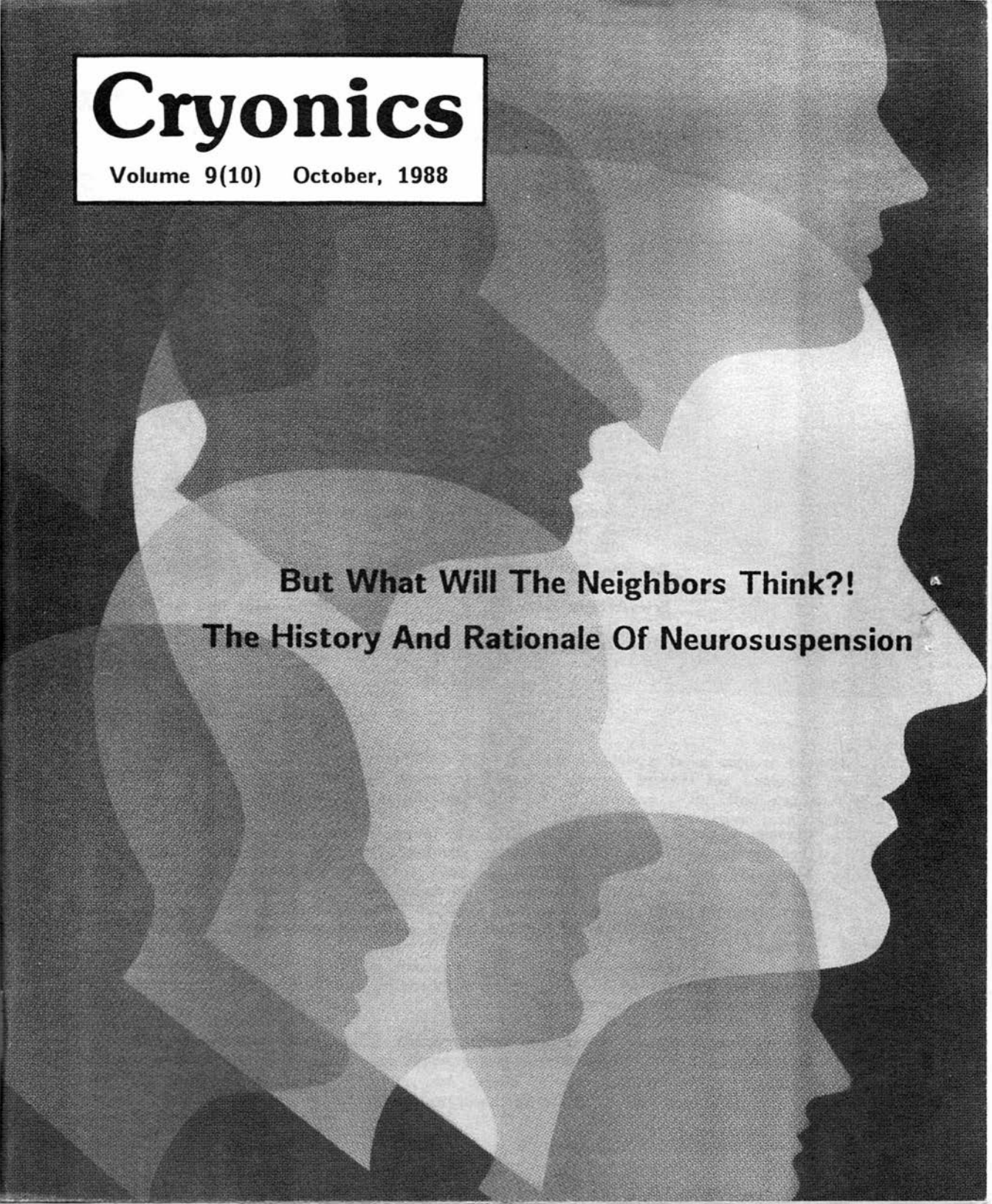
Cryonics

Volume 9(10) October, 1988



But What Will The Neighbors Think?!

