jones-B;

[140] If Jones, lacking sufficient neocortical function to support personhood, is dead even though he has a living body, then a baby born without neocortical function must also be dead.

Having distinguished Gervais' Jones into two individuals, Jones-A and Jones-B, my response to Gervais is unproblematic: It's true that the anencephalic are obviously not dead. But neither is Jones-B dead. On the psychological continuity view, Jones-A is dead, but there now exists a distinct individual, Jones-B, who lives. Jones-A, in losing personhood, lost so much connectedness that he ceased to exist. His body lived on, forming, along with the remaining mentality, the new individual, Jones-B. Jones-B has suffered no loss of connectedness, and so is clearly alive. His case is therefore parallel with that of anencephalic infants, for they—born without the capacity for consciousness—have never lost connectedness.

In considering a possible response to her objection from Green and Wikler, Gervais complains that granting that the anencephalic baby is alive while the brain-damaged ex-person is dead will lead to two identity criteria: "In the anencephalic case, identity criteria and conditions of life and existence do not over-

lap. It is confusing to speak of alive bodies and dead persons, since a similar distinction could be drawn across the board, even in brain-death cases." (141) Her response is unconvincing; I see no reason *not* to make a similar distinction across the board, including brain-death cases. Refraining from distinguishing conditions for life and death of bodies and persons, Gervais will be forced to say that someone survives even if practically everything that made them who they were is destroyed. She will have to claim that the bare capacity for consciousness is most of what makes someone who they are. Furthermore, Gervais' charge of inconsistency against Green and Wikler can be applied to her own position because her own criterion of upper brain death makes it possible to talk of alive bodies and dead persons. In attacking the whole-brain death criterion, Gervais made it clear that a person dies along with their upper brain, even if the lower brain continues to maintain the body.

Determining Death and Deanimation

When should a declaration of *deanimation* be made? A person should be declared deanimate (or be said to have deanimated) when it is judged impossible or pointless⁵ to revive them given the available medical technology; that is, when conscious activity: (i) has ceased, (ii) will not restart spontaneously, and (iii) cannot immediately be restored artificially. The third condition is optional: I include it because if the capacity for consciousness can (and will) be restored immediately (e.g., by defibrillation) probably we will want to regard them as alive rather than deanimate in order to maintain all their rights as living persons. We could refer to persons who meet the first two conditions, but not the third, as *dormant*. Deanimation might be declared on the same grounds that death is now declared: Cardiac and respiratory arrest, or lower brainstem dysfunction or destruction, or loss of neocortical function.

When should a declaration of *death* be made? An individual will be theoretically dead and can be so declared if their neocortex has been destroyed. In the theoretical view, death should not be declared on cessation of cardiac or respiratory function, nor upon brain dysfunction. However, though irreversibility provides a deeper criterion of death, the permanence view may better suited to *declaring* death. A declaration of death is as much a legal and social act as a medical act, marking a point where our attitudes toward the person shift. We will no longer expect to see them again; we will not think of them acting and living in the future; we will not make plans for them; we will no longer take into account their interests (except residual interests in the disposition of their former property).

The patient might be declared dead when heart-beat and respiration or brain functions cease. A declaration of death would then mean that the (theoretically) deanimate person was to be allowed to continue moving toward death without intervention. This would amount to a declaration that those involved regard the person as having permanently lost consciousness even if they are not irreversibly nonconscious. The patient may have stated that they wish to be regarded as dead when they deanimate, either because they believe their reanimated quality of life will be unacceptable, or because they believe that reversal of their deanimation is not now and never will be possible.

Practical Importance of the Deanimation Category

Embodying the category of deanimate in the law would have several beneficial results. Recognizing the category of deanimate persons, and the potential for expanding that category, would spur research in neocortical preservation and repair. Common practice would gradually move from disposal and dissolution of persons when they are not theoretically dead to a situation where the possibilities for maintenance and revival were

affirmed and acted upon.

Understanding the difference between deanimate and dead will help us to clarify the moral status of comatose persons. I cannot examine this issue here, except to note that the differential condition of deanimate and dead persons should be accompanied by differing rights and obligations. Deanimate persons should have rights more extensive than dead persons but weaker than those of living persons. When a person deanimates, they will lose rights which depend on awareness, such as being bound by new contracts, but will maintain rights against being harmed in various ways (including being killed), and some control over their finances (through agents chosen pre-deanimation or appointed post-deanimation).

As matters stand now, families suffer distress and heavy costs because persons who are either truly dead or else irretrievable with current techniques must be maintained on life support equipment. Using the informational criterion for death, more patients will be recognized as dead and so released from pointless support. In addition, some of those who would not be dead on the new criterion could be disconnected from life support in order to place them in biostasis instead of leaving them on a downward spiral. Setting conditions for transferring patients from mechanical functional support to stable biostasis is already needed due to the practice of cryonics and would be facilitated by a broader understanding of the deanimate/dead distinction.

