Cryonics

Volume 11(1) January, 1990

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- Helping Alcor Grow
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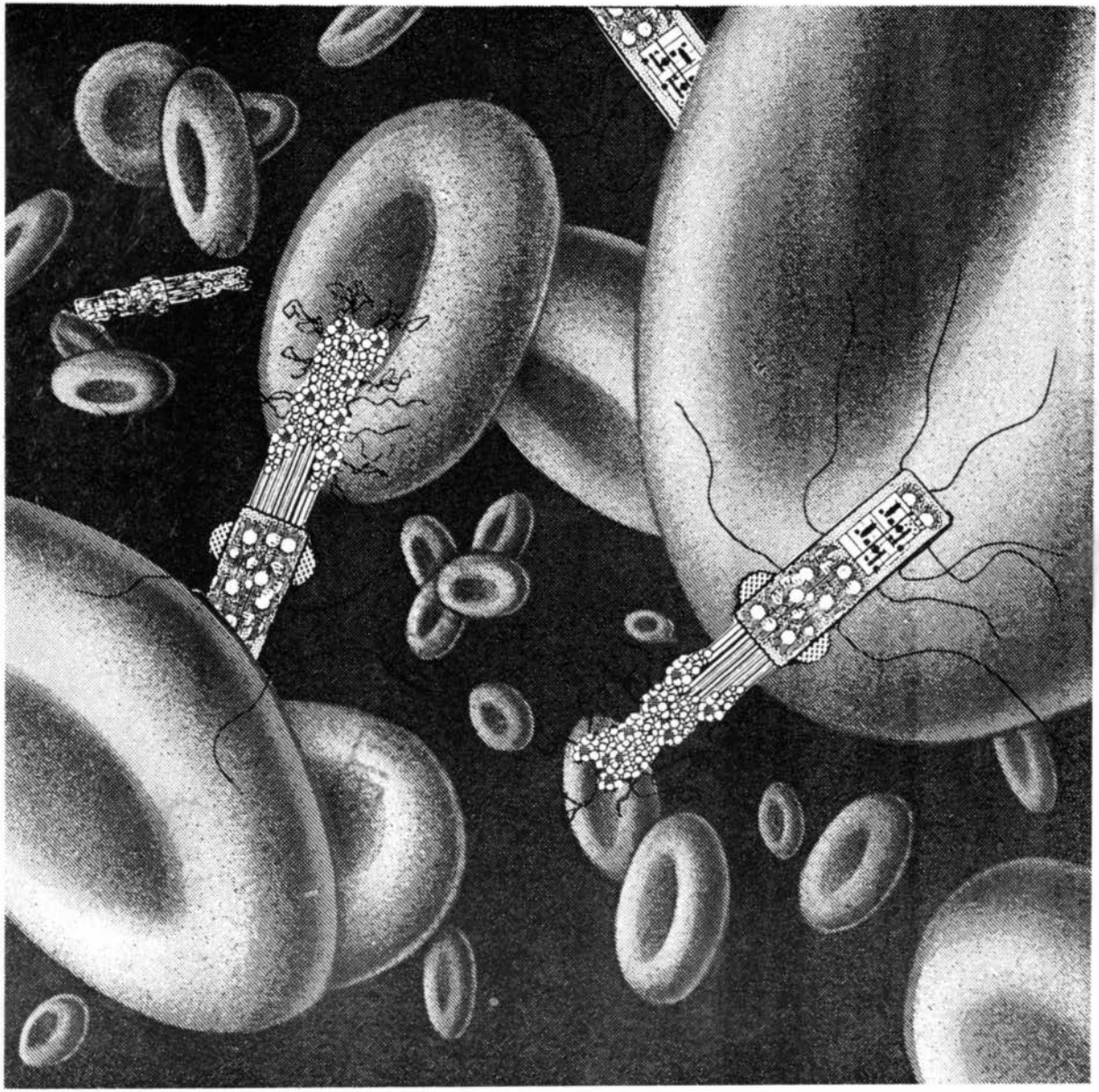

CRYONICS ■ Volume 11(1) ■ January, 1990 ■ Issue 114

CRYONICS is the newsletter of the Alcor Life Extension Foundation, Inc. Mike Darwin (Federowicz) and Hugh Hixon, Editors. Published monthly. Individual subscriptions: $25 per year in the US; $35 per year in Canada and Mexico; $40 per year all others. Back issues are $2.50 each in the US, Canada, and Mexico; $3.50 each all others.

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EDITORIAL MATTERS

In the November issue of *Cryonics*, we carried the story of a non-member suspension (Alcor's first) and asked for comments to help guide us. As of now (December 20th) we have received three replies. Two in favor of our action, one opposed. When we ask for your input, we mean it. We need to hear from you. No, we are not great believers in "mob rule". But we do want to hear the opinions and desire of our members whom we exist to serve. Please, take the time to write us or call us. And remember, it doesn't have to be a letter; a phone call will do too. Knowing how you feel on issues that affect you is especially important in situations which are complex and require judgment calls (like the case of non-member suspensions).

In short, let us hear from you on issues like this. Otherwise, you may end up with decisions being made which you don't like.

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WHO SENT THE BUTTONS?

Response to the request for button suggestions has been very good. We've received suggestions from Hank Lederer, Alan Sinclair, Sandy Booth, and a very excellent set of button slogans nicely done-up on a laser printer from some anonymous soul with a postmark in San Francisco! Who are you? We liked your slogans and would like to credit you if you'll kindly step forward.

from *Hank Lederer*:

A Mind Is A Terrible Thing To Lose, Burn, Or Bury

from *Sandy Booth*:

Never Say Die -- Say *Alcor*

Dozin' Frozen

Play Dead -- *Alcor*

Alcor Says: Have An Ice Day

Let Alcor Keep You In Suspense

Funerals Are Forever

Buy Time In A Bottle

from *San Francisco postmark*:

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GUESS WHAT? WE'RE STILL POOR!

Recently a Suspension Member was visiting the facility and remarked that we must be sitting pretty now that we had all the money from Dick Jones' estate! Further, he said that he hadn't contributed any money this tax year because he figured we were pretty well set.

Have we got news for you! Yes, ostensibly we got more money than we've ever had before. But we also got more problems. What has happened to the money we got? Well, most of it has gone to (three guesses) *lawyers*! What's the breakdown? Well it's pretty much as follows:

Dick Jones litigation: roughly $750,000.00 (yes, that decimal point *is* in the right place).

Kent v. Carrillo, Merkle v. Mitchell, Kent v. Trask, Zoning Expenses (Conditional Use Permit), Perry v. Superior Court, and Miscellaneous: approximately $100,000.00

We still owe on some of these bills. Some incoming money from the Jones estate has been spent on improved capabilities: we now have a a full-time caretaker (paid part-time at $6K/year) a full time President (needed to coordinate the complex legal and financial problems associated with our operation) and three other full time people (a Research Director, a Sign-up Coordinator, and a Facility Engineer to keep everything running). We have also made a few modest equipment purchases such as a copier and a fax machine (both absolutely essential).

But the point is, that hasn't left us with a lot of to play with. What's more, we are actually in the "poor house" at the moment, barely able to meet our bills? Why? Have we overspent?

The answer is a resounding "No!" What has happened is that the Trustee of the Jones Estate (his business partner Jenna McMahon) is not disbursing the money from the estate which is due us. Why not? Because they are hopelessly behind in filing the taxes. As a result, not only aren't we getting any of the money due us from the estate, *the family who took the whole thing to court in the first place has yet to get a single cent!* (There is some justice in all this: here it is Christmas a year after Dick's suspension and their stockings are still empty!)

When will money start to flow? We've given up asking and stopped believing the lies we have been told. The only consolation in all of this is that the family is leaning on the Trustee just as hard as we are. The whole thing will possibly end up in court again unless the Trustee gets busy and prepares the taxes so that funds can be released to the beneficiaries.

The result has been a severe cash crunch. In fact, money is tighter now than it has ever been at any point in Alcor's history (and believe me, that's saying something!).

So the point of all this is, we still need money. And we still need financial support from you, our members. We DID NOT get rich overnight (at least *not yet* anyway).

Reproduced below is a list of things we would like to purchase which represent real advances. They do not appear in order of priority. If you are interested in contributing towards one of these items, or better yet, outright buying it, we'd be very grateful.

We should also point out that the General Fund badly needs support too. We are often barely able to meet payroll.

Please help if you can!

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1) **Lift-Gate.** This is needed for the ambulance so that the Mobile Advanced Life Support Cart (MALSS) can be loaded and unloaded. The MALSS is our "portable heart-lung machine" which is used to rapidly cool and blood-substitute patients in the field. Unfortunately, it weights 465 pounds *without* a patient and ice on it. This means that at least six able-bodied staff members are required to be deployed with the unit: a major drain of labor, a logistical nightmare, and in many situations a downright impossibility.
COST: $2.5K

2) **New Reserve Battery.** This is needed for the ambulance. The existing large battery which provides power for the patient compartment lights, suction, and so on is dead. It needs to be replaced as soon as possible to give us the electrical "endurance" we need in an emergency.
COST: $180

3) **Car Phone.** Also for the ambulance. This is a long overdue acquisition. When the ambulance is "rolling" we currently have no way to communicate with on-board staff. This means that we can't advise them of the patient's condition on the way there and that they can't advise us of the patient's condition once the transport has begun. This is a potentially serious problem since the transport staff is essentially cut off. If a problem or a complication occurs, they have no way to call to Riverside, or elsewhere, for expert help or advice. We have already had one frustrating experience with an ambulance-related communications blackout. We don't want another!
COST: $500 to $1K

4) **Swing-Away File Locks and Other Earthquake Preparation.** The file drawers in the central corridor of the Riverside facility need earthquake proofing to prevent them from spilling out on the floor during an earthquake. Various other earthquake preparations also need to be undertaken. Additionally, the whole-body dewars need to be re-arranged and re-anchored in the patient care bay.
COST: $1K

5) **Earthquake Engineering Consult.** It has been suggested that we get an earthquake engineer in to consult about seismically secure storage of patients. This should be done. Our cryogenic dewar supplier is willing to do seismic calculations on the patient storage units we have and this should be authorized. Additionally, a competent seismic engineer should be consulted to insure that earthquake preparations for the building structure and the patient storage set-up are adequate.
COST: $1K to $3K

6) **Refractometer.** We need a refractometer that reads full scale over the area of

interest. This is a very important purchase and should be ranked right near the top. What is it and why is it a priority? We determine both the absolute concentration and the rate of increase of our cryoprotective agent concentration by evaluating the perfusate circulating through the patient with a refractometer. Measuring the refractive index (RI) tells us "how we are doing" and when to halt perfusion (i.e., when we've reached the target glycerol concentration). Currently we are using a little serum/urine refractometer that is time-consuming to use, does not allow real-time tracking of glycerol concentration and requires time-consuming calibration. We thus end up stopping perfusion on the basis of time-delayed readings and this has resulted in over-shoot of glycerol concentration in the past. Both the Florida and British groups have better RI equipment than we do!
COST: $3K to $8K

7) **Silicone Oil** Silicone oil is used as a heat exchange medium during cooling of patients to -79°C. We are about 10 gallons low on this and need to order some as soon as possible.
COST: $500

8) **Thermocouple Switch Box.** Dewar monitoring needs to be consolidated with hardwiring and a central monitoring station established. We need a thermocouple switch-box for this.
COST: $100

9) **Voice Operated Walkie-Talkie Head-Sets** (at least three units). These are critical for standby communications during suspension Transport operations. They allow the personnel inside the hospital to communicate with the ambulance staff and tell them how things are progressing. They also allow for "taped note-taking" during transport operations.
COST: $300

10) **1 Megabyte of RAM** The AT computer memory board needs another megabyte of RAM to bring total memory to 3M. With the on-going computerization of Alcor's operations more memory has become critical.
COST: $250

11) **750 Megabyte Hard Drive.** As per #10 above, more memory is needed to accommodate the load of data to be entered and manipulated. Most critical member data, patient data, and administrative data will hopefully be on computer in the next few years.
COST: $1.5K

12) **Sign for the Alcor facility with our logo.** No explanation needed here.
COST: $500 to $2K

13) **Update/Upgrade the MacIntosh.** The cell repair illustrations you see in this issue of *Cryonics* were done by Mike Darwin with difficulty using our Apple MacIntosh. The difficulty comes in because both drives are broken (a legacy from the coroners/police seizure) and diskettes must be inserted or extracted with a *pair of pliers*! We need new drives for this machine and it makes sense to upgrade from the 400K drives we have now to 800K drives -- so that we can run a lot of the sophisticated MAC software which we have, but which cannot be used with the 800K drives. A third drive, to read the 5¼" MS-DOS diskettes generated by our word processors, would allow the word processors to interact with the Mac's fancy graphics capability. We could then produce better-looking literature without hiring a commercial artist.
COST: $600

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Let us know your impression of "LA Law"'s cryonics case.
Thursday, January 4, 1989.

ALCOR ADOPTS POLICY STATEMENT ON NEUROSUSPENSION

Since 1982 Alcor has had as a policy the so-called "automatic conversion to neurosuspension" for whole body patients in the event a crisis -- financial, political, or otherwise -- absolutely mandated it. (In other words, if there were simply no other alternative for maintaining that patient in suspension.) Recently the Alcor Board of Directors voted to rename the "automatic conversion" clause the "emergency conversion" clause, since this more accurately reflects its true nature.

It should be emphasized that Alcor hopes never to have to exercise this clause and convert any *properly funded* (i.e., someone who has provided for his/her whole body suspension with the minimums Alcor requires) whole body member to neurosuspension. But the clause exists because we know that it may be necessary to maintain patients in suspension over a time course of decades to centuries.

The emergency neuroconversion clause is one of the most controversial ones in the Alcor contract. Indeed, it is one of the most controversial of Alcor policies. The argument is often put forward that we should allow members not only to *choose* which option they want, but also to choose not have emergency neuroconversion.

There is of course no small amount of merit to allowing people to choose what they want to do with their lives and bodies and what kind of care they want to receive -- even if those choices result in death or injury. All of the Officers and Directors of Alcor believe very strongly in the right to make choices.

Thus, the emergency neuroconversion clause would seem to be something that was incompatible with Alcor's overall philosophy in dealing with its members. However, there is another side to the issue too, and that's Alcor's side. In establishing policies we have to draw the line somewhere and we have to act responsibly. We have to have a set of internal guidelines which direct us and give us integrity as an organization. Just because we believe in the right of self-determination doesn't obligate us to do *anything* anyone asks us to do. For instance, if someone came knocking on our door asking to be perfused with honey before being frozen, we'd quite naturally refuse, and with good reason: because such a treatment is likely to be harmful and not supportive of our overall mandate to save our members' lives (In actual fact, someone *did* once ask us to perfuse him with honey *à la* Alexander the Great; we politely declined!)

Similarly, removing whole-body members from suspension and burying or cremating them is not likely to save their lives. If any option exists which offers a better chance than those two, we feel obligated to use it. Thus, the emergency neuroconversion clause.

To this end the Alcor Board recently adopted a statement of policy regarding emergency neuroconversion. It is as follows:

> *"Neurosuspension offers a chance of saving the life of an individual which is irretrievably lost if cryonic suspension should terminate altogether."*

This is the opinion of the Alcor Board and it is an opinion supported by much medical and scientific evidence. Thus, for the same reason that we freeze people, or perfuse them, or do anything else that we do to attempt to save their lives, which is reasonable and supported by scientific evidence, we not only offer emergency neuroconversion, but require consent to it from our members.

It must be emphasized that Alcor is a voluntary organization. Yes, we do have requirements, but we are not the government. If you don't like our policies you *can* go

elsewhere, and we hasten to add that there are two other cryonics organizations ready and willing to sign you up who do not require emergency conversion to neurosuspension.

Recently, Mike Darwin, the originator of the emergency neuroconversion clause, brought it up for a repeal vote by the Board of Directors. His reasons were that he felt that Alcor, in the absence of any stated policy or position about the worth of neurosuspension could not very well tell prospective or existing members who were unhappy with the clause, "We have it just because we have it and that's just the way it is." His motion was rejected. Then Dr. Mike Perry proposed the explanatory language modification, given above, which was adopted by the Board. Hence, this statement regarding our emergency neuroconversion policy.

We have tried to plan carefully to insure that the minimums set for whole body care (and neuro too!) are adequate. We believe they are, and we think that with the continued growth of cryonics, continuing technological progress, and greater worldwide affluence there is every reason to believe that they will continue to be. However, it would be irresponsible not to consider less rosy scenarios and however unpleasant, to plan for them.

Alcor is committed to getting its members safely into a future of indefinitely long and healthy lives. We will do that any way we can and we will strive to be sensitive to our members' needs and wants in doing so. Sometimes there will be disagreements, even among reasonable people, as to what constitutes the best approach. In such situations we are left with little choice but to act as carefully and as conservatively as possible.

Oddly enough, as radical as it may seem, if there is absolutely no other choice for a whole body member, neuroconversion may be a very conservative option indeed.

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MORE COURT DECISIONS ROLL IN

On December 15, 1989 two court decisions were handed down in cryonics cases. One was a clear victory for Alcor, the other a Pyrrhic victory for the Riverside D.A.'s office.

The Immunity Case

The first decision was a fairly straightforward one regarding the Riverside D.A.'s attempt (in the person of Deputy D.A. Curt Hinman) to rewrite the immunity laws in California by denying transactional (complete) immunity to three participants in the Dora Kent Suspension whom they wished to question. The D.A. instead offered use immunity, which does not offer the sweeping protection from prosecution that transactional immunity does. The three Alcor Suspension Team Members politely declined to accept such a *generous* offer to speak and exercised their 5th Amendment rights per counsel's advice (and common sense!).

Well, on December 15th the California Supreme Court refused to hear Mr. Hinman's appeal, effectively confirming the decisions of the Superior Court and the 4th District Court of Appeals. Mr. Hinman loses, the trial lawyers of California and civil libertarians everywhere breathe a sigh of relief, and life goes on. The Riverside D.A.'s response? Well, they think the law needs to be changed! After all, the public is in jeopardy! There are body freezers on the loose out there who have frustrated justice! (Actually, we've done quite a bit to further it!)