The History And Rationale Of Neurosuspension

Volume 9(10) October, 1988 Issue #99

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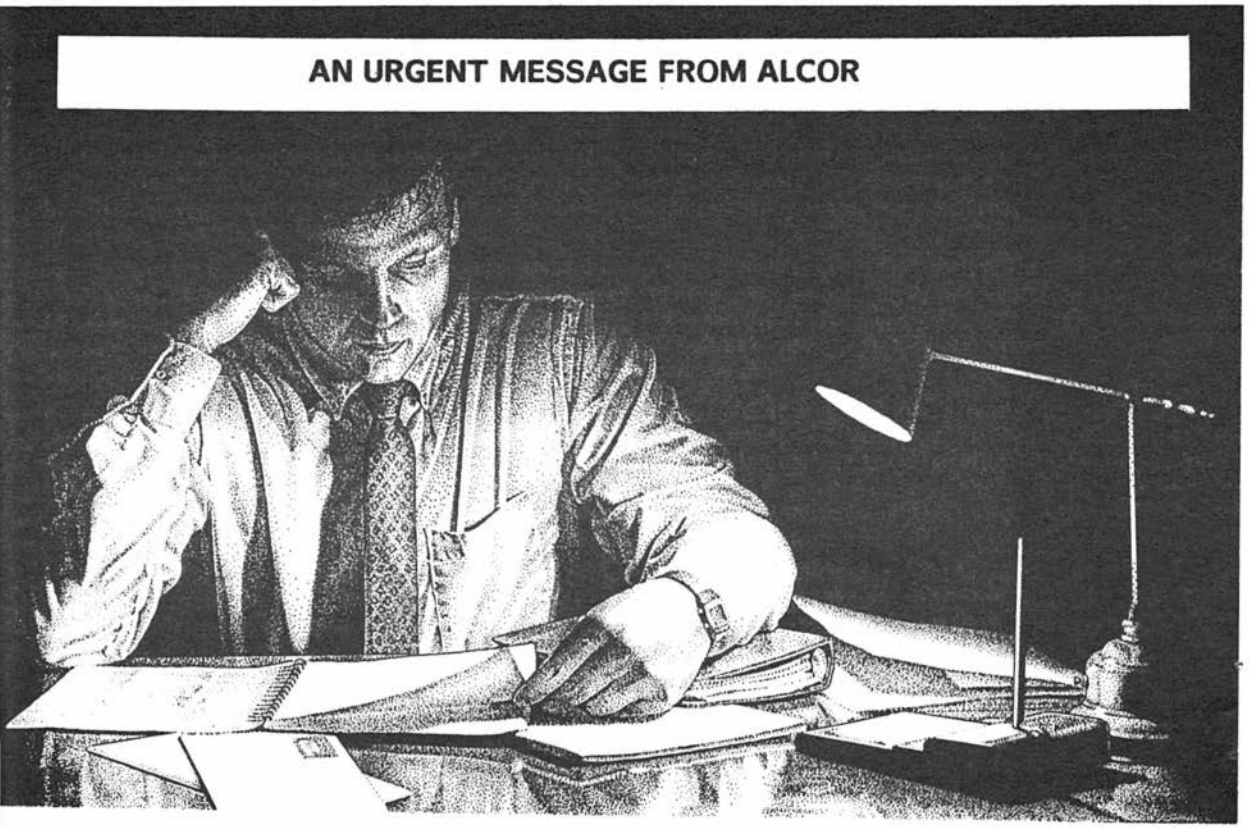
AN URGENT MESSAGE FROM ALCOR



Background

On September 25th, Alcor member "John Roe" (a legal pseudonym being used to comply with "Mr. Roe's" desire for privacy) entered a Los Angeles-area hospital for treatment of a very serious and imminently life-threatening AIDS-related infection. Mr. Roe was alert on admission, and he is an intelligent, articulate, pleasant, and impressive man. In short, he is not a kook or a fool, and he is someone who is reasonable and who can be expected to be taken seriously. Mr. Roe, his physician, and Alcor informed the hospital of his long-standing arrangements for cryonic suspension and asked for noninterference in execution of these arrangements; principally that Mr. Roe be promptly pronounced legally dead (after cessation of heartbeat and breathing) and that Alcor be given immediate access to him in order to stabilize and transport him to the Alcor facility.

The hospital not only refused to cooperate in prompt pronouncement of legal death but also refused to release Mr. Roe to us *even after clinical and legal death had been pronounced!*

While Mr. Roe remains very seriously ill and imminently terminal, his condition has improved somewhat. It is anticipated that he will survive this particular episode and be discharged from the hospital. However, the refusal of the medical facility treating Mr. Roe to give Alcor (or *any* other cryonics organization) access to Mr. Roe after legal death is a problem of enormous concern.

The reason the hospital cited in their refusal to release Mr. Roe to Alcor was that in their opinion "Alcor does not have the legal right to have or hold human remains." This statement apparently comes courtesy of the State of California Department of Health Services in Sacramento. We understand that this position will also be taken by Coroner's offices throughout California as well.

The Crisis

What this means is that the California Department of Health Services is choosing to regard cryonics as an *illegal* act. As a consequence, it is rapidly becoming (if it has not become so already) virtually impossible for Alcor to get access to its members after legal death and place them into suspension.

Without any doubt this is the most formidable and terrifying crisis cryonics has ever faced -- in or out of California. Make no mistake about it, we are in a battle for not only our freedom, but for our very lives.

What is the reason for this action by the DHS? Why, after 21 years of actual cryonics *practice* in the State of California have they chosen to act now? We believe there are a number of reasons for this. First and foremost is the sad precedent of Chatsworth. The original decision by the DHS to regard cryonics as illegal dates back to the DHS memo of April, 1980 (which was reproduced in the September issue of *Cryonics*). Second, the recent publicity and sensational lies surrounding the Dora Kent case have no doubt caused the bureaucrats to become even more polarized. And last, but not least, is the desire by the DHS and the medical establishment it represents to destroy cryonics once and for all.

It is very, very important that each and every cryonicist understand the magnitude of the problem and the high stakes that confront us as we enter this battle. For us here at Alcor Southern California it has been very hard to *emotionally* understand that we risk being *put out of operation* by these small-minded creatures. Indeed, the only thing that has prevented them from coming in here and seizing our patients is Judge Miceli's order and their fear of the enormous bad press and civil litigation that would result. Otherwise, we would have been "history" long ago. I can make this statement with such a high degree of assurance because, thanks to Keith Henson's diligent efforts under the California *Freedom of Information Act* we have copies of some of their internal correspondence (which are reproduced as part of this article). Make no mistake about it, the DHS bureaucrats want cryonics destroyed.

This situation is an intolerable one and leaves us with no choice but to go into court as soon as possible to try and obtain a preliminary restraining order to give us access to Mr. Roe and to any other Alcor member who may experience ischemic coma before the DHS lawsuit is resolved.

Action

By the time you read this article, Alcor will almost certainly have filed a motion for a preliminary restraining order (PRO) against the DHS to allow the suspension of John Roe or any other Alcor member who requires it. It is anticipated that our request for a PRO will either be granted or denied within two to three weeks of the time we file. *In the meantime, it is important that you understand that the ability of Alcor, or any other cryonics organization to suspend you under good conditions -- or even at all -- has been severely compromised.* We are, in short, in a battle for our very lives.