Law and medical practice should allow a patient to be declared deanimate before the patient is fully brain dead (or neocortically dead), in order to allow biostatic preservation of the brain in good condition. This will give the patient more choice over what happens to them: Estimates of the possibility, probability, and desirability of eventual revival will vary greatly between persons. Recognizing this as rightfully the patient's choice (perhaps with consultation) would be another benefit of introducing the category of deanimate.

⁵Pointless because, if revived, they would live only in great pain or with severe disability, or would deanimate again within minutes, hours or days. A decision not to revive a temporarily revivable patient is "no-coding".

The Invention of Memory

Israel Rosenfield, Basic Books, NY 1988

Reviewed by Thomas Donaldson

After some thought I decided to review this book, even though it was published 6 years ago, because its content begged for serious discussion, especially among cryonicists. I believe it to be important because of the divergent theory it offers on memory. It deserves attention by anyone concerned with memory just because Rosenfield does *not* accept some very common assumptions.

Unfortunately, the book also has a fault which almost overwhelms that virtue: I did not find Rosenfield to be the clearest expositor I've met. In some ways he even resembles Edelman in that respect: a very interesting theory, explained in an obscure, almost opaque manner. So I shall begin by giving my own exposition from my own perspective.

From time to time many readers may have heard of controlled studies of the accuracy of memory. In terms of how well people remember events they have witnessed these studies have uniformly given surprising results: often recall, when compared with (say) a film of the actual event, turns out rather poor. The person, when questioned, turns out to often construct a story whose participants and scene were quite different from the actual event. Nor is this the result of stupidity or falsehood: it seems to be universal. And the subjects of such study will remember their imagined scene with all the vividness and color of something quite real.

And here is a second piece of data. The experiments by Wilder Penfield in the 1930s involved mild electrical stimulation to one part of a patient's brain. To Penfield's surprise, such stimulation seemed to cause the patient to remember, in detail, a former event in their life. In fact, this was the interpretation which many commentators put on Penfield's experiments. However, when the actual lives of these patients were investigated, it turned out that these scenes, which seemed so vividly real to the patient, had in fact never happened at all.

The question is natural: just what kind of memory of the past do we have? Have we invented up our memories of our past entirely? And if we want suspension to preserve our memories, just exactly what is it

then that it will preserve? Clearly we do actually remember some things, such as our times tables ($3 \times 2 = 6$, $4 \times 5 = 20$, ...). And most (English-speaking) people can define many words in the English language. Yet being able to recall our times tables is hardly the main aim of successful cryonic suspension.

Rosenfield argues that we do *not* actually remember in the sense that a computer remembers: there is no special store of memories anywhere in our brain. We *do* learn, but what we learn consists of procedures for responding in particular emotional and physical contexts. These procedures involve such things as the recollections we might have when we see the house we grew up in. That house touches our emotions, and at the same time, when we see it, we *recognize* it as the house we grew up in. As children, we had learned to respond to this house in various ways, and when we see it as adults all kinds of images and sounds come to mind. But those images and sounds are created by our brain at *that* time, they are not memories of events in our childhood in the sense that a diary would record them. The context in which we see the old house has become very different from that of our childhood.

If we think in terms of *procedures*, then the issue of emotions and drives comes into the issue of memory at once. Computer programs do nothing unless some person activates them for some purpose. Whenever we remember (if I may be forgiven that word) we do so in a particular context and for a particular purpose. By "emotions" or "drives" I do not mean that we are wrought up or overcome in any way, but that our amygdala and other brain structures must play an active role in our remembering. And every event is new, and often touches off more than one procedure; what we do, implicitly, is to work out just what to do in this new case. A man whom we've never seen before comes out of the house with clippers, and starts clipping the hedge. What do we do? In fact, it would be virtually impossible for our brain to contain a single procedure appropriate to this new event. Our drives and emotions will inevitably become involved in devising a new procedure to meet the new event. . . and in doing so, we will invent our memories, too.

Although the notion of neural networks had not spread so widely when Rosenfield wrote his book, it can help explicate what happens here. Neural nets don't remember in the same way as standard computers either. They can learn many responses after training, but that memory has no particular location either in the neural net or in any particular node of it. Instead, the neural net simply responds to a new image with some version of the responses it has learned. Nor is that all: depending on its construction, it may even devise a new response from those it has learned before (cf. Kanerva, P. *Sparse Distributed Memory*, 1990).