Felony Practice of Medicine Without A License

This case, otherwise known as *Kent v. Trask*, was an attempt to block the Riverside D.A. from prosecuting principals on the Alcor Suspension Team for 19 counts of felony practice of medicine without a license (FPMWL for short). We had been told that "X" number of those counts would be for things done after Dora Kent was legally dead, raising the whole issue of "is 'post-mortem' cryonics medicine?"

This is a complex case. A really complex case. And the decision was complex. Really complex. In short, we lost on our bid to block prosecution for FPMWL. But -- the whole story is *much* more interesting. The judge took it upon himself to look into the underlying premises of cryonics and render a set of opinions which we had not dreamed of soliciting at this time. The resulting decision was *25 pages long*. In it he states the following things:

- *We have the constitutional right to cryonic suspension.*

- *We cannot be prosecuted for FPMWL for things done to patients* after *legal death has been pronounced by a physician.*

- *Diagnosis and treatment of suspension patients while they are alive in conjunction with preparing them for suspension can be carried out, but must be done by licensed medical personnel.*

- *Patients have the constitutional right to subject themselves to cryonic suspension before clinical death.*

It's this last one that is the bombshell and which we do not know how to interpret. Does this mean that terminally ill patients may enter suspension before legal death? Or does it just mean that patients may begin the "suspension process" only in the sense that starting the suspension process may be considered entering a cryonics facility to wait for the end by natural causes? We don't know! Some of the language which raises this question is quoted in the newspaper account of the decisions which follows this article.

Undoubtedly there will be some clarification on this point in the near future. In the meantime, we reproduce in its entirety the Riverside *Press Enterprise* article dealing with these decisions.

Anyone wishing a copy of this decision may obtain it by sending $8.00 (to cover copying, postage, and handling expenses) to Alcor along with a request for a copy of the decision and the written arguments from both sides. The Editors of *Cryonics* strongly recommend obtaining a copy of this decision and reading it. It is a fascinating document, perhaps one of the most fascinating legal documents yet generated in what even we consider to be a very bizarre case.

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MEMBERSHIP STATUS

Alcor now has 150 Suspension Members, 305 Associate Members, and 13 members in suspension.

The Press-Enterprise

• Saturday, December 16, 1989

Courts rule on 2 issues in cryonics case

By RONNIE D. SMITH
The Press-Enterprise

Two significant court rulings have been handed down in the bizarre case of Dora Kent, the elderly woman whose head was cut off and frozen by a Riverside cryonics lab two years ago.

In a decision yesterday by Riverside Superior Court Judge Robert J. Timlin, ruling in a civil lawsuit brought by Alcor Life Extension Foundation of Riverside against the Riverside County District Attorney, Timlin ruled that the district attorney can prosecute Alcor members for practicing unlicensed medicine when they prepared humans for freezing.

But Christopher Ashworth, Alcor's Los Angeles attorney, said Timlin's ruling against Alcor also states, for the first time, that a person has a constitutional right to have his body frozen and can order the procedure begun before he is dead. Prosecutors yesterday disputed Ashworth's interpretation of Timlin's ruling.

Riverside County Deputy District Attorney Robert G. Spitzer said the ruling stated only that a person has a constitutional privacy right to elect to have his body cryonically suspended, not to have the freezing process begun before his death.

Timlin's decision, if upheld by an appellate court, could possibly play a role in an ongoing district attorney's criminal investigation into the death of Kent on Dec. 11, 1987. Prosecutors are trying to find out if Kent was alive when she was administered drugs in preparation for freezing by Alcor.

The second court ruling involved the criminal investigation. The state Supreme Court refused Thursday to hear the district attorney's appeal of a ruling in August by the 4th District Court of Appeal in San Bernardino over the issue of immunity for some Alcor members. Spitzer said investigators will re-evaluate the investigation in light of the Supreme Court's ruling.

The strange case of 83-year-old Kent began two years ago after her son, Saul Kent of Woodcrest, said he took his ailing mother to the Alcor laboratory. Alcor officials said her head was surgically removed and placed in sub-zero storage. Saul Kent and other devotees of cryonics say they freeze human bodies and heads in hopes of one day bringing them back to life. Most scientists dismiss the fledgling cryonics movement as fantasy.

County coroner's officials later concluded that Kent died from a lethal dose of barbiturates pumped into her body to prepare her for freezing. Alcor officials say she was dead when they administered the drugs.

The 25-page decision released yesterday by Timlin in the civil suit focused on whether prosecutors have authority to charge Alcor technicians with practicing medicine without a license when they prepare a person for freezing. Timlin said the district attorney has that power, although no charges have been filed.

"Judge Timlin seems to have adopted a position totally in agreement with the position the district attorney has taken in these matters," said Spitzer, of the prosecutor's office. He said the ruling means that Alcor will have to have a licensed doctor present when the laboratory prepares a person for freezing before the person is clinically dead — which means no brain activity.

Ashworth, who was unsure whether Alcor would appeal Timlin's ruling, hailed some language in the decision. He said the language gives a person the right to have cryonic technicians and doctors prepare him for freezing before he is clinically dead. "In the past, you had to wait until your death" to be frozen, Ashworth said. "This is saying you can become cryonically suspended prior to the time you are visited by clinical death. . .This is a fairly bold first exposition of that kind of right."

In the opinion, Timlin wrote: "This court concludes that the adherents (of cryonics), including Dora Kent, under Article I, Section 1 of the California Constitution and the fifth and ninth amendments to the United States Constitution have a right to privacy, which includes the right to exercise control over his/her own body and to determine whether to submit his/her body, or any portion thereof, including the brain, to *premortem* cryonic suspension. In ruling on the application this court in no way comments directly or indirectly on the wisdom of such a choice."

Alcor's civil suit is separate from the criminal investigation by the district attorney's office.

"At this point in time, there is an active investigation into the death of Dora Kent," said prosecutor Spitzer.

Investigators are trying to find out who administered the drug to Kent and when. During the investigation, prosecutors offered three Alcor members — Hugh Hixon, R. Michael Perry and Scott Green — limited, federal-type immunity for testimony about Kent's death. Alcor members refused to testify. A Riverside judge later declined to force them to accept immunity for testimony, saying that state law does not allow federal-type immunity.

The district attorney's office appealed the judge's ruling on the immunity issue to the appellate court in San Bernardino. In August, the appellate court upheld the judge's ruling on the immunity issue. Prosecutors then appealed the case to the state Supreme Court, which, by refusing to hear the case Thursday, allowed the appellate ruling to stand.

Spitzer said prosecutors may ask legislators to change the state's immunity laws because of the case.

THE RIGHT TO DIE?
. . . OR TO BE KILLED?: The Nancy Cruzan Case

by Mike Darwin

It must be said at the start that the solution to the problem to be discussed in the following paragraphs is cryonic suspension. But that is not an option that anyone is likely to consider in this case. So, with disclaimer in place, read on....

* * *

By all accounts Nancy Cruzan was a super person: attractive, feisty, independent, full of life. On January 11, 1983, Nancy, who was then 25 years old, fell asleep at the wheel of her car and ran off the road. As a result of the accident Nancy experienced cardiac arrest and nearly 15 minutes elapsed before she was resuscitated.

Today, seven years later, she lies in a nursing home -- bedridden, contractured, and unable to speak or move purposefully. Her eyes are open from time to time and she will sometimes absently track objects moving in the room. She will cry out in an animal-like fashion if subjected to painful stimuli. Reportedly, she wept when a valentine from her husband was read to her, but she has exhibited no purposeful behavior since that one incident, although the nursing home staff has testified that she has called out isolated words or snatches of verbiage on one or two occasions. She experiences sleep and the Rapid Eye Movements (REMs) which in normal people are associated with dreaming.

Nancy has been unable to swallow since the day of the accident, and so she must be fed via a tube placed in her stomach through an opening in her stomach and abdominal wall. Given the current state of medicine, her prognosis for recovery or even significant improvement is described as "hopeless".

At issue in Nancy's case is the right of her parents to stop administration of food and fluid, which would result in her death. Their request to do this was refused by the Missouri State Supreme Court and is now before the United States Supreme Court.

I had decided to *not* to discuss this case in the pages of *Cryonics*. It is a difficult case which requires a great deal of thought, but I felt that anyone who considered it carefully would conclude as I have: the Cruzans *do not* have the right to terminate Nancy's life. I changed my mind about discussing this case when I heard several cryonicists at the Alcor Weekend Retreat in Wrightwood (on December 2) say that they "hoped the Supreme Court would decide to allow the Cruzans to end Nancy's life. After all, it's what she would have wanted, isn't it?"

The more I thought about the issues raised by the Cruzan case, the more I became convinced that an article was needed. Badly needed. As I discussed this case with others in Alcor, I became convinced that at least two points of view need to be presented on this

case. An opposing view will be presented in the February issue of *Cryonics*. It should be said at the outset that this a tough issue and a complicated one.

It should also be pointed out that part of the problem we confront with this case is that we do not live in a truly free society. This particular case would have been moot if it were not for tax dollars being used to support Nancy's care. The high cost of caring for a patient in her condition would long ago have used up the assets in her estate, and her parents, Joe and Joyce Cruzan, were and are under no obligation to pay Nancy's medical bills.

But the fact is, the state *is* paying those bills. I should also say at the outset that I feel that that is no small part of the problem: and further, that I do not believe the state should be paying for Nancy Cruzan's medical care -- or anyone else's for that matter.

However, even if the state *weren't* paying Nancy's bills, there would still be a problem. The fact is, Nancy, like the vast majority of other healthy young Americans, never left any written directions or instructions regarding her medical care in a situation like the one she is in. All there is to rely on is the statement of her parents and other relatives that Nancy wouldn't have wanted to end up like this.

This may very well be the case. The question is, how do we know that to be so? At issue here isn't just Nancy Cruzan. If the Supreme Court rules in favor of the Cruzans, it will (depending upon the details of the ruling) establish the precedent that next-of-kin in conjunction with the patient's physician can determine when to withdraw medical care or life support in the absence of written direction by the patient *even if the patient doesn't have so-called "irreversible loss of higher brain functions"*.

The possibilities for abuse in such a situation are all too imaginable. Witness the behavior of supposedly loving relatives in the Dick Jones case. Even leaving economic considerations aside, family members may also, as in the Cruzan case, be focused on *their* suffering. After all, Nancy is not apparently suffering. Indeed, it is the parents' and physicians' argument in this case that Nancy is essentially dead. Her father Joe is quoted as saying "To me, Nancy died that night. Medicine and man stepped in and pulled her back, but to what? Just a body existing. Now I feel that it's time for man and medicine to step out and say 'we couldn't do anything for her.'"

It would seem that Joe and Joyce Cruzan are mostly concerned about the suffering of Joe and Joyce Cruzan. If they are right, then Nancy is beyond suffering and the issues are aesthetic and related to whether keeping Nancy in that state is a reasonable expenditure of their and others' tax dollars.

The historical basis for all of Western law in dealing with such issues where the medical care of a patient is in question and no suitable prior direction has been left has been to apply a conservative standard, i.e., one which errs on the side of life. Please note, *if prior direction has been left to the contrary*, (i.e., if Nancy had a *Living Will*, a *Durable Power of Attorney for Health Care* or had expressed her intentions to her family physician and asked him to enter them in her chart) then the courts have been equally diligent in affirming the patient's right to refuse treatment -- even lifesaving treatment. What is at issue here is not Nancy's (or anyone else's right, for that matter) to refuse medical care or to elect not to remain in a persistent vegetative state, but rather the "right" of others, namely the next-of-kin and her physicians, to determine whether life-sustaining treatment should continue.

The decision the Supreme Court reaches will have important consequences for

cryonicists. If the Cruzans are granted their plea to end Nancy's life, it will establish as a precedent the right of next-of-kin, physicians, or court-appointed Guardians or Conservators to act other than to preserve the patient's life (even if the quality of that life is, in their opinion, low).

The fact is, we don't know what condition Nancy Cruzan is *really* in. Yes, we know she has been severely injured. But we do not know for instance how much of her memory and personality are left intact. The hippocampus is the area of the brain most susceptible to ischemia. It is the same area afflicted in Alzheimer's disease, and indeed, late Alzheimer's looks very much like a persistent vegetative state. What we don't know is how much of Nancy Cruzan is still left?

What will happen in the next 30 to 50 years in medicine? Nancy *could* live that long with good supportive care. Will fetal brain grafts be developed to treat Alzheimer's and restore the muted and inaccessible memories of these people to life? What about patients like Nancy Cruzan? Will it be possible to treat such severe brain injuries in the future with fetal grafts or other, even more incredible technology?

We don't know the answer to that question. But one question we do know the answer to: If Nancy Cruzan is buried or burned, she isn't going to be around to take advantage of any such advances.

No one is saying that Nancy is suffering. It is possible that she is, although we see no evidence of it. This society has already made a commitment to provide money to care for people like Nancy. In fact, such a commitment is part of a long and I believe good tradition of not giving up, of maintaining that where there is life there is hope.

Naturally, if it were me in Nancy's bed, I'd want to enter suspension. In fact, I would have wanted to enter suspension as soon as the extent of the brain damage became apparent. Why? Because it would be the procedure most likely to conserve my identity. But barring that as an option, I would choose to be like Nancy Cruzan, hoping against hope that somewhere in that injured brain enough of what makes me who I am would be left to allow for my recovery in the future. The chance of that, any chance of that, is better than giving up. Even the suffering of my friends and loved ones would be worth it.

Nor is history without precedent cases. Consider patients afflicted with "the sleeping sickness" (presumably a viral brain infection) which struck millions during the early years of this century. A small group of these patients entered into a motionless, apparently unconscious state. For some, those that were cared for and fed, this state persisted for over 50 years! It wasn't until Dr. Oliver Sacks treated these people with L-dopa during the 1970's that they were able to be awakened from their "irreversible comas". (This is described in *Awakenings*, by Oliver Sacks.)

Perhaps the most troubling and difficult issue the Cruzan case raises is the issue of *identity*. What makes a human being a human being? What is Nancy Cruzan? Is she an *I-ness* circuit somewhere deep in her midbrain? Is she her memories and are they faithfully locked away in un-injured but inaccessible brain tissue? If "I-ness" is the essential criterion, then perhaps Nancy Cruzan still exists -- after all, her midbrain and motor areas are still apparently intact. When does life end? And more to the point, what *is* human identity.

Even among cryonicists this is hardly a settled issue. It would seem that perhaps a little caution and conservatism where Nancy Cruzan's personhood is concerned are not unreasonable.

There is something weak and wrong in the position of Nancy's parents. Why are they so sure there is no hope? How do they know Nancy is a hopeless case and will remain so not just for today, but for tomorrow too?

What is needed in this case is not to give the power to end people's lives to their relatives and physicians in the absence of clear direction from the patient. What is needed is a major overhaul in the way medical care is delivered in this country.

It is already considered *de rigueur* for a physician to obtain a thorough history and physical on any patient he sees for the first time. It is also considered unconscionable for a physician not to inform a patient about the kind of medical care he or she will receive and get his or her consent.

We are long overdue for a broadening of that informed consent. Implicit in any doctor-patient relationship is the possibility that the patient may become or be rendered incompetent, temporarily or permanently. It may happen as a result of a complication of treatment, an accident, or a sudden change in the patient's health. It may happen the day after the patient sees the physician or 50 years later. But, increasingly, it can be counted on to happen. In my opinion, every patient-physician relationship should address that possibility *in advance* and *at the start* of that relationship rather than at the end of it.

If only Nancy Cruzan had asked her physician to note that, if she was ever severely brain-injured or rendered incompetent with no foreseeable prospects for recovery, she wished medical care (including tube feeding and hydration) withdrawn, then the Cruzan family would not be faced with the situation they are faced with today.

But she didn't. And to establish as a standard relying on hearsay testimony from relatives with potential conflicts of interest just won't cut it when it comes to making a decision to end someone's life.

One take home-message in all of this that *is very clear* and subject to little disagreement: don't let yourself end up like Nancy Cruzan. The fact is, that regardless

of where you live, the tools are available to allow you to protect yourself from third parties making decisions about your care in a vacuum when you're no longer able to do so yourself.

Would you want your parents, or brother or sister, kibitzing with your doctor, to determine the kind of medical care you will receive and whether or not your quality of life is good enough to justify continuing it? Maybe. But maybe not. Think about it.

And finally, there are the deeper problems the Nancy Cruzan case raises which must be addressed. What is medicine to do about all the people quietly assigned no-code status today? Most have not left prior direction about no-heroic-measures. What constitutes heroic measures anyway? Is cryonics a heroic measure? And, most importantly, what constitutes a "hopeless case" or "foreseeable therapeutics". These issues are at the core of cryonics and the decision in the Cruzan case will probably touch these issues in important ways.

What is the right thing to do? A tough question!

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NO EASY ANSWERS

by Mike Darwin

Over the last few months I have traveled extensively, meeting with local groups and evaluating local facilities where they exist. One of the less than pleasant reasons for one of my trips was to meet with a long-time member who was experiencing serious health problems.

Richard Leibee* has been signed up for cryonic suspension for over 10 years. Long before he was signed up, he was an advocate for cryonic suspension, having heard about the idea in the mid-1960's with the publicity surrounding the publication of *The Prospect of Immortality*. For years he had a weekly column published in several local newspapers, and cryonics was something he advocated from time to time while pointing out that it was something he also had planned for himself.

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* All the names in this account have been changed to protect individual privacy.

Like most cryonicists Richard Leibee has a strong, independent personality and a colorful past. He had a long career on the New York stage and he knew anybody who was anybody in theatre world of the 1930's and '40's.

Richard was without any close family: Both his wife and son had predeceased him by many years, leaving him without family members to rely on. Richard is both an independent and private person. Unfortunately, these traits did not work in his favor when illness struck. Repeatedly he was urged by members of both the local Alcor group and by Jerry Leaf and I to execute a Durable Power of Attorney for both health and finances. The very idea of doing this was anathema to him. He once told me "Why, my mind is as sharp as it was when I was on the stage, and I'm not going to lose it either!"

Unfortunately, several years ago Richard suffered what was to be the first of several strokes. He was hospitalized briefly but shortly recovered sufficiently to return home and continue independent living. Several smaller strokes followed and about a year ago we began to notice a sharp deterioration in his written communications. Not only was his handwriting almost illegible, but we began to get notes and enclosures which didn't make any sense.