COUNTY OF RIVERSIDE - DEPARTMENT OF HEALTH

3575 11th STREET MALL (POST OFFICE BOX 1370) - RIVERSIDE, CA. 92502

Edward J. Gallagher, M.D., M.P.H.
Director of Health

May 18, 1988

David Mitchell, Chief
Office of State Registrar
California Department of Health Services
410 N Street
Sacramento, CA 95814

Dear Mr. Mitchell:

On May 11, 1988 a representative of the ALCOR Foundation applied for a burial permit on a ship-in case from Florida (copy of certificate attached). Our department refused to issue a burial permit on the basis of Health & Safety Code Section 7153.5 and 7054 as verbally instructed by your staff.

I would appreciate your advice or appropriate action in addressing this particular issue. It is believed the body is already located at the facility. In addition, during an onsite investigation by the Riverside County Coroner's Office, a number of body parts, and possibly a whole body, were uncovered and found to be without corresponding permits for disposition of human remains as required by the State Health & Safety Code.

Sincerely,

Edward J. Gallagher, M.D.
Local Registrar of Births and
Deaths

EJG:slh

Attachment

cc: Riverside County District Attorney
Riverside County Coroner's Office

STATE OF CALIFORNIA—HEALTH AND WELFARE AGENCY GEORGE DEUKMEJIAN, Governor

DEPARTMENT OF HEALTH SERVICES
OFFICE OF THE STATE REGISTRAR OF VITAL STATISTICS
410 N STREET
SACRAMENTO, CA 95814
(916) 445-2684

June 28, 1988

Edward J. Gallagher, M.D.
Riverside County Health Department and
Local Registrar of Births and Deaths
Post Office Box 1370
Riverside, CA 92502

Dear Doctor Gallagher:

This is in response to your letter dated May 18, 1988 regarding the storage of the remains of a Florida decedent at the ALCOR Foundation.

As you are aware, instructions from the Office of State Registrar are very specific regarding allowable conditions under which Permits for Disposition of Human Remains may be issued. Existing California statutes provide no basis to authorize cryonic facilities to store human remains. Therefore, if the ALCOR Foundation has any bodies or body parts stored in the facility, the Foundation is guilty of a misdemeanor (Health and Safety Code Section 7054) and should be reported to the local District Attorney for investigation and prosecution as appropriate.

If you have further questions, I can be reached at (916) 445-1719.

Sincerely,

David Mitchell, Chief
Office of State Registrar

It is equally important to understand that this is not just Alcor's battle. It is *every cryonics organization's battle in every state in the country and every country in the world.* If Alcor loses this action cryonics will, for all practical purposes, be illegal in California. In my conversations with Mr. Mitchell of the DHS, he was at pains to point out that since the California Health and Safety Code does not allow for the "disposal" of human remains by cryonic suspension, *no cryonics organization inside or outside the State of California would be given access to the remains of people dying in the State of California.*

Aside from the practical implications of such a statement, there is the issue of precedent. If Alcor loses this struggle and cryonics becomes *de facto* illegal in California, a very, very unfavorable precedent will have been established for the rest of the United States and even for the rest of the world. I believe this is particularly true since Alcor represents the cutting edge. We are the most sophisticated cryonics organization, not only technically, but financially and intellectually as well. Alcor's physical plant is top-flight and professional (the Coroner's deputies have repeatedly remarked to media people that we are better equipped than some small hospitals and that our physical plant puts theirs to shame). Indeed, it was our cutting edge technology (i.e., that Alcor's procedures would have prevented "brain death" and allowed for metabolism of barbiturates) that raised all the questions in the Dora Kent case to begin with.

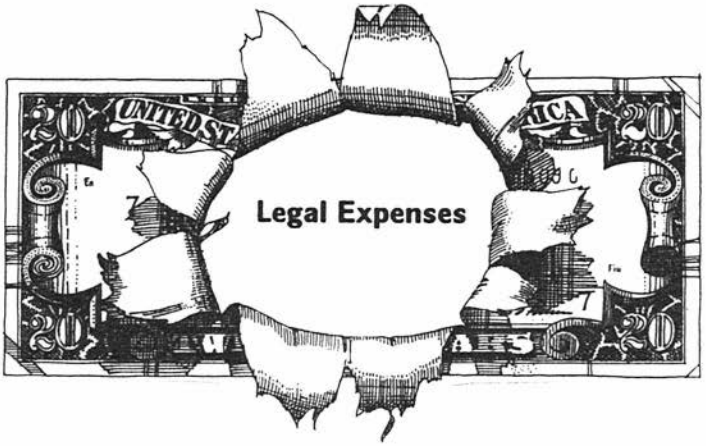
I do not point these facts out in an attempt to puff up Alcor or engage in chest-beating. I point them out because it is important for everyone to understand that what this means is that a loss for Alcor, given its strengths and professionalism, would be an especially crushing blow for the future of cryonics and for other cryonics organizations around the world. We cannot afford to lose this fight.

I have been told by people close to the DHS that the DHS and other State bureaucrats have a definite agenda in winning this fight. They intend to simply wear us down. They are well aware of our numerical size and of the prevailing scientific climate towards cryonics. Their strategy is to exhaust us personally and financially.

I for one don't think they have even the faintest idea of what they've gotten themselves into. For them, this is a "career move" and a chance to get rid of something that fails to fit conveniently into one of their pigeonholes, and which offends their sense of the proper order of things. For us, it is battle for our freedom and for our lives.