Kanerva refers to concepts, but when we think of what actually happens in our brain, we see various neurons successively activated for a short time. We are seeing not a concept in the sense of something static, but an activity of our brain started off, again, by a particular context and drive. The relation between "memory" and "emotion," in a working brain, is that of two different sides of a single action. Even for the neural nets, now occurring in all kinds of commercial and technological contexts where something needs recognition, this role of emotions and drives has been specifically omitted from their design. A truly *independent* machine, just like a life form (and I would claim it would then *be* a life form), would need drives and emotions.

Does this theory say anything to us as cryonicists? Most neural nets are distributed "memories": there is no single node of the net to which we can point and say that *this* node contains a particular memory. This trait may make revival easier, since it's very likely (not certain) that our brains, as neural nets, are distributed.

As for identity, it says that we should think of ourselves as bundles of actions rather than bundles of knowledge, again with no specific location in our brain. Certainly we have some kind of central awareness, but that awareness acts as part of the process by which we make new actions from old ones, and does not characterize us as individuals. It is no more necessary that our Self be in one particular place in our brain than it is that our individual memories have locations in our brain.

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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 new cryonics and life extension group with members from Washington, D.C., Virginia, and Maryland. Meetings are held monthly. The remaining 1994 meeting is scheduled for December 11. Call Mark Mugler at (703) 534-7277 (home), or write him at 990 N. Powhatan St.; Arlington, VA 22205.

Colorado

A cryonics group will be forming in Colorado. Further information may be obtained by contacting Walter Vannini at 111 East Drake Rd, Suite 7046, Fort Collins, CO 80525, or 71043.3514@compuserve.com (email).

Southern California

The Southern California chapter of Alcor meets every month in an informal setting in one of our member's homes. Meetings are on the fourth Sunday of the month. For more information, call Michael Riskin at (714) 879-3994.

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There is an Alcor chapter in England, with a full suspension and laboratory facility south of London. Its members are working aggressively to build a solid emergency response, transport, and suspension capability. Meetings are held on the first 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:

Alcor UK
18 Potts Marsh Estate
Westham
East Sussex
Tel: 01323 460257

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People coming for AUK meetings must phone ahead—or else you're on your own, the meeting may have been cancelled, moved, etc., etc. For this information, call Alan Sinclair at 01273 818558. Near metropolitan London, contact Garret Smyth at 0181 789 1045 or Garret@destiny.demon.co.uk, or Mike Price at 0181 845 0203 or price@price.demon.co.uk.

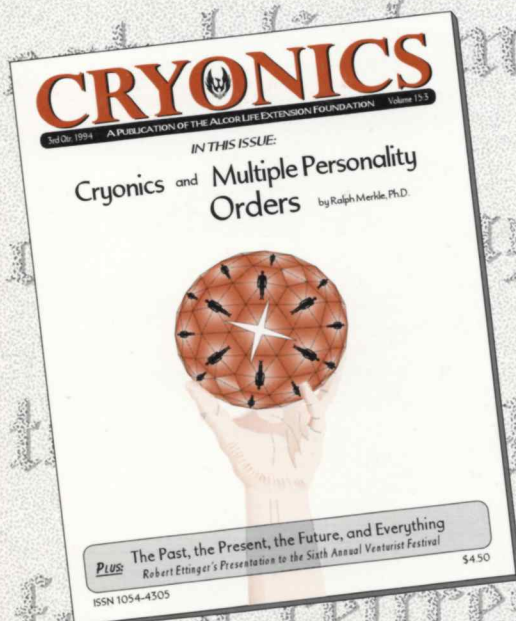
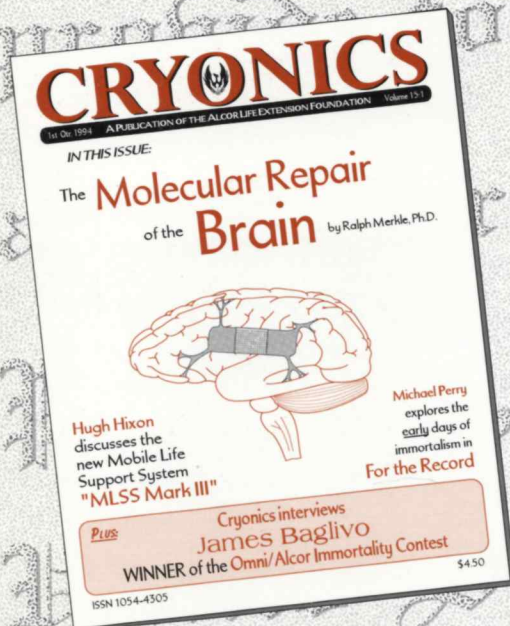
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