A call to the local Coordinator, one of Richard's few close friends, alerted him to keep an even closer eye on Richard than he had been doing already (it was this Coordinator, whom I'll call Jim, who Richard always turned to when he was hospitalized or needed to be).

Jim reported that while Richard was deteriorating, he was still capable of independent living. Unfortunately, the situation did not long remain that way. Richard began to deteriorate mentally at an increased rate. He became paranoid, verbally abusive, and almost impossible to deal with, flying into rages without provocation and accusing everyone around him of being after his money.

He made several "irrational" trips to stay with close friends, only to be turned out by them (these "friends" were in reality people he hardly knew). He began complaining of assaults by landlords and experiencing hallucinations and ideation.

Jim contacted Richard's physician and his banker in an attempt to get some intervention.

Another friend of Richard's (Alissa) began to make efforts to alert local social service people to the emerging problem and try to get Richard to accept outside help. Alissa was one of the few people that Richard would talk to, even after he reached the point that he refused to see or speak to Jim. In consultation with Jim and Alcor management, Alissa began to contact people in the local social welfare system to sound out getting some help for Richard. The situation had become even more critical since Richard had reached the point of either moving out or being thrown out of several apartments. He had given his automobile away to a virtual stranger and was apparently disbursing large amounts money in an imprudent fashion. Help was clearly needed.

On July 21st I had dinner with Richard near the motel where he was staying. While he was clearly not the man I remember (in terms of his mental status) it took a fair amount of time before I could determine he was no longer thinking coherently. Only after we had spent some time together did he relax enough to let his guard down and really tell me about all the terrible things that had been happening to him.

Shortly after my return to Southern California we received a frantic call from Alissa

stating that Richard was on a plane and headed for Alcor in Southern California...." The next 24 hours were nightmarish. Somehow we had to persuade Richard to return to the state where he lived since there would be some chance at getting a court-appointed guardian for him (our probate/estate attorneys informed us that this would be nearly impossible to do here, given California law).

As it turned out, Richard never made it to Alcor. He became confused and disoriented at LAX and was taken into "custody" by a social worker who found him a motel room and called Alcor.

After much patient cajoling we managed to get an alternately tearful and abusive Richard on a return flight and arrange for Alissa to pick him up from the airport.

The social worker in Los Angeles was put in touch with the social worker in Richard's home state and in short order a *guardian ad libitum* was appointed. The social worker was sympathetic to both Alissa and to cryonics and worked to have Alissa appointed as guardian.

The trouble was Richard. As soon as he realized that Alissa was trying to be appointed his guardian he turned against her. He began complaining about cryonicists trying to "cut his head off and take his money...." He requested that an old acquaintance whom he had had no contact with in years be contacted and asked to serve as his Guardian. This was done, and ultimately this reluctant and distant "friend" from the past was appointed Richard's Guardian.

Recently, Richard has reversed himself on this point and began asking for Alissa again. The point is that Richard is not and has not been competent to make any major life decisions for some time.

Where does this leave Alcor? Well, we're not exactly sure. His suspension agreement was never canceled and his trust fund is still in force, although there is a serious problem there. Because he did not establish an "irrevocable trust" the assets in it are subject to "spend-down", wherein his nursing home and medical care will consume those assets until he has only a $2,000 burial allowance left.

Theoretically his suspension contract is and will remain valid until there is inadequate money left in his trust to fund his suspension. At this point, Alcor is in the process of contacting Richard's Guardian and asking what his intentions are towards honoring Richard's cryonic suspension agreement with Alcor.

Unless Richard experiences legal death soon he will very quickly experience spend-down and have an inadequate amount of money in his trust to be suspended with. It is quite possible that Richard could live for several more years and perhaps even longer. Thus we are very likely to have a situation where a member made good faith arrangements for his cryonic suspension and now, due to brain disease, is unlikely to get suspended.

What should Alcor do?

As a minimum we feel we must try to establish to what extent the Guardian will cooperate. Will he allow us to take possession of Richard at the time of Richard's legal death and will he notify us of his illness or legal death so that we can take action?

What do we do if the Guardian is not cooperative? Do we petition the court to compel the guardian to honor Richard's wishes? If we do this, how should it be paid for? What do we do if the Guardian is cooperative (or can be made to cooperate) but there is insufficient money to suspend Richard?

Even if Richard had appointed a Power of Attorney, there is no guarantee things would have turned out any differently. And, it must be kept in mind that Richard's failure to establish an irrevocable trust with Alcor that amounted to most of his assets is very understandable. Richard had seen cryonics organizations come and go and had been a member of several groups that failed. His reluctance to commit all of his assets to us was understandable.

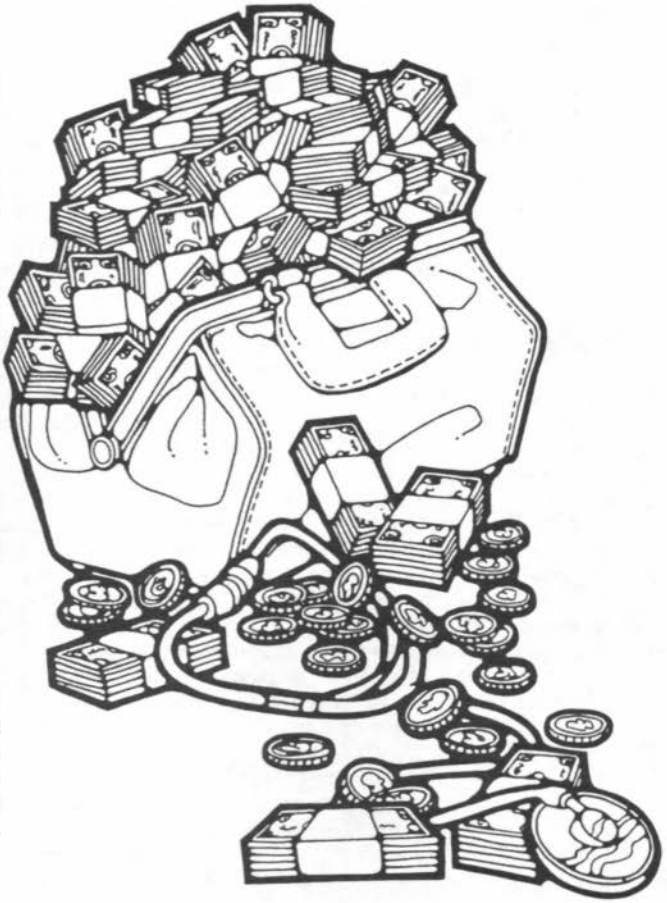
Richard's situation is a difficult and frustrating one. And we can bet he won't be the last. What do we do in the case of members who may be unable to afford the cost of suspension due to some terrible situation like this one or due to the action of a relative, the court, or perhaps an insurance company, in the future?

One proposal is to establish a suspension emergency fund to handle situations like this one, or others which may be even more deserving, that will undoubtedly crop up in the future. The Alcor Board of Directors is scheduled to consider this option at its January meeting.

As to Richard's situation, we can only inquire of his Guardian and wait. In the meantime, we'd like to hear from our suspension members. What do you think we should do in this situation? Do you favor an emergency fund and how do you think it should be funded (voluntary giving, increased dues, a surcharge on suspension expenses). Call us or write us and let us know how you feel:

(800)367-2228 (outside California) or (714)736-1703 (inside California)

We will keep you posted as we get information both about Richard's situation and with respect to what we hear from you, our members.



Late News

Almost as we go to press with this issue we received word that Richard's Guardian has petitioned the court to set aside his cryonics arrangements. Alcor intends to file a "friend of the court brief" in an attempt to block this action.

HOW MEMBERS CAN HELP ALCOR GROW

by Saul Kent

Alcor depends entirely on its members. We are funded solely from membership dues and donations, all our employees are members, and we rely heavily on volunteer work by members. In the past few years, Alcor has been able to build a strong cryonics program and conduct important scientific research because of major contributions in time and money by its members.

Alcor is currently experiencing the most rapid growth in its history. New members are being added every month and some of these members are proving to be every bit as dedicated as the old-timers. As a result, Alcor is moving forward at an unprecedented rate and expectations for future progress are at an all-time high.

Membership growth is one of the most critical objectives on the Alcor agenda for the 1990's. The contributions of new members are not just additive, but are explosive in their impact. In Alcor's early years, a few members were forced to carry the organization on their backs. They had to do everything themselves, no matter how unsuited they were for certain tasks, and they had to pay for most things out of their own pockets. The result was that some things were done poorly, while others were not done at all.

The continuous addition of new members has provided Alcor with the synergistic benefits of new knowledge, new skills, and greater financial resources. As professionals in business, communications, engineering, law, medicine, and science have joined Alcor, it has enabled us to develop specialized areas of expertise, and to work together more effectively to achieve our primary long-term goal -- the ability to restore cryonics patients to life, health, and youth. As increasing numbers of affluent members have joined Alcor, it's become possible to raise relatively large sums of money for new facilities and equipment as well as for training, education, research, and promotion.

Accelerating Membership Growth

We are currently working on several programs to accelerate membership growth. First is an attempt to generate more radio and TV interviews on cryonics. A mailing about Alcor has been sent to talk shows around the country and we are developing improved written and photographic materials for public relations purposes. These materials will be used for Alcor conferences, seminars, and TV appearances; for the development of print ads and (possibly) TV commercials; for mailings aimed at increasing the number of speaking engagements by Alcor personnel; and in attempting to stimulate interest in Alcor seminars for big business and Government.

Alcor is developing a database system to attempt to convert the leads generated by these activities into new members. We will be doing a minimum of six mailings over a period of twelve months or more to everyone who writes or calls

Cryonics: The Super-Cold Topic That Burns Up The Airways!

Cryonics is hot. In the last few months, it has been covered by the media giants. *Good Morning America* had a 5-minute segment, *People* magazine printed a 3-page story, *Larry King* devoted half his show to the subject. Everyone wants to know about the practice of freezing terminal patients for future reanimation. They want to know why people are doing it, how it is done, and whether it will work.

Cryonics is a fascinating talk-show topic because it is a bold and defiant act. The idea of cheating death by transporting patients into the future in 8-ft-high stainless-steel "timeships" is an adventure that few can resist listening to or watching on TV.

Cryonicists are brilliant, highly-articulate individuals with great self-confidence and a wealth of mind-boggling ideas and information about cryonics, its implications for society, and the fantastic world of the future. They welcome the opportunity to debate scientists who say it can't be done!

They also have breathtaking photos and video footage of patients being placed into cryonic suspension and visions of future technologies that will provide us with super powers and a world of incredible wealth and diversity.

What's really fueling the public imagination these days is the growing realization that cryonics may actually work! Recent technologic developments have convinced the scientific elite that cryonics offers a realistic opportunity for new life in the future.

Now there is a brand-new organization (*The Reanimation Foundation*), which has been set up in Liechtenstein to enable people to "bring their money with them" when they are frozen. People now have the possibility of waking up youthful, healthy, and wealthy!

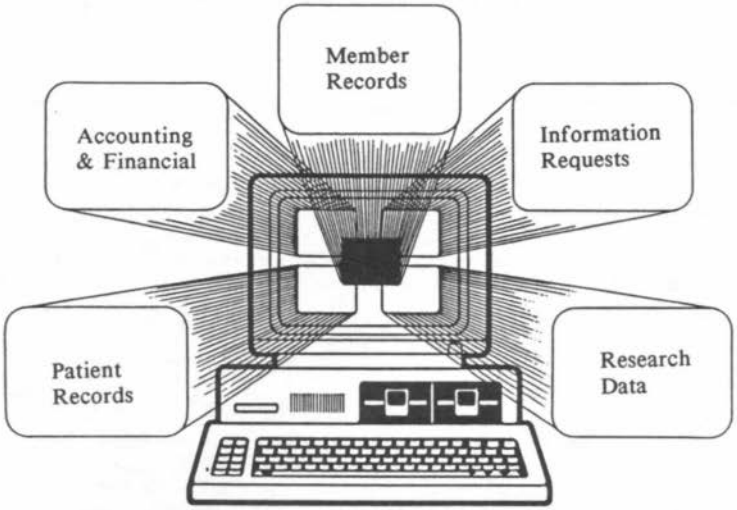
The Alcor Foundation is the largest and best cryonics organization in the world, with several marvelous speakers available. If you want to do a talk show on cryonics call Alcor right now:

1-800-367-2228

for information about cryonics. These mailings, which will differ considerably in content, will urge prospects to join Alcor or -- if they are not yet ready to join -- to subscribe to *Cryonics* magazine for only $10 for the initial year -- 60% off the regular subscription price.

We will also be doing mailings to subscribers to urge them to become members and to members to ask for their financial support for special projects involving research, long term cryonics care, and critical legal issues.

All these mailings will be closely monitored with sophisticated database programs being developed by Alcor member Joe Hovey, which will also be used for administration and accounting. By monitoring these mailings, we'll find out a great deal about what marketing approaches work best, where our new members are coming from, and what characteristics they have in common. This type of feedback will enable us to make appropriate changes to improve the effectiveness of our entire marketing effort.



The Best Resources Of All

This new marketing program to accelerate membership growth has been in the works for the past six months. We expect it to significantly increase the rate at which new members will be joining Alcor in the 1990's. But in developing the program, we neglected, to a considerable extent, the best resource of all for membership growth -- our existing members! Alcor members are intelligent, creative, and caring people from many different fields and backgrounds who have two things in common -- the desire to continue living in good health for as long as possible and the belief that cryonic suspension offers a realistic chance of continued life for terminal patients.

In the past, many Alcor members have shared their knowledge and enthusiasm about Alcor with their relatives and friends in the hope that they would join the organization. These attempts to recruit new members have been quite successful. Many of our current members joined Alcor in large part, or entirely because of, the influence of one or more existing members. Not one of us can say that we haven't been influenced to some extent by other members regarding our participation in Alcor.

The problem is that -- in large part -- attempts by existing members to recruit new members for Alcor have been done *spontaneously*, without the encouragement and assistance of Alcor. As a result, these recruitment efforts have not been as effective as they might have been, and some members who would like to help in our recruitment efforts, have never tried to do so.

Alcor Needs Your Help

The time has come for Alcor to provide greater impetus to the efforts of existing members to recruit new members. This article is the first step in a new membership recruitment program that I and others will be developing. This program will be designed to provide assistance to all Alcor members who wish to be involved in recruitment.

The first and most basic message is that Alcor very much wants you to help recruit new members in every way possible. We want you to inform your family members, your friends, your business associates and your acquaintances about cryonics. We want you to provide them with information about the tremendous opportunity that cryonics offers; to share your enthusiasm and excitement about cryonics with them; to invite them to cryonics meetings, seminars and conferences about cryonics and reanimation, as well as to the Alcor facility in Riverside; and to refer them to the appropriate experts when they have questions you can't answer.

Spreading The Word

Every member who wishes to help us in recruiting will have to decide how much time and effort they want to expend in this effort. A few Alcor members have been very active in recruitment for years. In addition to speaking to people around them about cryonics, they've also given talks about cryonics and appeared on radio and TV shows. If you want to get involved in recruitment to this degree, you should have special training. Alcor will soon be offering interactive seminars and workshops for members who want to participate heavily in our recruitment program. (More about that later.)

But those of you who don't have the time or inclination to get heavily involved in recruitment may still want to spread the word about cryonics in a more casual way. If that's the case, all you have to do is tell people what cryonics is, that you're signed up to be suspended, and that you think cryonics has a great deal to offer.

If they have any questions, you can answer them if you're willing and able to do so, or you can tell them to contact Alcor directly. Everyone on the Alcor staff can answer the majority of questions about the organization or about cryonics in general. In addition to this, we now have a list of Alcor experts in specific areas relating to cryonics such as cryobiology, nanotechnology, legal issues, and sign-up procedures, which will soon be sent to all members. Alcor can also provide you with copies of our literature for distribution to prospects as well as guidelines and tips about how to approach them and how to deal with their questions and objections. Members who wish to obtain any of this material should call Alcor at: **1-800-367-2228**; in California call: **714-736-1703**.

Talks About Cryonics

If you want to give talks about cryonics to local groups, you should be fairly knowledgeable about cryonics and have some experience in dealing with how people react to it. Alcor now offers a slide presentation (that you can purchase from us) as well as seminars and workshops that will aid you greatly in giving talks about cryonics.

If you're not that ambitious, however, you can still help us set up speaking engagements for Alcor experts in your area. Alcor now has a speakers' bureau which features leading authorities in cryonics, nanotechnology, space exploration, and other relevant subjects, and we have literature available that you can provide to organizations looking for speakers.

The same principles apply to radio and TV shows. If you'd like to appear on such shows yourself, you'll have to acquire the knowledge and training to do so. But we also welcome your efforts in informing local producers about the availability of Alcor's experts for radio & TV appearances. If you'd like to help us in arranging such shows, just give us a call.

Writing Articles And Letters

If you want to write articles about cryonics for consumer publications, you'll need to be well informed about cryonics in addition to having the talent and contacts to do so. A few Alcor members have already published such articles and are working on other articles (and books) about cryonics and related subjects. But even if you're not able to write articles for publication, you can help us to grow by writing letters.

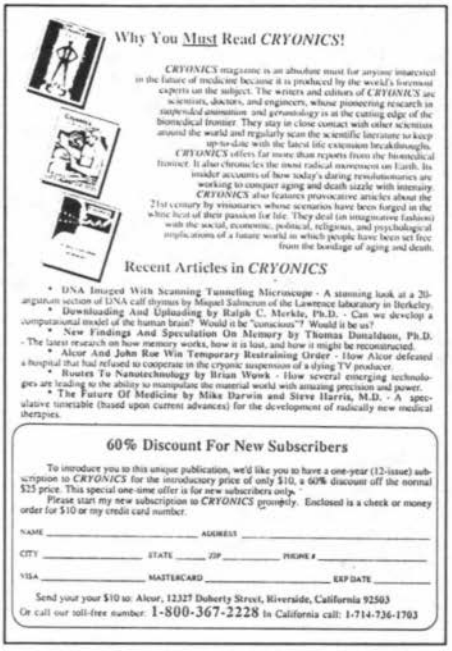
You can write letters to the editor of newspapers and magazines in response to articles about cryonics. You can write to editors to encourage them to print articles about cryonics, nanotechnology, and other subjects. You can write to TV shows when they air programs dealing with cryonics. And you can encourage producers of shows on related subjects, such as euthanasia or assisted suicide, to include cryonics in their programs. You can also write to celebrities you admire in an effort to stimulate their interest in cryonics.