Regardless of which cryonics organization you are in, Alcor needs your help and we need it *now.* The expenses of litigation we and certain of our members have borne in the last 10 months now exceed $90,000!! If you figure in ancillary expenses such as staff time, printing costs, and so on, we are probably well over $100,000 into this battle -- and the end is nowhere in sight.

Each and every one of you who wants cryonics now has to make a very tough decision. You have to decide what it's worth to you. How high a price are you willing to pay?



Alcor cannot simply start billing each of you for the enormous expenses we have experienced and will continue to experience in the coming years to fight these battles. All we can do is to ask you to support us to the extent that you are able to do so. If we lose our lawsuit against the DHS we will have little choice but to appeal -- all the way to the U.S. Supreme Court if necessary. We are committed to doing that.

Rest assured also that we are committed to suspending our members if and when they need it and we will do whatever is necessary to that end, including relocating operations out of California, or out of the United States if necessary. We will not give up so long as we have your support and can continue to fight.

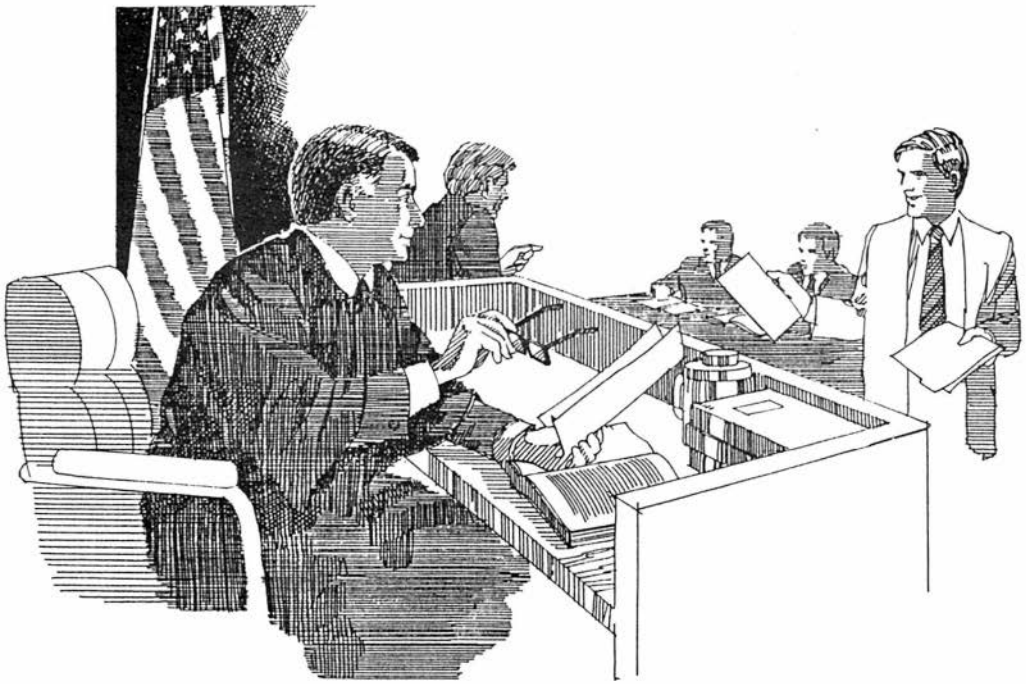
Finally, it is important that you understand that this is a *long battle* we are engaged in. We are only in the opening skirmishes. If you think things are hair-raising now, just wait, you ain't seen nothin' yet.

It is critical that you understand these things so that you are not discouraged. Most of you have been around cryonics long enough to know how slow and painful progress has been. Some of you have seen the enormous personal price paid by those who have lead the struggle so far. It is essential that you realize that the battle is far from over.

I believe it is also important to realize that this battle was inevitable. This realization is an important one, because it strips away the recrimination and the wasted energy of asking "what if" when we should be asking "what next". Most of us in leadership positions in Alcor knew that this was coming. We just didn't know the particulars.

We knew it was coming because we have watched the problems encountered by other unorthodox or unpopular groups both in the historical past *and in the recent past.* Just talk with the Scientologists or Madalyn Murray O'Hair's American Atheists to get an idea of what it might be like. Mrs. O'Hair has filed literally thousands of court actions, been jailed on countless occasions, been shot at, had her brake lines cut, and been subjected to every kind of threat, humiliation, and legal action imaginable (although I do not believe any public official has accused her of homicide). Similarly, the Scientologists have had numerous and hair-raising legal and political encounters which have cut to the core of their ability to operate.

I do not point to these two very different organizations because I agree with their philosophies. Rather, they are instructive as examples of once small and enormously



unpopular organizations that toughed it out. I would imagine that Mrs. O'Hair's group has spent at least several million dollars on legal actions against state and federal agencies which have interfered with her constitutional rights. And Mrs. O'Hair has prevailed. While she has lost some battles, she has "won the war". She succeeded in removing prayer from public schools and she has created and maintained a viable organization with substantial physical plant(s) and assets in the face of incredibly adverse conditions; all the while militantly advocating one of the least popular ideas in the world.

These are worst-case examples. Cryonics is in a better position by far. We are asking only to be allowed to continue to care for those we love when everyone else has given up. We do not thrust ourselves upon others and we do not wish to interfere with how they live their lives or handle their deaths. *We ask for no sweeping changes, just to be left alone.*

I think there is enormous strength in our position. We are, from a rational standpoint, *right*. Cryonics is a reasonable thing to do. We have a good physical plant, with a long history of protection of our staff, as well as the public health. Our history is one of attention to detail in every aspect of our operation. We also have an outstanding group of medical and technical experts to support us. And most importantly, we are *morally* right as well. Our values are in consonance with the highest values of this society. Not only are we practicing conservative medicine by not destroying our patients, we are demonstrating love, fidelity, courage, and optimism by continuing to care for them. And we do not ask for government money or society's "help" in carrying out our goals. We merely ask to be allowed to pursue our dreams and happiness without

interference. Those are powerful ideals and I believe they will insure our success over the long haul.

But battles such as the one we are engaged in are not won all at once. They are won a little at a time. They are won by persistence, by courage, and by brains. I believe the people of Alcor have all those things.

Regardless of which cryonics organization you are member of, Alcor needs your support. If you have an advanced degree, we can use technical declarations in support of cryonics from you. We also need financial support. We know that the mean income of cryonicists is about $40,000. We need a greater level of support than we have been receiving. The court costs we have experienced so far are just a harbinger of what's ahead. You must now decide how important cryonics is to you.

I am addressing this especially to those of you who have not made commitments yet. The moment of truth is at hand. If we don't have the resources to continue this fight, there won't be an Alcor any longer and there won't be cryonic suspension services available from any cryonics organization in California. The California Department of Health Services will attempt to seize and inter or cremate our patients, and the battle, for the time being, will be lost.

The situation is just that serious. Alcor needs, as a bare minimum, to raise at least another $100,000 in the coming year to defray the legal and technical expenses associated with the DHS assault. I strongly suggest that if you can help you do so *now*. The alternative may well be that there will be no tomorrows -- not only for the 15 patients now in suspension in California -- but for *you* as well.

--Mike Darwin, Principal Planner

KEYSTONE CORONERS

by Mike Darwin

The stories we are about to tell you are almost unbelievable. As close as we are to them, we have found an element of black humor in them. Whether or not you share in our dark laughter, each of the two incidents we are about to relate goes a long, long way to explaining why the Dora Kent case unfolded as it did, and why Alcor was assaulted by the Riverside County Coroner as it was. There almost certainly is no one simple explanation for the Coroner's actions, but as the following stories will point up, there are certainly three fairly straightforward underlying ones: incompetence, stupidity, and projection.

The first story broke in July and concerned the mistaken cremation of a suspected homicide victim by the Riverside Coroner's office. The victim's body was found after several days in the desert near Cathedral City (In the Palm Springs area) and was brought into the Riverside Coroner's office for autopsy. We have reprinted the story of this Keystone Cops mix-up which appeared in the Riverside *Press Enterprise* because we don't think anyone would have believed it otherwise. But there are other details which Alcor has learned about from sources inside the Coroner's office which we would like to share with you.

We understand Supervising Deputy Coroner Dan Cupido was on-duty at the time the mistaken release and cremation took place. Indeed, not only was Mr. Cupido on duty, we understand that he was present in the autopsy room and personally witnessed and authorized the release. The release was unusual in that it involved decomposed remains and was carried out during business hours when four autopsies were being conducted at the same time. Reportedly it is the Coroner's Office's policy not to release decomposed remains during business hours because of the odor and health hazard this represents. Reportedly Mr. Cupido released the remains as a favor to a friend at the mortuary.

In an attempt to save money, the Coroner's office had previously discontinued the use of bright red body bags for identifying homicide victims. They were relying instead on red toe and bag tags, which in this case were reportedly both illegible and not the

Riverside *Press-Enterprise*
July 26, 1988

Body of suspected homicide victim cremated by mistake

By DON BABWIN
The Press-Enterprise

In a case of mistaken identity, the body of a suspected homicide victim was released by the Riverside County Coroner's Office to a mortuary for cremation before an autopsy could be conducted.

The mistake was discovered July 20 when Cathedral City police officers drove to the coroner's downtown office for an autopsy on a woman whose decomposed body was found July 17 in the desert.

"We went there for a post (post-mortem examination) and they didn't have a body to do a post on," said Sgt. John Holcomb.

Holcomb said the homicide investigation will be more difficult without the body, but detectives will continue to work on the case.

"There have been some scenarios where there was no body and they still prosecuted," he said. "The burden is a lot more on us to prove she was killed, but it can be done."

Coroner Raymond Carrillo, whose office released a statement yesterday on the error, said a man's body, not a woman's, was supposed to be turned over to the mortuary.

"Nobody looked in the body bag," said Carrillo. He said neither the coroner's employee nor the person transporting the body checked to see if they were releasing the right body.

Carrillo said the employee, whom he would not identify, claimed that she checked a tag on one of the body bags. "She said part of the tag was rubbed off and all she could see was the word 'male,' " said Carrillo.

Carrillo said the coroner's employee was not authorized to release bodies. The internal investigation is continuing, said Carrillo.

Carrillo said the error is as much the fault of the mortuary as the coroner's office. "They should have looked inside the bag," he said.

Rubidoux Mortuary owner Dennis Butler said the coroner's office gave his employee the wrong body. "We feel the responsibility is with the county coroner's office," said Butler. The tag on the bag received by his mortuary showed the body was that of the man, not the woman.

Butler explained that both bodies were decomposed and

Body . . .

(From Page B-1)

both had been found in the desert.

Later, the man's body was cremated, Butler said.

The body mistakenly cremated was that of a 29-year-old woman whose last known address was in Palm Springs. The woman's name has not been released because her husband has not been notified, said Holcomb.

Holcomb said the woman's body was found the morning of July 17 by a jogger in Cathedral City. At that time, the police determined she had been dead approximately two days.

The sergeant said animals had gotten to the body so detectives could not determine how the woman died. But, he said, "There were indications at the scene (that) the cause of death was suspicious."

Holcomb said the investigation would go forward just as if the detectives knew the cause of death. He said detectives are in the process of trying to determine who may have last seen the woman alive, and "do a biography of her life."

"We can't confirm she was killed, but we're still taking the stature of a homicide investigation," he said.

appropriate color. The body was released without making a proper identification (i.e., looking inside the bag), as is mandatory.

As a consequence, the woman's remains were released in the place of a male decedent who was also decomposed and found in the same general area, but who was not a homicide victim. When the police officers in charge of the case showed up later in the day to be present during the autopsy, what they found was the male decedent's remains.

According to the Cathedral City police, the case is still under investigation.

Of course, it goes without saying that in the absence of an autopsy report it will be problematic at best to establish the cause, let alone the mode of death. Mr. Cupido was subsequently suspended for three days.

Mr. Cupido's name is an important one to remember. He was responsible for the so-called investigation into Alcor, and in his capacity of Supervising Deputy Coroner is also responsible for the day-to-day operation of the Coroner's office.

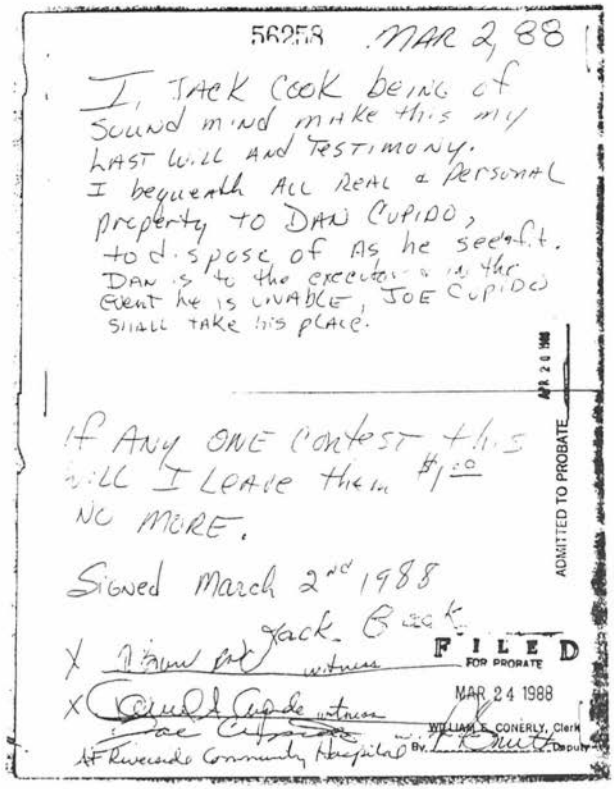
If the body mix-up and the ensuing melee of charges and counter-charges doesn't establish what kind of Keystone Cops run the Coroner's office (read the following *Press-Enterprise* articles for a revealing glimpse of Coroner Raymond Carrillo's professionalism and fast thinking...), the article on Mr. Cupido's more recent problems entitled *Coroner's Official Sued In Will Dispute* should help.

When we first saw this article we wondered what to make of it. Having been worked over at the hands of the press we were willing to extend the benefit of the doubt. So we went down to the Probate desk of the Superior Court and requested a copy of the probate file on former Deputy Coroner Jack Cook -- the man whose estate Cupido is being accused of having improperly appropriated. What would Mr. Cook's will be like, we wondered. Especially since Mr. Cook's estate is reportedly valued at $536,252.48!

Even we were surprised by what we found. A copy of Mr. Cook's will accompanies this article. We reproduce it here because if you didn't see it, you probably wouldn't believe it!

The will consists of two scratch-pad-sized pieces of paper which have been stapled to an 8 1/2 by 11 inch-sized sheet. The will is in two different hands and is completely hand-written. The signature is a shaky scrawl near the bottom of the second sheet.

The lawsuit filed by Mr. Cook's relatives alleges that the will was written in the hand



56958 MAR 2, 88

I, JACK COOK being of sound mind make this my LAST WILL AND TESTIMONY. I bequeath ALL REAL & PERSONAL property TO DAN CUPIDO, to dispose of As he see's fit. DAN is to the executor in the event he is UNABLE, JOE CUPIDO SHALL TAKE his place.

If ANY ONE contest this will I LEAVE them $1.00 NO MORE.

Signed March 2nd 1988

Jack Cook

witness

witness

Joe Cupido

At Riverside Community Hospital

ADMITTED TO PROBATE APR 20 1988

FILED FOR PRORATE MAR 24 1988 WILLIAM S. CONERLY, Clerk By Deputy

* * *

of Mr. Cupido. If this is so, it tells us much about Mr. Cupido's level of intellectual sophistication -- or lack of it. Every one of the three sentences in the will has serious errors in either grammar, punctuation, or spelling. There are other problems: In California, a will need not be witnessed if it is holographic -- that is, written entirely in the testator's own handwriting. But if the signature is Mr. Cook's, then the rest of the will is obviously in someone else's hand. Therefore, it is not holographic, and requires witnesses. It *is* witnessed, *but at least two of the three witnesses on the will, including Mr. Cupido, are beneficiaries named in the will*: a decided no-no under California law.

There are many other problems with the will, not the least of which is that it was executed in an acute care facility by a critically ill man who was on high doses of steroid medication known to affect mood and judgment (see Mr. Cook's death certificate, which is reproduced below). No lawyer, patient ombudsman, or other third party was called in to facilitate execution of the will or to protect Mr. Cook's rights. The third of the three witnesses on the will was Mr. Cupido's brother, Joe Cupido. In spite of these deficiencies, the will was accepted by the Probate Court, probably on the grounds that anything was better than nothing, as long as there was no contest.

Before Mr. Cook's relatives learned of the situation, Cupido was only days away from being awarded the estate. Reportedly he had already moved his brother, Joe Cupido, into one of the homes Mr. Cook owned in the Riverside area.

CERTIFICATE OF DEATH
STATE OF CALIFORNIA

1A. NAME OF DECEDENT—FIRST	Jack
1B. MIDDLE	———
1C. LAST	Cook
2A. DATE OF DEATH (MONTH, DAY, YEAR)	March 21, 1988
3. SEX	Male
4. RACE/ETHNICITY	Cauc.
5. SPANISH/HISPANIC NO	Ex
6. DATE OF BIRTH	May 17, 1921
7. AGE	66
8. BIRTHPLACE (STATE OR FOREIGN COUNTRY)	CO
9. NAME AND BIRTHPLACE OF FATHER	William Slaughter, OH.
10. BIRTH NAME AND BIRTHPLACE OF MOTHER	Lesta Cook, TX
11A. CITIZEN OF WHAT COUNTRY	USA
11B. IF DECEASED WAS EVER IN MILITARY GIVE DATES OF SERVICE	19 4 2 TO 19 4 6
12. SOCIAL SECURITY NUMBER	556-24-8036
13. MARITAL STATUS	Divorced
14. NAME OF SURVIVING SPOUSE (IF WIFE, ENTER BIRTH NAME)	
15. PRIMARY OCCUPATION	Deputy Coroner
16. NUMBER OF YEARS THIS OCCUPATION	32
17. EMPLOYER OF SELF-EMPLOYED, SO STATE	County of Riverside
18. KIND OF INDUSTRY OR BUSINESS	Government
19A. USUAL RESIDENCE—STREET ADDRESS (STREET AND NUMBER OR LOCATION)	2368 Knob Hill Dr.
19B.	30600
19C. CITY OR TOWN	Riverside
19D. COUNTY	Riverside
19E. STATE	CA
20. NAME AND ADDRESS OF INFORMANT—RELATIONSHIP	Daniel A. Cupido-Executor 5838 Virginia Pl. Riverside, CA 92506
21A. PLACE OF DEATH	Riverside Community Hospital
21B. COUNTY	Riverside
21C. STREET ADDRESS (STREET AND NUMBER OR LOCATION)	4445 Magnolia Av.
21D. CITY OR TOWN	Riverside
22. DEATH WAS CAUSED BY: (ENTER ONLY ONE CAUSE PER LINE FOR A, B, AND C)	
IMMEDIATE CAUSE	(a) Candida Sepsis — 10 days
CONDITIONS, IF ANY, WHICH GAVE RISE TO THE IMMEDIATE CAUSE, STATING THE UNDERLYING CAUSE LAST	(b) Immunosuppressive State (on Steroid) — 4 mon DUE TO, OR AS A CONSEQUENCE OF (c) Chronic active hepatitis — 4 mon
APPROXIMATE INTERVAL BETWEEN ONSET AND DEATH	
24. WAS DEATH REPORTED TO CORONER?	Yes-88M-436
25. WAS BIOPSY PERFORMED?	NO
26. WAS AUTOPSY PERFORMED?	No
23. OTHER SIGNIFICANT CONDITIONS—CONTRIBUTING TO DEATH BUT NOT RELATED TO CAUSE GIVEN IN 22A	Diabetes mellitus, Rheumatoid Arthritis
27. WAS OPERATION PERFORMED FOR ANY CONDITION IN ITEMS 22 OR 23? TYPE OF OPERATION / DATE	None
28A. I CERTIFY THAT DEATH OCCURRED AT THE HOUR, DATE AND PLACE STATED FROM THE CAUSES STATED.	3/14/88
I ATTENDED DECEDENT SINCE / LAST SAW DECEDENT ALIVE	3/18/88
28B. PHYSICIAN—SIGNATURE AND DEGREE OR TITLE	Joseph J. Lee, MD
28C. DATE SIGNED	3/21/88
28D. PHYSICIAN'S LICENSE NUMBER	A31028
28E. TYPE PHYSICIAN'S NAME AND ADDRESS	Joseph J. Lee, MD, 4000-14th St., Ste 311, Riverside, C
29. SPECIFY ACCIDENT, SUICIDE, ETC.	
30. PLACE OF INJURY	
31. INJURY AT WORK	
32A. DATE OF INJURY—MONTH, DAY, YEAR	
32B. HOUR	
33. LOCATION (STREET AND NUMBER OR LOCATION AND CITY OR TOWN)	
34. DESCRIBE HOW INJURY OCCURRED (EVENTS WHICH RESULTED IN INJURY)	
35A. I CERTIFY THAT DEATH OCCURRED AT THE HOUR, DATE AND PLACE STATED FROM THE CAUSES STATED. AS REQUIRED BY LAW I HAVE HELD AN (INQUEST-INVESTIGATION)	
35B. CORONER—SIGNATURE AND DEGREE OR TITLE	
35C. DATE SIGNED	
36. DISPOSITION	Cremation
37. DATE—MONTH, DAY, YEAR	March 22, 1988
38. NAME AND ADDRESS OF CEMETERY OR CREMATORY	Riverside National Cemetery, Riverside, CA 92508
39. EMBALMER'S LICENSE NUMBER AND SIGNATURE	Not Embalmed
40A. NAME OF FUNERAL DIRECTOR (OR PERSON ACTING AS SUCH)	Preston and Simons Mortuary
40B. LICENSE NO.	F131
41. LOCAL REGISTRAR—SIGNATURE	
42. DATE ACCEPTED BY LOCAL REGISTRAR	MAR 21 1988
STATE REGISTRAR	A. B. C. D. E. F.

* * *

Leaving aside the morality of doing what Mr. Cupido did, the question arises about the stupidity of it. The will is pathetic: a reasonably bright 12-year old could have done better. Indeed, anyone with $14.95 plus tax in their pocket who could buy (and, more to the point *read*) *Nolo's Simple Will Book*, from Nolo Press, could have done a better job. How stupid, base, and incompetent could Mr. Cupido be?

The answer to that question is, *stupid* enough to accuse innocent people of a crime that they not only didn't commit but *which didn't occur*. *Base* enough to *project* onto Alcor the kind of greedy, dishonest, and money-grubbing motives which Mr. Cupido seems to live *his* life by. *Incompetent* enough to not even be able to follow elementary format in properly drafting or executing the will or even in constructing adequate sentences and punctuating them properly! In short, the Coroner's office appears to be run by a subliterate.

As for Mr. Raymond Carrillo, the Coroner of Riverside County, well, he's the elected official in charge and responsible for the actions of his staff. (Although the affair with the will is Mr. Cupido's private affair, strictly speaking.) There is ample evidence to support the notion that Mr. Carrillo has lost control of his office and sight of his sworn responsibilities.

After our experience with the Coroner and his merry men, none of this should come as a surprise. And yet it does. No matter how hard we try, we find it hard to believe that these people could be this base and have the might of the State in their hands. Boy, have we been getting an education. And it looks like it's only just begun.

Riverside *Press-Enterprise*
September 27, 1988

Coroner official sued in will dispute

By ROBB FULCHER
The Press-Enterprise

Relatives of former Riverside County Deputy Coroner Jack Cook have sued Supervising Deputy Coroner Dan Cupido contending Cupido used undue influence to persuade Cook to name him sole beneficiary in Cook's will.

The lawsuit, filed in Riverside County Superior Court by six of Cook's cousins and a sister-in-law, seeks to invalidate the will and secure Cook's estate, valued at $415,000, for his relatives.

Cook died March 21.

A handwritten will dated March 2 leaves Cook's entire estate to Cupido.

Raymond L. Riley, a Los Angeles attorney representing Cook's relatives, said yesterday he believes the will was written by Cupido. A handwritten will must be drafted by the person leaving the will, Riley said.

Cupido said he wanted to speak with his attorney before deciding whether to comment on the lawsuit. His attorney, David B. Bowker, was unavailable for comment yesterday.

The lawsuit contends that during the last months of Cook's life, while he was "seriously ill" and taking medication, Cupido was able to "control the mind and actions" of Cook.

Riley said Cook suffered from a serious long-term illness and his judgment and moods were affected by high doses of steroid medication.

Cupido "suggested and drafted" the will and arranged for its execution, the lawsuit contends. The will did not result from a "free and voluntary" effort on the part of Cook, the suit claims.

The suit also claims that execution of the will was not proper because two valid witnesses were not present. The will lists three witnesses, two of whom are Cupido and Joe Cupido, who was identified by Riley as Cupido's brother.

If the will naming Dan Cupido as heir is declared invalid, Cook's relatives probably would become the heirs, because there is no other known will, Riley said. He added, however, that he is continuing to investigate the possibility that another will exists.

In addition to Cook's estate, the lawsuit seeks unspecified punitive damages.

The lawsuit, filed last week, is expected to come to trial within two years, Riley said.

Plaintiffs in the suit are: Weldon and Gordon Tidwell, Floy Heath, O.W. Harrison Jr., Charles T. Craig, Rae Nell Nimmo, all cousins of Cook; and sister-in-law Eleanor Gehling. Gehling lives in Riverside County and the other plaintiffs live outside California, Riley said.

* * *

As Steve Harris recently said, "All of this makes completely comprehensible why bureaucrats, when they seize total power, kill the intellectuals *first*."

At least we aren't asking "why" so much around here anymore.

* * * * * * * * * * * * * * * * * *

READ ON...THERE'S MORE!

The irony grows deeper still. When I arrived home from writing the above piece I sat down to have lunch, relax, and read the paper. When I turned to the local section of the *Press Enterprise* I found an unbelievable story. I won't even attempt to chronicle it here, rather, I will just run several of the articles that have appeared in the Riverside paper on the following pages.

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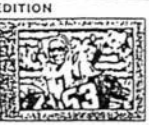
MEMBERSHIP COUNT

As of October, 1988, Alcor has 109 Suspension Members and 224 Associate Members.

RIVERSIDE FINAL EDITION

Rough day: Rams, Raiders get trounced SPORTS



Moving day takes macabre twist in Riverside LOCAL, P-1

Public health dilemma at center of AIDS issue HEALTH & FITNESS, pg 1

A look at the arguments for Measure B BUSINESS

The Press-Enterprise

MONDAY, October 3, 1988 RIVERSIDE COUNTY, CALIFORNIA Circulation: Daily, 147,553; Sunday, 155,420 - - 25¢

Couple makes grim discovery at new home

By ROBB FULCHER
The Press-Enterprise

Mark and Gail McClure were moving into their new house in Riverside's Magnolia Center area yesterday when they found a note from the previous owners asking for a phone call if the McClures ran into any "problems."

Boy, did they run into problems.

The first-time home buyers, he a 24-year-old auto technician and she a 28-year-old homemaker, were busy moving belongings from their former home in Moreno Valley into their three-bedroom, $85,000 house on Dewey Avenue near Carlo Drive.

As they worked inside the house about 4 a.m., the McClures heard Puffy the cat crying and crying in the back yard.

"She was really freaking out," