

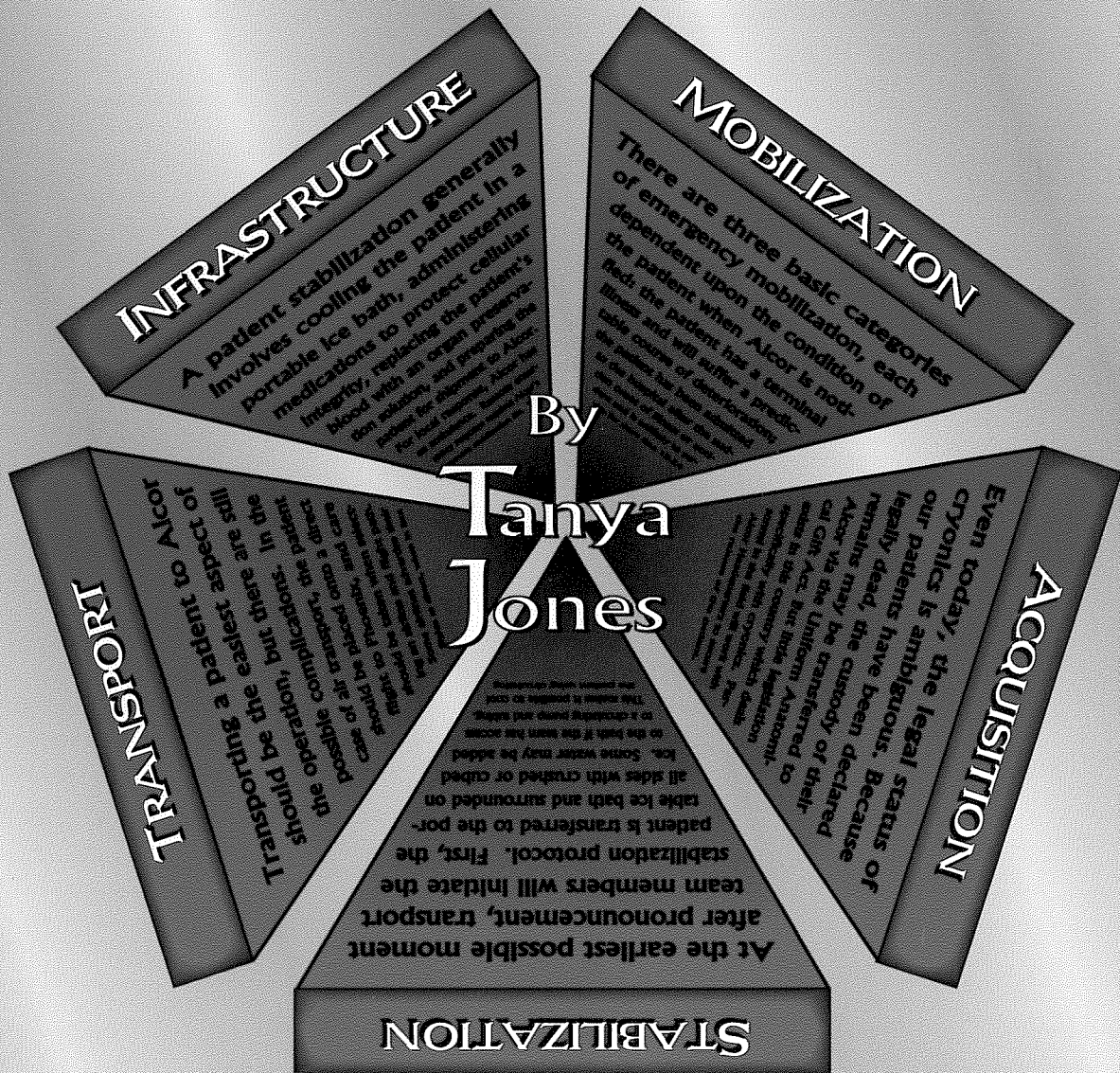
# CRYONICS

2nd Qtr. 1995

A PUBLICATION OF THE ALCOR LIFE EXTENSION FOUNDATION

Volume 16:2

## Elements of a Transport



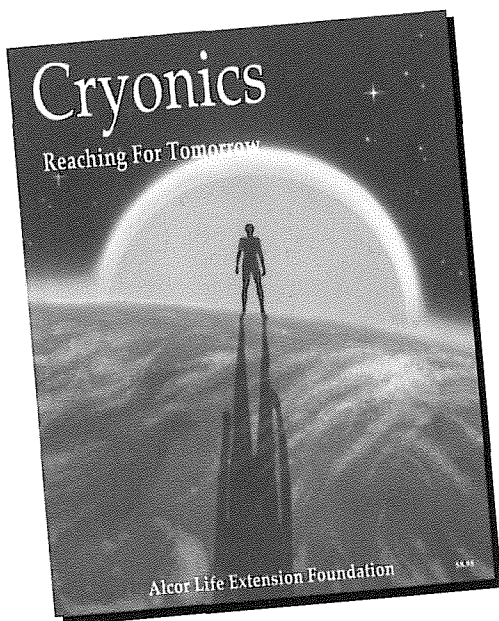
*Plus:*

The Suspension of Paul Genteman • Cryonics and Religion  
Cryonics, Cryptography, and Maximum Likelihood Estimation

# “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.



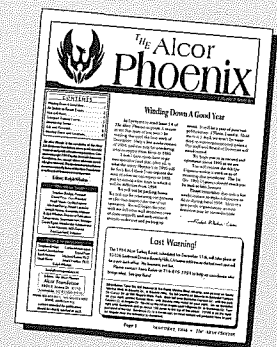
## “How do I find out more?”

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 live 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.



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ISSUE TO PRESS: JULY 5, 1995



## LETTERS to the EDITOR

Dear Mr. Whelan:

After discussing membership growth and recruitment with Derek Ryan recently, I've had occasion (on some long road trips) to mull over possible outreach tools.

I've come to the conclusion that *Cryonics* is one of Alcor's most powerful tools. Since it has gone quarterly, it has become an exceptionally professional publication that reflects extremely favorably on Alcor as an organization. The new typesetting, editing, and wonderful two color covers say *magazine* rather than *newsletter* to anyone who casually picks it up. The trick is to get people who have never heard of Alcor to pick it up.

I understand that the old monthly *Cryonics* was distributed to newstands, and did quite well until the letters section became overburdened with political squabbles. Perhaps it is time to try again with the new and (vastly) improved *Cryonics*. One problem with this, however: as I write this it is the middle of April and I have yet to receive the 1st quarter 1995 issue. Though it doesn't bother me, it is clearly unacceptable for newstand distributors.

The only real solution is to face facts; drop back and punt, wave the white flag, cry uncle. Give up. My wife, who is a technical services librarian and supervises serials at a local college claims there is nothing shameful about renumbering and redating periodicals; it is done all the time with no repercussions other than greatly annoying serials librarians.

There would be many advantages to this, not the least of which is removing the pressure from Our Humble Editor and his horde of minions to catch up as well as keep up. Once the redating is accomplished, all you would have to do is maintain a regular every 3 months schedule. In addition, you will have the time to make the next issue perhaps a little larger and a little better, giving it impact as the first issue on the newstand. It would be especially impressive given that it should contain a suspension report.

The only downside I can see is that you will incur the wrath of serials librarians from now until the end of time.

In the spirit of putting my money where my mouth is, I would be willing to give a (small, unfortunately) directed donation for this purpose should you be so bold as to actually take my advice.

Keep warm.

Stephen Van Sickle

*Thanks for taking the time to make your eminently reasonable suggestion, Steve. As it happens, though, we (Alcor management and I) have decided on a market-oriented approach to solving this problem: by getting Cryonics printed on time, I will have more money to take to the market.*

*Plus, the editing of our other publication, The Alcor Phoenix, has been shifted to Mike Perry, another employee. The problem should be solved over the course of the next three issues. And if not, your suggestion will remain foremost in our minds.*

*About the "horde of minions" that you mentioned: If you see them, could you please inform them of our new address? Perhaps they were misplaced in the move. —Ed.*

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

### PUBLICATION NOTES

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Editor: Ralph Whelan

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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.

## Alcor Suspends Andy Epstein, 29th Patient

Alcor performed a whole body suspension on June 13th. Anatol ("Andy") Epstein was a 66-year-old history professor from New York City. He had been a suspension member less than one year. While none of us at Alcor had met Andy in person, we had enjoyed our telephone conversations immensely. He was a kind and literate man, with a loving, supportive family.

We were aware that Andy had been battling brain cancer; but we did not know that he was currently hospitalized with pneumonia. Alcor received less than an hour's notice of the situation before clinical death, which was about 10:00 p.m. in New York (7:00 p.m. in Phoenix) on the 12th. This precluded a prompt field washout, since our Scottsdale team could not have arrived in New York until late the next morning, several hours after the first morning flight from New York to Phoenix. This was also too late for the back-up washout solution to be flown in from Ft. Lauderdale.

However, thanks to some exceptional assistance from hospital personnel, our cooperating New York mortician, and two transport-trained volunteers, the suspension proceeded as well as could be expected in such a situation. The hospital staff packed the patient in ice, administered heparin, sodium bicarbonate, and Maalox, and the physician on duty performed closed-chest compressions for 15 minutes to circulate the drugs. The mortician quickly picked up the patient and, with the assistance of Gerry Arthus and Curtis Henderson, packed the patient in water ice for shipment to Phoenix via the first America West flight on the 13th. (America West's overnight cargo crew in Phoenix was again extremely helpful in setting up the shipment.)

By the time the patient arrived at Alcor's Scottsdale facility at 11:15 a.m. (Phoenix time), his temperature was about 4 degrees C. The suspension

team was prepared, and cardiac surgery proceeded rapidly. The glycerol perfusion went very smoothly and no clots were visible during the procedure. Cryoprotective perfusion was completed at 4:10 p.m. and the patient was placed into the dry ice bath at approximately 6:00 p.m. We achieved a very high glycerol concentration of approximately 7 molar (measured in effluent from the brain burrhole). This is excellent under any circumstances and is extraordinary in a no-washout situation after approxi-

mately 18 hours of (chilled) ischemia. It is obvious that the hospital intervention provided an immense benefit to the patient. We are grateful to the hospital staff, Curtis and Gerry, and the mortician for all of the extra work they did.

Alcor now has 29 suspension patients, 11 whole body and 18 neuro. A full suspension report will be published in *Cryonics* in a future issue.

# Up Front

By Ralph Whelan, Editor

Life in the cryonics business is a lot of things, but never is it dull. So far, 1995 has been no exception. The year started with a bang from which we've still not fully recovered: the January 3rd cryonic suspension of Paul Genteman, a man who was actively involved in cryonics throughout most of its existence, and a dear friend to many of us. See the tribute to Paul (pp. 22-23) and Tanya Jones' account of his suspension (pp. 24-27) in this issue.

Just weeks ago, New York Alcor Member Andy Epstein was unfortunate enough to require our services, and fortunate enough to have made the arrangements well in advance of need. We will publish a full report of Mr. Epstein's suspension in next quarter's issue.

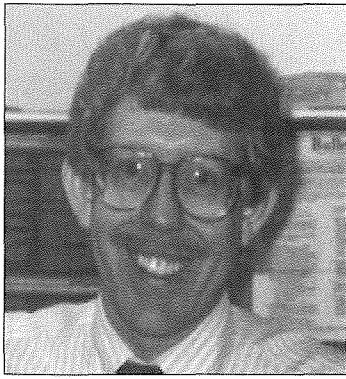
Adding to the heat this Summer has been an onslaught of media attention, including (most notably) the creation (now in progress) of a one-hour documentary on Alcor and cryonics by the Emmy-winning creators of The Discovery Channel's *The Operation*, scheduled for release some time next year. We also expect a lot of inquiries to result from our second full-page ad in *Omni* magazine. The ad will appear in the first issue of their new quarterly format, and will likely generate thousands of information requests (if our last full-page ad is any indication).

This very issue will be sent out to many of the *Omni* ad respondents; if you're one of them, welcome to the cryonics community. As you'll soon find out, for many people being a part of the "cryonics community" means nothing more than reading *Cryonics* magazine and monitoring the progress of this fascinating technology. Of course, we hope your interest will eventually lead to an Alcor Membership and possibly even active involvement. But at the very least, please consider the \$15 one-year subscription very seriously; you'll receive a free copy of *Cryonics: Reaching For Tomorrow*, and more importantly you'll be "in the loop" of what is quite possibly the most profound and life-saving technology of the twentieth century.

We hope many of you, members and otherwise, will travel to Phoenix this coming February for the Alcor Cryonics Technology Festival (see page 37 for more information).

Lastly, feel free to call us (602-922-9013) and request a free copy of Alcor's 1994 Financial Statements.





# Frozen Souls: Can a Religious Person Choose Cryonics?



*“Why on God’s Green Earth would someone want to be frozen and come back later?”*



*“I guess I am of the mind that Death is natural and something I look forward to because of my belief in God and an afterlife.”*



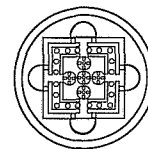
*“How does God fit into cryonics? Or does He?”*

These are some of the questions that a friend asked me last year; but they are not new. I have been asked variations on these questions many times in my 18 years in cryonics. They may be the same questions you get from your friends and family; or you may have these questions yourself. One is always admonished to avoid the topics of religion and politics at a party; people just feel too strongly about them. I recognize that this is true, and I may be wading



into a deep and tangled swamp by tackling this subject at all; but it is too important to ignore.

A further caution: I am not religious myself. I was raised as a Christian and even had aspirations to be a minister at



one time. In college I decided that religions were untrue and I became an atheist. However, I am not *anti-religious* and I have discussed religious beliefs with many different people.

For a different point of view, ask for a copy of Alcor’s pamphlet, *Cryonics and Christianity*.

Some cryonicists and many interviewers assume that *only* an atheist can become a cryonicist, that religion and cryonics are totally incompatible. This is completely untrue. The reasons that

one person chooses cryonics may be very different from another person's reasons.

Some people have gone so far as to say that the success of cryonics will mean the destruction of religion. I think such a viewpoint is nonsense. *Changes* in some religions, yes; just as many religious groups have adapted in various ways to knowledge of the solar system, birth control, transplant technology, and in vitro fertilization. Certainly *more* of Alcor's suspension members are atheists than are religious. Often these non-religious people have stepped away from the mainstream in

many areas of life and are willing to look at and adopt new ideas more quickly than others. However, as cryonics matures and seems more likely to work, more traditionally religious people have also decided they want the expanded possibilities for life in the future that cryonic suspension will be able to offer.

The first and most important point to make is that in most ways cryonics has nothing to do with religion at all, any more than do penicillin or heart transplants. Cryonics is a technology to help keep people alive. The entire history of medicine is about helping people live longer and healthier, and most religions (with rare exceptions, such as Christian Science and some small "faith healing" Christian sects) have embraced and advanced medical knowledge. Some of the finest hospitals in the world are owned and managed by Catholics, Jews, Methodists, Seventh Day Adventists, and other religious organizations.

Cryonics is NOT about bringing the dead back to life. We are not talking about performing miracles. The entire point of cryonics is that physicians of today often pronounce patients dead at a point when doctors of the next century would consider them alive and would cure them. At some point real death occurs; but we think we may actually be *preserving life* (rather than *reversing*

*death*) when we suspend patients.

It is a basic tenet of cryonics that what criteria we use to label people as "dead" at one point in history are not the same criteria we use for that label at a later point. A simple example is the modern ability to revive humans from several minutes of no circulation or breathing—a condition that was rou-

*"As cryonics matures and seems more likely to work, more traditionally religious people have also decided they want the expanded possibilities for life in the future that cryonic suspension will be able to offer."*

tinely labeled as permanently dead in the early part of this century. From that point of view, many thousands of people have been "revived from the dead."

If we use the word "death" to mean a permanent cessation of function, it is currently impossible to specify the exact instant when a patient crosses that line. Every year researchers make great strides in their abilities to resuscitate seemingly "dead" individuals, and we are a long way from reaching the limits of this technology. For example, how can we know what to label someone who is in a coma? One patient may have a nearly destroyed brain but have a heartbeat, while another may appear brain dead for months and suddenly wake up with all his memories. Each case may appear the same even to experienced neurologists, yet the outcome is quite different.

People often ask where the "soul" goes when a person dies and is frozen. If we wish to revive that person in the future, will the soul still be there? I suggest that these people need to ask that question about the people who are already being revived from "death-like" experiences. Excellent examples are the many children who have been revived from cold water drownings after thirty minutes underwater—no respiration, no circulation, no brain waves. They

appear to be dead, and fifty years ago any physician would have labeled them that way and would have made no attempt to revive them. Yet now they can survive such conditions. The record is *66 minutes* underwater by a 3-year-old, with full recovery, no apparent brain damage. The child had no electrical activity for an additional two hours after

being pulled out of the river. Did the "soul" go somewhere and come back? Did God want the child to survive?

Robert Ettinger, in his original book about cryonics, *The Prospect of Immortality*, pointed out that "no one seems to make an issue" of

where the children's souls went while they appeared to be dead. They were just happy to have their children alive. Ettinger then goes on to point out:

*Why, then, should anyone be concerned about the souls of the frozen? The mere length of the hiatus can hardly be critical; in God's view, 300 years is only the blink of an eyelash, and presents no more difficulty than 2 1/2 hours.*

*Except quantitatively, then, the problem is not new, and the religious communities have already made their decision. They have implicitly recognized that resuscitation, even if heroic measures are employed, is just a means of prolonging life, and that the apparent death was spurious.*

Another kind of medical rescue now possible is a "suspended animation" brain surgery for aneurysms. A medical team lowers the patient's body temperature to about 50°F, shunts the blood out of the patient's brain, and performs bloodless surgery on the brain for about 50-60 minutes. There are no brain waves during this time. The team then warms the individual back up and restarts the cerebral blood flow. The patient survives with his memory and personality (and presumably his "soul") intact.

One cryonics laboratory, building on what Alcor did several years ago, can now take a dog, begin cooling it, replace all the blood in its body with an organ preservation solution, cool it to about 3-4 degrees above freezing, and hold it at that temperature for *nearly six hours*. At that time the dog can be warmed and his blood reintroduced, and he survives. He still answers to his name and he knows the same commands as before. We assume that surgeons will apply similar techniques to many human operations in the next decade.

What this proves as much as anything is that we don't know much about life and death. It seems apparent that physicians of the late 21st Century will define the point of death much differently than most people do today. A doctor from the future traveling back to today would no doubt be saddened by the hundreds of thousands of patients we call dead when he could see they would be repairable with future knowledge. If this is true, then we should consider them "alive" now, and arrange to get them to that doctor in the future.

Cryonics should be viewed as an extension of clinical medicine, not a new kind of dead-body storage. The entire purpose of this technology is to save lives. From that point of view, religious beliefs are irrelevant as far as cryonics is concerned. Cryonics success would not prove or disprove Christianity, anymore than heart transplants or other life-saving treatments do.

Assuming there is a God and assuming that God created humans, then God also created our brains. He (or She) also created our curiosity and the desire to explore the limits of our existence. God apparently allowed us to develop CPR, antibiotics, heart transplants, brain aneurysm surgery, and other medical advances. It appears that if this is God's creation, it is our *duty* to continue to explore that creation and find

out what our human limits are. From this point of view, if cryonics works, God meant it to and meant us to explore it. If it doesn't work, then God didn't mean it to. As with heart transplants and other medical advances, God doesn't tell us in advance. Humans have to explore for themselves.

One of the interesting things about religious arguments is that almost everyone has their own opinions based on what they were taught; but many extend those opinions to saying they *know* what God's plan or purpose is. I don't believe anyone can know that. Anyone who did would by definition BE God. All we can do is our best and try to help each other. I choose to do so right now by helping people stay alive—or at least by giving them as much of a chance as possible.

Because of this sort of reasoning, Alcor and other cryonics groups have

*"It seems apparent that physicians of the late 21st Century will define the point of death much differently than most people do today. A doctor from the future traveling back to today would no doubt be saddened by the hundreds of thousands of patients we call dead when he could see they would be repairable with future knowledge."*

sometimes attracted suspension members who are religious. This has given us the chance to ask them about their beliefs and often to speak with their religious leaders about cryonics. (I will point out that no religious group has—as far as I know—stated an *official* position on cryonic suspension. The following ideas are from *individual* members and religious leaders.)

For example, the members of one conservative Christian family believe that God wants them to stay alive as long as possible to spread the Word. Choosing cryonics for them means doing God's work.

Orthodox Jews, Seventh Day Adventists, and some other religious groups believe that the Bible says nothing about a person's soul floating up to

Heaven when he dies. They believe the Bible tells us that when you are dead, you are completely DEAD—until the Resurrection, which means the revival and reconstitution of the physical body, including the soul. Therefore, you may as well stay alive as long as you can; when God is ready for the resurrection, it won't matter if you're alive or dead—or frozen.

There are several reasons to believe that the Catholic Church in the next century will actually view cryonics with favor. As far back as the late 1960s, a Catholic priest was photographed blessing a capsule at the Cryonics Society of New York. On at least two occasions in the 1980's, television interviewers added Catholic ethicists to cryonics programs to provide "the other side"; and the ethicists decided that they saw no conflict with Church teachings.

At some point in the late '80s, the case of some frozen fertilized embryos in Australia brought an official Vatican reaction (I don't recall if this was an official statement of the Pope, though). Fertility researchers had already proven that human embryos could be frozen in liquid nitrogen, thawed, transplanted, brought to full term, and produce normal, healthy children (the first in 1984, now many thousands worldwide). The Church's position was that these fertilized embryos had souls, were humans, and destruction of them was murder. This seemed to imply that liquid nitrogen on its own was not inimical to "soul storage."

Several years ago, I had a conversation with a prospective member who had spoken to his priest about cryonics and had gotten an interesting answer. I have since asked at least one other Catholic priest about this and was told that the answer had theological merit.

Today, if a Catholic is in a hospital with an illness for which life-saving treatment is available, some theologians



would argue that for the Catholic to *refuse* that treatment would be *willful death*—suicide. God chooses when you die, not you, and God has given you a way to survive through medicine. By extending that argument, if cryonics could be shown to work—to save lives—then choosing not to undergo cryonic suspension when current medicine cannot save you could *also* be considered willful death.

A firm answer to this question cannot be given yet, because cryonics is still experimental. Perhaps these people in cryonic suspension should be considered alive or perhaps they should be considered dead. We won't know for a very long time. But if they are really dead, then God has already taken care of their soul and it doesn't matter. A person can lose nothing spiritually by trying cryonic suspension. God does not punish people for trying to stay alive.

Neither priest could find anything inherently wrong with cryonics as a potential life-extending technology.

Back to those questions at the beginning of the article: One of the most often heard comments about cryonics, from religious and non-religious people alike, is that "death is natural." There are at least two ways to reply to that. You may recall Katherine Hepburn saying to Humphrey Bogart in *The African Queen*, "Nature, Mr. Allnut, is what we were put on this world to overcome." It is our "nature" to overcome what is "natural." "Natural" is running around naked in the woods eating roots and grubs. Our human nature (whether given by God or evolved) has led us to build homes, make tools and clothing, and invent air-conditioning, surgery, libraries, bifocals and hearing aids, Cadillacs, digital watches, and gourmet restaurants to make our lives easier, longer, and more interesting.

Another approach is to point out that rape and murder and war are also "natural." Does that mean we should not try to prevent them? Does that mean that God *wants* us to rape, kill, and bomb? Or are these actions things we must learn to overcome? If so, then why not learn to overcome dying?

In the 1800s, many whites in the

American South told black slaves that their conditions were the "natural, God-given" state of things. Further, they said that African people were naturally inferior and destined by God to be slaves of the superior descendants of Europeans. In fact, slave owners made a great deal of noise about how slaves were happier being slaves, about how slavery made them better people, even brought them closer to God. This was the equivalent of giving seminars in how to be a happy

#### **Alcor Life Extension Foundation Non-Discrimination Policy**

The Alcor Life Extension Foundation believes that every person has a right to choose and arrange for his or her own cryonic suspension and to enjoy its possible benefits of greatly extended lifespan. To this end, the Alcor Life Extension Foundation does not discriminate against any person on the basis of race, religion, color, creed, age, marital status, national origin, ancestry, sex, sexual orientation or preference, medical condition, or handicap.

However, nothing in this statement prevents Alcor from avoiding any situation that genuinely threatens the health or safety of Alcor employees, volunteers, patients in suspension, or the public, or from requiring reasonable medical evaluations in some instances where a genuine threat to health or safety may be suspected to exist, or where the legal status of an individual with regard to mental competency may be in question.

slave instead of showing them how to be FREE.

Likewise today, why give ourselves seminars in how to be happy that we will soon die? Let's learn how to be free of death instead.

"Why on God's Green Earth would someone want to be frozen and come back later?"

That's the easy one. I don't particularly want to be frozen and come back—I want not to die in the first place. But if

my condition is so poor that all other options are closed to me, I want to be placed into cryonic suspension so that I can *continue* my existence.

The question should be, "Why do you want to live indefinitely?" The answer is both easy and complex: Because I like being alive, in this form and in this identity. Because life is good and infinitely varied. There is much more to learn and experience and explore of this universe (this "creation," if you prefer) than we can do in thousands of years. Living includes thinking and studying and learning, maybe in other parts of the galaxy, comparing my observations with beings much different from myself. Perhaps people who can live a very long time will spend a lot of it examining and defining the meaning of human existence, the nature of the universe, the relevance of religion, and the existence of God. Are religions elaborate lies or tricks we have played on ourselves to remain sane in the face of death? Or does one of those hundreds of sets of beliefs that people swear are "true" actually reflect the reality of our existence before and after the event we call death?

If today we are dying and do not choose cryonic suspension—and if it turns out that this existence is all there is—then we lose the bet and no more choices are possible. If we choose to be suspended and can be revived again, we can continue to look for the answers. Death and "going beyond"—if such a thing can happen—will always be options.

It is my personal belief that all human religions most likely have evolved from our primitive fears of death and of the power of nature. I suspect there is a space in our brains that requires religion to fill it. It may be natural or it may be trained, but the near universality of the religious impulse seems to suggest that humans have an evolved need for religion, which they will fill by learning or by invention.

Cryonics itself is only a technology, not a religion. However, I will admit that for me cryonics is part of a philosophical approach (which includes

*Concluded on page 21. . .*

# Cryonics in books, recordings, and television

by Stephen Bridge

One of the signs that a new concept is becoming a normal part of society is that it appears as background for all kinds of television shows and books. For many years just about the only time cry-

onics was seen in the media was as "something really weird and creepy" or as an excuse to have zombies without souls wandering around eating really bad actors.

## Television

The trend toward cryonics acceptability on television, at least, began in 1989 with *L.A. Law*'s excellent fictional representation of the Thomas Donaldson situation (where an individual with a brain tumor asked the court for permission to be suspended before legal death). Since then, cryonic suspension has been in the plot line of *Wise Guy*, *Golden Girls*, *Mad About You*, *SeaQuest*, *The X Files*, *V.R. 5*, and even an offhand mention in *Chicago Hope*. Of course, there was also the episode of *Picket Fences* last year which was completely about cryonics. (Not to mention a hilarious one-

liner in an old episode of *The Simpsons* in which the townsfolk are contemplating how to rescue a boy who has fallen into a well. A scientist steps forward and suggests that they simply fill the well with liquid nitrogen "so he can be rescued by future generations.")

## Chiller

A few novels have taken the concept seriously in the past few years. Tops among them was Sterling Blake's thriller *Chiller* (Bantam hardcover, 1993; Bantam pb 1994). It is an exciting, well-written suspense novel wherein a killer is stalking the leaders of a cryonics organization. Now, as the leader of a cryonics organization, this makes me a tad nervous. But at least the cryonicists were the *good guys*, and with the possibility of suspension at hand, murdered good guys can sometimes get a second chance. *Chiller*'s plot is properly convoluted with many surprises, and the characters are totally believable—especially if you know a cryonicist or two yourself.

This is probably the best cryonics novel that has been written, ahead of Heinlein's *The Door into Summer*, Pohl's *Age of the Pussyfoot*, and Platt's *The Sili-*

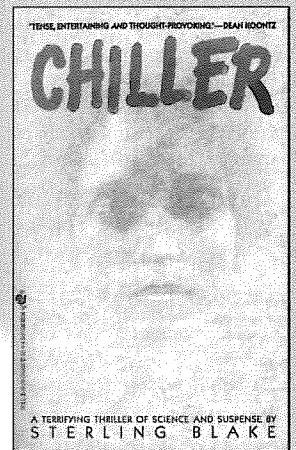
*con Man* (which is more about uploading minds into a computer anyway).

Blake is a writer who took the time to understand cryonics and to visit cryonics labs. He was even nice enough to put Alcor's phone number and address in the acknowledgements. This courtesy has gotten Alcor quite a number of information requests and at least two members.

We have heard that *Chiller* is likely to be out of print soon (unless a film is made), so we have ordered extra copies of the paperback. See the ad elsewhere in this issue to find out how you can order a copy for yourself.

## Solis

Another recent novel which has already resulted in several requests for cryonics





information is *Solis* by A. A. Attanasio (Harper Collins hard cover, 1994; Harper Prism pb. 1994.) This science fiction novel is about Charlie Outis—"Mr. Charlie"—whose brain was frozen in the early 21st century and thawed one thousand years later. Unfortunately, ex-frozen brains have become property in most places by then, so Mr. Charlie becomes the "brains" of a robot factory on an asteroid. Being an isolated brain is fairly boring; so Mr. Charlie sends out a message to whomever will listen. Who listens are an android and one of the last Earth humans. They rescue him (or "steal him," depending on your point of view) and make a dash for Mars—where life *really* gets strange for Mr. Charlie.

In his futuristic tale, Attanasio deals with the questions we frequently ask ourselves: what is "human"? Can anyone "own" another person's brain? What will happen if we get brought back in the future? I don't always like his *answers*, mind you. I think we are likely to be treated a lot better than Mr. Charlie when we are revived; but I also recognize the writer has to have a plot with conflict.

Attanasio also gives Alcor's address and phone number, for which we are grateful. However, if you should give this book to someone, please note that the address is Alcor's old one in Riverside (it's not *too* bad; we paid extra to have the mail forwarded for at least one more year). The toll-free number is correct; but two typos have rendered impossible the number for use outside the U.S. Just write in our correct number before you give the book to others.

#### Other Book mentions

*Mirror Dance*, a science fiction novel by Lois McMaster Bujold (Baen Books hardcover 1994; Baen paperback 1995) depends on cryonics for part of its plot. Miles Vorkosigan is severely wounded in a battle and is placed in suspension. His clone brother Mark is forced to take on some of the roles of Miles, including meeting Miles' (and his?) parents for the first time. Bujold is already a two-time winner of the Hugo Award for best SF novel. This book has also been nominated for this year's honors, so a lot more people will get a subtle reminder that cryonics is a *positive* breakthrough. This series is deservedly one of the most popular in SF, with clever use of technology, some of the best-written characters in the field, and a great sense of fun.

Ed Regis, author of *Great Mambo Chicken and the TransHuman Condition*, which included quite a few pages on Alcor, has written a new non-fiction book, *Nano: the emerging science of nanotechnology: remaking the world—molecule by molecule*. The book was just published by Little, Brown (1995) and appears to be more a biography of Eric Drexler than a detailed examination of nano-engineering. We'll review it in a future issue.

You hate to see this old idea one more time, but frozen Nazis try to take over the world again, this time in Allan Folsom's suspense/spy novel, *The Day After Tomorrow* (Little, Brown, 1994). Actually, while the cryonics aspects are pretty darn silly, the novel is a very exciting read. An American physician visiting Paris sees the man who murdered his father twenty-five years earlier and tries to kill him. And a retired Los Angeles detective—a specialist in serial murders—is called in to advise Interpol on a strange case. Bodies with the heads surgically removed are being found in odd places all over Europe, and (horrors!) they seem to have been frozen to near absolute zero and then thawed. The two crimes are connected, of course, through a spiderweb of plot twists. As the doers of evil find out that the detective and the doctor are on their trail, gunplay ensues, and dead bodies (mostly *with* their heads) pile up at every con-

ceivable angle in every corner with six feet of space.

If you don't mind the violence, it's all a lot of adrenaline-pumping fun. Folsom is also a screenwriter, and the movie possibilities are obvious. Still, I couldn't help grimacing at the basic plot flaw: if the Nazis have so many billions of dollars available to them, with a spy seemingly in every hotel, police station, and bathroom in Europe, why didn't they think to buy a mortuary to cremate those headless bodies?

#### Music

Finally, there is the compact disk that we missed telling you about last year. Karen Hart, a Southern California singer, has recorded a jazzy album called *Put Me in a Box*. The title song cheerfully asks for the listener to "Put me in a box, put me in a deep freeze. Put me in a box 'till my blood stops." Yes, that's about cryonics. She goes on to sing, "Wake me up when things warm up around here; wake me up when we're seeing clear."

Ms. Hart's letters and conversations suggest that she is fascinated by cryonics and that she hopes her song will bring the idea to many people outside of our traditional membership areas. If you would like to purchase this entertaining record, you may send \$15.00 (\$20.00 outside of the U.S.) to Karen Hart at 3513 May Street, Los Angeles CA 90066-3003.





## William Godwin as Pioneering Futurist

*"The sum of the arguments ... here offered amounts to a ... presumption that the term of human life may be prolonged, ... by the immediate operation of intellect, beyond any limits which we are able to assign."*

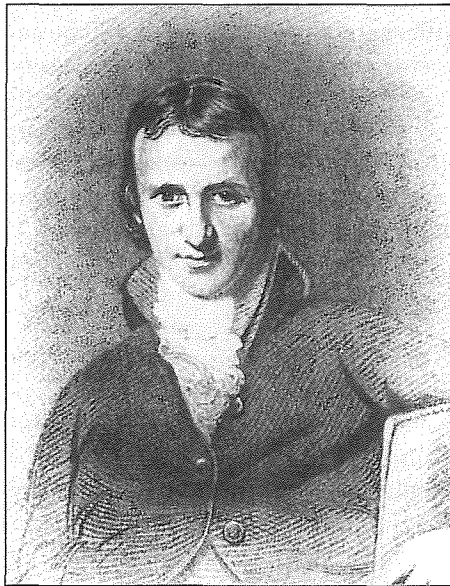
*—William Godwin*

The cryonics movement has existed for three decades—not very long on the scale of history. Before that, however, people were not indifferent to the issues cryonics attempts to address. Most importantly this includes the idea of progress, and specifically, the progress of the human race to something more than human, with mortality and diseases put aside. In contemplating the means that would be used to effect the transition from mortal to immortal, people most commonly looked to a power beyond the human level. A benevolent God would solve the difficult problem for us, grant the conventional wisdom, and bring about the fulfillment of our ancient dreams. A minority opinion, however, focused on unassisted human efforts as the likely means for *all* advances in the human condition. In the eighteenth century such thinking became more widespread as science and industrialization progressed. One of its chief proponents was the English political philosopher and novelist William Godwin (1756-1836) who wrote an influential book advocating anarchy, that also speculated about future advances, including lengthening the human lifespan.

Godwin was brought up by a strict Calvinist father and, a precocious child,

by the age of eight had decided to become a minister. Although this may seem hardly radical to us, we should remember that in England Calvinism was a “dissenting” faith. Many privileges were denied its practitioners that were open to those of the state-supported (Anglican) Church. Municipal and government jobs were forbidden, for example, as was attendance at major universities such as Oxford and Cambridge. To the latter the dissenters responded by establishing their own institutions of learning, which, like Hoxton Academy which Godwin attended, acquired a reputation for excellence. Among their virtues was to encourage free inquiry, which the young Godwin took to heart. His resolve on a profession lasted long enough that in his twenties he did become a candidate minister, but his views were too radical for his congregations and this career came to a rocky close by 1783. After that he devoted himself to writing.

In 1792 he embraced atheism, and in the following year brought out the first edition of *An Enquiry Concerning Political Justice*. It is for this book, along with a propagandizing novel (*Caleb Williams, or Things as they Are*, 1794), that Godwin is chiefly remembered today. *Political Justice*, which runs to over 700 pages in a modern (Penguin) edi-



William Godwin in 1794

tion, is a spirited attack on the evils of government in all their forms, with the abolition of all government as the proposed remedy. Instead of coercion imposed from without, then, enlightened mankind would impose restraints from within, obviating both the need for and misuse of force against former citizens of countries, who now would form a common humanity, devoid of national or other partisan divisions. Each individual could then direct unencumbered efforts toward *enlightened* self-interest, which would translate to (1) each showing sincere benevolence toward all, and (2) a vast improvement in the overall human condition.

Godwin did not advocate the use of violence to achieve the transformation to enlightened society, but felt that it could be accomplished by peaceful and constructive means. In the words of anarchist historian James Joll, "starting from the commonplaces of eighteenth century philosophical belief," the book "elaborated the most complete and worked-out statement of rational anarchist belief ever attempted, a philosophy of anarchism carried through to its logical conclusions, however surprising and absurd these might be." The immediate effect of the book was to establish Godwin's reputation as among the foremost sages of his time. To William Hazlitt, a contemporary, "no one was more talked of, more looked up to, more

sought after, and wherever liberty, truth, justice was the theme, his name was not far off ..."

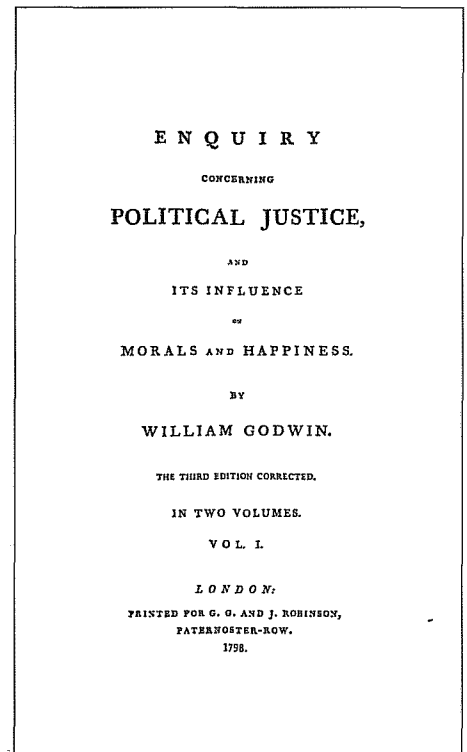
This preeminence was short-lived, however. The excesses of the French Revolution soon revolted many thinking people who had looked for human betterment in the abolition of old institutions. More generally, there was doubt about Godwin's confident assertions such as, "In proportion as weakness and ignorance shall diminish, the basis of government will also decay." Leslie Stephens, a later critic, would write, "He must have been a quiet and amiable dreamer, able to ignore all inconvenient facts, whose opinions were too deeply rooted in abstract speculation to be upset by any storms raging in the region of concrete phenomena." *Political Justice*—and its author—fast fell into obscurity; however, the world has not entirely forgotten. Godwin's idealistic philosophy is still studied and respected today, and much of it will be found agreeable to serious individualists, including a large fraction of our own camp of cryonicists.

Let's turn now to Godwin's ideas concerning the prolongation of human life, which occupy several appendix pages of *Political Justice*. Despite his idealism, Godwin was under no illusions that, writing as he was in the 1790s, any big breakthroughs in life extension were imminent. He offered this portion, then, "as eminently a deviation into the land of conjecture," and to reassure readers added, "If it be false, it leaves the system to which it is appended, in all sound reason, as impregnable as ever."

Why, then, did Godwin see fit to add this little appendix, seeing that it clearly *was* so highly speculative and moreover, not necessary to his philosophical system? The reason, in large part, seems to be that Godwin was most ironically using the possibility of life extension to *counter* the argument that attempts at generally improving the human condition must be defeated by the extra population that would follow. (His arguments in turn would soon be answered at length by Malthus in the first edition of his famous book, whose full title is *An Essay on the Principle of*

*Population as it affects the Future Improvement of Society, with Remarks on the Speculations of Mr. Godwin, M. Condorcet, and other Writers.*) Godwin's remarkable position anticipates immortalist thinking that many still find disturbing and puts him among the ranks of transhumanists.

Before turning to this, though, I'll say something about the means Godwin envisaged for lengthening life. Here his idealism and dreaminess are given free reign, and his speculations, though interesting, must not be pressed too much for detail. He is aware too that others have offered favorable opinions on the subject, such as Condorcet and before him, Francis Bacon. These "have inclined to rest their hopes ... upon the growing perfection of art," or what we would call technology. Godwin instead starts with "the sublime conjecture of Franklin, a man habitually conversant with the system of the external universe, that 'mind will one day become omnipotent over matter.'" Franklin, in so remarking, had in mind the use of the mental faculties to create labor-saving machinery and other such benefits, but Godwin imagines applying our talents



Title page of *Political Justice*, vol. 1, 1798

to our own minds and bodies. (Franklin, in other writings, also showed he anticipated the ending of aging, however; see my column in *Cryonics*, Jan. '91 p.11.) The modern reader may be struck by the thought that actually we too—our bodies and minds—are a kind of technology, which should be amenable to modification much as human technology is now changed and improved. So Godwin's position may not be so much at variance as he thought with hopes resting "upon the growing perfection of art."

At any rate, his starting point for lengthening life is a healthy mental attitude and happy disposition, which are known to help ward off sickness and promote physical well-being. Attitude is important in the aging process too; a significant factor in growing old, Godwin urges, is "the cares that rise out of our mistaken institutions" whose abolition, then, would put us on the road to extra lifespan. More generally he imagines an "intellectual" branch of medicine, which "has been infinitely too much neglected." When this is appropriately developed, prodigious feats of control and improvement of physiological processes should follow. "The sum of the arguments which have been here offered amounts to a species of presumption that the term of human life may be prolonged, and that by the immediate operation of intellect, beyond any limits which we are able to assign."

Godwin is vague throughout on details of a more conventional nature, medical or biological, that would extend the lifespan. However there is no doubt that he foresaw the indefinite prolongation of life through a rational, non-mystical process. He saw it too as profoundly beneficial. "A habit," Godwin tells us, "peculiarly favorable to corporeal vigour is cheerfulness," and, "The surest source of cheerfulness is benevolence." This provides a vital link between the lengthening of life and the role a person is to play in future society, in which the advantage of the individual works to the good of all. Finally, there is the remarkable passage I alluded to ear-

lier, in which Godwin imagines a future society with lives indefinitely prolonged. (He resists the term "immortality" on ground that its meaning is unclear, but effectively his future is a world of immortals.) In this utopian vision population will reach its proper limits and then remain constant, while all enjoy an ideal and mutually beneficent existence.

"The men therefore whom we are supposing to exist, when the earth shall refuse itself to a more extended population, will probably cease to propagate. The whole will be a people of men, and not of children. Generation will not succeed generation, nor truth have, in a certain degree, to recommence her ca-



Mary Godwin Shelley, author of *Frankenstein*, in 1841

reer every thirty years. Other improvements may be expected to keep pace with those of health and longevity. There will be no war, no crimes, no administration of justice, as it is called, and no government. Beside this, there will be neither disease, anguish, melancholy, nor resentment. Every man will seek, with ineffable ardour, the good of all. Mind will be active and eager, yet never disappointed. Men will see the progressive advancement of virtue and good, and feel that, if things occasionally happen contrary to their hopes, the miscarriage itself was a necessary part of that progress. They will know that they are members of the chain, that each has his

several utility, and they will not feel indifferent to that utility. They will be eager to enquire into the good that already exists, the means by which it was produced, and the greater good that is yet in store. They will never want motives for exertion; for that benefit which a man thoroughly understands and earnestly loves he cannot refrain from endeavouring to promote."

A passage like this, of course, is sure to provoke the criticism of being an unrealistic daydream, especially among opponents of the idea of life extension. But I submit that, with one small change of terminology, it accords with what many of us immortalists have imagined for an attainable and desirable future. That is, we must replace "men" with "more-than-humans" or some such phrasing. Godwin is not talking here about the species *homo sapiens* which arguably could no more sustain an ideal, anarchic society than a crew of monkeys could operate a cruise vessel. He is instead referring to what our species will hopefully develop into, when advancing understanding makes possible the elimination of death and other impediments to a rewarding existence. What life will become then, we can scarcely imagine, except that *some* of the possibilities ought to be wonderful indeed. This, I think, is a very good reason to be in cryonics.

The third and definitive, final edition of *Political Justice* appeared in 1798. Godwin's later life was less eventful, in terms of lasting influence, but a few particulars are of interest from an immortalist standpoint. His political radicalism, so thoroughly articulated in his famous book, he eventually largely repudiated. He continued, however, to defend with vigor his views on the improvement and extension of human life against the likes of Malthus. From atheism he was finally led back to religion—in the form of pantheism. And his daughter Mary, nurtured in part on his well-voiced opinions, produced the first science fiction classic, *Frankenstein; or, The Modern Prometheus* (1818).

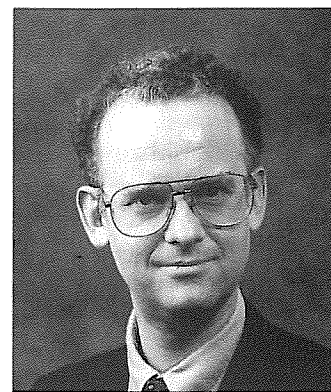
*Concluded on page 21. . .*

# Cryonics,

# Cryptography,

# and

# Maximum Likelihood Estimation



Ralph Merkle, Ph.D.

Reprinted from *Proceedings of the First Extropy Institute Conference on Transhumanist Thought*

Most people, if they think of cryonics at all, think of Woody Allen in *Sleeper*, Sigourney Weaver in *Aliens*, or Mel Gibson in *Forever Young*. The hero, after spending decades or centuries in the deep freeze, thaws out gradually and some what painfully. Rather stiff from the cold, the warmth of the new era slowly penetrates into their chilled limbs until they at last stretch

and look about the world with renewed interest and vitality.

Not!

The damage done by the cryonic suspension (and the probably poor condition of the patient before the suspension even began) are quite sufficient to insure that nothing even remotely resembling these scenarios will ever take place. First, there are fractures in the frozen tissues caused by thermal strain—if we warmed our hero up, he'd fall into pieces as though sliced by many incredibly sharp knives. Second, suspension is only used as a last resort: the patient is at least terminal and current social and

legal customs require that the patient be legally dead before suspension can even begin. While the terminally ill patient who has refused heroic measures can be declared legally dead when he could in fact be revived (even by today's technology), we're not always so lucky. Often, there has been some period of ischemia (loss of blood flow), and the tissue is nowhere near the pink of health. The powerhouses of the cells, the mitochondria, have likely suffered significant damage. *Flocculent densities* (seen in transmission electron microscopy) likely mean that the internal membranes of the mitochondria are severely dam-

aged, the mitochondria themselves are probably swollen, and cellular energy levels have probably dropped well below the point where the cell could function even if all its biochemical and metabolic pathways were intact. The high levels of cryoprotectants used in the suspension (to prevent ice damage) have likely poisoned at least some and possibly many critical enzyme systems. If the

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cryoprotectants didn't penetrate uniformly (as seems likely for a few special regions, such as the axonal regions of myelinated nerve cells: the myelin sheath probably slows the penetration of the cryoprotectant), then small regions suffering from more severe ice damage will be present.

All in all, our hero is not going to simply thaw out and walk off.

And yet the literature on freezing injury, on ischemia, and on the other damage likely caused by a cryonic suspension forced me to conclude that cryonics would almost surely work: how can this be?

Fundamentally, people are made of molecules. If those molecules are arranged in the right way, the person is healthy. If they're arranged in the wrong way, the person is unhealthy or worse. While a surgeon's knife does indeed rearrange molecular structure, it does so only in the crudest fashion. The living tissue itself is what really arranges and rearranges the intricate and subtle molecular structures that underlie life and health. When the tissue is too badly damaged, when intracellular levels of ATP are too low to provide the energy the tissue needs to function, when its own internal structure is disrupted, it can no longer heal itself. Today's surgical tools, gross and imprecise at the cellular and molecular level, can no more aid in this process than a wrecking ball could be used to repair a Swiss watch.

Technology advances, though. The "Third Foresight Conference on Molecular Nanotechnology" (Palo Alto, 1993) was attended by almost 200 research scientists, chemists, computational chemists, physicists, STM researchers, and other research scientists from a range of disciplines. By a show of hands, almost all think we will develop a general ability to make almost any molecular structure that we want, including a broad range of molecular tools and

molecular machines. Over half think this technology will be developed in the next 20 to 40 years. A medical technology based on such molecular tools will quite literally be able to arrange and rearrange the molecular structure of the frozen tissue almost at will. The molecules in frozen tissue are like the bricks in a vast lego set, bricks which in the future we will be able to stack and un-

*"A medical technology based on molecular tools will quite literally be able to arrange and rearrange the molecular structure of frozen tissue almost at will."*

stack, arrange and rearrange as we see fit. We will no longer be constrained by the gross and imperfect medical tools that we use today, but will instead have new tools that are molecular both in their size and precision. Repair of damage, even extensive damage, will simply not be a problem. If molecules are in the wrong places, we will move them to the right places, hence restoring the tissue to health.

This ability, awesome as it will be, will not let us cure all injuries. Before we can move a molecule to the right place, we must know what the right place is. This is not always obvious. Consider, for example, what happens when we cremate a person and stir the ashes. There's more than damage. We can't tell where anything was nor where it should go. We haven't a clue as to what the person looked like, let alone the structure of the tissues in their nervous system. This kind of damage will be beyond even the most advanced medical technology of the future. A person who has been cremated is truly dead, even by the criteria of the 21st or 22nd century.

This true and final death is caused by loss of information, the information

about where things should go. If we could describe what things should look like, then we could (with fine enough tools, tools that would literally let us rearrange the molecular structure) put things right. If we can't describe what things should look like, then the patient is beyond help. Because the fundamental problem is the loss of information, this has been called *information theoretic death*. Information theoretic death, unlike today's *clinical death*, is a true and absolute death from which there can be no recovery. If information theoretic death occurs then we can only mourn the loss.

It is essential that the reader understand the gross difference between

death by current clinical criteria and information theoretic death. This is not a small difference of degree, nor just a small difference in viewpoint, nor a quibbling definitional issue that scholars can debate; but a major and fundamental difference. The difference between information theoretic death and clinical death is as great as the difference between turning off a computer and dissolving that computer in acid. A computer that has been turned off, or even dropped out the window of a car at 90 miles per hour, is still recognizable. The parts, though broken or even shattered, are still there. While the short term memory in a computer is unlikely to survive such mistreatment, the information held on disk will survive. Even if the disk is bent or damaged, we could still read the information by examining the magnetization of the domains on the disk surface. It's not functional, but full recovery is possible.

If we dissolve the computer in acid, though, then all is lost.

So, too, with humans. Almost any small insult will cause *clinical death*. A bit of poison, a sharp object accidentally (or not so accidentally) thrust into



a major artery, a failure of the central pump, a bit of tissue growing out of control: all can cause *clinical death*.

But information theoretic death requires something much worse. Even after many minutes or hours of ischemia and even after freezing we can still recognize the cells, trace the paths of the axons, note where the synapses connect nerve cell to nerve cell—and this with our present rather primitive technology of light and electron microscopy (which is a far cry from what we will have in the future).

It is interesting to note that “The classical methods for tracing neuronal pathways are histological methods that detect degenerative changes in neurons following damage. These staining methods provide a remarkably accurate picture of neuronal projections in the central nervous system” [5, page 262]. Such degenerative changes typically took days or weeks to develop. In many cases, the actual nerve fiber need not be present at all: “Some injuries, such as the crushing of a nerve, may transect peripheral axons but leave intact the sheath that surrounds it. In such injuries the sheath may act as a physiological conduit that guides regenerating axons back to their targets” [5, 264]. Thus there are multiple sources of information about neuronal connectivity, the actual neuron being only one such source.

If we can tell where things should go, then we can in principle (and eventually in practice) restore the patient to full health with memory and personality intact.

How can we tell if information theoretic death has taken place? How can we tell if someone has been so injured that they are beyond all help, both today and in the future? The medically accepted method of evaluating any proposed treatment is to conduct clinical trials: try it and see if it works. The appropriate clinical trials to evaluate cryonics

are easy to describe:

- (1) Select N subjects.
- (2) Freeze them.
- (3) See if the medical technology a century (or more) from now can indeed revive them.

The clinical trials are ongoing (contact Alcor at 800-367-2228 if you wish to join the experimental group—no action is needed to join the control group), but we don’t expect the results to be available for many decades. Which leaves us with a problem: what do we tell the terminally ill patient prior to the completion of clinical trials?

This is not an entirely novel situation for the medical community. Often, new and promising treatments are undergoing clinical trials at the same time that dying patients ask for them. There is no easy answer, but in general the potential benefits of the treatment are weighed against the potential harm, using whatever evidence is currently available as a guide.

In the case of cryonics, the potential harm is limited: the patient is already legally dead. The potential benefit is great: full restoration of health. The medically conservative course of action is to adopt the strategy that poses the least risk to the patient: freeze him. If there is any chance of success, then cry-

*“The medically conservative course of action is to adopt the strategy that poses the least risk to the patient: freeze him. If there is any chance of success, then cryonic suspension is preferable to certain death.”*

onic suspension is preferable to certain death. This is also in keeping with the Hippocratic oath’s injunction to “do no harm.”

If cryonics were free there would be no dilemma and no need to examine its potential more carefully: we would sim-

ply do it. It is not free, and so we must ask: how much is it worth? What price should we pay? Part of this question can only be answered by the individual: what value do we place on a long and healthy life starting some decades in the future? How many dollars would we pay to see the future?

We will leave these rather difficult questions to each individual, and confine ourselves to a simpler question that is more accessible to analysis: what is the likelihood that current suspension methods prevent information theoretic death?

For information theoretic death to occur we would have to damage the neuronal structures badly enough to cause loss of memory or personality. The structures that encode short term memory seem particularly sensitive: they are likely not preserved by cryonic suspension. The electrochemical activity of the brain is stopped when the temperature is lowered significantly (as in many types of surgery that are done after cooling the patient) so it is certainly stopped by freezing, with probable loss of short term memory. But human long term memory and the structural elements that encode our personality are likely to be more persistent, as they involve significant structural and morphological changes in the neurons and particularly in the synapses between neurons. Thus, we would like to know if the structures underlying human long term memory and personality are likely to be obliterated by freezing injury.

The evidence available today suggests that the freezing injury and other injuries that are likely to occur

in a cryonic suspension conducted under relatively favorable circumstances are unlikely to cause information theoretic death.

Not all cryonic suspensions are conducted under “favorable circumstances;” some circumstances have been

decidedly unfavorable. When should we give up? How much damage is required to obliterate memory and personality in the information theoretic sense? What level of damage is sufficient to produce information theoretic death?

Which brings us to cryptanalysis: the art and science of recovering secret messages after they have been deliberately distorted and twisted, ground up and then ground up again by a series of cryptographic transformations carefully designed to obscure and conceal the original message. In cryptography, the person who wants to send a secret message transforms it. The Caesar cipher, for example, changed each letter in the message by "adding" a constant. "A" becomes "C", "B" becomes "D," etc. Modern cryptographic systems are more complex, but the principle remains the same.

Of course, enciphered messages are meant to be deciphered. We know that each step in the scrambling process, each individual transformation that turns "Attack at dawn!" into "8dh49s-lkghwef" is reversible (if only we knew the key...). Surely this makes freezing and ischemia different from cryptography! However, the basic "transformations" applied in a cryonic suspension are the laws of physics: a physical object (your body) is frozen. The laws of physics are reversible, and so in principle recovery of complete information about

the original state should be feasible.

Of course, reversibility strictly applies only in a closed system. When we freeze someone, there is random thermal agitation and thermal noise that comes from the rest of the world: this source of random information is not available to the "cryptanalyst" trying to "decipher" your frozen body (the "encrypted message"). In cryptanalysis, though, we don't know the key (which, as far as the cryptanalyst is concerned, is random information mixed in with the plaintext). In addition, many cryptographic systems add random information to the plaintext before encryption to make the cryptanalyst's job more difficult.

So the question of whether or not we can revive a person who has been frozen can be transformed into a new question: can we cryptanalyze the "encrypted message" that is the frozen person and deduce the "plain text" which is the healthy person that we wish to restore? Are the "cryptographic transformations" applied during freezing sufficient to thwart our cryptanalytic skill for all time?

It is commonplace in cryptography for amateurs to announce they have invented the unbreakable code. The simple substitution cipher was once described as utterly unbreakable[1]. Substitution ciphers can be broken quite trivially, as we are now aware.

This weakness is not confined to

amateurs. The German Enigma, to which the Nazi's war machine trusted its most sensitive secrets, was broken by the Allies despite Nazis scientist's opinion that it was unbreakable[1].

It is also well known that erasing information can be much more difficult than it seems. The problem is sufficiently acute that Department of Defense regulations for the disposal of top secret information require destruction of the media. (This poses an interesting question: if a person with a top secret clearance is cryonically suspended, is this a violation of security regulations? Would their cremation be required to insure destruction of the information contained in the their brain?)

Against this backdrop it would seem prudent to exercise caution in claiming that freezing, ischemic injury, or cryoprotectant injury result in information theoretic death (and hence that cryonics won't work). Such prudence is sometimes sadly lacking.

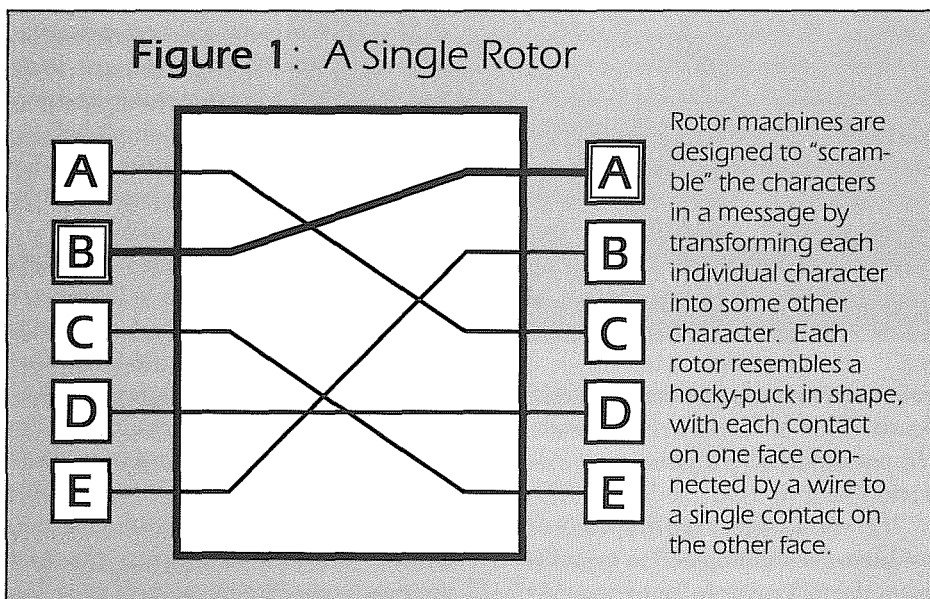
We now consider a particular method of cryptanalysis, the application of Maximum Likelihood Estimation (MLE), and discuss how it might be applied to frozen tissue.

The purpose of MLE is to determine the most probable configuration of a system, given many individual (and possibly correlated) observations about the state of that system.

MLE has been applied to World War II rotor machines[2]. While the connection between cryptanalysis of rotor machines and inferring the neuronal structure of frozen tissue might at first be obscure, the parallels are often compelling.

Rotor machines are designed to "scramble" the characters in a message by transforming each individual character into some other character. Rotor machines use a more complex transformation than the Caesar cipher. In particular, they use a series of rotors. Each rotor, which resembles a hockey-puck in shape, is a short cylinder with 26 contacts on each face (for a total of 52 contacts on the rotor). Each contact on one face is connected by a wire to a single contact on the other face. If we assign the letters A through Z to the contacts on

Figure 1: A Single Rotor



one face, and do the same to the contacts on the other face, then connecting the "P" on one face to a battery might make a voltage appear on (for example) the "H" on the other face. A single rotor thus is a hard-wired permutation of the 26 letters.

In the illustrations, we will pretend that the alphabet has not 26, but only 5 characters: A, B, C, D and E. This will make the examples that follow much more manageable. The reader should be aware that real rotor machines have the full 26 characters and contacts, and that we use 5-letter rotors only to illustrate the concepts.

A single 5-letter rotor is illustrated in **Figure 1**. The illustration shows the input "B" as active, producing an output "A".

If we put several rotors next to each other (like a stack of coins), the contacts on one rotor will make electrical contact with the contacts on the adjacent rotor. If we apply a voltage to the letter "E" on the first rotor in the stack, we will be able to read off the voltage from some contact on the last rotor. The electrical signal, instead of going through a single wire in a single rotor, will have travelled through several wires in several rotors. Connecting the 5 contacts on the last rotor to 5 light bulbs, we can see at a glance which output has been activated by our input signal.

If we just stack several rotors together and pass an electrical signal through the stack, the result is actually no more complex than a single rotor, e.g., one rotor with the proper wiring would produce the same permutation as a series of rotors. The value of using several rotors becomes apparent if we rotate individual rotors by different amounts, thus changing the electrical connections in a complex and difficult to analyze fashion. Various mechanical contrivances have been used to move the different rotors by different amounts, but the important point here is that the result is a complex and changing network designed to defy cryptanalysis.

The application of MLE to cryptanalysis of a multi-rotor system is rather interesting. We assume, for the moment, that the series of motions that

each rotor goes through is known (which is usually true for such machines) but that the pattern of wiring in the individual rotors is unknown. Thus, we don't know which contacts on opposite faces of the rotor are connected, although we know the general structure of the machine.

Rotor machines usually came with a set of pre-wired rotors. By selecting which rotors were used and by setting the initial rotational position of each rotor in the machine, the user could select a unique and hopefully difficult-

*"If the 'plaintext' produced by a proposed solution is 'rough,' i.e., the distribution of letters has the unlikely peaks and troughs of English text, then the proposed solution is very likely right."*

to-cryptanalyze cipher. In what follows, we will simply assume that the permutation described by the wiring of each rotor is initially completely unknown, and will not attempt to take advantage of the fact that each permutation was in fact drawn from a relatively small set of possibilities.

The information typically available to the cryptanalyst is the ciphertext. Fundamentally, to determine the plaintext from the ciphertext the plaintext must contain redundancy. In English, for example, "e" is more common than "b". If the cryptanalyst pro-

poses a set of wirings for the rotors and says "Aha! This is the solution!" then we would expect, upon deciphering the ciphertext, that there would be more "e"s than "b"s. If, when we deciphered the message, we found that "e" and "b" were equally common (particularly for a long message) then we would likely conclude that the cryptanalysis was incorrect.

More generally, if the frequency distribution of the 26 letters obtained by "deciphering" the ciphertext with a proposed solution is "smooth," i.e., if the distribution could reasonably have been produced by chance assuming that all 26 characters were equally likely, then the proposed solution is almost certainly wrong. If, on the other hand, the "plaintext" produced by a proposed solution is "rough," i.e., the distribution of letters has the unlikely peaks and troughs of English text, then the proposed solution is very likely right.

It would seem, however, that to use this "smooth" versus "rough" method, we would have to try all the different possible rotors until we found the right ones. The wiring in a single rotor encodes one of 26! (twenty-six factorial, i.e.  $26 \times 25 \times 24 \times \dots \times 2$ ) different permutations, and three such rotors encodes  $26! \times 26! \times 26!$  different possibilities. Simple exhaustive search would be rather expensive.

The problem that we face (common in cryptanalysis) is that the possible keys are discrete, and different keys produce very different results. Thus, a "small" change to a single rotor might produce a big (and hard to predict) change in the deciphered message.

This can be overcome by mapping the discrete cryptanalytic problem into a continuous cryptanalytic problem.

In the discrete case, either "a" is connected to "c" or it is not. There is no halfway about it, no partial connection. In the continuous problem, we will represent our state of knowledge of the rotors by allowing "partial" or "probabilistic" connections. We might have a 40% chance that "a" is connected to "c," and a 60% chance that "a" is connected to "e". Or there might be a 20% chance that "a" is connected to "c," a

33% chance that "a" is connected to "e", a 12% chance that "a" is connected to "b", an a 35% chance that "a" is connected to "d".

More generally, we can assign probabilities that any letter is converted to any other letter. For our 5-character alphabet, we can assign a probability to the connection between "a" and "a", "a" and "b", "a" and "c", "a" and "d", and finally "a" and "e". This would give us a vector of probabilities, such as: (10%, 20%, 30%, 40%, 0%). Instead of percentages, we will adopt fractions, so that the preceding vector will be denoted by (0.1, 0.2, 0.3, 0.4, 0.0).

If we wish to describe the connections between all five input characters and all five output characters, we will need five vectors. Thus, we can describe a single rotor using a 5x5 matrix, as illustrated in Figure 2. The particular rotor described in figure 2 is actually a specific real rotor (the rotor described in figure 1), for each row and each column of the matrix has a single 1 with all other entries being 0. The "1" in row A column C means that the input A is connected by a wire to the output C. This matrix notation lets us describe all possible real rotors.

The great advantage of this notation is that it also lets us describe our uncertainty about a rotor. For example, if we don't know which wire is connected to

what (the state of affairs when we begin cryptanalysis) then we could use the matrix of Figure 3. In this matrix, all the entries are 0.2. That is, any input is equally likely (a priori) to be connected to any output. We don't know what's connected to what, and this uncertainty is captured by the matrix. The reader should note that this matrix does not correspond to any "real" rotor. In some sense, it describes the probability that a specific physical rotor is the "right" rotor (physical rotors are rotors whose matrix has a single "1" in every row and column, with all other entries being "0").

How does this help solve our original problem? Yes, we can now use the three "we don't know what's connected to what" rotors of figure 4 as the rotors in our machine, but what does this gain us? How do we "decipher" the ciphertext, and how do we decide if the resulting "plaintext" is smooth or rough?

When we decipher a given letter with a physical rotor, the result is another letter. When we decipher C we get A. When we decipher a letter with a matrix, we get a probability distribution over all letters. When we decipher C we might get a 20% chance of an A, a 10% chance of a B, a 30% chance of a C, a 15% chance of a D, and a 25% chance of an E. In vector notation, we get (0.2, 0.1, 0.3, 0.15, 0.25). When we decipher many

letters with a physical rotor, we get a probability distribution over our alphabet. When we decipher many letters with a non-physical matrix, we also get a probability distribution over our alphabet. We know how to measure "roughness" and "smoothness" in a probability distribution: if all the letters are equally probable, the distribution is "smooth". If the letters are not equally probable, the distribution is "rough".

Our method of cryptanalysis is now clear. We start by assuming non-physical rotors (as in figure 3) which represent our initial state of knowledge: all permutations are equally likely. We can "decipher" the ciphertext with these rotors, and compute the distribution. Initially, of course, the resulting "plaintext" distribution is smooth. We can now make a small perturbation in our matrix. We might, for example, make the connection between A and C slightly more likely, while making other connections slightly less likely. We can again decipher our ciphertext with this new (slightly modified) rotor. If the distribution of the resulting plaintext is still smooth, we're no closer to the answer. If the distribution is somewhat rougher, then we're moving in the right direction.

In short, we can now make small changes and ask "Are we moving in the right direction?" If the distribution of

Figure 2:

A 5x5 matrix describing the rotor from Figure 1.

		Ciphertext				
		A	B	C	D	E
Plaintext	A	0	0	1	0	0
	B	1	0	0	0	0
	C	0	0	0	0	1
	D	0	0	0	1	0
	E	0	1	0	0	0

Figure 3:

A 5x5 matrix describing a rotor about which we have no information.

		Ciphertext				
		A	B	C	D	E
Plaintext	A	0.2	0.2	0.2	0.2	0.2
	B	0.2	0.2	0.2	0.2	0.2
	C	0.2	0.2	0.2	0.2	0.2
	D	0.2	0.2	0.2	0.2	0.2
	E	0.2	0.2	0.2	0.2	0.2

plaintext is rougher than it was, the answer is "yes!" If the distribution of plaintext is smoother than it was, the answer is "no!" Instead of playing a game of hide-and-seek where you only know if you've found the answer when you actually stumble on it, we're now playing a game where we can take a few steps and ask "Am I getting warmer or colder?" As the reader might appreciate, this makes the cryptanalysis much easier.

There is actually greater sophistication in picking "good" directions than is described here, but the additional mathematics involved is all based on the same concept: we can tell when we're getting warmer or colder, and move in the appropriate direction.

This type of method has been used to successfully cryptanalyze rotor machines with three independent rotors over an alphabet of 26 characters on a rather small computer in the late 1970s[2]. A larger computer should be able to handle more than three rotors, although as the number of rotors increases the cryptanalysis rapidly becomes more difficult. Generally, methods like this either succeed or fail completely. If there is sufficient information for the algorithm to start moving in the right direction, it will usually succeed. If things are so confused that it can't even make an incremental improvement, then it will fail utterly amid data that is totally confusing.

How might this be applied to cryonics? In general, frozen tissue can be analyzed to determine its structure. The most information that can usefully be obtained about the frozen structure is the location of each atom. (Purists might argue that we also need information about electronic structure, but the electronic structure can almost always be inferred from the locations of the nuclei. For those few cases where this might not be the case, some additional information might be used, e.g., the state of ionization of an atom.) Future technologies will almost certainly be able to give us information about the frozen tissue that approaches this limit: we will know the coordinates of essentially every atom when we begin our "cryptanalysis". Even today, SPM (Scanning Probe

Microscopy) methods already image individual atoms, thus demonstrating the feasibility in principle of this kind of analysis. Economically producing a sufficient number of sufficiently small instruments able to scan a sufficiently large volume should be feasible, based on published proposals for molecular manufacturing systems[3].

The kind of information this gives us is shown in Figure 4.

The computational load implied by this approach is enormous. Again, extrapolation of future computational capabilities strongly supports the idea that we will have more than enough computational power to carry out the required analysis, even when it quite literally entails considering every atom in our brain[4,6].

Analysis of the frozen tissue will, on a local basis, allow the recovery of what

might be called *local neuronal structure* or LNS. If the suspension took place under favorable circumstances, the LNS will be substantially correct with little ambiguity, that is, we will be able to assign a single interpretation based upon local information, (e.g., this synapse connects this neuron to that neuron; this axon carries information from one well identified location to another well identified location, etc.). Under adverse circumstances, the LNS will become increasingly ambiguous. An axon might have one of two possible targets, which cannot be fully disambiguated based only on local information. Which axon a synapse is connected to might not be distinguishable based on the remaining local structure. This will result in a situation where the LNS will not be a single, specific neuronal structure, but will instead be a set of possible structures with

**Figure 4:**

**The Information Present in Frozen Tissue**

The coordinates of individual atoms in a format commonly used in computational chemistry programs. X, Y, and Z coordinates for each atom are given, along with the type of atom.

```
REMARK An example of the Brookhaven (or Protein Data
REMARK Bank) file format. This file format includes
REMARK the type of atom, the X, Y, and Z coordinates,
REMARK and other information (not shown).
REMARK
REMARK      Atom           X           Y           Z
HETATM      1 C           4.345      1.273     -12.331
HETATM      2 C           4.588      2.559     -13.195
HETATM      3 C           5.207      1.273     -11.095
HETATM      4 C           4.587     -0.015     -13.194
HETATM      5 C           2.967      1.273     -11.724
HETATM      6 N           3.431      2.503     -14.246
HETATM      7 C           4.375      3.884     -12.439
HETATM      8 N           6.121      2.503     -13.491
HETATM      9 O           4.947     -0.028     -10.418
HETATM     10 O           4.947      2.575     -10.419
HETATM     11 C           6.673      1.273     -11.440
HETATM     12 C           4.375     -1.339     -12.437
HETATM     13 N           3.431      0.041     -14.245
HETATM     14 N           6.121      0.041     -13.490
HETATM     15 O           2.836     -0.028     -11.011
HETATM     16 C           1.894      1.272     -12.781
HETATM     17 O           2.836      2.574     -11.012
HETATM     18 C           3.585      1.271     -15.031
HETATM     22 C           2.982      3.838     -11.807
HETATM     23 C           7.069      2.560     -12.244
```

initial probabilities assigned based on local information.

Our experience with MLE suggests that ambiguous local neuronal structure can be disambiguated by global information (just as ambiguous information about a single rotor can be disambiguated using the ciphertext and the redundancy of the plaintext). As in cryptanalysis, the fundamental observation is that neuronal structures are redundant. We can use this redundancy to correct errors or omissions in the LNS. We consider as an example the neuronal structures that process visual information (not least because this system has been extensively studied, and hence we have some reasonable idea of what's involved).

The retina is exposed to photons which describe the visual scene. This information is processed initially in the retina, then transmitted along the optic nerve to the lateral geniculate nucleus and from there to the primary visual cortex in the occipital region. The output coming from the primary visual cortex is highly characteristic: the image has been processed and basic image elements have been isolated and identified. From our point of view, the interesting thing is that certain types of input to the retina (a spot of light, a line, a moving line, etc.) produce characteristic outputs from the primary visual cortex. We have, in short, "plaintext" (the input to the retina) and "ciphertext" (the output of the primary visual cortex), a great deal of knowledge about which "plaintext" can correspond with which "ciphertext," and some knowledge about the structure of the "key" (the possible structures of the neural circuits in the retina, lateral geniculate nucleus, and the primary visual cortex).

Given that we have knowledge derived from the frozen tissue about the LNS in the retina, the lateral geniculate nucleus, and the primary visual cortex, we can then enter "plaintext" (images on the retina) and observe the resulting "ciphertext" (neuronal outputs from the primary visual cortex). If the "ciphertext" is inappropriate for the "plaintext," we can incrementally modify the descriptions of the LNS and see if the

resulting plaintext-ciphertext pairs become more or less reasonable. If the result is more reasonable, we are moving in the right direction and should continue. If the result is less reasonable, we are moving in the right direction and should stop and try some other direction.

More generally, the brain has many cortical areas connected by projections. The processing in each cortical area and the information that can pass along these projections is characteristic of the function being performed. When inappropriate responses are observed, we can incrementally change the relevant LNS in an appropriate direction (e.g., we can change the initial probability vector which describes the state of the LNS by taking a small step in the multidimensional hyperspace).

The high degree of redundancy in the brain is evident from many lines of evidence. One of the more dramatic is the ability of the embryonic and infant human brain to correctly wire itself up. Initially, the "wiring diagram" of the brain is quite rough. As the brain receives input, the growing neurons utilize the characteristic patterns of neuronal activity to quite literally make the right connections. Individual neurons can determine, based only on local information, that they aren't wired up correctly. They will either change morphology (often dramatically) or (in the case of roughly half the neurons growing in the brain) will actually die.

The same redundancy that allows the growing human brain to wire itself up can be used to verify that we have correctly inferred the neuronal structure of the frozen brain. If the characteristic neuronal behavioral patterns (simulated, of course, on a computer) are inappropriate, then we have somehow erred in our analysis and need to incrementally modify the LNS until it is appropriate.

This approach will let us start from a state of partial knowledge of the original neuronal structure (perhaps after twenty-four hours of warm ischemia followed by a straight freeze in the absence of cryoprotectants) and successively improve that partial knowledge until we

have fully reconstructed a neuronal structure consistent with the original data.

If there has been so much damage that we have been unable to infer sufficient local structure to allow even an incremental improvement in our description of the system, then this approach will fail. Published work on the cryptanalysis of multistage rotor systems has already demonstrated an ability to infer the wiring of the rotors even when there is no knowledge at all of the wiring in the intervening states period. In the case of the frozen human brain, there is typically a wealth of information about the neuronal wiring (or LNS) unless the structures involved have quite literally been obliterated.

Or, as experience with erasing top secret media has demonstrated, it's hard to get rid of information when sophisticated means of data recovery are employed. And we'll have *very* sophisticated means of data recovery available to us in the future.



## Notes

- 1) *The Code Breakers*, by David Kahn, Macmillan 1967.
- 2) *Maximum Likelihood Estimation Applied to Cryptanalysis*, by Dov Aneliman, 1979, Ph.D. Thesis, Stanford Dept. of Electrical Engineering.
- 3) *Nanosystems: Molecular Machinery, Manufacturing, and Computation*, by K. Eric Drexler, Wiley 1992.
- 4) *The Technical Feasibility of Cryonics*, by Ralph C. Merkle, *Medical Hypotheses* 39, 1992, pages 6-16.
- 5) *Principles of Neural Science*, third edition, by Eric R. Kandel, James H. Schwartz, and Thomas M. Jesse, Elsevier 1991.
- 6) *The Molecular Repair of the Brain*, part I, by Ralph C. Merkle, *Cryonics*, 1994, Vol. 15 No. 1, pages 16-31.

... "Frozen Souls," continued from page 7

immortalism, life extension, space travel, and other ideas) that fills the psychological space in my brain previously used for religion. It performs well in one of the primary roles of religion: to help people stay sane in the knowledge that death comes to everyone. I don't know if cryonic suspension will preserve life or not. I think it is likely, based on my understanding of science; but I have no guarantee. However, if it turns out that my life only exists in this physical reality, then I want to prolong that reality for as long as possible.

I am not saying this to persuade you that my beliefs are correct. Religion or lack of it is very personal, and my beliefs may not have any influence on yours. Besides, mine may change again over the next decade. But I want you to see where some of my beliefs originate and to remind you that there are many approaches to life and philosophy that can co-exist with the choice of cryonics.

I also want to inform all prospective

suspension members (and remind the current suspension members) that Alcor's official policy is to take no position on the relationship of cryonics to religion, whether Christianity, Judaism, Islam or any other belief. Individuals make their own decisions on the correctness and acceptability of cryonics, based on whatever criteria they consider important. Alcor's approval of suspension membership is not related to an individual's religion or personal belief system. Please see Alcor's "Non-Discrimination Policy" in the box on page 7.

We welcome your further thoughts on these issues, especially if you can discuss how cryonics might fit in with Islam or other religions with which most Americans are less familiar.

If you are not yet a suspension member of Alcor, do some thinking about how important living is to you. If it seems a lot more important than dying does, you may wish to make cryonic suspension arrangements, so your safety

... "William Godwin," continued from page 12

In it one can see the idealism of Godwin tempered with a cautionary tale of how things do not necessarily go as planned even with the best of intentions.

Victor Frankenstein, the young genius biologist who has just discovered the secret of reanimating dead tissue, resolves to create the ideal man out of snippets recovered from graveyards. His more-than-human creation is about eight feet tall, endowed with high character and intelligence, and, as far as possible, very handsome and appealing. Frankenstein, however, is a better scientist than artist and plastic surgeon and his ambling colossus is rather less attractive than hoped for. Such a being must cope with a society not at all prepared for it, and matters go from bad to worse.

But if *Frankenstein* is one depiction of the possible perils that may befall our quest for more-than-human status, it must not blind us to the desirability of making the effort. There is no turning back the clock, nor stopping it.

We must make the attempt to become higher life-forms. *We must succeed*, or, I maintain, very likely we will self-destruct. Fortunately, the astonishing progress in science and technology shows we are moving forward. *We are* in fact making the attempt to transcend our humanity, whether many people yet recognize it or not. We in cryonics *do* recognize it, and our freezing arrangements will, we hope, help us, *as individuals*, to reach and enjoy this glorious outcome.

#### References

*Encyclopaedia Britannica*, 14th ed. 1948 vol. 14, p. 744 ("Malthus").

Godwin, W. *Enquiry Concerning Political Justice*, Penguin, 1985.

Marshall, P. *William Godwin*, Yale Univ. Press, 1984.

Shelly, M. *Frankenstein; or, The Modern Prometheus*, Bantam, 1981.

net is in place. You might make that decision based on your religious beliefs, on a desire to fill some part of your own empty "religion slot," or for reasons based completely on logic and science. Whatever causes you to make this choice to live, we welcome you.

## Advertisements and Personals

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# Alcor bids farewell to Paul Genteman

On January 3, 1995, Alcor placed former Director Paul Genteman into cryonic suspension. Paul was 47 years old, and had been actively involved in cryonics since the 1970s. Alcor has only seven current members who have been signed up longer. Paul was on Alcor's first suspension team, and served as Secretary, Vice-President, and Chairman of Alcor's Board of Directors.

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. And we wish to express our gratitude to Alcor founders, Fred and Linda Chamberlain, and to Alcor Member Romana Machado, for permitting us to print their moving tributes to Paul. Good luck on your journey, Paul. The world will be a poorer place until your return.

Dear Paul,

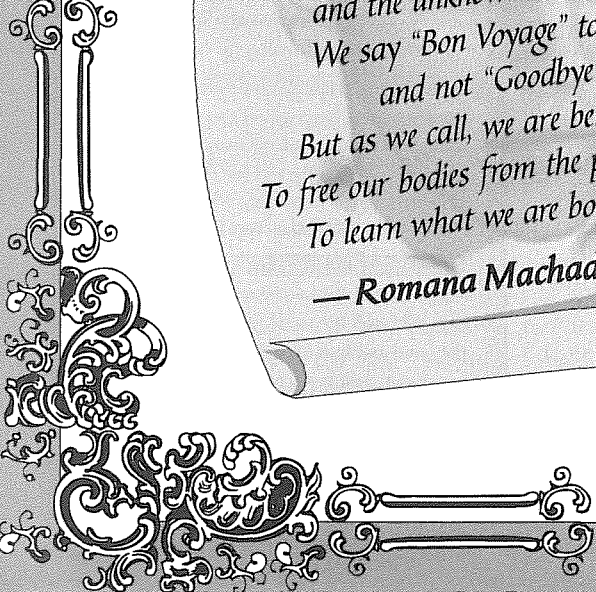
As a cryonics pioneer, you were one of the first to truly honor the memories of your suspended companions, and hold them in the highest esteem for their

ability to have had the vision to understand the importance of cryonics before it was mainstream. You were also very aware that if cryonics works and if we are fortunate enough ourselves to experience circumstances favorable to our own suspensions, that we (and our suspended family members, friends, and fellow Alcorians) may someday share a unique reunion and a future bond. . . which humans who did not have to go through death and suspension will never be able to share.

When we first met you over 20 years before your suspension, you frequently wore a black flag (set in gold) around your neck. You considered yourself to be an anarchist. You had a delightful sense of humor, valued freedom and life, and became one of the most well-liked of all twentieth century cryonicists. Each of us who knew you will remember different traits, different agencies, different abilities. But our combined memories represent a valuable resource.

Amongst the items we are sending to Alcor for your archives are a few of the items you shared with us during your first life cycle, including your letter about a Monty Python event on September 26, 1980, with a "Python Poem" which must have appealed to you. The "Fall '82 Listings of LUDICROUS HOUSE PUBLISHERS" is included also, with your business card printed on it, telling us a great deal about both your values and your humor. More seriously, there is a detailed chart which, we recall, you made of cryonic suspensions to date, even before the compromises at Chatsworth were discovered.

We have shared these with those who attended your Bon Voyage at Alcor after your sus-



## Bon Voyage

Now Paul has left us.  
We will think of him  
as if he were on a quest:  
A long, slow, perilous trip through time.  
He may return to us new, in the morning  
When youth need never end,  
and our bodies need not wither;  
When failure may be averted,  
and the unknown understood.  
We say "Bon Voyage" to Paul,  
and not "Goodbye".  
But as we call, we are being called:  
To free our bodies from the pain of death,  
To learn what we are born to know.

—Romana Machado, 1/3/95



pension. We hope that these will help them keep your memory living. We requested that they put these in a safe place, along with their own memorabilia of you and their friendships with you. We hope this will mark the beginning of a new cryonics custom whereby we keep "memory-sakes" for each of our suspended loved ones, with the hope that someday we may be able to return these (to you, Paul, and to others) to help rebuild lost memories, old friendships, and possibly even enhance identity.

We will have to wait many decades for you to read this letter. Conversely, you will not have to wait at all. This letter may be one of the first things you "see," when you awaken, and you may breeze through it in less time than we now need for a heartbeat. For now, we will ask Alcor (in addition to others) to safe-keep this for you.

Will Alcor be able to do what's required for you to ever read this letter? While you hurtle through time, will Alcor be able to grow into a stronger and stronger time machine, which will not crash into some barrier? Will Alcor be able to develop a

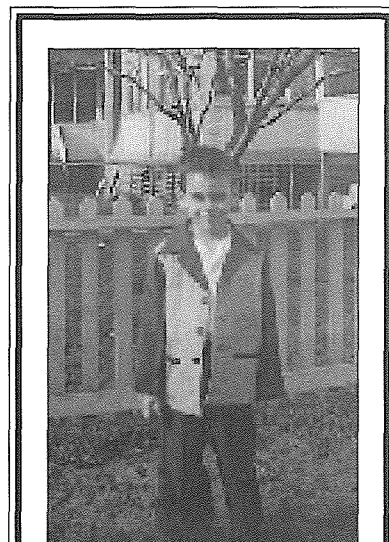
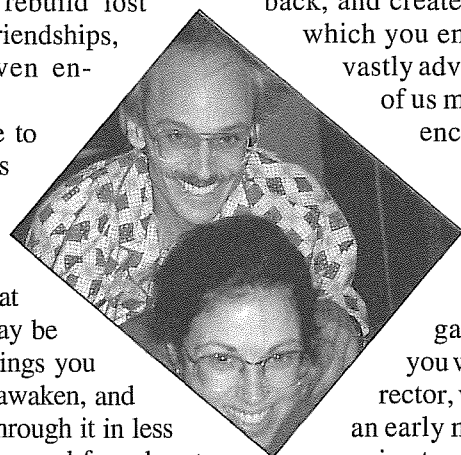
reliable, practical way to get you back? Will Alcor be able to find ways to provide "safe harbor" into which you will emerge, take a deep breath, and skim through this letter?

These are unknowns as we write this. But at least you have this going for you: those of us who remain alive must make it work for you, or it will not work for us. Alcor must be made into a safe vehicle for forward time travel, and do research to get you back, and create a safe haven into which you emerge to explore a vastly advanced world, or all of us may go out of existence together.

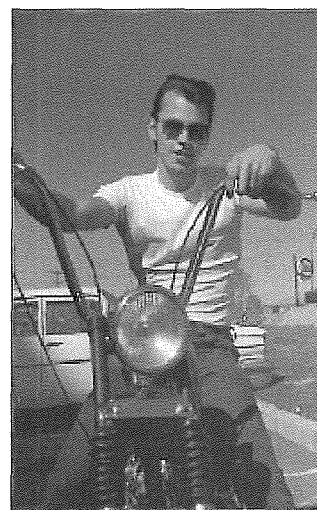
One thing that is certain is that the dedication, hard work, and vision which you gave to Alcor while you were secretary, a director, vice-president, and an early member of the suspension team, will play a large part in Alcor's success in the end.

Travel swiftly through time, Paul! Travel safely! Now, if you have actually read this, the intent of this letter has become a reality. And the universe awaits you!

Bon Voyage, Paul, and Boundless Life,  
Linda and Fred Chamberlain



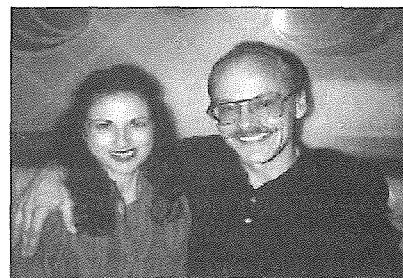
*Paul in 1954*



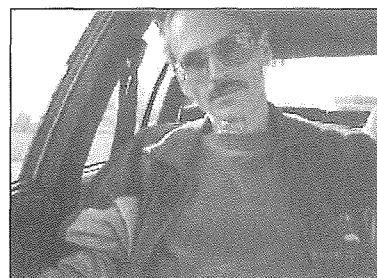
*1967: Paul's self-titled "Rebel Without A Clue"*



*Early '80s: Paul (left) assists Jerry Leaf in surgery*



*In 1994, with fiancée Rhonda Iacuzzo*



*A few days before his suspension, Paul acts as his own photographer*

# The Cryonic Suspension of Paul Genteman

by Tanya Jones

*Paul Genteman was among the very first people to become a member of Alcor. He was actively involved in the cryonic suspension movement from the mid '70s to the mid '90s. For more information about Paul, see the spread on the preceding pages.*

As a new year approaches, most people anticipate positive changes and resolve to actively improve their lives. Some exercise, some diet, and some choose to just "get out of the house more." Long-time Alcor member Paul Genteman chose to schedule an operation. He'd been putting off intestinal surgery for years and decided to finally have it done.

For many reasons, Paul chose to have his surgery in Phoenix. After the operation (which took place in late December), he was discharged from the hospital and went to stay with his new love, Alcor member and Surgical Nurse Rhonda Iacuzzo, who lived nearby. Unfortunately, serious complications led to his being readmitted after only a brief release. Although we knew Paul to be generally healthy and expected him to recover and live a very long life following the operation, the complications

were sufficiently severe that we were concerned. When the complications ultimately resulted in his suspension, we were deeply saddened. Paul was 47.

When Paul Genteman first joined the Alcor Society for Solid State Hypothermia in 1977, there were few people with an active interest in cryonics. (Only seven current Alcor members have been signed up longer.) From the beginning, Paul was enthusiastic about helping Alcor to thrive and established himself as an active participant in many aspects of Alcor's operations. He participated in early cryonic suspensions and research as a surgical assistant and perfusionist. More impressively, Paul served on the Alcor Board of Directors for many years—holding the positions of Secretary, Vice-President, and Chairman of the Board. Paul was renowned for his fairness of mind and ability to consistently consider all aspects of a situation.

His opinion was universally respected, and his calm demeanor was always welcome, especially during the more tumultuous years in Alcor's history. Paul had many friends. And almost everyone who saw him at the hospital found that, despite his surgery, Paul was able to maintain his excited and optimistic outlook and was looking forward to being well.

Derek Ryan and I had been walking out the door to visit both Paul Genteman and Paul Garfield (our incredibly helpful volunteer who was hospitalized with Valley Fever and multi-lobed pneumonia at the same time) at about 3:30 PM on the afternoon of January 3, 1995. Steve Bridge had just answered Alcor's phone and came quickly rushing out of his office waving his arms for us to wait. Steve had just received a call from Paul's wife, Maureen (they'd been separated for about ten years.), and she told us that Paul had apparently

been taken back to the hospital by ambulance. Steve then paged Rhonda Iacuzzo, whom we expected to have more information about Paul's condition. Rhonda responded, and informed Steve that Paul was in serious condition and unconscious. Derek and I temporarily postponed our social visits and began to prepare for a suspension. It was only a few minutes later that Steve rushed in to say "Paul's heart stopped." Both Pauls were in serious condition, and my heart skipped a few beats as I asked, "Which Paul?" and heard the answer of "Genteman."

We were told that the hospital was attempting to resuscitate him. But we knew that there was no guarantee that the resuscitation efforts would be successful, and we had to respond. We loaded the Mobile Rescue Cart (MRC III), chests of crushed ice, and copies of Paul's paperwork into the ambulance (everything else was already on board), and within 15 minutes of the call, Derek, Scott Herman, and I were on our way to the hospital. We expected the drive to take thirty minutes, and we had little time to get ready. Scott was driving, and Derek and I were busy calculating medication doses and preparing them for administration.

As we neared our destination, we called Alcor (using a cellular phone in the ambulance) for an update on Paul's condition. What we were told confirmed our darkest fears: the resuscitation efforts had failed, and Paul had been pronounced legally dead. Our next course of action became expediting Paul's release from the hospital. Fortunately, the hospital staff had been informed about Paul's cryonics arrangements and were both interested and cooperative.

We were told that a mortician had to sign the release forms before we could remove Paul from the room, but we were

allowed to administer heparin and cooling while we waited. Fortunately, Steve Bridge had already informed Funeral Director Anthony Cerullo of the situation, and he was on his way to the hospital. So, while we were waiting, the hospital staff assisted us with moving the MRC III into Paul's room and with moving Paul into the ice bath. We packed him in ice and positioned our mechanical CPR device. Cardiopulmonary support was begun at about 4:30PM, while still awaiting our mortician's arrival. Tony Cerullo arrived within ten min-

was developed commercially for the hypothermic flushing and storage of transplant organs, and it is used to convey asanguinous organs from a donor to a distant recipient. Organs may be transported anywhere in the world (within 24 hours) and successfully transplanted.) However, because this transport wouldn't involve multiple hours, we hoped that the washout step could be eliminated if preparations for the cryoprotective perfusion were complete within a short time of our arrival.

We entered the driveway at about 5:30 PM: a scant two hours after our initial notification and arrived to find the cryoprotective perfusion preparations well underway. The heart-lung machine circuit was strung; the surgical instruments and other supplies were being assembled; and those team members not already present were on their way.

We did have one major missing link. The [glycerol] perfusate was being mixed, and it wouldn't be ready for several hours. Instead of waiting, we decided to use the MRC III and do what we would do in any other case where we need to buy some time: blood washout using the organ preservation solution.

The MRC III was specifically designed for blood washouts and rapid core

cooling of a cryonic suspension patient, though it has never been used during a transport while in our operating room. It worked just as well as it does in the field, perhaps even better. For once, if we were missing any equipment or supplies, they would be in the next room; there were *several* people capable of carrying out the surgery and perfusion (rather than one or two); and we had plenty of volunteers.

Dr. Nancy McEachern and Surgical Nurse Rhonda Iacuzzo began the femoral cutdowns while Hugh Hixon



*Arriving at the Alcor facility*

utes of our transferring Paul to the MRC III, and we ran out the door as he was signing the paperwork.

Paul was quickly secured in the ambulance, and we administered the remaining transport medications as we drove to the Alcor facility.

During a remote transport, the patient is usually taken to a mortuary or funeral home after being released from a hospital. Once there, the patient's blood is washed out and replaced with an organ preservation solution before transport to Scottsdale. (This solution

## Archival Storage

Even in the cryonics community, where the average participant is highly intelligent, independent and (more often than not) stubborn, appreciation for Paul Genteman was apparent. His sense of humor and of life were unique and widely admired. We at Alcor would like to extend our deepest sympathies to the Paul's family and many friends. We also have a request.

Paul was extremely serious about improving his chances at revival. He documented his life meticulously. He believed that the more data available about his path, the better his chances for a successful reanimation with identity intact. The logic of this thinking appears (to me) to be indisputable. But Paul is no longer able to document his life. We can help and perhaps, you can as well.

In the interest of assembling as much personal information about Paul as possible, Alcor is now accepting copies of personal correspondence or other archival information that those who were close to Paul may have. All personal information about an Alcor patient may be placed into environmentally stable, archival vaults in underground salt mines in Kansas. If such information is sent to Alcor, sealed in envelopes with Paul Genteman's name on them, they will be placed into an archival storage container unopened.

Everything stored in these underground vaults will be maintained perpetually by Alcor. Limited complimentary archival storage is available for every Alcor patient, and consists basically of one cubic foot. Not everything may fit into one cubic foot of space, and additional storage is available at \$250/ft<sup>3</sup>. Items of a size larger than a standard "banker's" box may be accepted with an additional charge, provided that the storage company agrees to accept such materials. Please contact Tanya Jones at Alcor for more information about archival storage in general, or to request storage space for a patient.



*Dr. Nancy McEachern (left) and Rhonda Iacuzzo perform the femoral cutdown*

assembled the perfusion circuit on the MRC III. After some initial hovering to make certain that things were progressing well, I withdrew from the operating room to assist with other preparations. When I returned, the surgery was complete and the circuit was primed. We were ready to begin the blood washout. By this time, Paul's esophageal temperature had dropped to 20°C, and with the exception of the surgical site, he was still completely packed in ice.

The washout began at 6:57 PM, but was stopped almost immediately when a lack of venous return was detected. For thirty frustrating minutes, we tried to locate the root of our flow problems. Normally, poor venous return is the result of flow through the tubing being improperly channeled or impeded by a clamp. These are our most common failure modes, and each was eliminated as Hugh checked the circuit without finding the source of our inadequate venous return.

With each attempt to restore flow, we pumped in a little more fluid. Solving this problem was somewhat limited by how comfortable we were with adding more. Of the multiple liters pumped in, only a liter (or so) had been recovered. Further, excepting minor abdominal swelling and a slow nosebleed, there was no direct evidence of fluid accumulation or pressure build-up in his body.

With the common failure modes eliminated, our remaining possible solutions to the venous return problem would take longer to implement than would open-heart surgery, and were still without guarantee of success. Further, our initial impediment to open-heart surgery and cryoprotective perfusion—the readiness of the glycerol perfusate—was nearly overcome. In our estimation, the open-heart surgery and final perfusate filtering would require about the same length of time to complete. At this point, we decided to begin the open-heart surgery.

At 7:50 PM, Paul was transferred from the MRC III to the operating table. His chest was quickly shaved and prepped for surgery. Dr. McEachern and Rhonda were assisted by Surgical Nurse Judy Kranz. The operation proceeded smoothly, and our time estimates were close: the filtration and surgery were completed within ten minutes of each other. Cryoprotective perfusion began at 9:30 PM.

Results were good. There were no inexplicable losses in our bypass circuit, the color of the venous return was lightening, and there were fewer clots in the system than we'd expected. The lack of significant clotting is probably the direct result of the early administration of heparin. As the concentration of cryoprotectant in the circuit increased, the

typical skin discoloration which accompanies a glycerol perfusion was observed. Generally, the skin of a patient who had an extensive ischemic episode will perfuse distinctly patched, but even with a short ischemic episode, we found that the discoloration in this case was remarkably uniform.

Burrholes provide a direct view of the brain. We use two burrholes, placed to observe both hemispheres of the brain directly during the cryoprotective perfusion. This direct observation of the brain is important for catching signs of cerebral edema. Swelling is undesirable and invariably occurs in patients with long ischemic episodes, sometimes preventing perfusion altogether.

Judy Krantz had prepared the burrholes earlier, so we were able to observe the brain (beneath the dura) throughout the operation. As the perfusion progressed, we noticed some leakage from the burrholes (which occurs frequently) and that both hemispheres were slightly receded, although unevenly (right more than left).

Perfusion was stopped at 2:45 AM due to elevating pressures. Final molar glycerol concentrations were 6.54M (venous sample), 5.97M (sub-dural burrhole), and 6.64 M (arterial).

With the perfusion complete, the circuit was disconnected, and Paul was prepared for dry ice (and eventually liquid nitrogen) cooling. In an attempt to test Hugh Hixon's "crackphone" (a pro-

totype system for detecting the occurrence of cracking during the temperature descent), we attached both crackphone elements and our standard temperature probes inside the burrholes.

Cooling was carried out using Alcor's automated cooldown system, with the crackphone elements ready to record any suspicious sounds. Only one cracking event was detected, and that even was detected between -108.1°C and -112.0°C, but it also appears the reliability of the recording system may have been compromised. After reviewing the crackphone data for the initial cooling, Hugh realized that the crackphone elements might have come loose from their bindings. If so, the crackphone data from this case will be filed and not used in future patient comparisons. (The crackphone project is still in development, and its failure to record accurate information in no way affected the outcome of the perfusion or cooling.)

Some questions remained after the freezing, which was a neurosuspension, and an autopsy was performed on Paul's torso and lower extremities, in part, to establish the cause of his death. The pathologist's findings were of interest; he determined that Paul "died from complications of abdominal surgery. The specific condition was sepsis secondary to severe peritonitis following necrosis and wound dehiscence at the colonic anastomosis site. He also devel-

oped marked hypoxia secondary to focal bronchopneumonia and severe pulmonary edema which was exacerbated by intravenous fluid therapy."

All of the cannula and connectors were left in place after the suspension, to make it more likely for the pathologist to identify any possible error in Alcor's procedures during the suspension. The only comments made by the pathologist with specific reference to the bypass operation or the femoral cutdowns were straightforward observations that they had taken place and the cannula were in place. He did state that the aortic cannulation was of "usual caliber". Unfortunately, there was no indication of a cause for the poor venous return during the washout in the autopsy report.

Still, the suspension went fairly well. We found that our coordination and logistics need more attention during local transports, as there was loss of time where the washout cannulations might have been started sooner. Our sample collection system for post-suspension evaluation must be reorganized to become more efficient. Everyone, but especially the volunteers, provided many helpful suggestions for inventory control and suspension preparations during a debriefing which took place a few days after Paul's suspension. Many of the recommendations were simplifications of our current system, and once implemented (and many already have been), will bring Alcor's standards of operation closer to that found in a hospital.

I would like to thank all of the Alcor staff for their participation in Paul's suspension, and I especially would like to thank the volunteers who made their time and skills available: Rhonda Iaccuzzo, Judy Muhlestein, Nancy McEachern, Judy Krantz, Fred Chamberlain, Linda Chamberlain, Jay Skeer, Ted Kraver, and Lucinda Torres.



*Tanya Jones (left) assists Dr. McEachern in the open-heart procedure*



# Elements

of a

# TRANSPORT

By  
Tanya Jones

People are usually surprised when I tell them that when handling the suspension of an Alcor patient, my biggest sense of accomplishment and relief usually occurs *before* the actual suspension procedures even begin. I've participated in about a dozen suspensions and almost that number of transports. With some suspensions, I've felt joy. With others, terror. But either way, from the moment I walk in the door with a patient, a huge weight begins to lift from my shoulders. While the job is far from over, the hard part is done.

Why is it that most of the major obstacles to a favorable cryonic suspension occur before the patient arrives at the Alcor facility? What makes transporting a "legally dead" person so complicated? Presenting and explaining the many aspects of a "successful" transport is difficult, but it's important that Alcor Suspension Members and potential Members understand the complexity involved, since each of you is in a position to dramatically improve your chances of a successful transport by taking some action *now*.

The major components of a cryonic patient transport are Infrastructure, Mobilization, Patient Acquisition, Stabilization, and Transport. Let's look at each of these separately.

## Infrastructure

A patient stabilization generally involves cooling the patient in a portable

ice bath, administering medications to protect cellular integrity, replacing the patient's blood with an organ preservation solution, and preparing the patient for shipment to Alcor. For local emergency response, Alcor has an ambulance. This ambulance is well equipped to allow a transport team to carry out each of these steps internally, but naturally ambulance travel is usually limited to the Phoenix area. (Air travel is much faster for distant regions.) With several days' notice of a member's decline, however, the ambulance has traveled to northern and southern California, and may be used in other nearby states.

Remote emergency response (where "remote" means beyond ambulance range) requires Alcor's remote stabilization kit. This kit consists of eight sturdy boxes which accompany transport team members on a commercial airline. Together, these boxes replicate the capability of the ambulance in a relatively compact, if less convenient, package. Because shipment of the remote kit could cause serious delays in the patient's stabilization if pronouncement is unexpected, some local groups of Alcor members have been issued smaller versions of this kit. These kits generally contain medications and a portable ice bath. Some also contain a mechanical cardiopulmonary support device and oxygen. With this equipment and the cooperation of a local mortician or funeral director and/or trained local Alcor volunteers, a patient may be stabi-

lized for shipment to Alcor.

Simply having equipment available is not enough to carry out a transport, nor is it enough to ensure that a patient will receive a good stabilization or transport. There are many things that people may do to prepare for their eventual suspension.

First and foremost, of course, a person must *be* a member, i.e. *sign up*. Generally, a cryonics organization will not suspend an individual who has not chosen to be frozen. Legal documents establish this intent, and some states have laws which require that a person's wishes for the disposition of their human remains must be followed as long as they don't impose a financial hardship on the family. A signed *Cryonic Suspension Agreement* and *Authorization for Anatomical Donation* will go a long way toward demonstrating the desire to be frozen. For those who haven't decided which organization to sign up with, but who know that they do wish to be frozen, the *Declaration of Intent to be Cryonically Suspended* is a form which establishes intent without obligating the individual to a specific organization, and without empowering or obligating a suspension organization to freeze him/her. (These forms are available from Alcor upon request.)

Another legal document which is useful to a cryonic suspension patient is the *Durable Power of Attorney for Health Care*. With this form, an individual chooses a medical surrogate (an

agent to make medical decisions when the individual is unable to communicate his intentions) and states the degree of medical intervention in an emergency. For example, I have no desire to be connected to life support equipment if there is no hope of my waking from a coma with my identity intact, and this is specifically detailed in my *DPAHC*.

A transport may be impeded by relatives of the patient, especially if they haven't been informed of the patient's desire to be suspended *before* Alcor's services are required. In one of Alcor's cases, the patient's relatives had only heard cryonics mentioned by the patient once, and that had been years before he became ill. They had no idea that any paperwork had been signed and were initially defensive and unhappy. For this patient, things ultimately worked out well, because he came from an understanding and supportive family. The desire for confidentiality will always be respected by Alcor; however, a person who informs his family of his cryonics arrangements before decisions must be made during a crisis will probably receive a stabilization superior to one who does not. Family members will often be the ones to call Alcor when a member becomes ill, and having their cooperation is crucial. We are always willing to have discussions with family, medical staff, and morticians in advance of a suspension.

Having some familiarity with Alcor's cryonic suspension protocol will also help an individual explain cryonics to others. Alcor's introductory handbook, *Cryonics: Reaching For Tomorrow*, and *Cryonics* magazine carry information about Alcor's procedures, in the form of suspension or research reports and explanatory articles. Detailed information is available to those who attend Alcor's transport certification course. (To date, Alcor has offered this course at no charge.) During this week-long course and subsequent refresher weekends, Alcor members are introduced to the specific cryonic suspension protocol, to the equipment used during a transport, and to the multitude of technical and medical references used to formulate the procedures. They are shown how every hand can be of assistance during a transport. Many go home and share this information with other

Alcor members, their family, and friends, thus expanding the resources upon which Alcor may call during an emergency.

Knowing about the protocol is great, but there's much more than that to optimizing your own chances for a favorable transport. Each Alcor member should consider preparing a list and map of local suppliers for transport supplies and consumables and sending copies of these to Alcor. As an example, oxygen cylinders may not be transported on commercial airlines, and oxygen is needed both to power the mechanical cardiopulmonary support (CPS) device and to oxygenate the patient during stabilization. Alcor's central remote kit carries an air compressor (which has never been tested in a field situation) as an alternative for the CPS device and a bagging device which will respire the patient with room air as an alternative to pure oxygen. However, these alternatives are less effective and more labor intensive and will only be used in cases where compressed oxygen is unavailable. Ice (hundreds of pounds) must be available 24-hours a day. Generally, local grocery markets carry ice in this quantity and increasing numbers are perpetually open as well. Having a central list with this and similar information will aid the transport team in their attempt to do the best that they can for you.

For legal reasons, in most states no transport can be performed without a local funeral director or mortician's involvement. We expect this to change as cryonics continues to become more commonplace. Adding the names, addresses, and phone numbers of local funeral homes and mortuaries can save a *lot* of time during an emergency. Contacting some in advance is even better. Morticians are generally quite interested in cryonics and sympathetic to an individual's desire to be cryonically suspended instead of buried or cremated. Morticians are usually needed to secure the release of a patient from a hospital; they have space, equipment, and supplies which can be useful—especially in an emergency; they are frequently willing to assist with femoral surgery or perfusion and are experienced in carrying them out quickly; and they have a comprehensive knowledge of the legal and practical requirements for transporting

a patient across state lines and are frequently willing to prepare the paperwork.

A member who chooses to assist Alcor in negotiating a contract with a local mortician has many things to discuss, and should have some familiarity with Alcor's protocol. (However, if a member simply *finds* a cooperating funeral director, Alcor personnel are available to conduct the contract negotiation.)

Mortuary contracts should at least address the 24-hour availability of an individual who is capable of signing for the release of a patient from the hospital. Some morticians have had sufficient personnel available to stand by with the transport team members to enable the fastest possible release of the patient from the hospital. If a mortuary transport vehicle is to be used to take the patient to the funeral home and the patient will be in the portable ice bath, the mortician will generally have to remove his gurney from the back of his vehicle before taking it to the hospital, so that the patient may be loaded.

Alcor will usually supply the personnel needed to stabilize the patient for transport, and in these cases, will need the uninterrupted use of a "prep" room table for at least two hours. If suction is available, it might be useful during the washout procedure.

Because of the volume of equipment needed during a stabilization, storage space is also required for the duration of the stand-by. If the equipment is placed in a prep room that will not be needed by the mortician during the timeframe of the standby and transport, it may be possible to string the perfusion circuit in advance of pronouncement (and save up to thirty minutes later).

In cases where insufficient trained personnel or equipment are available, morticians have been used to perform femoral surgery, and their embalming pumps have been used (only when those pumps have variable pressures which may be set to meet our needs). The conservative approach to cryonics requires that the conditions of a hospital operating room be duplicated throughout a stabilization. As a result, any mortuary equipment which is used must be *thoroughly* cleaned and rinsed with sterile water (and sterilized, whenever possible) before being used on a patient.

# Transport Summary and Timeline, with Patient Temperature Correlation

by Ralph Whelan

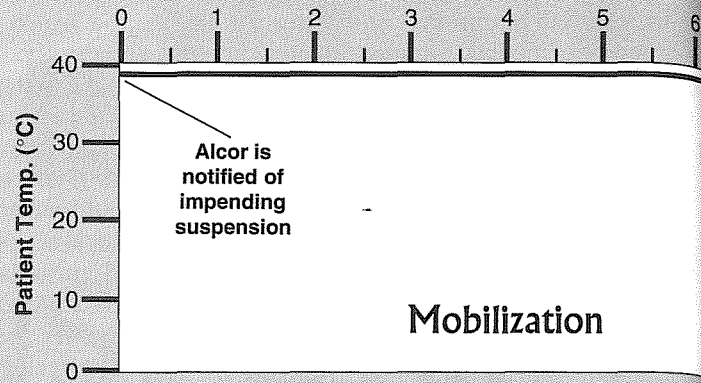
The transport of a cryonic suspension patient can be broken down into five basic categories. Four of those categories are graphically displayed at right, along with patient temperatures for a hypothetical transport beginning in New York and ending in Arizona. The fifth category, **Infrastructure**, is not depicted because it refers to transport *readiness*, rather than an aspect of the actual transport.

## Mobilization

When Alcor is notified that a cryonic suspension is imminent, we immediately put our representatives in touch with the hospital personnel caring for the patient, while other Alcor personnel notify transport team members local to the patient, begin negotiations with local morticians, and begin air transport arrangements for team members and for the patient. In this example, the patient is distant from the Alcor facility, but is expected to live for several hours.

## Patient Acquisition

About eight hours after Alcor's notification, and shortly after the arrival of the transport team, the patient is pronounced legally dead. The hospital allows the team to begin immediate surface cooling, so his temperature slowly begins to drop. Meanwhile, various legal requirements for his release are being fulfilled by Alcor personnel and a local mortician. Twenty minutes pass before the hospital is prepared to release the patient.



It's important to note that, while morticians and their equipment are sometimes relied on heavily in an emergency, members can usually avoid the risks inherent in this option by (when feasible) keeping Alcor well-informed of all serious surgeries and life-threatening conditions. Note as well that, while mortuary contracts have been negotiated at the last minute, they have *occasionally* turned out to be with unprincipled persons who charge Alcor unreasonable amounts because of a misconception that cryonics is a profit-making venture. Emergency contractings should be avoided whenever possible.

When an emergency response begins, a transport team must have access to everything listed above (and more). Having things done in advance means that the team members may concentrate on other, equally critical aspects of preparedness.

## Mobilization

Transport team members are deployed by Alcor Headquarters upon notification of an Alcor member's distress. There are three basic categories

of emergency mobilization and each is dependent upon the condition of the patient when Alcor is called: the patient has a known terminal illness and will suffer a predictable course of deterioration; the patient has been admitted to the hospital after the sudden onset of illness or accident and is unlikely to survive for more than 12-24 hours; and the patient has died suddenly and is at risk of autopsy.

## Advance Notice of Death

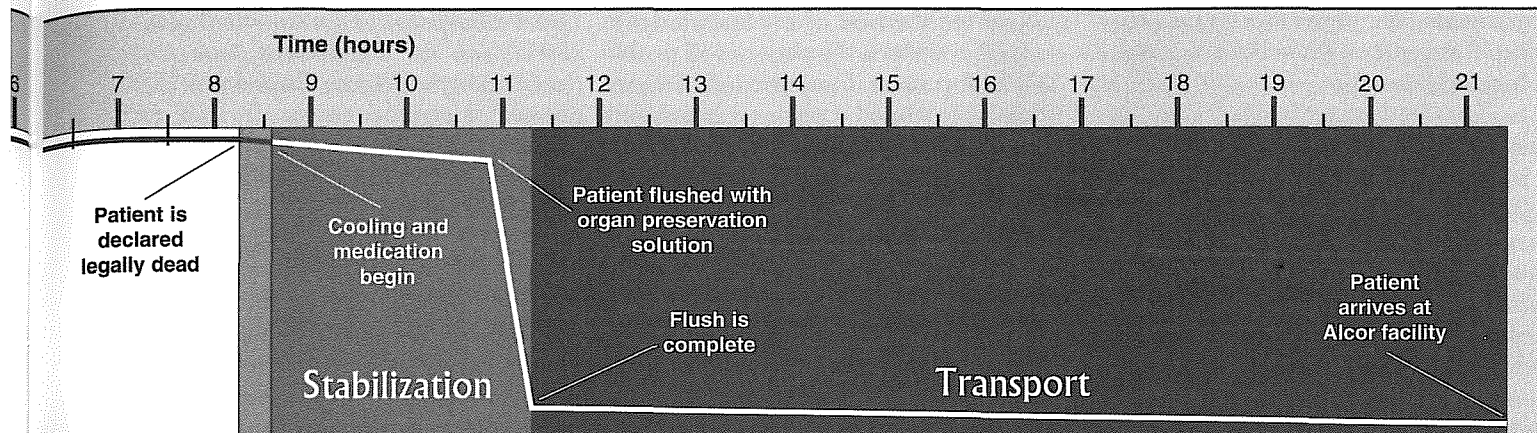
With advance notice, a remote standby may be deployed. (But please note, *Alcor's basic membership contracts make no provisions for standby*. Special arrangements are required, and the relevant documents are available from Alcor.) In a standby, a transport team is deployed before the member has been pronounced legally dead. Advance deployment generally means that the team can prepare for the impending transport, take the time to negotiate service contracts, facilitate a smooth and speedy release of the patient, and procure all of the necessary equipment and personnel before the patient is pro-

nounced. This significantly improves the chances of a smooth stabilization. Standby contracts are optional but *highly* recommended.

A transport team may be comprised of one or more Alcor staff members, one or more experienced transport team members flown in from around the country, and one or more local volunteers. These team members will invariably interact with members of the conventional medical community. Every interaction between that physician, hospital administrators, charge nurses, or hospice nurses and Alcor personnel will affect how well the patient is treated prior to and immediately following the pronouncement of legal death.

The climate is changing. In the past, when transport team members discussed cryonics with conventional medical personnel they were often met with hostility and fear. Today, I can't remember when I last encountered this attitude during an emergency. This doesn't mean that there is uniform acceptance of cryonics in the medical community, but there certainly is more curiosity than ever before. An interested





### Patient Acquisition

### Stabilization

### Transport

Once in Alcor's care, the patient receives medications that will prevent clotting, reduce metabolic demand, protect his cells and prepare them for the low temperatures ahead. The team relocates to a local mortuary, where a field Operating Theatre is already assembled. A "femoral cutdown" is performed and the patient's blood is replaced with an organ preservation solution, while his core temperature is quickly reduced to near (but above) freezing.

The patient is packed in ice in a specially designed transport container and taken to a local airport; the airport personnel are expecting him. He is placed on the very next available flight, though most of the transport team must take a later flight. Waiting in Phoenix are more Alcor personnel, who've negotiated with the local airline representatives for a prompt transfer to the waiting Alcor ambulance. The patient is driven to Alcor's main facility.

physician or nurse can do a lot to see that the patient is given a head-start toward a good stabilization. (But this is a hospital—the shifts change every eight hours or so, and the cryonics arrangements must be discussed anew with each staff member.)

What would we ask for? We'd like access to the patient. (After all, it's something we *ought to know* if the rosy-cheeked patient who laughed heartily with you that morning is lethargic and pale by evening.) We'd like to wait nearby. Is the floor lounge comfortable? The transport protocol demands that cooling begin immediately after pronouncement. Ideally, we should have our equipment in place at the moment of pronouncement, and that can only be accomplished if it is stored nearby. How about the next room or the storage room down the hall?

Cryonic suspension procedures may only be implemented after legal death has been pronounced. Because of the known dangers of ischemia, we'd like to have a physician available at all times to pronounce. If we have to wait, may we pack the patient's head in ice? Can the

hospital provide the ice? Many patients will receive intravenous (IV) therapy during their hospitalization. If any IV lines are in place, leaving them in means that once the patient is released, Alcor personnel can begin injecting cell-stabilizing medications immediately without placing a new line. (This also applies to airways.) Will they leave all lines secure? And if there are no IV lines, may one be placed before pronouncement? Lastly, we'd like to begin our transport procedures immediately after pronouncement, as we are running for the door.

Most doctors encountering a transport team have called in the hospital administrators when faced with these questions. The transport team leader will present cryonics to an administrator (and sometimes, to an accompanying attorney) who is primarily concerned about hospital liability. A *Hold-Harmless Agreement* may be offered to the hospital which states that Alcor will not hold the hospital responsible for any charges or damages arising from a civil lawsuit over the cryonic suspension of the patient.

Alcor literature and other cryonics information is carried with the remote kit, and may be handed out freely to doctors and administrators. Transport team members have occasionally found themselves performing impromptu talks when many hospital workers express an interest in Alcor. Taking the time to inform these individuals about cryonics and the unusual way they can help their patient is rarely a waste of time, and it can be quite invigorating to present a neat idea to a receptive group of people.

Some terminal patients are discharged from the hospital and placed into home hospice care. Home care is generally limited to patients with a terminal illness who wish to die at home. Performing a transport from an Alcor member's home can be challenging.

All of the above considerations apply in these cases as well. The question of prompt pronouncement becomes more critical, as in some states hospice nurses may pronounce legal death. In others, the patient's physician must pronounce. Whoever declares legal death, the patient's physician must sign the death certificate. Without a signed death

certificate, no patient may be transported anywhere. (Certified copies are obtained later.)

### *Emergency Notification*

In cases where little advance notice is available, there will be little time to negotiate contracts or cooperation. The quality of these transports is often determined by the calibre of people the team encounters, and the speed with which the team members and equipment arrive. Depending on how long it takes to obtain custody of the patient, the stabilization protocol may be modified.

If there is significant delay before the team can begin, oxygen may not be used at all. Reintroducing oxygen to a physiology which has used all of its oxygen supplies and is consuming alternative forms of energy causes additional damage. Some of this "reperfusion injury" may be avoided if the patient is not oxygenated during stabilization. This is generally only for patients who have experienced more than an hour without heartbeat or breathing before stabilization procedures are started.

If the delays are extreme (several hours), it may not be possible to replace the patient's blood with an organ preservation solution before shipment. Decisions of this nature are made by the transport team leader in consultation with Alcor Headquarters.

### *Sudden Death*

Sudden deaths are rare, but they do occur. When they do, members of the transport team often will interface with a coroner or medical examiner, and the patient risks autopsy. Currently, five states (New York, California, Rhode Island, New Jersey, and Ohio) allow an individual to state his objection to being autopsied by signing a *Religious Objection to Autopsy*, and there is no requirement to state the specific objection. Maryland also has a weaker, but still useful, version of these statutes.

There are some cases where an autopsy is required by law, and the religious objection form will not prevent the dissection. The Centers for Disease Control (headquartered in Atlanta, Georgia) have the authority to require an autopsy for all patients dying from specific contagious illnesses. This has never happened to a cryonic suspension

patient (to the best of my knowledge) and if it ever does, the patient will probably be fortunate if any portion of their brain is suspended. Local coroners have also been known to conduct independent investigations into disease. In one Florida county, the coroner stated his intention to autopsy every person dying of AIDS in his county. (He later softened his position on this somewhat, after local Alcor members met with him to discuss the matter.)

Autopsies may sometimes be unavoidable, but there are things which may be done to minimize the damage to the patient. Transport team members should try to have the scope of an autopsy limited to the minimum dissection necessary to determine the cause of death. The pathologist may be able to avoid damaging the brain and still fulfill the requirements of the investigation. An attempt should be made to have the autopsy performed right away. If the patient dies late in the afternoon, and no autopsies are scheduled until the next morning, the transport team leader may offer to compensate the county for any overtime involved, if the autopsy is performed immediately. If there will be a delay, the patient should be kept in a morgue cooler at temperatures above 0°C to prevent the tissues from freezing. Patients who are autopsied almost never receive a washout or cryoprotective perfusion.

Once the autopsy is complete, the transport team leader must verify that all of the organs are intact or have been placed with the patient. Then, the patient is shipped to Alcor.

### **Patient Acquisition**

The legal status of cryonics is somewhat ambiguous. Because our patients have been declared legally dead, the custody of their human remains may be transferred to Alcor via the *Uniform Anatomical Gift Act*; but little legislation exists in this country which deals specifically with cryonics (see "The Legal Status of Cryonics" by Steve Bridge, *Cryonics*, 1st Qtr, 1995).

Personnel in the field will work with Alcor Headquarters to secure the release of the patient. Alcor will deliver copies of the patient's paperwork to the hospital and mortuary, as the situation merits. These legal documents consist of the

*Cryonic Suspension Agreement*, the *Authorization for Anatomical Donation*, the *Consent for Cryonic Suspension*, and powers of attorney for health care or *Relative's Affidavits*.

The staff at Alcor Headquarters is available to provide documentation of the patient's intent, to discuss cryonics procedures with hospital personnel (over the phone), and to provide general support for the team members in the field. Copies of relevant court decisions are available, if the circumstances merit a firmer approach during negotiations. Additional letters have been generated for hospital administrators who are unfamiliar with cryonics, and these letters are sent from Alcor Headquarters after they've been modified for the situation. They may also be sent out in advance of a patient's admission to the hospital.

In some suspensions, little documentation has been needed except for the patient's legal paperwork. If a physician and hospital choose to cooperate with Alcor personnel, they may improve the patient's chances for a quality transport.

A physician has the opportunity to prescribe medications for a patient while legally alive, and there are a few which have been shown to improve later cryoprotective perfusion if administered before pronouncement. Some of them are also in Alcor's stabilization protocol. If these items will not interfere or react with the medications currently being taken, a physician might prescribe vitamins C and E, selenium, magnesium, and beta carotene. These are powerful anti-oxidants which help to reduce the damage caused by inadequate tissue oxygenation. Dilantin is also recommended as a calcium channel blocker. Cimetadine hydrochloride (Tagamet) will reduce the accumulation of stomach acid. Many patients have experienced gastric bleeding during stabilization, and have lost large volumes of fluid through holes in the stomach lining. This damage may be mitigated by the administration of Tagamet within the hours before pronouncement. Prior to pronouncement, these medications may be administered only by conventional medical personnel acting under a physician's orders. Premedicating a patient requires a cooperating physician

and a patient willing to request the assistance, and generally, is one of the last topics broached by transport team members when discussing the prompt release of the patient.

Once the patient is released to Alcor personnel after pronouncement, the stabilization may begin.

### Stabilization

At the earliest possible moment after pronouncement, transport team members will initiate the stabilization protocol. First, the patient is transferred to the portable ice bath and surrounded on all sides with crushed or cubed ice. Some water may be added to the bath if the team has access to a circulating pump and tubing. This device is called a "squid" and makes it possible to cool the patient using circulating ice-water, which cools much faster than simply surrounding the patient in ice.

Once the patient has been transferred to the portable ice bath, a mechanical CPS device (such as the Michigan Instruments Heart-Lung Resuscitator) is placed and started. This will restore circulation. An airway is placed to restore respiration, and IV medications are administered to combat the damage of oxygen deprivation and hypothermia. Ideally, all of this is done and documented in the transport notes before the patient leaves the hospital premises. As a minimum, the patient should be packed in ice and administered heparin (an anticoagulant), which should be circulated for 5-10 minutes using conventional manual cardiopulmonary resuscitation.

A local patient may be brought directly to the Alcor facility, with all of the stabilization procedures (except the washout) being performed in the ambulance. Whether the organ preservation solution will then be administered before cryoprotective perfusion begins depends upon the readiness of the perfusate. This perfusate takes many hours to prepare in sufficient quantity for a cryonic suspension (although we are working on shortening this procedure), and if mixing the perfusate is expected to take longer than the open-heart surgery, the washout may be performed while the perfusion preparations are completed.

Once released from the hospital, a

remote patient will be transported to the cooperating funeral home. There, the blood replacement surgery will begin, and the patient's blood will be replaced with an organ preservation solution through the femoral artery and vein. During the blood replacement, a heat-exchanger will cool the fluids being introduced, and the patient's core temperature will drop to about 5°C.

After the washout is complete, the patient must be packed for shipment to Alcor. This usually involves Alcor's custom-engineered water-tight container. This is sent out as part of the central remote kit, and its arrival might delay the shipment of a patient to Alcor if there was little or no advance notice of the suspension. A conventional mortuary shipping container also may be modified to hold the patient and ice. The patient should be placed inside a body bag and completely surrounded by sealed bags of ice. (Ziploc™ baggies work well.) Containers carrying human remains *must not leak*, or they will be removed from the commercial carrier and quarantined until the coroner has an opportunity to inspect them.

Once the patient is packed for shipment, the necessary transit paperwork has been prepared, the operating theater has been cleaned, and the mortician paid, the patient may be taken to the airport for transport. A cooperative mortician will be able to recommend commercial carriers and will have a familiarity with the shipping requirements; he may even be willing to make all of the necessary arrangements and should also provide transportation for the patient to the airport. Alcor should be kept apprised of progress, since we have often been able to speed arrangements through the local airline offices.

### Transport

Shipping a patient should be the easiest aspect of the operation, but there are still occasional snags. The patient should be placed onto a direct flight to Phoenix, if possible, and care should be taken when selecting an airline and flight path. Some airlines advertise their flights as direct, when in fact, the plane will make additional stops before it reaches its ultimate destination. Avoid these flights as long as there will be no significant delays in transport time.

Delays can be expected before the patient is loaded onto the aircraft. Most commercial airlines require that cargo be taken to the loading dock at least four hours before flight time. In the past, we have found a few airlines (like America West) to be especially cooperative, and they have waived this requirement for our suspension patient. Such cooperation has been unusual, though, and should not be expected or planned for during a transport.

At least one transport team member should be on the same flight as the patient and should have copies of all relevant transport permits and the death certificate. All of the transport equipment should also be shipped. Medication kits and other consumables are inventoried and replaced at Alcor Headquarters before the remote kits may be redeployed.

### Conclusion

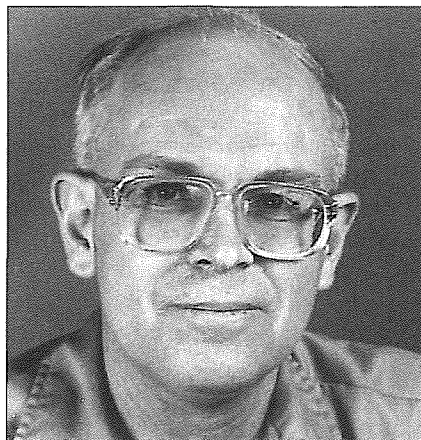
Of course, even after all of this has been accomplished, the actual suspension has still not begun. But it may be clearer to you now why my overwhelming emotion is relief when I finally arrive at the Alcor facility with each new patient. There are many, many variables affecting the quality of a stabilization and transport, several of which are completely out of the hands of Alcor personnel. Once those variables can no longer prevent a successful cryonic suspension, the patient's future is a little more secure.

Please remember that much of the groundwork for a successful transport can be done in advance by local cryonists. Many of you live in areas which Alcor has not had the time or opportunity to include in its transport preparedness infrastructure. You can help us change this, and though it will certainly save Alcor personnel a major headache if you do, the primary beneficiary is *you*.

Anyone wishing to discuss local preparedness should contact me at Alcor for more information.

My thanks to Ralph Whelan for his invaluable assistance in the preparation of this article.





# *Another Path*

by Hugh L. Hixon

**F**or some years, I have been looking over other people's shoulders at electron micrographs of frozen tissue, and listening to them say unkind (and true) things about the expense, the quality of the pictures, the difficulty of interpretation of what's in the pictures, and what's in the pictures. What

is often seen in EM's of cryoprotected tissue is a rather homogeneous mess: no internal cellular structure comparable to just about anything in pictures of control tissue. You can't tell what it was, and you can't tell how it got that way; which is really not too useful at all.

I am unable to say where the obsession with EM's in cryonics came about; the first dog cryoperfusion that I was present at (in 1977) had as a goal the generation of EM's. EM's, EM's EM's. . . . It seems more like a mantra than a useful technique. Besides which, I'm a biochemist by training, and while electron microscopy can sometimes give you a remarkable picture of what's going on, it's only a single technique in the vast armamentarium of biochemistry and molecular biology.

While the interiors of bacteria are a

rather uniform stew of large and small molecules, the cells of the higher lifeforms are not. The eucaryotic cell (i.e., ours) is subdivided into a number of compartments, or organelles, plus a lot of other structures. A short list reads: nucleus (or nuclei), mitochondria, Golgi apparatus, endoplasmic reticulum, lysosomes, a zoo of vesicles (wrapped packages of materials), cytoskeletal structures, ribosomes, etc., and there is a great deal of order apparent in control EM's. The homogeneous mess we often see in electron micrographs of cryopreserved tissues is the end point of a host of destructive processes.

A good part of chemistry is the sorting out of mixtures like this to reconstruct the previous state of affairs, and the most powerful tool for this is chromatography.

The literature of chromatography is so vast that the time when one person could read it all passed thirty or forty years ago, but the fundamental idea is quite simple. Put simply, every molecular species (pure chemical) has a different affinity for every other molecular species, and so molecular species are held back to different degrees when they are moved with respect to each other.

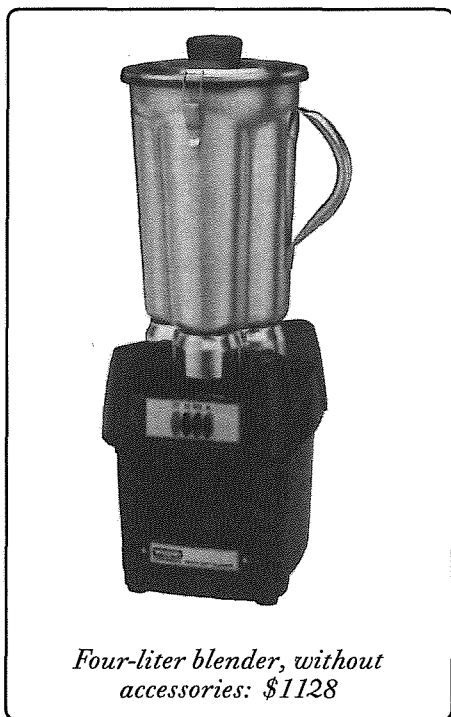
A common example of this process is the concentric patterns found in water spots on a ceiling. Here, the water has diffused through the plaster, pressed cellulose, or whatever, from where it came in contact with the ceiling. As it has diffused, it has dissolved some of the components of the ceiling material. But each of those solutes has a different affinity for the water and for the insoluble portion of the ceiling material, and so

has been held back in its traveling to one degree or another. And so the solutes are separated into the concentric rings characteristic of waterspots. And if gasoline had dripped onto the ceiling instead of water, the pattern of separation in the resulting spots would be different. And so would the separated components. (See sidebar.)

Back to the problem of freeze-damaged tissues. It is possible to grind them up and separate the different types of cells. The separated cells can then be broken up, and the organelles separated; and the lipids (fats); and the proteins; and the metabolic intermediates; and so on. From there, we can go on to identify, measure, and assign locations, and eventually create a picture of the internal economy of a cell. We can then compare it to an undamaged cell, and infer the nature and path of the damage process.

How well can these separations be done? I know of one system (and there are certainly others) that can separate red blood cells by their age! (As they age, the proteins and lipids in the external cell membrane undergo chemical changes, and this changes the affinity of the cell surface for the chromatographic solvents.)

Anyway, here is a tentative separa-



*Four-liter blender, without accessories: \$1128*

tion scheme to determine which components of cells in the brain have been damaged (this would be for a control): Perform a carotid cannulation of the animal and wash out the blood with an intracellular perfusate of choice. Remove the top of the skull.

Inject into the carotid circulation perfusate containing 2 Molar glycerol, to open up the blood-brain barrier. (The blood-brain barrier is a single layer of cells on the inner side of all the blood vessels in the brain that chemically isolates the brain from the rest of the body. Only a very few of the chemicals in blood can cross it, under normal conditions.)

Inject into the carotid circulation a digestive enzyme such as collagenase or trypsin to specifically digest away connective tissues between the brain cells. Stop circulation and let marinate. Remove the brain.

After some experimentally determined time, place the brain in a small speed-controlled blender with perfusate (and other components as suggested by examination of the appropriate literature) and gently take it for a spin. More than any other organ, the brain is a tangled mass of nerve fibers, which are inevitably going to be ripped free of the neuronal cell bodies, so a brain that has been disaggregated becomes a suspension of neuronal cell bodies, glial cells, the tangled mass of dendrites and axons (in small masses), and the remains of the blood vessels. The disruption is controlled by the shearing force (determined by the speed of the blender and the size of the structures being sheared) and the strength of the different components of the tissue. It's crude, but with some skill, the degree of disintegration can be controlled fairly well.

By one of several centrifugation methods (differential sedimentation; repetitive sedimentation in solutions of different density; density gradient separation), the suspension of brain components can be given a preliminary separation. The blood vessel material can be separated and discarded. The mass of dendrites and axons can be taken for a harder spin in the blender and broken up into fibers and the synaptic processes. These can be separated centrifugally

## Chromatographic Separations

You too can perform a chromatographic separation. Take a long, thin strip of paper and put a spot of ink near one end. Put that end of the paper strip (but not the ink spot) into some water.

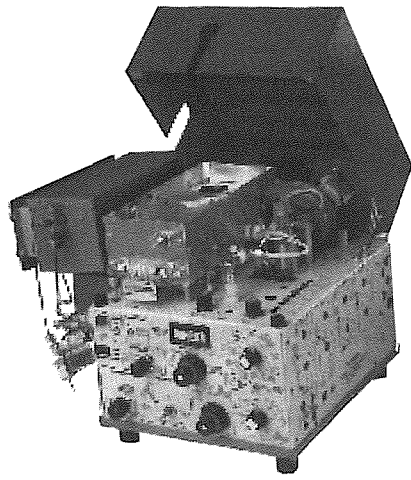
The ink will be separated into the several colors of water-soluble dyes that are some of its colored components, and you have just performed a partial chromatographic separation of ink.

If you put the end of the strip into a glass, and ran the strip over the edge and down the outside of the glass, you have performed descending chromatography. If you tacked the strip to something above the water, and let it go up the strip, you have performed ascending chromatography. The results are different.

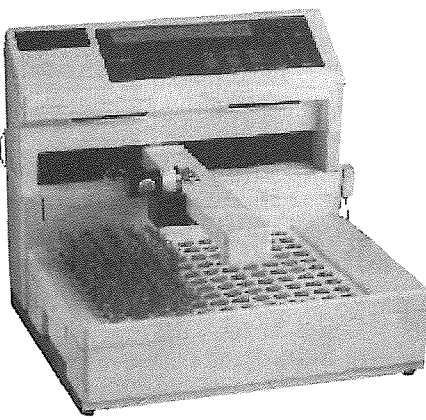
Use a different kind of paper; add a little window cleaner to the water; or a little vinegar; mix some vodka with the water; lay the strip flat on a piece of glass, wet the whole strip with water, put a spot of ink at the center, attach a battery to the ends of the strip and (maybe) watch components migrate in both directions. (This is called paper electrophoresis, but it's still chromatography.)

Anyway, you get the idea. Endless variations, and a different result for each.

and/or subjected to chromatographic separation. The synaptic processes can be taken for another spin in the blender to break them up into the synapses, vesicles, Golgi apparatus, soluble proteins, sulfated mucopolysaccharides, etc., etc., which can also be separated by centrifugation and/or chromatography. The vesicles and other compartments



*Gas chromatograph, with thermal conductivity and flame ionization detectors: \$7985*



*Programmable fraction collector for use with chromatographic columns: \$4180*



*Table-top centrifuge, to 26810 x g, refrigerated, without rotor: \$7995 (rotors: \$695 - \$995)*

can also be concentrated and broken up. At each step, it is possible to separate out the membranes of the vesicles and organelles, and chemically react them to make them volatile (approximately, able to evaporate), after which they can be separated by gas chromatography (retardation in a gas stream flowing over a non-volatile liquid) and then fed into a mass spectrograph for absolute identification. (The output of the gas chromatograph, consisting of separated pure compounds, is fragmented and sorted by size and charge. Each compound has a characteristic and often unique distribution of fragments, which constitute a fingerprint and are readily identified

by associated computer software and databases.)

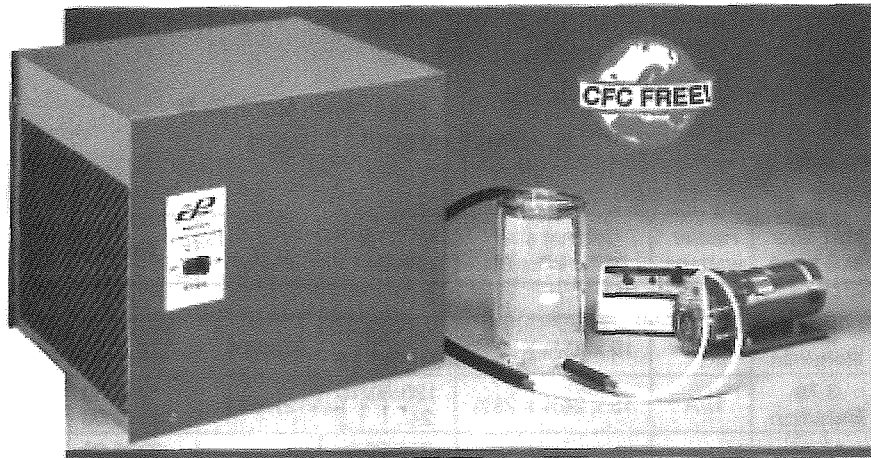
Separation of the neurons (and neuronal processes) should be rather interesting. All the literature I have read (including current material) claims that the brain is the most biochemically complex organ in the body, even more so than the liver, which has over a hundred different cell types and carries out a very large number of specialized chemical reactions. I do not believe that anyone, anywhere, has sorted out neurons by chromatography, and I am not aware of any reason why it couldn't be done.

Anyway, we can separate out the neurons or not. Then we go on to break

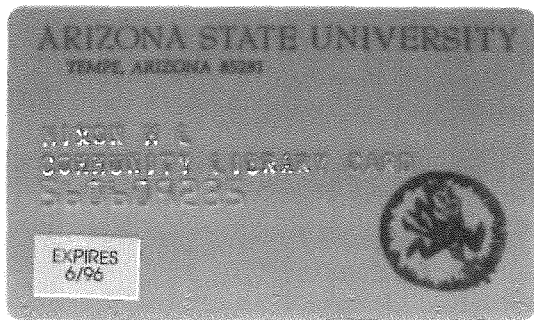
them up and get to the heart of the matter: which organelle populations are missing after ischemia, cryoprotection, etc. This may give us some indication of the nature and source of the destruction seen in electron micrographs. If necessary we can treat our experimental brains in small steps to do a time-course on the destructive processes, to see if we can find the beginning of them.

For the intact organelles, we can disrupt them and determine their enzymatic contents with specific substrates that yield colored products. Enzymes are the reactors for specific biochemical reactions, and are quite specific about which molecules they will react with. With appropriate chemical insight, it is possible to make other, similar, molecules that not only react, but change color when they do so, the evolution of which we can follow in a spectrophotometer (which is an instrument that can measure a specific color change).

We can also test to find the enzymes from the organelles that are present, but this will take some guesswork, and the enzymes may be too diluted in the separation process. If necessary, we may be able to reconcentrate them and separate them on an ion-exchange chromatography column. (The enzymes have characteristic charges, and are attracted to column materials with the opposite charge. Depending on the technique, they can be separated on the column, or



*Auxiliary circulating chiller, -25° C to -40° C: \$815*



Critical research equipment: a library card

released all at once.)

There are several other ways to separate proteins. One very common and powerful method is gel electrophoresis, which separates them by their ratio of charge to size, in a sort of sieving process. Another method is by isoelectric focusing, which will separate proteins by the behavior of their charged groups at different pH's.

Identifying separated proteins is more difficult. The most common way is to attempt to match the behavior of an unknown protein to a known sample of what you think the unknown protein is. This involves a certain amount of guesswork. An absolute method of identifying a protein is to take it apart, amino acid by amino acid, but this is a rela-

tively slow, finicky, and expensive process at this time.

The point I'm attempting to make by detailing all these separations and identifications is that techniques exist to get to the heart of almost any cellular function or structure, and new methods and new insights are being developed constantly. Reliance on a single technique, such as electron microscopy, results in se-

vere limitations on what can be discovered. The paths and techniques I have outlined here are a small sample that happened to spring to mind as I wrote this article. I do not doubt that there are many other paths and techniques, and that the solution to cryonic suspension lies at the end of more than one of them. The problem is to come up with a reasonable path to investigate, and then obtain the money for the equipment, time, and skilled people to explore that path—which is why this article is unsubtly accompanied by illustrations and prices from scientific

catalogs and books.

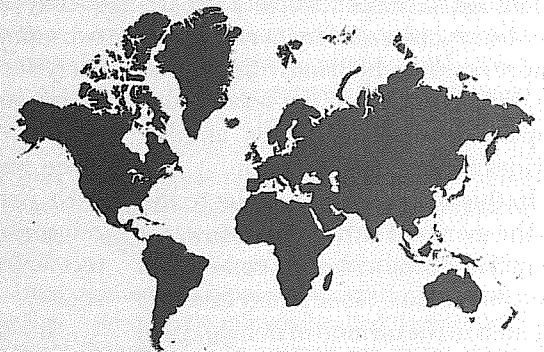
The process of discovery in biochemistry and molecular biology is a vast interconnected web, which we must navigate with both art and science. The biggest aid to this is all the work that has been done to this time by other researchers in related fields, extending far beyond electron microscopy or even cryobiology.

A library card is perhaps the single most necessary (but *not* sufficient) tool a researcher can have. I've got one.



## Membership Status

Alcor has 365 Suspension Members, 608 Associate Members (includes 70 in the process of becoming Suspension Members), and 29 patients in suspension. These numbers are broken down by country below.



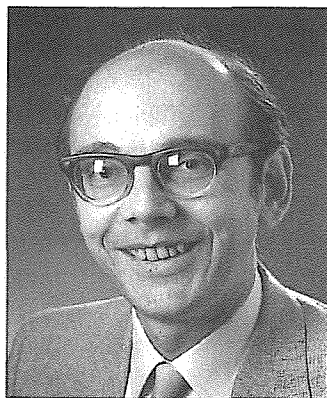
Country	Membership Status			Country	Membership Status		
	Members	Applicants	Subscribers		Members	Applicants	Subscribers
Andorra	0	0	1	Ireland	0	1	2
Argentina	1	0	1	Italy	0	2	3
Austria	1	1	0	Japan	1	0	3
Australia	12	1	7	Lithuania	0	0	2
Brazil	0	0	1	New Zealand	0	0	2
Canada	10	3	42	Russia	0	0	5
Costa Rica	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	3	11
Germany	1	2	1	U.S.A.	317	57	440
Holland	0	0	2	Ukraine	0	0	1
				<b>TOTALS</b>	<b>365</b>	<b>70</b>	<b>538</b>

## Alcor Cryonics Technology Festival

February 16-18, 1996

The Alcor Foundation is sponsoring a cryonics technology festival next February in Scottsdale, Arizona. Confirmed speakers for the festival include Ralph Merkle, Ph.D. (Report on Fourth Foresight Conference on Molecular Nanotechnology), Mark Voelker, Ph.D. (Alcor Research), "Father of Cryonics" Robert Ettinger (Cryonics Institute Research), Alcor President Stephen Bridge (Alcor current activity and future plans), Ben Best (Structure and Function of the Human Brain, and its Relevance to Cryonics), Paul Segall, Ph.D. (Normothermic and Hypothermic Blood Substitutes), and Hal Sternberg, Ph.D. (Cryogenic Preservation).

Registration is \$55 before December 1, \$75 after that (including at the door). The registration fee includes some meals and all events, but does not include lodging. For more detailed information and a registration form, contact Alcor at 1-800-367-2228.



## Cryonics Reinsurance

Disputes between the different cryonics societies and providers of cryonics services have been endemic ever since cryonics began. The latest chapter in such disputes (which I hope closes soon) consists of arguments about the merits of “bundled” services versus “unbundled” services. Bundled services, such as those provided by Alcor, involve a cryonics society in all aspects of suspension. The cryonics society itself provides both the suspension team and the long-term care services. Unbundled services involve a separation: the cryonics society oversees one or more entities which individually provide different parts of the service: one company does the suspension, another provides for storage, and so on.

In this column I do not aim to discuss the merits of either kind. However one very important idea has come out of these discussions. Since it may be easily forgotten in the turmoil of debate, I will focus on it here. That is the idea of cryonics reinsurance.

The idea of reinsurance is at least 100 years old and is now very well accepted by insurance companies. It works like this: suppose I am an insurance company, and I sell you a life insurance policy. Like all companies, even if I have lots of money to pay off your policy, the possibility still exists that when pay off time comes I will have gone bankrupt, for one or another reason. I therefore make an arrangement with other insurance companies: they will take over some of the risk in your life insurance policy, and I will take over some of the risk in

their life insurance policies. The result of such an arrangement is that even if your insurance policy goes bust, you (or your heirs/beneficiaries) will still receive a substantial fraction of what you would have received if it had not gone bust.

Not only do such arrangements strengthen the ability of insurance companies to sell new policies, but they also help protect those who have policies.

Unfortunately, the cryonics societies have not really worked out any such arrangements. Moreover, the benefits of “cryonics reinsurance” extend much farther than those for insurance companies. Even if a society is in fine shape, no society yet has grown enough to provide two complete suspension teams able to carry out two simultaneous suspensions. So far we have all been lucky that such a problem hasn’t occurred, though we’ve come very close. Not only that, but as with insurance companies, explicit reinsurance agreements would help protect us from failure of one or the other society.

It’s not even very unlikely that two people may die almost simultaneously. We all know of the parlor game in which a group of people are asked to put their birthdate on a piece of paper, and when the birthdates are examined two of the people there turn out to have the same birthdate. A similar calculation will show that, with hundreds of members, dates of deanimation can easily coincide too.

This issue of reinsurance will also help recruitment by *all* cryonics societies. One major question some people ask of cryonics is: how do I know that you will last long enough to reach a day when I can be revived? Sure, we can provide lots of analogies, from the Ro-

man Catholic Church to the longevity of established businesses, but we can’t really *prove* our ability to last so long until we have done so. And of all the questions someone may ask, that one seems the most reasonable. It’s fine to believe that in the future the human race will routinely perform medical miracles, using nanotechnology or any other means. Yet how do I know that I will remain suspended long enough to reach that time?

In one sense, the reluctance of cryonics societies to deal with reinsurance closely resembles the reluctance of people at large to deal with death. *If* reinsurance becomes necessary, whether because your society has fallen apart or because its suspension team is now working furiously to save someone else, *you will have no choice* but the services provided by another society. The alternative, of course, is *nothing at all*. Within very wide limits, questions about the quality of that service matter very little. Even if you believe that your own society provides the very best, if it cannot provide those services when *you* need them, their quality doesn’t matter.

Right now three different organizations can reliably provide suspension services: Alcor, Biopreservation, and CI. ACS may well join this list soon. A reinsurance agreement between all of these organizations would help their members (or clients), and make all of them look stronger to anyone considering whether to join any one of them.

*Note: Alcor’s contracts have long included provisions for switching its patients to another organization if that necessity ever arises, though the recipient organization is not explicitly specified. —Ed.*



## Mind Matters

*How Mind and Brain Interact to Create Our Conscious Lives*

By Michael S. Gazzaniga, Houghton-Mifflin, 1988

Reviewed by Thomas Donaldson

Gazzaniga is most famous for his work with split-brain patients: people for whom the connection between the two halves of their brains has been severed, and the effects this has on them. (Basically, each half reacts as if it were a separate, but brain-injured, individual). In this book he takes up a much larger subject: the interactions between what we think and believe and the physiological state of our brain.

One issue which he specifically does not discuss is that of how we come to have a sense of awareness at all, and what the significance of that sense of awareness may be. The title and even the subtitle might suggest that—and were, plus his work with split-brain patients, exactly what led me to buy the book.

Moreover, although he discusses a variety of serious conditions (loss of memory with age, schizophrenia, depression), he never goes beyond the standard American doctor's idea of accepted knowledge and practice. This is not a book to read about the possible memory-enhancing effects of tacrine or acetyl-carnitine.

However, reading it was far from a total loss. It may actually serve as an antidote to much discussion within cryonics of our brain and our selves, specifically because it focuses not just on intelligence but on all the other parts of our awareness too. It is very easy in discussing our Selves (or Souls, the word I have suggested we use because it most characterizes what we really mean) to forget that we don't just think and remember, we also feel. . . in many different ways. To revive a creature which had our memories but no feelings at all, or very different feelings from our own, comes close to not reviving us at all: as if our memories had simply been logged in a library and were to be used by someone else.

Most of the book goes into what is known about the detailed relations between brain events and feelings, for all the most notable feelings. It begins with Pain, then discusses memory and thinking after age 40, then Intelligence, then Crazy Thoughts (which comes down mostly to a discussion

of schizophrenia and schizophrenic episodes), Anxiety, Depression, Obsessions, Addiction, Love, Sleeping, Stress, and Healing. In each case Gazzaniga argues for a constant feedback between the feeling, our brain, and all the other sides of our personality.

Gazzaniga does have interesting things to say about each of these. The perception of pain, for instance, differs significantly between nationalities and also depends on context and understanding. People wounded in battle respond to a physical injury very differently from that of someone who received a similar injury in an auto accident. Some peoples can become so injured to pain that they don't even notice it (Gazzaniga tells about the Sherpa carriers in the Himalayas, and how their reactions differed from those of their European employers. His story raises interesting thoughts about how we might see our own perceptions, 1000 years from now).

He also discusses both schizophrenia and depression. Both of these can begin with serious brain malfunctions. But when they happen to thinking human beings, they may not end there: instead, some people respond to their schizophrenia by devising explanations for it, which become more and more florid as time passes. This has a serious consequence: if the condition continues untreated, those suffering from it will come to see their views of the world and their condition to be the *correct* ones, and therefore actively resist any other ideas. What began as a chemical derangement becomes much more global, and something which no simple drug treatments will help. Who would give up a true set of beliefs, worked out after long thought, merely because of a drug?

In the case of depression, as each of us knows from our own experiences, we can feel depressed because of events outside us or because of chemical changes in our brain. Chemical treatments now exist for depression: tricyclics and MAO inhibitors among them. Yet a completely chemical theory doesn't explain how these drugs can take several weeks to have an effect. One serious possibility comes simply from the fact that a depressed person will construct their own theories as to why they feel depressed: no one listens to them, no one cares for them, they are worthless. Yet again, simply giving

a drug doesn't help that state.

As I noted when I began this review, Gazzaniga discusses Love also. In this discussion he very much does not concentrate on sexual intercourse itself, but on the feelings we have. And as we might guess, lots of moralists have thundered from the pulpit and the legislature against any study of love. Yet some interesting work has been done, though no one really claims a "complete theory of love." An interesting fact: people passionately in love secrete a chemical, phenylethylamine. And if for some reason the affair is broken off, some take to eating chocolates for a while—which happen to contain phenylethylamine. As before, though, our soul is involved, not just our brain.

Gazzaniga doesn't pretend to summarize all the literature on any of the conditions he discusses in one chapter for each. He aims simply to touch most on those points that suggest an interaction between our feelings and our understanding. His version of "the mind" of course consists really of the activity of our cortex, which reacts not just to events in the outside world but to what we feel, too. Like it or not, we are (short of major surgical alterations to which none of us would consent!) a unity from which thinking and feeling cannot be separated, not ever.

These ideas may even tell us something as cryonicists. One kind of depression produced in animals is called "learned helplessness". The animals are given shocks with no ability to escape. They respond by showing all the physical signs of depression. The depression resulting means that if anything these animals will actively resist any action. I will leave immortalist readers to work out just what inevitable (so far) event gives nearly everyone a sense of helplessness. . . . And finally, since we are human beings with cognitive ability too, people have constructed theories to account for this helplessness and make it seem proper and right.

If all of history up to now has been the story of people in severe depression, then when that depression lifts we may see many wonderful changes, too.

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Alcor's Emergency Response capability includes equipment and trained technicians in Arizona, New York, Indiana, Northern California, Southern California, and England, and a cool-down and perfusion facility in Florida. Alcor's Arizona facility includes a full-time staff with employees present 24 hours a day. The facility also has a fully equipped research laboratory, an ambulance for local response, an operating room, and a patient care facility using state-of-the-art storage vessels.

## Meetings

### Board of Directors Meetings

Alcor business meetings are held on the first Sunday of every other month: January, March, May, July, September, and November. (The July and September meetings are on the second Sunday.) Guests are welcome. Meetings start at 1 PM. For more information, call Alcor at (602) 922-9013.

*Sunday, September 10, 1995:*

ALCOR  
7895 East Acoma Dr., #110  
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### Bay Area

Alcor Northern California meetings: Potluck suppers to meet and socialize are held the second Sunday of the month beginning at 6:00 PM. All members and guests are welcome to attend. There is a business meeting before the potluck at 4:00. For meeting information, call Alcor at 1-602-922-9013

### 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.

### Midwest

Alcor Midwest is in full swing. It produces a monthly newsletter and holds monthly meetings. It has a state-of-the-art stabilization kit and responds to six states: MI, IL, OH, MO, IN, and WI. For meeting information or to receive the Alcor Midwest Newsletter, contact Brian Shock at (317) 769-4252, or 670 South State Road 421 North; Zionsville, IN 46077.

### 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).

### England

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.

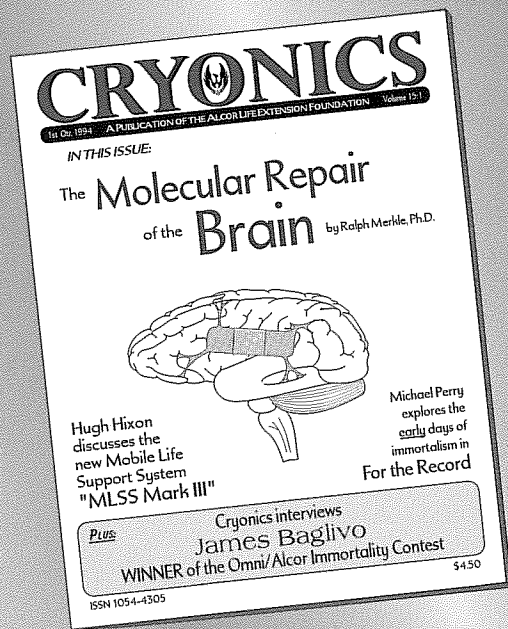
The address of the facility is:

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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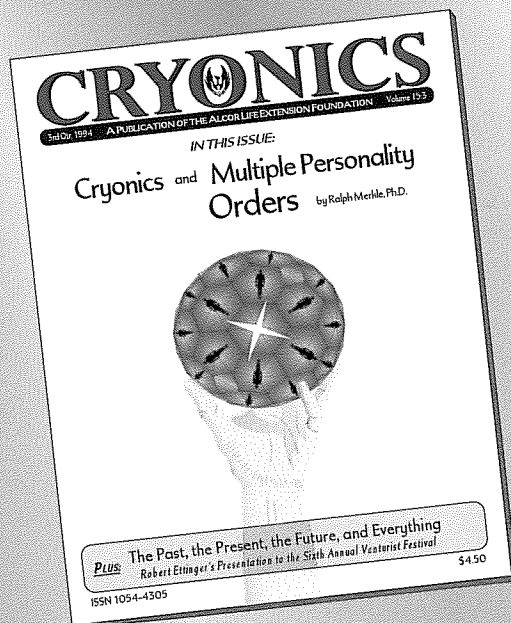


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