To assist you in letter writing, Alcor will be sending you sample copies of letters that other members have written to promote cryonics. These sample letters can serve as a guide in writing your own letters. If you wish, you can use the exact wording in these samples when composing your own letters.

Placing Ads

If you'd like to help us reach people by placing (and paying for) ads in local or national publications, we'll be happy to help you do so. Alcor is developing several ads for different publications and can make copies of these ads available to you if you'd like to place them in other publications. If you want to develop your own ads, please send

us a copy of your proposed ad (prior to the final version) for our prior approval. And please make sure to tell us when the ad has been placed and when and where it will run so we can report its effectiveness to you.



Seminars And Workshops

Alcor will be holding an interactive seminar workshop to help members in their efforts to spread the word about cryonics on Saturday, March 24th, from 12 noon to 6 PM at the home of Bill Seidel in Culver City. (You will be receiving a flyer about this meeting shortly.) We expect to hold more such meetings in Southern California and other areas where there are a substantial number of Alcor members. These meetings will be exclusively for Alcor members.

The March 24th meeting will feature short talks and group discussions on many subjects including:

Alternative Methods Of Introducing People To Cryonics,

How To Talk To Relatives About Cryonics,

How To Answer Questions About Cryonics, and

How To Make A Presentation About Cryonics To A Group.

What We Have To Gain

Cryonics is not a simple idea to sell. It almost takes direct contact with existing members to convince people to sign up. Sometimes it takes years, or even decades, of friendly persuasion to recruit a new member. On the other hand, few members drop out once they're signed up and persuading people to join Alcor has become progressively easier because of recent scientific advances and our own growth and development.

The slow growth of cryonics over the past 25 years has been quite frustrating for all of us. We know cryonics can work. We know that a healthy, radically-extended lifespan will eventually be achieved, and that the future has incredible wonders in store for us. But we also know that we're growing older with each passing day and that we need to move a great deal faster to improve our chances.

Sitting back and waiting for others to do it isn't good enough. If we wait for a handful of "leaders" to sell cryonics, we'll make progress, but at a much slower rate than if we all pitch in. The growth rate from widespread member participation is geometric. Right now Alcor has about 150 members. If all of you work to recruit new members and if the new members continue to recruit even more new members, we'll move forward at a faster and faster rate, like a snowball rolling down a high, snow-covered mountain. When we have 1,500 members, we'll be picking up momentum. When we have 15,000 members, we'll be moving at lightning speed. By the time we have 150,000 members, we'll be utterly unstoppable.

Let's move faster right now! The future is ours: let's seize it!

But Are You Signed Up Yet?

by Dave Pizer

Every so often a new person comes along
"I'm going to make cryonics skyrocket!"
After I listen to their stupendous song
I ask, "But, are YOU signed up yet?"

"I'll make a speech."
"I'll write a book."
"That's nice, but FIRST there's just one thing
You should not overlook."

"I'll contact politicians."
"I'll call on every millionaire."
They seem to have such great ambitions
Sitting in their snug armchairs

They rave for days
On what they're going to do
They have a million ways
They're going to follow through

But they won't be there in the future
Is my safest bet
'Cause they always sidestep the question
"But are you SIGNED UP yet?"

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THE QUESTION COLUMN

by Mike Darwin

For a number of months I have been wondering what our Alcor ID numbers mean -- if in fact they mean anything at all. Based on a sample size of one, I hypothesize that:

The "A" stands for Alcor

The first three digits form a member number assigned sequentially (so I would be the 120th member)

The last digit indicates a whole body or a neuro (since I am whole body, that would be a 1 and since a neuro is obviously less than a whole body it should be represented by a 0.

If the ID's really do contain information of interest, a short article on the subject in a future issue of Cryonics *might be in order. If the numbers are assigned (pseudo)randomly, perhaps we might consider changing to a more orderly system.*

Michael B. O'Neal
Ruston, LA

Your question is a good one, and I think I can answer it straightforwardly enough. None of Alcor's current management was around when the ID numbering system was thought up and implemented. It was one of the very first administrative things done and dates back to 1972 when Alcor was founded (alas, I was but a Junior in high school then....).

Thus it was necessary to call the founders of Alcor, who have moved on to a higher plane (in the mountains above Lake Tahoe, California). They (in the person of Linda Chamberlain) provided me with the following history:

The numbers were assigned consecutively. The A stands for Alcor, as you correctly guessed. A four-digit number was selected so that all the numbers would come out the same length for aesthetic reasons and simplicity in paperwork (forms and so on). There was never any intention of having the numbers encode additional information.

That was then. What about now, you ask. Well, it's pretty much the same, except that a couple of years ago the numbers stopped being assigned in strict chronological order. Why? Well, actually because of problems with the company that supplies our bracelets. They are horrible! Almost impossible to deal with. You have to call them 20 times to get an order delivered. They don't want to even deal with you unless you are ordering 50 tags at a time.

How they stay in business we don't know, since they deal primarily with the public on *individual orders*. Probably they are still around because most of their customers, poor saps, don't know their phone number. (Although even that may not work, since they frequently have a recording on the line saying "all of our lines are busy, call back tomorrow!").

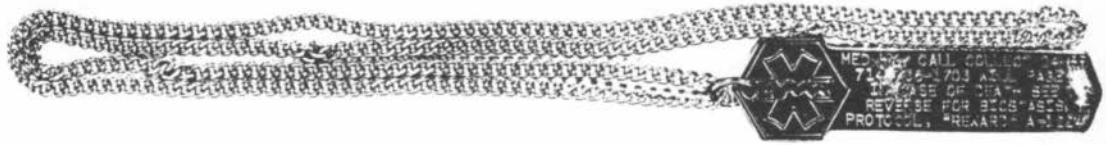
Why do we deal with such a company? Because they are the only company in the whole wide world whom we have found (and believe me, we've looked!) that produces a tag big enough and nice enough to get our complicated message on.

The end to this shaggy dog story is simple: we have gone to ordering a huge number of tags from them in advance. Since we offer both bracelets and necktags and we never know in advance which new member will want which, we simply order the tags in consecutive blocks of numbers. Thus if you want a necktag, you may get 25 numbers ahead of the next in line for bracelets.

It's sort of sad really, because you used to be able to tell exactly where you were at in terms of people who've joined up. Now, like with quantum mechanics, we can only tell you a "range" based on your Alcor number.

Can we change the system. Probably not for now. We have too many other pressing things to worry about.

However, your suggestion of using the number to encode things about the member is not a bad one. The only trouble is, what happens if a guy switches from neuro to whole body? Does he have to be issued a new bracelet? The idea has its limits because it generates administrative overhead. After all, what kind of information could we encode that would not be subject to change?



THE FIRST FORESIGHT CONFERENCE ON NANOTECHNOLOGY

by Ralph Merkle

The *First Foresight Conference on Nanotechnology*, hosted by the Stanford Department of Computer Science and sponsored by the *Foresight Institute* and *Global Business Network*, was the first major conference to examine molecular systems engineering as a path to nanotechnology. Held on October 27-29 in the wake of the Bay Area earthquake, the conference in Palo Alto drew about 150 invited participants from three continents and many disciplines. It was a success by any measure.

The Saturday sessions featured scientists defining the state of the art in various enabling technologies leading to nanotechnology. By Saturday afternoon, participants had a good overview of where work stands in these fields: further along than conference chairman Eric Drexler predicted in 1986, but still an undefined number of decades away from nanotechnology, which was defined as "thorough control of the structure of matter."

Researchers in protein design, chemistry, biochemistry, biology, scanning tunneling microscopy, quantum electronics, computer science, micromachines, physics, molecular modeling, and molecular electronics were all drawn together to discuss a common theme: understanding and building structures, devices, and systems on the scale of molecules. The excitement was palpable. Asked to rate the conference on a scale of one to ten, one conference attendee said "Eleven!"

Nanotechnology has been described as the manufacturing technology of the 21st century, which some argue will be able to manufacture almost any chemically stable structure at low cost. If realized, such precise fabrication abilities could be used both to improve existing products and to build products that are impossible with present technology. Based on estimates of parts count and power dissipation, components of molecular size could make a single desk-top computer of the future more powerful than all the computers in existence today combined. Devices smaller than a red blood cell might circulate through the body and attack and remove both fat deposits and infectious organisms. These are potential long-term applications of nanotechnology, but the conference started with an examination of where we stand today in efforts to engineer molecular systems.

Michael Ward of *Du Pont* described the design of self-assembling systems by controlling the charge on individual molecules. If the pattern of electrostatic charge on individual molecules is properly controlled, then it is possible to control many properties of molecular aggregates.

Federico Capasso, head of *Quantum Phenomena and Device Research* at *AT&T Bell Labs*, discussed current work on exploiting quantum effects in devices built with controlled bandgap variations on a nanometer scale. A major limit in building and commercializing smaller devices is fabrication.

Tracy Handel of *Du Pont* discussed the *de novo* design and construction of a protein by

William F. DeGrado's group. This work provides a dramatic illustration that protein engineering is possible, and thus that objects of multi-nanometer scale can be designed and built to precise molecular specifications.

Jay Ponder, of the *Department of Molecular Biophysics and Biochemistry* at *Yale*, described systems for molecular modeling and for the computer-aided design of proteins. He reports that an algorithm developed in collaboration with Frederic Richards has been quite successful in generating sequences of hydrophobic amino acids which will successfully pack to form the core of a protein with a specified backbone geometry. Molecular modeling is of general importance in molecular systems engineering because the proposed structures are at present often expensive to synthesize and characterize; longer-term proposals (under examination for exploratory purposes) may involve structures that are entirely beyond today's synthetic capabilities. In either case, molecular modeling can frequently distinguish between workable and unworkable proposals.

Robert Birge, Director of the *Center for Molecular Electronics* at *Syracuse University*, reported on attempts to build a large optical memory with access times below two nanoseconds, using bacteriorhodopsin as an optically activated molecular switching element. They currently can achieve 20 nanosecond access times, the major limitation being the speed at which the optical beam can be positioned to "read" or "write" single bits.

A later talk by Hiroyuki Sasabe of Japan's *Institute for Physical and Chemical Research* reported on the current state of molecular engineering research in Japan. He described a broad range of interdisciplinary projects in "intelligent materials" and molecular electronics.

John Foster, manager of *Molecular Studies for Manufacturing* at *IBM's Almaden Research Center*, presented work with STM (scanning tunneling microscopy) technology, describing advances in both surface imaging and surface modifications. The latter could in theory be used to construct a memory device with storage densities on the order of 100,000 million bits per square millimeter, through a demonstrated mechanism which involves pinning individual molecules to a surface.

Joe Mallon, Co-president of *Nova Sensor*, described the wide ranging abilities of current micro machines. These devices, typically measured in tens of microns, are made primarily of silicon using semiconductor fabrication technology, but are mechanical in nature. Electrostatic motors, gears, levers, joints, sensors, turbines, pumps, and a wide variety of other mechanical devices have been made in this size range and shown to work.

Norman Margolus, of *MIT's Laboratory for Computer Science*, explained the known theoretical limits to computation, perhaps more properly termed the lack of known limits. Quantum uncertainty, thermal noise, and other factors commonly thought to limit computation are, instead, merely constraints. By designing computers in an appropriate

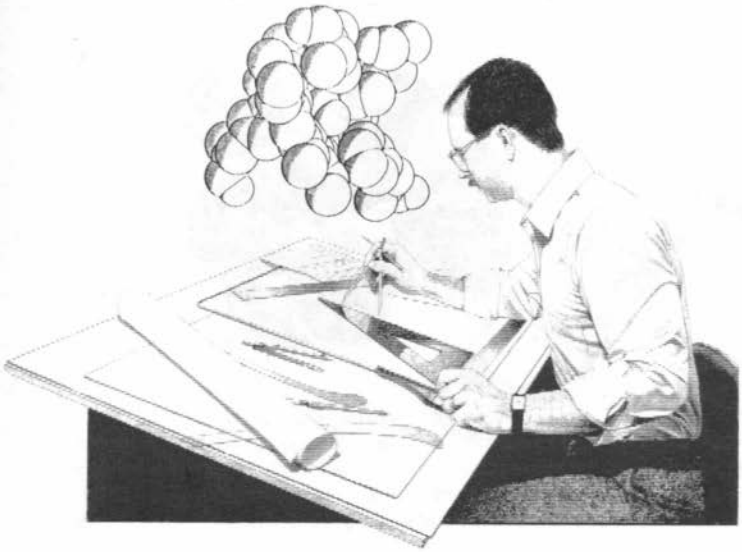
way (for example, by building reversible computers) these constraints can at least in principle be satisfied without loss of speed and without requiring any fixed energy dissipation per logic operation. Even with practical constraints, quantum computers that dissipate much less energy per gate operation than the background thermal noise seem possible, and gate speeds in the femtosecond range seem plausible.

Eric Drexler, of the *Foresight Institute*, presented recent work that clarifies technical issues in the design of an "assembler," a device capable of guiding the synthesis of virtually any specified chemically stable structure via positional control of chemical reaction sites. Both in his talk and in an accompanying inch-thick preliminary draft, he outlined the design of a sub-micron scale articulated mechanism capable of positioning its tip with a standard deviation in position of less than 0.04 nanometers, despite both thermal and quantum effects. He also presented design sketches for proto-assemblers: cruder devices that might be made in the next decade which could be used both to experiment with positional control of chemical reactions and to build more sophisticated devices. His proposal that AFM (atomic force microscope) tips might be capped by engineered molecular structures, thus providing precise atomic control of the structure at the tip of the AFM (something that is notably lacking at the present time), was met with particular interest.

On Sunday afternoon several talks explored the future implications and policy issues raised by this new technology. This process was perhaps the other major achievement of the meeting: consideration of the consequences of a powerful new technology decades before development is completed.

Bill Joy, Vice President of Research and Development at *Sun Microsystems*, discussed what might be done with a trillion processors. He said truly large amounts of computational power would provide us with a new tool which would let us model and understand both physical phenomena and our environment better, and so let our society make better decisions.

Lester Milbrath, Director of the *Research Program in Environment and Society* at the *State University of New York at Buffalo*, expressed his concern that the anticipation of nanotechnology development and its proposed use in environmental cleanup would make policymakers overly optimistic. He doubts that nanotechnology can be developed in time to head off the environmental problems now facing us.



Ralph Merkle, a computer science researcher at *Xerox PARC*, discussed techniques for controlling artificial self-replicating systems. While attractive from an economic point of view, such systems must be designed to avoid any opportunity for unchecked replication and mutation. While *Star Trek* has popularized the idea that "nanites" could rapidly evolve into intelligent social beings capable of negotiating for their own planet, this popular vision

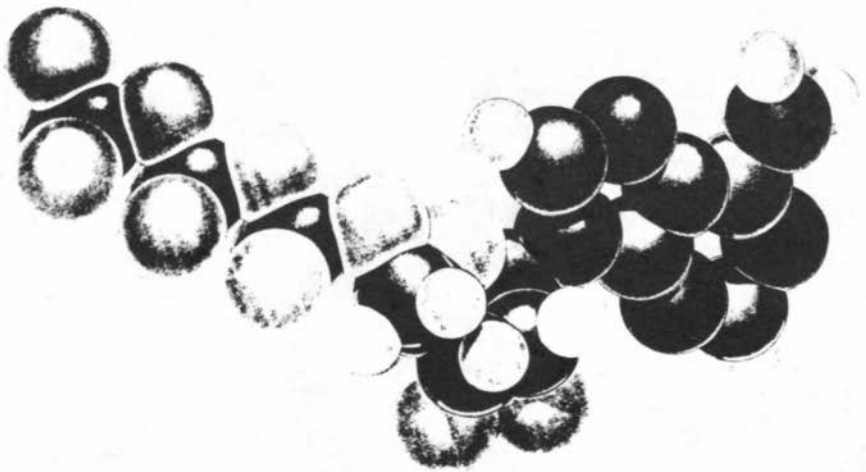
appears highly implausible. The simplest and most practical artificial self-replicating systems will have inflexible designs and special raw-material requirements, making them unlike anything able to survive in nature and unable to change. Nonetheless, regulation of the design and use of such systems seems essential to ensure that dangerous new capabilities are not added by irresponsible or malicious parties.

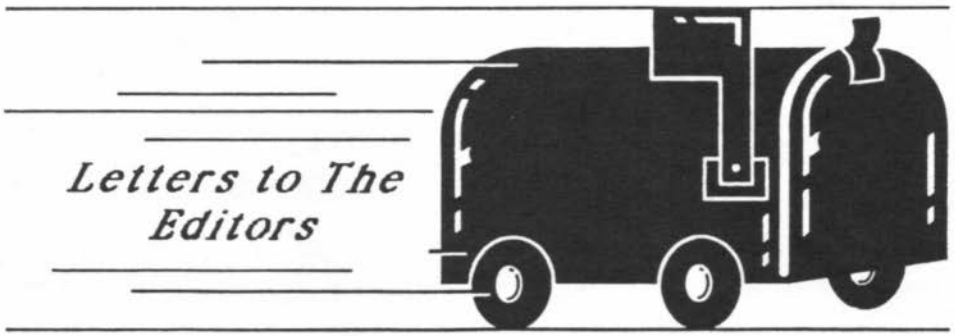
Greg Fahy, a researcher with the *American Red Cross*, discussed the medical implications of progress toward nanotechnology. Aging is a consequence of molecular changes that take place within the body, including changes in genes and their expression. Experimenters have successfully slowed aging in experimental animals; if this work can be extended to humans it should result in increased decades of healthy life. Progress in molecular design on the path to nanotechnology is likely to continue and strengthen this trend, eventually allowing the retention of good health for a prolonged period.

The conference closed with two presentations on the broader impacts of technological advance. Economist Gordon Tullock of the *University of Arizona* cited historical trends showing that, although individuals can be hurt economically by technological advances, the overall effects have been positive. Arthur Kantrowitz of *Dartmouth* argued for keeping research programs open rather than classified, suggesting that if classified programs must exist, they will benefit from parallel research programs which are open.

While it is too early to tell the ultimate impact of this first international conference on nanotechnology, it has clearly raised the level of interest and focused greater attention on both the technology and its consequences. It may well prove to have been the seminal event in the coalescence of a new field and in the emergence of a new and powerful technology.

Sessions were both audio and video taped. Conference proceedings are planned. Further information on availability both of the proceedings and of the tapes will be made available both here and on *sci.nanotech*.





Dear Cryonics;

Saul Kent's recent article, *Why Suspension Members Need More Than Minimum Funding* (Nov, 1989, p. 9), correctly argues that the long term probability of success for cryonics is increased if more resources are available. The most dramatic illustration of this recently has been the costly expenses of various legal actions. The probability of success is also increased by spending more time, effort, energy, and money on the technical, social, and political issues surrounding cryonics. It seems likely that the bulk of these resources will come from people who believe that cryonics is both feasible and worthwhile: us!

However, some of Saul's rhetoric is rather overblown. "Once the idea of cryonics takes hold, it will lead to political, economic, social, and religious turmoil throughout the world." "Cryonics is more explosive than any idea in history because it threatens the entire fabric of society." "Sometime soon, the financial establishment will discover that cryonics is likely to mess up their system." Cryonicists are "... radicals who not only want to change the system, but who want to overthrow the species."

I have not the slightest desire to "overthrow the species" nor is there any need to do so. The changes that have to be made in "the system" to accommodate cryonic suspension are quite modest. Cryonics has been practiced in the United States and in California for over 20 years. Despite the recent claims by certain state officials to the contrary, there is no reason to believe that cryonics is illegal. It seems likely that we will soon have a court ruling to that effect. Although obtaining such a court ruling is a strain on our limited resources, it falls far short of "overthrowing the species."

While I deplore the actions of those individuals who have jeopardized my life and the lives of others by attempting to block or obstruct suspensions, the fact remains that not one of Alcor's suspended patients has been thawed, nor has one suspension been blocked. Given the controversial nature of cryonics and the widespread ignorance and misunderstanding on the subject, this is an accomplishment in which we can take great pride.

To continue this happy track record will require more work, more effort, more time, and more money.

The world is still largely ignorant of who we are, and must be educated. Cryonics is based on reasonable and indeed well supported premises, a fact that is gradually being understood. In the future, we will need to establish the legal right to be cryonically suspended when, where, and in the fashion that we decide is appropriate. We must educate those who are ignorant, persuade those with open minds, and counter the arguments of those

with closed minds. (Fortunately, the latter task is greatly assisted by the rather modest abilities of those who actually speak out against cryonics).

Every time we talk with someone, every time we appear on television or radio or in print, we are telling the world what sort of people we are and what we stand for.

Telling them we stand for the overthrow of "the system" and "the species" is flat out wrong. Telling them cryonics "...will lead to political, economic, social, and religious turmoil throughout the world" is also totally wrong.

Many people are easily frightened, especially when they are ignorant. Quite frankly, if I had read Saul's article and knew nothing about Alcor or cryonics, I would take a dim view of both.

This is not what we want, it is not what we should want, and it will not help us at all. Frightened people can do foolish things.

The statement is also entirely incorrect.

First, the size of the cryonics movement today is simply too small to change the course of human history. Even as we grow into a movement with hundreds of thousands of people (a rather likely event over the next few decades given current trends) we will still have only a modest impact. The primary impact we do have will be in the proper treatment of the terminally ill cryonicist.

Second, the cryonics movement is, from a historical perspective, transitory. It can only thrive when it is clear that repair of frozen tissue will be feasible, but before general repair abilities are actually developed. There is little need to freeze a person who can be successfully treated, and if you can successfully treat someone who has been frozen then there will be very few things that can't be treated without the need to be frozen. The few things that can't be treated will likely be immediately fatal. (Cryonic suspension will still occasionally be useful in the future; it just won't be needed very often nor for very long).

Third, cryonics is about staying alive and staying suspended. This will require a stable supply of liquid nitrogen. This is easier to get in a stable society with stable institutions. Political and social problems create shortages and distribution problems. We simply can't afford to run out of liquid nitrogen. Not once. If anything, cryonics will have a conservative and stabilizing influence on the fundamental institutions of society, out of sheer necessity.

We see many trends in the world around us: the collapse of communism, the growth of Japan, the development of nanotechnology, the exploration of space, and the development of artificial intelligence. While we can try to understand and use these trends to chart a safe course to the future, the trends would be there with or without cryonics. We ride on the crest of great forces, we do not create them. Everyone concerned about the future of humanity will strive to channel these trends in safe and beneficial directions. As individuals we will sometimes have impassioned views about this or that issue. As a community interested in the success of cryonics we are concerned primarily about increasing tolerance, increasing understanding, controlling or eliminating murderous violence, and encouraging basic and applied research in medicine. If we are to journey successfully into the future, we seek a world most likely to provide the conditions needed for success. A chaotic world of violence and social upheaval seems unlikely to be optimal. A prosperous and peaceful world which accepts our right to be suspended is the ideal towards which we must strive.

I want to see the 22nd century. I have every reason to believe it will be a wonderful time to be alive. The technology for the trip is available, and I want to use it. A few people oppose this. While legal action is and will continue to be necessary, our primary weapons are knowledge and understanding. On the legal, social, political, and technical fronts the better people understand what is happening, the better off we are. We must educate people. This is a slow and tedious process, but in the end it is the surest route to success.

All of us educate those around us about cryonics. If we tell them we are radicals bent on the overthrow of "the system," they'll believe us. This is not only false, but can hurt us. "The system" does not take kindly to being overthrown, and is quite capable of destroying groups that seriously threaten to do so. Being viewed as "radical", "dangerous", and "revolutionary" does not seem like the best method of insuring a stable supply of liquid nitrogen; nor does it seem like the best route to a long and prosperous life.

Yours truly,
Ralph C. Merkle

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Saul Kent responds:

I hope you are right, Ralph.

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The following articles were written by Thomas Donaldson and Steve Harris in response to Ralph Merkle's article Molecular Repair of the Brain, *in the October issue. Ralph's reply follows them.* --Eds.

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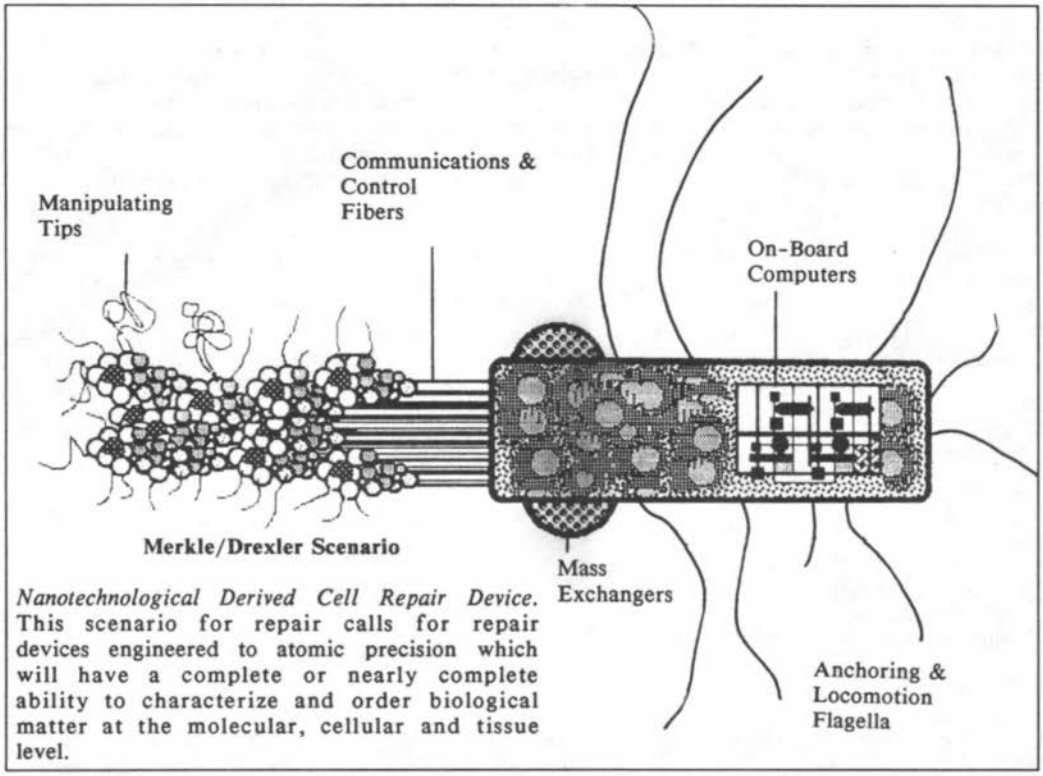
WHAT ARE THE REAL COMPUTATIONAL PROBLEMS OF CRYONICS?

by Thomas Donaldson
MacArt by Mike Darwin

Ralph Merkle published quite a good article in the October, 1989 issue of *Cryonics*, basically going through the "nanotechnological" approach to repair. In its pure form, this approach envisions robots the size of very large molecules, designed for cell repair. These robots would contain onboard computing capacity, and discussion of the computation involved in repair plays a large role in a classical "nanotechnological" analysis. He was good enough to give me a copy prior to publication. I felt that my own thinking on repair differed so fundamentally that it required a separate article. This is that article.

Its title expresses one persistent problem I've had with descriptions of nanoscale 68040's [Motorola's current leading-edge microprocessor. -- Eds.] inside repair robots. A robot of molecular size astounds and amazes. But exactly what computations is it supposed to *do*? Without answers to that question, no one can even decide whether the approach is practical. What capacity (size, memory, or speed) *must* it have? Without more detailed repair scenarios, we can only shrug.

In particular, it's not enough just to store our brain and/or memories. The



Nanotechnological Derived Cell Repair Device. This scenario for repair calls for repair devices engineered to atomic precision which will have a complete or nearly complete ability to characterize and order biological matter at the molecular, cellular and tissue level.

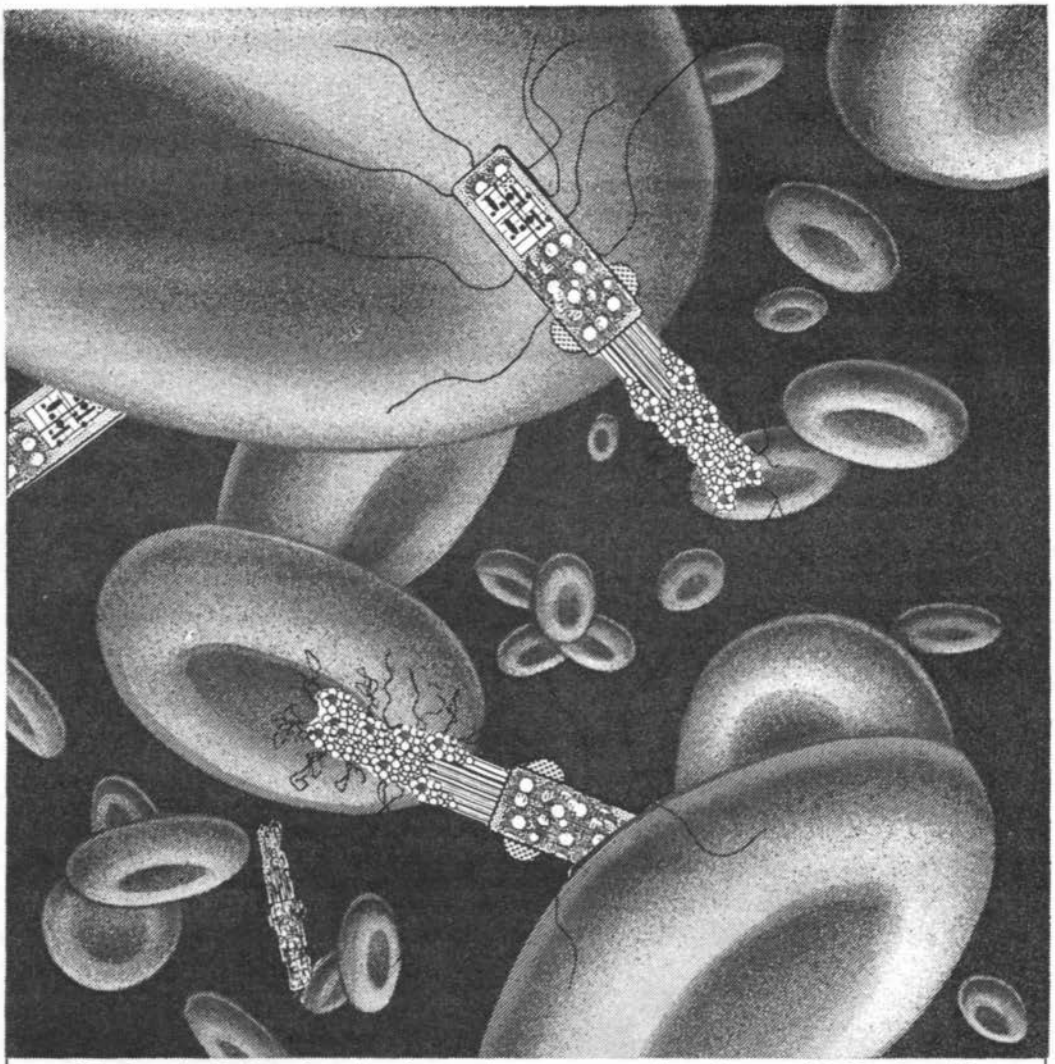
computations will also need additional memory, of (so far) unknown size. In fact, the possibility of memory devices large enough to store our brains follows trivially from the fact that we exist and therefore contain all such information. It is this other issue, the amount of memory required by the repair robot, which is hard.

Three fundamental issues and a statement

Before any serious discussion of these points, three fundamental issues need discussing.

First, *molecular* scale repair is a red herring, since virtually all significant damage to cells by either freezing or anoxia does not appear on a molecular level, nor do we have to duplicate brains on molecular scales. We want to repair *cells*. The distinction is critical, since every single molecule might end up perfectly repaired while the brain cells remain damaged and unviable. Furthermore, a century of intense study has already told us a great deal about cells in general and neurons in particular. Just by knowing that it is in a neuron, which type of neuron it is, and where, already tells the computer a good deal about what to do. This information is available if we think in terms of cells. If we think in terms of molecules, it's abstract and faraway, requiring (quite unnecessary) computational resources to discover.

Second, no amount of computational power can recover someone who has been obliterated. Storage of long term memory in our brains remains unsettled. A lot of



Cell Repair Devices late in the repair sequence, afloat in arterial blood amidst oxygen carrying red blood cells. With most repairs completed, the repair devices are withdrawing from the tissues to be collected from the blood stream (Merkle/Drexler Scenario).

important work has uncovered, using both biochemical and microscopic techniques, changes in synapses and neurons occurring with learning. Yet we still don't know if these are the permanent changes or instead only transitory steps in creation of those permanent changes. Some issues in physical memory remain quite unstudied: specifically, connections between neurons and their maintenance and recovery. However, anyone who seriously studies the physical basis of our memory would say that the permanent changes, whatever they are, will almost certainly survive great damage to our brains. That damage could be ischemia or chemical destruction.

Third, in any ideas for repair the issue of parallelism arises (it will continue much farther, but here is where it begins). Our brains contain approximately 10^{12} cells. To achieve repair in reasonable time we must work on all or most of them simultaneously: that is, in parallel. Yet since all of these cells connect to one another, each independent repair robot must communicate with others. To recover connections between neurons will need communication between robots working on each neuron. If repair requires a search, communication demands increase. The communication network, then, is just as important as the abilities of individual parts.

The word "robot" originally came from Karel Capek, who used it to describe imitation human beings. These would act more or less independently. Since we need coordination for repair, we are discussing not robots but a repair device with many parts.

Finally, to make one aim of this article clear. This article aims to define just how bad conditions can be without preventing complete repair. If we seriously look at neural damage after ischemia and freezing, it becomes evident that comparatively simple treatments (unfortunately not yet discovered, but still simple) will repair many suspendees. Nowhere near the kind of machinery I describe is likely to be needed for most patients.

So what are the problems for repair?

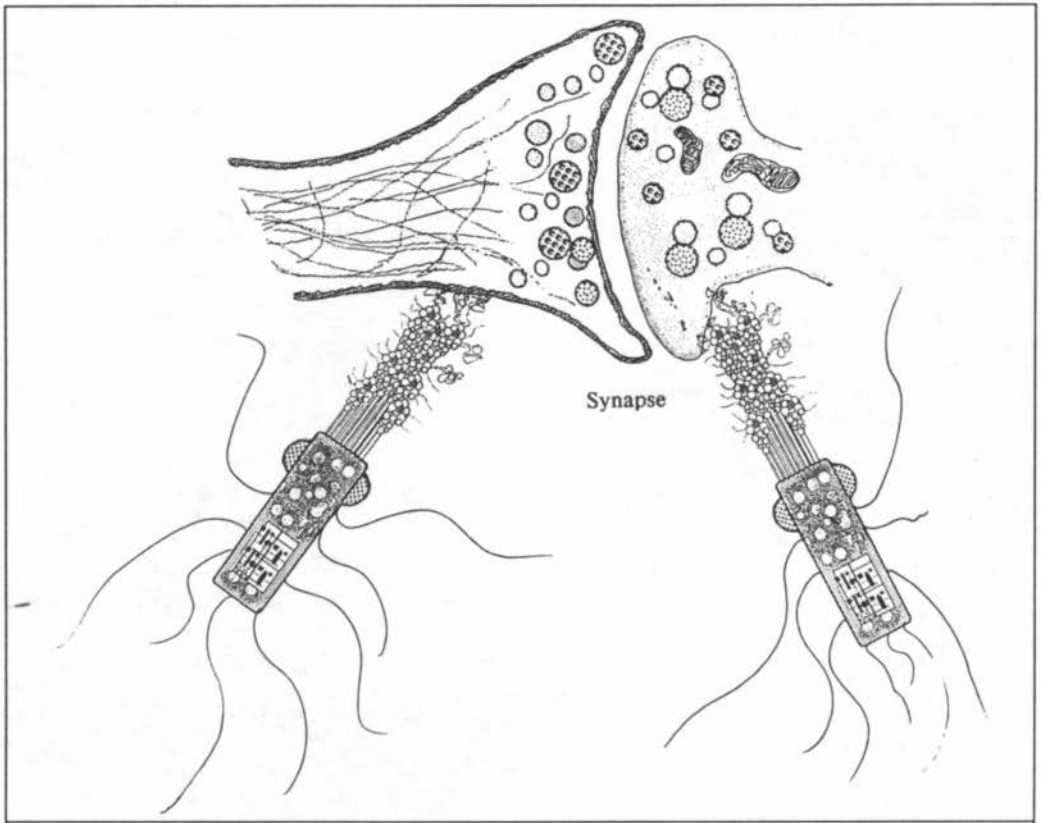
I shall go directly to one (perhaps not the only) central computational problem for repair.

The original robots were more than just computing devices. They could wander about in the world, reacting to its environment, at least as well as human beings. The nanorobot must first understand its surroundings, before any issue of repair can arise. In fact, even if directions and information come from outside, and the nanorobot is only a part of a much larger device, it would still need to recognize cell parts; membranes, mitochondria, DNA, and many other molecules and structures. The major computational task such a device must achieve is *recognition.*

For many years computer scientists have attempted to find methods for recognition which work sufficiently fast on single-CPU computers. Unless the problem is severely restricted, they have uniformly failed, even on Cray-XMPs. We don't already see robots everywhere about us, precisely because of that failure. Somehow, a problem absurdly trivial for us becomes very hard. Some computer scientists (Hans Moravec, for example) concluded that computer power simply wasn't enough. Yet "power" takes many forms. We need much more precision than that.

Recently, though, we've achieved far more success. Even without any connection to computing, most readers will have heard of machines capable of recognizing signatures, even handwriting. Underneath these machines we have parallel computers (or sometimes, chips with parallelism designed on board). These consist of a team of smaller computers, operating together in cooperation. Very easy methods exist to make such a team learn to recognize objects, faces, and many other things. A large enough team, operating in cooperation, can achieve results on recognition problems, in both speed and capacity, which *no* single computer can achieve, even in principle.

(Here are some comments for the computer scientists. Yes, Turing was correct that a single machine can perform any imaginable calculation. At Carnegie-Mellon a long-running project has attempted to create robots, driven by a sequential *computer, and able to drive* outside *along a path. It makes about 5 mi/hr on a good day, and still*



Synaptic Repair being carried out by nanotechnologically derived cell repair devices (Merkle/Drexler Scenario).

tends to run off track. The time *variable was forgotten entirely. And that is important).*

One type of highly parallel computer capable of recognition is called a *neural net.* This is *not* an accident. Only highly parallel distributed computers can finish this computation in reasonable time. Even with parallelism, only *neural nets* have come anywhere close to solving recognition in reasonable time. It's far from clear that any algorithms even exist for use by computers which are *not* neural nets *and* give a solution in reasonable time. We are neural nets ourselves.

With these points in mind, let's look at the recognition problems a repair nanorobot must solve. It needs to recognize cell membranes and other parts of the cell (synapses, mitochondria, nucleus, Golgi bodies, and others). It will almost certainly need to understand issues like: "this synapse gives a connection to this other neuron". It would also need to have a capacity to sample its chemical environment, and recognize the chemicals involved, their combination, and what that means for its repair.

Repair nanorobots can lie between two poles of computational ability. We may have many different kinds of nanorobots, each specialized to recognize one particular cell

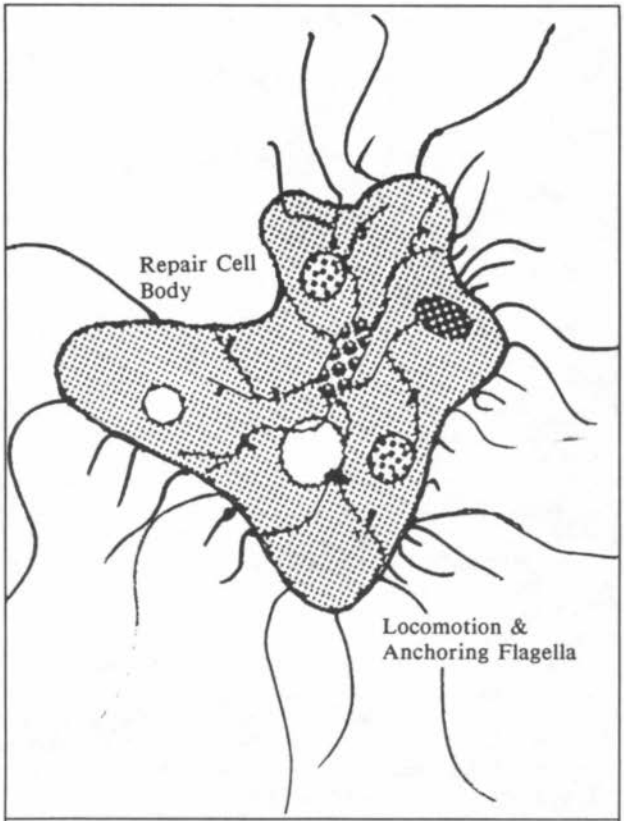
structure or a part of it and respond, and each one (individually) very dumb. Again, we may have a very general nanorobot with correspondingly general computational power.

The first pole already has its representatives. We call them enzymes. They cooperate together, combined with other chemicals and biochemicals, in many chemical reactions within and outside cells; functioning cells, "dying" cells, and "dead" cells. The overwhelmingly important fact about enzymes is that they possess a *recognition ability*. Their molecular shapes fit with those they must recognize like lock and key. Recognition happens as a chemical reaction from the mass effect of many molecules on the same enzyme. Each enzyme is highly specialized to react with only a small number of targets.

To speak of enzymes as if they were robots or computers may seem extreme. I'd point out, though, that present-day computers evolved out of adding machines, which evolved out of abacuses, which evolved out of counting on our fingers. If a nanorobot is a highly complex chemical, then a chemical is a highly simplified nanorobot. And there is another way to see it, too: the computer consists of the mass of enzymes together. A single enzyme molecule is only a small part. (This corresponds with the observation that a mob of independent nanorobots probably won't work for repair).

These systems are very powerful. Since our cells function in this way, that should not surprise us. They are not only powerful, but neatly solve two further problems. The farther we generalize computational ability, the more we need sensing devices. Enzymes combine sensing and computation, lacking any generalized ability. Nanorobots require specialized means for sensing, even prior to any recognition. This is the sensing problem: what senses would nanorobots have, and how would they work?

And too, the tool problem: precisely what "tools" would nanorobots carry, and how would they work? (The nanorobot cannot carry tools for every type of molecule. Does it make the tool first? With enzymes, the entire cell volume can be worked on. If the tool attaches to the nanorobot, then the number



Biologically Derived Cell Repair Device. This approach assumes a biologically based, diffusion driven scenario for repair. No large scale onboard computational requirements are anticipated using this approach. Repairs would be carried out using existing biological paradigms relying heavily on self-assembly and "biochemistry". (Donaldson scenario)

of reachable molecules varies proportional to the surface area of the nanorobot).

Finally, if any of these means involve lock-and-key matching as enzymes do, what is the merit of a nanorobot at all? I shall not discuss these problems here, restricting myself only to computation. But they do require much more specification than currently developed. However, I would like to say one thing more, about all three problems (computation included). Any nanotechnologist interested in repair should listen to the *ideas* embodied in these biochemical systems. No one is preventing them from making their own quasi-enzymes which work as well as or better than biochemicals. I will touch further on that point later.

What about the other pole of possibility? The central issue here is of how far we can go towards generalized repair nanorobots. At this point the real computational problem arises. We would like a nanorobot capable of very general recognition. Yet recognition requires very great computational power, whether we attempt to do it by force on Cray XMPs (even then, unsuccessful due to lack of enough power) or whether we attempt to do it with thousands of independent processors. Fortunately for projections, a variety of specialized neural net computers have already been built, some even for sale. We can examine these and their powers to estimate what nanotechnology might do. Since we are neural networks ourselves, we may even learn what *we* can do.

Some basic principles: first, neural networks operate like content-addressable memories. This means that given a fragment of information, the neural net (NN) tries to recover the memory item best approximating it. NNs do this very efficiently. However, we also see the first intimations of a problem. A neural net is (among others) a database. It only achieves recognition by containing stored information about the objects it must recognize; and cells contain very many different objects and molecules needing recognition. A general nanorobot would therefore need a quite large memory capacity. And since "neurons" in an NN are highly active, memory storage will be much less compact than in the DRAM of ordinary computers.

What is the memory capacity of an NN? Already we have quite firm estimates of this for at least one kind of NN (Y.S. Abu-Mostafa and J. St-Jacques, p.96; R.J. McEliece et al. p.100, in V. Vemuri (Ed.), *Artificial Neural Networks*, Computer Society of the IEEE, 1988). The upper bound of storage capacity for any NN containing n neurons, no matter how connected, is n bits. For existing NNs, capacity is approximately

$$n/\log n \text{ bits}$$

This means that the memory capacity of a human being is on the order of 10^{11} bits.

(This figure exceeds a previous estimate of 10^9 bits by K. Landauer (*Cognitive Science*, **10**, 477 (1986)) by two orders of magnitude. Furthermore, I believe it is far better founded. Examination of Landauer's paper suggests that the data derived simply do not imply the conclusion claimed. The paper only gives the memory filled up in a normal human life (100 years). But then it would also imply, incidentally, that we already have memory capacity for a lifespan of (about) 10,000 years, something very significant!).

(Neural nets have other interesting properties which make other highly significant points about ourselves. Several NNs designed to emulate a nervous system show a quite different behavior from ordinary computer memories when the memory is full. DRAM memories cause, at best, a warning by the operating system that the memory is full. These NNs automatically, by reason of their structure rather than any programming, will forget the least recently used information (cf. J.A. Anderson,

p.19, in *Vemuri*). If our memory capacity covered 5000 years, we'd not have to worry about a catastrophe as our 5000th birthday approached).

So then, what size of neural net is needed for a repair robot to achieve recognition through computation? That depends upon its generality and the diversity of recognition it must perform. It also depends on the sensor problem alluded to above (the nanorobot must have a physical ability to tell objects apart before it ever needs a computational ability to do so!).

At this point, the nanorobot may very well need to recognize not only cellular structures but individual molecules. Cell structures observed at low magnification can be recognizable even though the cell has suffered extensive (submicroscopic) damage. Since it is repairing nerve cells, it must also recognize the connections to other nerve cells, distinguishing healthy synapses from damaged ones. Complete chemical databases even now contain terabytes of data.

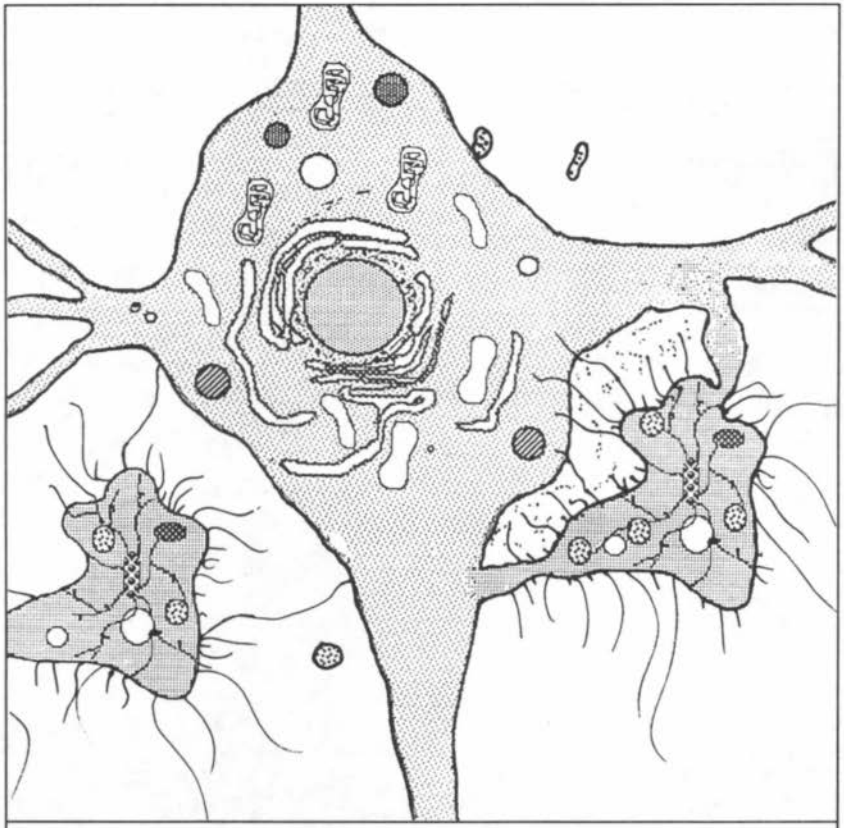
To estimate what this means, let's look at the size of memory device needed for the nanorobot to equal the capacity of a human brain (its contents would be very different, of course). A contemporary CMOS NN chip uses 75,000 gates for 54 "neurons", about 1380 per neuron (H.P. Graf et al, *Proc 1987 Stanford Conf Advanced VLSI*, P. Losleben (Ed.), MIT, 1987). It seems unreasonable to me that we could reduce the gate number significantly, even if we reduce the physical size. Using Drexler's estimate of 5 nm^3 for the size of a gate, we get a size for the total memory of about 6,800,000 $microns^3$. That is 190 microns on a side. Neurons vary in size, but their central body runs to about 20 microns in diameter, or a volume of about 8000 $microns^3$. The repair nanorobot might very well not fit inside a neuron, by a factor of 1000.

What if we reduce the memory requirement? Take human capacity as "one memory". A millimemory nanorobot would approximate cell size; a micromemory nanorobot could actually fit inside (at 1/10th cell size, without a lot of room). A nanomemory nanorobot, with 1000 neurons and a total recognition capability of about 300 different objects, would indeed approximate a nanorobot as envisioned. At this size, however, we should ask seriously about just what tasks such robots would do and how they could really turn out superior to those even finer robots, the enzymes. These only remember a few chemicals, but exist in such profusion that they always lie nearby.

It's very important that recognition is a normal activity of enzymes and other biochemicals. On these estimates, modified or invented biochemicals, acting the way enzymes do now, perform far more efficiently on specific recognition tasks for repair. The nanorobot may still play an important role, as a message center, with specialized "hooks" to sensitize it to the recognition biochemicals. Among the software functions it could facilitate might be searches, which would involve software. For repair, some computation may occur in response to the *outcome* of recognition done by other means.

Yet even so, systems of enzymes and other biochemicals, acting *en masse*, can show far more actual efficiency at every one of the "computations" involved. As to feasibility of repair by modified quasi-biological systems, some simple observations should be made. There is no individual repair needed by neurons or other cells which cannot be done by these biotechnological means and is not done already. Torn membranes can *already* heal themselves and cell organelles can *already* be recreated.

Other approaches, essentially involving much more parallelism with much dumber processors, do exist. These are the pure use of biochemistry and its technological extensions. A repair system might operate as follows: first, a "fixation" phase (which only needs to chemically bind those structures needed for memory. Advocates of fixation



Neuronal Repair as undertaken by biologically derived cell repair devices (Donaldson Scenario).

may have it backwards. Fixation happens in repair, not storage!). Then, the system enters the neuron, which is now in stasis. It recreates another neuron with the same connections as the last, reading off genetic information from the original cell's nucleus (or its own!) and memory from the synapses or the nucleus, wherever it is stored. Normal cell processes then dispose of the original. Even finding the original connections of neurons (if these were damaged) requires complex recognition ability, beyond the computational power of a nanorobot.

Fixation is not the only way to proceed, either. The temperature range within which existing biochemicals operate is much larger than that within which we operate. Antarctica teems with microscopic life, growing and prospering at below zero Celsius. Enzymes can operate at even lower temperatures, in liquid ammonia. The mass action principle essential to the enzyme "idea" needs only a liquid solvent. The idea of nanorobots might well flower not into conventional "robots" but into engineered devices acting just like enzymes, RNA, and DNA, but at -196°C.

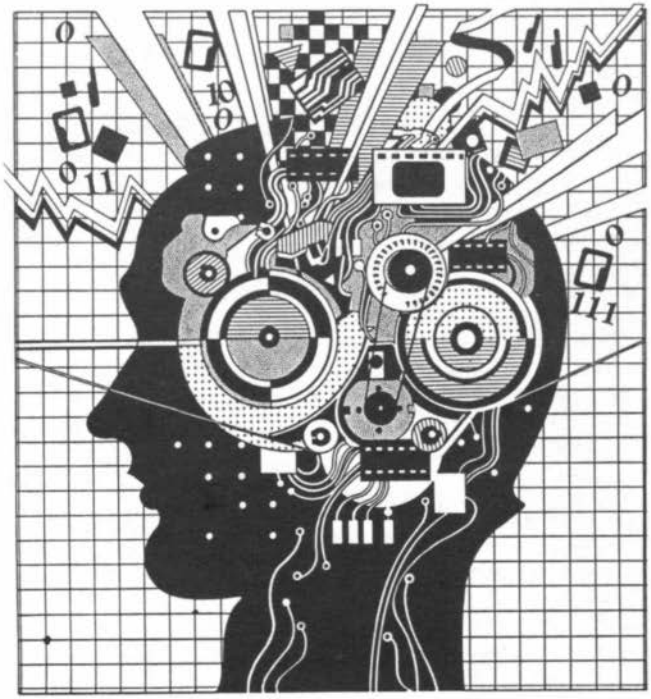
Does size really matter at all?

The short answer is *no*. The point made when we began, about size limitations,

remains in force. We should not tie ourselves to the notion of nanorobots carrying along with themselves an independent, significant computation capability. Why not think of a computer devoting 1 cc to each cell, applying biological systems to discover faults and decide on repair? The resulting repair machine in action would be about 100 meters on a side. This is not obviously too large. It would even stand on Earth. If each cell repair took a computer the size of the human brain itself, the repair machine would fit into a cubic km (these are Ettinger's "gigantic machines repairing brains cell by cell"). Certainly, we couldn't build Ettinger's machines now, or on the Earth. That is only a measure of our poverty and backwardness: ability to manipulate very large amounts of matter, on interplanetary scales, comes from economic/technical growth alone. It only needs time. If we have anything once frozen, we have TIME.

Finally, and more likely, if the repair device, in aggregate, was twice the size of a human brain, then a brain under repair would consume much less than a cubic meter of volume. As Ralph has observed, and I also have observed elsewhere (cf. *The Immortalist*, 12, 5 (1981)), if we can manipulate brain cells fully, then no law of Nature prevents us from separating them, repairing each one, and putting them back together again.

Very highly parallel *quasi-biochemical* systems ought to achieve repair with far smaller devices. We already possess quite detailed information about those neural connections which are definitely inborn, of which there are many. Another mode for repair might come from modifying the normal systems for embryonic development. After fixation, inject a few linked cells. These would first multiply and grow into a bare schematic of the human brain, each cell matching the corresponding fixed cells. It would continue to develop as an overlay of the nervous system, reading off the existing memories as it does so. Significant evidence exists that nerve cell connections are maintained and stored chemically, rather than simply existing by physical accident (cf. P. Pietsch, *Shufflebrain*). Reading such chemicals, the repaired system as it grew would form the corresponding links. When every cell had a live twin, the original would be absorbed.



Some comments on nerve cell connections

As mentioned before, survival of these connections will be important for memory. It's reassuring that several electron micrographs of brain tissue frozen by cryonics methods show most connections surviving. If these connections are lost and no biological markers already exist storing this connectivity information, then repair may indeed require the full force of the machinery I have described. (The papers of Purves and others suggest that biological markers do exist).

Some reflections on the simplicity of repair

I am a cryonicist myself. I have been so for many years before the word nanotechnology existed. One major event in my own understanding of cryonics came when I understood the immense abilities (in the case of the recognition problem, fairly called *computational* abilities) accessible to us on the *other* end of this pole of possibilities. These arguments don't prove repair is impossible or impractical. They analyze what roads to repair exist and which do not.

Furthermore, by raising the concept of repair nanocomputers, Drexler, Merkle, and others have done a great service to cryonicists by widening the bounds of thought about *possibilities*. For instance, small repair nanocomputers working *together* with molecular and cellular repair devices may achieve ends inaccessible to one or the other alone. One case would be to achieve the total read-out of a patient's memories. The nanocomputer comes along as part of a team. In each neuron, this team reads off the neuron's memory into the nanocomputer, which is then returned to a central location. Once read out, other teams equally complex could recreate the person elsewhere, with every neuron receiving the original memories of its ancestor. In these teams the recognition task would happen biochemically, while other decisions depending on either memory or computation would come from the nanocomputer. Other combinations can achieve similarly hard tasks.

Another separate use of nanorobots would be to perform chemical syntheses otherwise difficult or even impossible. In fact, to me that possibility looks far more important, and efficient, than any direct use in brain repair. Among other points, the recognition part of its task becomes far smaller. Chemistry, not cryonics at all, may become the area where such tools flower mightily.

When we became cryonicists, we took on ourselves the aim of doing away with "death". We did so amid a history of thousands of years of myths about "death", metaphysics, theology, and other thought all "proving" that "death" was fundamental, it was a barrier no one could escape, an Emperor over everyone and everything. For myself, I remember reading neurology and cryobiology and coming to understand that this Emperor had no clothes, not even a body; he was a myth as Lord Dracula is a myth. This doesn't mean that injury and pain are imaginary at all. They become even more real when we see them as events we might escape. It is the sense that they are unavoidable and inexorable that is a foolish delusion.

This is the sense in which this "death" is a trivial problem. We don't need complex calculations to see that practical methods for repair must exist. When we state the theorem correctly, its proof becomes obvious to anyone. Sufficient storage capacity for one patient's memory and personality can exist in an object about the size of a human head. Sufficient computational capacity for repair follows from already known highly parallel distributed computers, that is: the biochemistry operating inside that head. True, that neural biochemistry doesn't currently solve that particular problem, but as a problem it is no harder than those it is currently solves.

Finally, for those who want to learn about how these biological "nanocomputers" work, I would suggest Albert L. Lehninger's, *Biochemistry: The Molecular Basis Of Cell Structure And Function*, in its latest edition.

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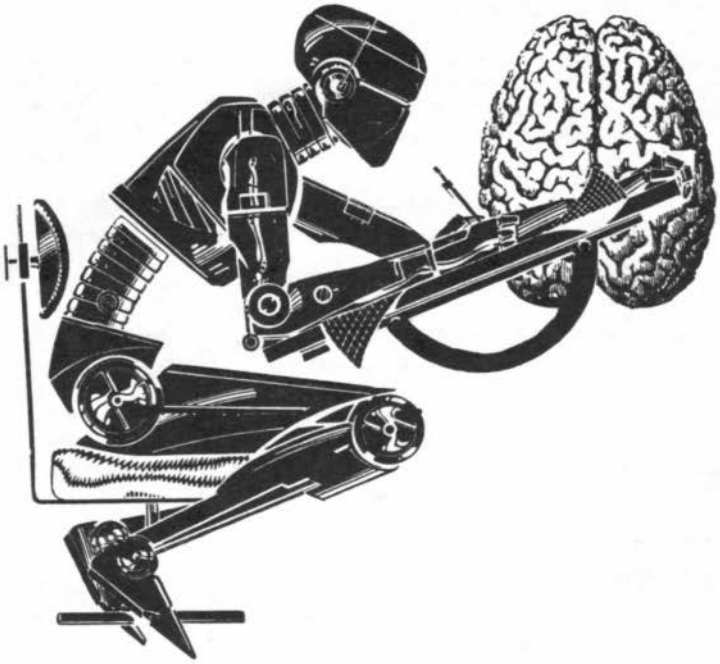

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Dear *Cryonics*:

I enjoyed Ralph Merkle's imaginative paper on molecular repair of the brain. I was particularly interested in his presentation of an "off board" model of brain repair, which would have the advantage of not requiring mobile assemblers and associated navigational equipment. There is no doubt that the mobility and navigation of assemblers both present formidable problems.

Mobile assemblers will suffer from Brownian motion, which is the random dancing motion of small objects in liquids due to uneven impact of solvent molecules upon them. Anyone who has viewed swimming bacteria under a microscope knows that small objects really take a beating from Brownian motion, and that the smaller the object, the worse the jostling. Assemblers would have a much worse time with Brownian motion than anything large enough to be visible under a microscope.

To get some idea of how significant this effect would be, a simple calculation can be done. As noted by Merkle, the energy of a molecule in a liquid is on the order of kT (actually it averages $3/2\ kT$), where k is Boltzman's constant and T is the temperature. The average water molecule at body temperature (310°Kelvin) has an energy of about 6×10^{-21} joules and a momentum of 2×10^{-23} kg-m/sec. This may not seem like much, but the average water molecule at these temperatures is traveling at almost twice the speed of sound in air, and packs quite a wallop when it hits something the size of a nanomachine. A spherical 10^9 amu nanomachine with half the density of diamond would have a radius of about 60 nm, and a moment of inertia less than 3×10^{-33} kg-m^2. Impact and recoil of a single water molecule at the tip of a 100 nm arm sticking out of such a machine (creating a 160 nm moment arm) would transfer 6×10^{-30} kg-m^2/sec. of angular momentum. The arm

itself would be expected to stay rigid (if the joints held) because energies of this magnitude are not sufficient to stretch relatively stiff carbon-carbon chemical bonds very much. However, the transfer of angular momentum to the entire structure in this case would result in instantaneous rotation of the entire assembler at a rate of about 16,000 rotations per second (Almost a million RPM!).

In the real world, of course, this figure would be modified by liquid viscosity and (shortly) by other impacts (some of them in the opposite direction). Yet even with these factors, the statistical irregularity of things at this level would surely insure random motion of the tip of the arm (because of motion of the entire assembler) at a much faster speed than would be conducive to carrying out molecular repair on the millisecond timescale proposed by Merkle.

Conditions such as the above will require that nanomachines will not float free while doing repairs, even in liquid nitrogen (where the calculated rotation rate is still almost half as much as in water). Rather, in order to guard against both rotation and linear translation of the repair arm tip because of Brownian motion, the machine will need to be securely anchored (with no slack) in three dimensions by grasping arms or molecular guy wires. Such anchors will replace the hydrogen bonds which attach biological repair molecules to their substrates in present cells. If we need a visual metaphor for future cellular repair, then, the picture which arises finally is not the traditional one of working assemblers drifting about in the cell like fish in a pond, but rather instead one of assemblers wedged and anchored into cell membranes like octopi clinging to the rocks in a tidepool. It's a violent world at this scale.

Perhaps assemblers will work while securely attached, but "swim" between attachment points? Many assemblers will not be free even to this extent. Repair (and especially replacement) of many structures in a brain will require precise knowledge of the spatial location of these structures with regard to structures micrometers, millimeters, or even centimeters away. Thus, many assemblers will be required to know exactly where they are spatially with regard to an overall coordinate system (just as in a geodetic survey). At this scale, navigation is not something which can be done by inertial systems or even by signal triangulation (no signal moves that slowly). Instead, it must be done by brute force mechanical measurement, which in turn means that key assemblers will have to be connected to a coordinate grid by rigid, semiflexible measuring "arms." An intact brain in the process of reconstruction would necessarily be a pincushion of such coordinate grids and arms, representing a number of different measuring scales.

The alternative to all this envisioned by Merkle is an "outboard" (quasi 2-dimensional) sort of repair, in which the brain is subdivided into tiny pieces by an outside "ultramicrotome" which keeps track of spatial relationships. Each brain piece would eventually be mounted on an immobile workstation surface for repair. Later, after repair is completed, the pieces would be reassembled, and the necessity for navigational tracking would be confined mainly to work at boundaries being constructed between pieces.

All this will take room. Merkle has envisioned division of the brain into 1.8×10^{16} pieces, each roughly 0.42 microns on a side. If a complete set of such pieces is laid down on a flat work surface (doubling the area in order to give some room between pieces), a set of pieces may be expected to cover an area of about 6,350 square meters (around 25 tennis courts' worth). Of course, this area can be folded and stacked. The theoretical limit to compaction is a structure only several times the volume of the original brain, but consisting of onion-like layers of supporting substrate coated with biological material, and separated by spaces smaller than a bacterium. How closely this ideal can be approached is impossible to say, but we can guess that quasi 2-dimensional repair of the brain is likely to require a good deal more volume. I note that Robert C. W. Ettinger in

The Prospect of Immortality (1964) envisioned "giant surgeon machines" repairing tissue "cell by cell or even molecule by molecule." That vision may yet turn out to be the clearest one of all.

Steven B. Harris
Los Angeles, CA

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Dear *Cryonics*:

I have read the response of both Steve Harris and Thomas Donaldson to my article, *Molecular Repair of the Brain*, with interest. I have also heard several informal responses from others and, as time goes by, I expect to get further responses and opinions. I am pleased to report that no one has found any serious problems with the approach; as this paper echoes the conclusions about repair of frozen tissue reached by Drexler in *Engines of Creation*, this result is perhaps not surprising. In science, of course, this is merely an invitation for more careful scrutiny and more detailed analysis. Judging from the presently available information, however, it seems very likely that the technical premises underlying cryonics will be proven valid. In my judgment the probability that cryonics as a technical proposition will work is in excess of 95%. This estimate does not take into account the rather more complex social, political, and legal problems; but here we can influence the odds. We cannot change Nature, but we can certainly influence our fellow humans (and we have done so already!).

Steve Harris' interest in thermal vibration is quite well placed. It is a significant issue, and must be dealt with. Drexler presented an inch-thick preliminary draft of what will eventually become a technical book on nanotechnology at the *First Foresight Nanotechnology Conference* (held in late October). The draft included design ideas for the arm of an assembler. A substantial part of the design and mathematical analysis of the arm concerned thermal vibration and how to control it.

Thermal vibration can certainly be controlled. Assemblers can both attach themselves to scaffoldings and anchor themselves on the frozen tissue upon which they are working. This problem can be dealt with, as can those of navigation, communications, power distribution, etc. which arise during analysis of on-board repair scenarios.

My major concern about on board repair was not technical feasibility, but ease of explanation. More issues must be discussed, and examined in more detail, before a technically trained person would conclude, "Yes, this looks feasible." The simplest approach is to use brute force. It's easier to explain and easier to justify. Whether or not it will actually be needed or used is a much more difficult question to answer, but it is certainly available if necessary.

In addition, I found the idea of actually building a complete data base that literally provides all the information that it is possible to glean from the frozen structure quite attractive. This represents some sort of limit, and lets us cleanly present the fundamental issue in cryonic suspension: is the information content of the frozen structure sufficient to support repair? We can literally acquire all the information that is present, is this sufficient? While this method of repair is perhaps more than is needed, it demonstrates quite clearly that many problems that might otherwise be of concern are simply not relevant. We don't have to devise a specific repair mechanism for each specific form of damage in order to show that it will not cause cryonic suspension to fail. If the damage can in principle be repaired, then it can almost certainly be repaired in practice.

For example, we might be concerned that the mitochondria have suffered "irreparable" damage. However, from the general principle given above, we can immediately conclude that any damage to mitochondria is simply irrelevant. Mitochondria provide energy, and can in principle be replaced without loss. The possibility that they are damaged or indeed destroyed need not trouble us in the least.

On the other hand, damage that might obliterate the structures that code memory must be viewed very seriously. If memory were in fact densely coded into individual molecules (e.g., if somehow a cell were to store a kilobit of information by synthesizing a single molecule, and later "read out" the memory by examining that same molecule) then we would have to view damage to that molecule as a direct threat. Fortunately, all the evidence we have implies that memories are stored in a very diffuse fashion, involving tens of thousands of molecules for even one "bit" of memory. Destroying a memory stored in this fashion would require truly extensive damage.

Thomas raises the point that estimation of the computational requirements for repair is difficult. While this is quite true, we can do much more with respect to this problem than (as Thomas suggested) simply shrug.

First, it does not seem that large amounts of computational power are in principle required to analyze molecular structures. For example, current methods of determining the structure of DNA or protein are not computationally intensive but instead use clever chemistry.

Second, and perhaps simpler, we can simply bury the problem in excess computational power. Even crude estimates of the computational power required, leaving generous margins for error, will result in some finite limit. The computational power assumed is generous on a per-bit or per-molecule or per-atom basis, so I have no great concerns on this issue. Further, the estimates of future computational power are conservative. By adopting the proposal of Likharev (which dissipates several orders of magnitude less energy per gate operation than that of Drexler), it is possible to increase these margins by three orders of magnitude. By slowing down Drexler's rod logic, and by reducing the temperature (thus reducing kT) we should also be able to decrease the energy dissipation per basic operation, and so improve the available computational power by several orders of magnitude -- probably five or six, or more.

Also, the energy cost assumed was the currently available cost of electric power: 10 cents per kilowatt hour. This is unrealistically high. It seems grossly improbable that energy costs will not fall in the future. One likely method of generating power in the future is to use solar energy. If we presume that space travel becomes reasonably cost effective, then we can get solar power by placing a large solar power system in solar orbit. For best efficiency, we might wish to place the solar power system as close to the sun as possible without suffering thermal damage. Two obvious technologies might be employed: solar cells and solar powered turbines. Solar cells of 37% efficiency have already been demonstrated by *Boeing*, though they are currently too expensive to be commercially useful. Alternatively, solar powered turbines with efficiencies above 40% should be feasible. The solar constant near Earth's orbit is about 1,360 watts per square meter; 37% of this is about 500 watts. Therefore, we can produce 500 watts of power per square meter at about 150,000,000 kilometers from the sun (the approximate radius of Earth's orbit). If we (arbitrarily and without adequate analysis, but plausibly) reduce this distance by a factor of 5 to 30,000,000 kilometers, then total power output increases by a factor of 25 to 12,500 watts per square meter. If we assume that we use a solar cell built from a single cubic meter of matter, and that it is one micron thick (again, one cubic meter of matter is not very much, and one micron is substantially thicker than seems

necessary) then we get a total surface area of 1,000,000 square meters, for a total power output of 12,500,000,000 or 12.5 gigawatts. This is about six orders of magnitude more power than the paper assumed was available. It seems likely that more than a single cubic meter of matter would be available, and also likely that we could place the solar cell closer to the sun, so we can increase even this estimate without much difficulty.

Combining these two factors, e.g., lower energy dissipation per basic operation and lower energy costs per kilowatt, each of which by itself should be able to provide an additional six orders of magnitude improvement in our computational capabilities, yields a total of twelve orders of magnitude improvement, for a total computational capacity of about 10^{45} gate operations in a three year period.

This is enough, I think, to allow us to presume that there will indeed be sufficient computational power in the future for our purposes.

Even though the margins for error appear extremely large, a more detailed analysis sounds like a good idea. It would be more desirable if a relatively small amount of computational power were required, for then we would presumably be able to perform the repairs sooner. For this reason alone a detailed analysis of the computational power and programming strategies for the solution of this problem would be desirable. More important, a careful published analysis of this issue would provide an additional piece of evidence that cryonic suspension should indeed be feasible. And, of course, the less computational power we require, the easier it will be to persuade people that it will be possible. The preceding analysis would require explaining why space flight should eventually be inexpensive.

As far as "molecular" repair being a red herring, I tried to emphasize that each molecule must be repaired chemically, and then restored to its correct position and orientation in the overall structure. The term "molecular repair" is intended to include both these processes. As Thomas suggests, knowledge of the cellular structure, as inferred from the data derived during the analysis phase, will almost certainly play a prominent role in the computations. Indeed, it seems likely that surface analysis of the 0.422 micron pieces into which the tissue is at first divided will yield a fairly complete description of the cellular structure, even before these pieces are disassembled into their component molecules. Such a general outline of the structure will almost certainly be used to guide further analysis.

Thomas emphasizes recognition as an important computational task, as indeed it is. Recognition of unconstrained images from the three dimensional world is indeed a formidable problem. Recognition of molecular structure, in a highly stereotyped world, where we almost certainly can constrain the molecular type to one of a small number of possibilities by *a priori* knowledge, is another matter entirely. How much computational power is required to say: "yep, this is another lipid in this membrane I'm taking apart?" Unlike (say) trees in the three dimensional world, all the molecules of a given type are in fact truly identical. The analysis, therefore, should not be as difficult as the analysis performed by the human image processing system. (And recall that the estimate of the computational power required was derived by estimating the computational power used by the human visual system in analyzing complex, unstructured images).

Again, a more detailed analysis would be a good idea. Given the truly massive computational power that will be available, it seems unlikely that this issue will affect feasibility in the long run.

It should be apparent that many massive volumes could be written on molecular repair of frozen tissue. Indeed, I expect that such volumes will in fact be written. Yet even

today we can say with confidence that systems capable of repairing frozen tissue should be feasible. The fundamental requirements are; (1) imaging systems capable of recovering the needed information, (2) computational power capable of making sense of that information, and (3) manipulative abilities able to repair or build the needed structures.

None of these three requirements seems either unlikely or impossible. Indeed, given current trends in technology, it is difficult to argue that such capabilities will not eventually be developed. The real debate is not whether, but when.

Ralph Merkle

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BIOETHICS AND CRYONICS: A PRESENTATION OF THE CASE

by Thomas Donaldson

By now the subject comes up in the paper every few weeks. What to do with patients when they are terminal, unconscious, or unable to care for themselves with no prospect of recovery. Often but not always they are old. Establishment doctors and others gather in seminars to discuss these problems. What can they do?

Any cryonicist can answer. By choosing cryonic suspension they have lifted themselves clear out of these debates into another realm entirely. It is not a realm free of uncertainty or problems. But these problems don't relate to those of the other realm. The purpose of this essay is to present the case that every cryonicist feels in their bones, that suspension and immortality have become the leading questions, that they do not solve but transform utterly. And that their problems, once understood, make those others the puzzling of apes.

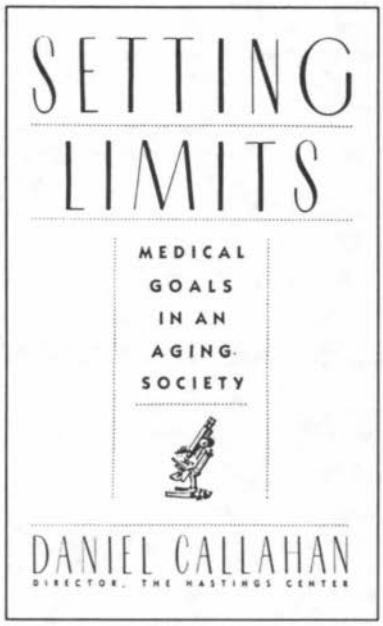
The issues cryonics addresses aren't really just suspension. It asks *what is the purpose of medicine*, and gives its own clear answer. The purpose of medicine should be immortality, for everyone. Not an immortality of age decked with spiderwebs, but immortality of youth, which must include rejuvenation as one of its aims. If a single human life is valuable, then it remains valuable indefinitely.

It is impossible to take any other position while remaining humane. So only human lives aged between 0 and 70 are valuable? Why not 71, or 90? So only human lives are valuable in the peak of "health", however this is defined for any age? Why not, then, install gas chambers for the ill in every hospital? Wouldn't it cost far less?

Some of those who argue against this conclusion.

These conclusions may seem extreme. Yet some authors have quite explicitly argued to them. Daniel Callahan, in *Setting Limits*, discusses precisely the issue of the aims of medicine. Of course he has a problem we do not have. He wants to argue that somehow we should cease efforts to prolong the life of the very old. Scrutinized analytically, his argument falls apart. He does not like the idea of a "natural death" for the good reason that no death is natural. Instead, he proposes the concept of a "tolerable death", which occurs when someone has had the opportunity to experience and do all those things they "should". (What "should" I experience and do? Circumnavigation of the galaxy? If not,

why not? The circularity of the galaxy seems a better and more real experience than the circularity of Callahan's argument).



In his book, Callahan also implicitly shows extreme lack of imagination about what "prolonging life" can mean. Not once does he discuss the possibility of life prolongation which does *not* leave the patient injured and helpless. I would like to say that Callahan here simply shows he has not heard of all the serious prospects for antiaging research. Unfortunately that cannot be true. Callahan has been around others who state very well the potential of biotechnology in prolonging life. He attends conferences where such matters are raised. Yet in *Setting Limits* nowhere does he grip that issue.

It is exactly on this point that he shows his true colors. This man is not deluded or foolish. Nor does he lack imagination. *He is a liar and a fraud.* The implication we will never prolong life except by prolonging helplessness and pain underlies Callahan's entire argument. Rather than openly discuss that *one* major counterargument to his thesis, Callahan carefully omits to discuss it at all. Don't liars and frauds usually proceed by not mentioning truths, rather than by stating falsehoods?

A second author arguing to similar ends is Robert Morison, who does raise the technological prospect of immortality even if only to argue against it. Morison is honest and I believe the problem genuinely bothers him. I find it hard to argue against published discussion by Morison, not because he comes up with cogent points but because his points are so *un*-cogent as to make me wonder seriously how he could stand up publicly and state them, were it not that immortality is so much denigrated already. Where is his sense of embarrassment?

For instance: if population remains constant, and people lived longer lives, then the total number of lives lived per century would decrease. Morison concludes that would be *bad*. It seems then that medicine by prolonging life already has therefore *decreased* human welfare? Or again: biology "proves" that we must have our current longevity. (It does not, nor can it. Longevity, like other traits, *must* fit an animal's lifestyle. Well, OK. Change the lifestyle. We aren't cavemen; perhaps Morison feels we should return to that situation.) Or that longevity would diminish novelty. (How so? New ideas would still give someone a competitive advantage. Business corporations are already immortal; yet capitalist societies aren't noted for their crystallization. Perhaps immortality would even increase novelty by giving people more opportunity to bring their ideas to fruition).

In fact, Morison presents many such counterarguments to immortality, each one needing only a few lines to state and each one highly complex and questionable once scrutinized. But Morison *nowhere* actually scrutinizes any of them! What a scholar he is, what an advocate of study and reflection!

In fact, many people argue against immortality this way, with a hurried list of all the many problems immortality *may* raise. No one could answer these arguments with the careful scrutiny they may deserve *here*, when they are raised, because that scrutiny would take an entire book for each. Is that the intention? Perhaps they hope to prove their

point by piling up so many bad arguments for it that their total mass will outweigh any good arguments for the other side. Or perhaps again, the many problems they see overwhelm them.

My own best short answer to Morison's problems simply accepts them and then goes on. If immortality creates problems, then we will have to solve them. To live consists of solving problems. Yes, longevity must change both individuals and society, forcing everyone to think through old assumptions, arrangements, and behavior once more. So, too, did coming out of the caves. But that should not be the issue. If you choose immortality, you choose such problems. In practical terms, adjustments aren't likely to raise problems because, in practical terms, longevity is most likely to come slowly, by long effort. Despite enthusiasts for nanotechnology, instant immortality just isn't a serious prospect.

Some moderates would put the argument otherwise: why, they would say, raise immortality as a purpose when we have no immediate practical prospect of immortality? Unlike the others, I believe this point really deserves consideration.

By now molecular biology and our increased understanding of how living things work, even at a molecular level, should demonstrate to an objective person that there is no question that finding a way to eliminate aging is attainable. Reasonable people may argue about timing and methods alone. But if immortality remains many years in the future, then how can it make sense to put it as the goal of medicine *now*?

It makes sense because our decisions now can alter future events into the indefinite future. A goal of immortality gives a better touchstone to evaluate current research and practice than any other goal, such as curing cancer. Among its leading consequences must be increased funding, *now*, for research into aging. That funding must come from research into other conditions, including heart disease and cancer but not only them. The justification for such funding comes directly from the goal. Everyone knows that total cure of heart disease and cancer for most people would lead only to death soon after by other means. What human benefit derives from merely replacing one disease by another?

A goal of immortality also has quite current implications for care of patients. These implications lead directly to cryonic suspension. Suspension makes no sense unless aging becomes curable. A refusal to cure aging implies that cryonic suspension, no matter how technically developed the operation is in itself, must fail. Any doctor who refuses to consider immortality as the ultimate result of medicine (if not the ultimate goal) must logically advise against suspension. To him it comes under the heading of "extraordinary measures".

Are there problems with care of terminal patients?

If, then, we accept that immortality should be the goal of medicine, where does that put us with terminal patients?

Many problems of care for terminal patients deal with ethics in a situation in which the patients have left no clear word about their own desires. Today, when so many people refuse to come to any intellectual and emotional grips with their own situation, they eventually leave exactly this problem for their survivors. I shall discuss such problems later, but any argument begins with simple cases and proceeds from them. The simple case, most clear, and the case faced by survivors of those asking for suspension, is that of ethics when the person dying has left full, clear, explicit word for what they want.

They may well want suspension, and with preparations made in advance no immediate barriers to suspension usually exist. However, since we live in a society where cryonic suspension is definitely not an accepted medical procedure, are there moral issues involved in choosing cryonic suspension? My answer is: No. Not at all, not in any respect or degree, never.

Still, because many people think so, some discussion is needed.

First, suppose that suspension were "known" (by someone at some time) to fail. If this knowledge arose after the patient became incompetent, and the patient had left explicit directions, then some people might think that a case for intervention existed. However the word "failure" here begs a very big question. Applied to a terminal patient, just exactly what are we to take as "failure"? That some other treatment would restore the patient to life and health? Yes, certainly in that case refusal to follow their directions to the word would violate their spirit. But if "failure" merely means that the patient will never revive, in what way does that promote some other treatment also known to "fail"? Or perhaps by using this word the agent who attempts to intervene leaves the goal implicit: their aim is annihilation of the patient, so that suspension does indeed "fail".

Indeed, since cryonic suspension is *not* known to fail, while every other treatment for a terminal patient is *known* to fail, any objective resolution suggests that doctors have a positive duty to perform cryonic suspension rather than any other alternative. That duty arises only when all other ways to life and health are exhausted. But it does arise, even so. We can even give doctors an easy test: if, and only if, other than palliation and treatment of pain, the only act of commission (not omission!) you can do is declare your patient dead, *then* your duty is to suspend them.

Second, some may object to the use of resources by someone towards an aim they feel is unlikely to succeed. Yet here again, no one objects when people leave their money to promote "world peace by vegetarianism", or other goals just as unlikely to succeed. To raise moral grounds of this kind against cryonics, consistently and without special pleading, requires far more widespread intervention in people's wills and bequests than anyone would normally accept. Must we have a committee sitting in judgment of everyone's Will, as to whether its purposes are likely to succeed?

Any doctor or agent who feels cryonic suspension to be immoral or unlikely to succeed is free to abstain from performing it, much as doctors uneasy with abortion do not perform that procedure. To actively prevent its performance on others constitutes interference in their own moral rights.

Third, some may feel that cryonic suspension puts too much burden on society. But examine: where is the burden, exactly? The patients earned the money to pay for their suspension. After suspension, that money is invested. The income from that investment pays for the suspension. Where are the people burdened by this decision? Perhaps those who thought they would receive a bequest?

The issue of burden on society needs addressing in another way, too. It must be said: if we ever come to a high consensus that immortality is the goal of medicine, and start working concertedly toward that goal, the option of cryonic suspension before "normal death" will look far better than it does now. Given the current high cost of caring for those who are terminally ill (over $50,000 at least), providing terminal patients the choice of a government-funded cryonic suspension will *decrease* the burden on society.

This is not a measure achievable without a public consensus for immortalism, and a *real* program to work for it. That program need not even be funded by the government. But it must be *real*: truth always comes out, sooner or later. A sham will someday be seen as such. If some government official wants to end their life as a head on a fencepost, or drawn and quartered with all their relatives, sham immortalism gives an excellent recipe.

What about those who left no word of what they wanted, or even asked not to be suspended?

Children, and incompetents who had never attained competence, deserve suspension on the same terms as any other medical treatment. However because these patients often cause a financial burden greater than that they would cause in suspension, an honest discussion also faces the pressures to suspend them prior to that point.

I do not think there is any logical rule anyone can make about the points when suspension becomes appropriate here. Counterpressures will exist in every individual case: perhaps there is hope, perhaps the defect is not quite bad enough for suspension, perhaps the child's parents want to try to recover their child for longer than others might. If cryonic suspension becomes widespread, some parents, in some legal jurisdictions, will have their malformed and severely retarded children suspended. But note the other side: cryonic suspension *cannot* become widespread without more people accepting its ultimate success, no matter how long they think that success will take.

Furthermore, suspension isn't cheap at all. To suspend someone is a positive act of caring for them, incurring a large financial burden for funding. Raising $50,000 or more for a child's suspension cannot be an act of parental neglect. Some may think it wrongheaded, or even criminally incompetent, true, but neglect it is not. Death, on the other hand, costs nothing.

As for society at large, any case on moral grounds for a *law* to keep such a child alive but unsuspended fails unless it also implies full financial support to the child's parents, and if not them, others, to care for that child. Morality is always cheap if others will bear the entire cost. Many ways exist to spread that cost widely if desired. If society doesn't provide that support, any couple is morally (if not legally) entitled to make their own choice from terrible alternatives.

Again, issues arise when a competent adult specifically disallowed suspension, or never deigned to leave word.

Morally, the first case is very clear. Almost no one now agrees with forcing treatments upon people who don't want them. Their relatives and friends may look on this with very deep regret, but should do nothing physical to forbid this. Argumentation, if tolerated, would be appropriate, but nothing stronger. And if the patient refuses to listen even to argument, then that should not be given either.

The second case is not an issue of morals at all. Someone must try to work out what the patient "would have wanted if they had made a choice". That is certainly not free of error, nor easy. But it raises no issues of ethics or morality. Moreover, if suspension were commonly regarded as appropriate treatment, even this decision would usually become far easier.

It is interesting that these problems of "bioethics" tend to evaporate when examined

under a cryonic eye.

The special case of criminals.

Criminals, especially those given the death penalty, provide an interesting special case here. I believe it deserves discussion.

Fundamentally, a rational argument for the death penalty proceeds by observing that first, some persons, whether through moral fault or biological defect, simply cannot act in any way less than dangerous to everyone else. Second, that no one will bear the cost of keeping them alive and under strong guard indefinitely, which is the treatment they have shown they require. Since no one has a specific moral obligation for altruism, up to now the kindest act is to put these people to death. However that is no longer true. A suspended patient presents no danger to any other patient. The suggestion is: offer these people a choice between death and indefinite cryonic suspension. The hope would be that some day we would have means to lessen the danger these people present while awake.

I would like to point out that the above rational argument often is *not* the reason for execution. To me those other reasons have no weight; execution because of them is a moral crime itself. In fact, we should best call the persons described above "irreconcilables", not criminals. If either execution or suspension were called for, a trial should focus on this irreconcilability rather than particular criminal acts.

Some people may complain that suspending any criminals makes a slippery slope into a moral pit. Imprisonment costs money. Should we suspend anyone whose imprisonment would cost more than suspension? I'm not arguing for that. My own feeling is that the level of treatment meriting forced suspension may change depending on prospects for revival *and* public attitudes. If revival after five years were guaranteed, then perhaps suspension for five years would replace imprisonment. But no moral pit opens unless those who would oppose suspension in these cases cease to remain vocal, active opponents. In practice, that's how all slides down into moral pits are stopped.

Bioethics, humanism, and humanity.

As our ability to keep people alive though incapable and incompetent has increased, an interest in "bioethics" has grown. Observing the writings of prominent "bioethics" advocates such as Callahan and Morison raises serious issues of humanity. What we have here is a body of thought and advocacy seeking to invent specious reasons for neglect of patients, even of their outright execution, in the name of ethics and morality.

In wartime triage can always become necessary. We are of course at war with mortality because we are alive. In the past (and even perhaps the future too, since no wealth is truly infinite) we had to neglect some patients. We simply didn't have the resources or the ability to help. Yet it is one thing to accept this fact as a necessity of existence and quite another to actively argue for its indefinite continuation. These bioethicists argue quite specifically to *forbid* work against aging or any progress to immortalism. What else can that mean? Put plainly, they seek to *kill*.

True, anyone with some experience of life understands where to look for Evil. You look for it among those who constantly, incessantly, continually, profess their devotion to Good. This fact is old now, and it may well go on for all future history. Yet when everyone attains an age of 1000, they will see much deeper into others around them. Perhaps that will make a difference, perhaps not.

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Meeting Schedules

ALCOR

Alcor business meetings are usually held on the first Sunday of the month. Guests are

welcome. Unless otherwise noted, meetings start at 1 PM. For meeting directions, or if you get lost, call Alcor at (714) 736-1703 and page the technician on call.

The FEBRUARY meeting will be held at the home of:

(SUN, 4 FEB, 1990) Bill Seidel
10627 Youngworth
Culver City, CA

The MARCH meeting will be held at the home of:

(SUN, 4 MAR, 1990) Virginia Jacobs
29224 Indian Valley Road
Palos Verdes, CA

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Alcor members in the San Francisco Bay area have formed an Alcor chapter, and are aggressively pursuing an improved rescue and suspension capability in that area. Meetings are generally held on the second Sunday of the month, at 4 PM. Meeting locations can be obtained by calling the chapter's Secretary-Treasurer, Thomas Donaldson, at (408) 732-4234 (home), or at work, (415) 593-3200 (ask for Thomas Donaldson).

The JANUARY meeting will be held at the home of:

(SUN, 14 JAN, 1990) Keith Henson and Arel Lucas
1794 Cardel Way
San Jose, CA

The FEBRUARY meeting will be held at the home of:

(SUN, 11 FEB, 1990) Leonard Zubkoff
3078 Sulphur Spring Court
San Jose, CA

The MARCH meeting will be held at the home of:

(SUN, 11 MAR, 1990) Ralph Merkle and Carol Shaw
1134 Pimento Ave.
Sunnyvale, CA

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The New York Cryonics Discussion Group of Alcor meets on the the third Saturday of each month at 6:30 PM, at **72nd Street Studios**. The address is 131 West 72nd Street (New York), between Columbus and Broadway. Ask for the Alcor group. Subway stop: 72nd Street, on the 1, 2, or 3 trains.

The meeting dates are as follows:

JANUARY 20 FEBRUARY 17 MARCH 17 APRIL 21

If you live in the New York, Philadelphia, New Jersey, or Boston areas and would like to participate in the rebirth of New York cryonics please contact one or more of the following people:

Gerard Arthus (516) 474-2949
Curtis Henderson (516) 589-4256

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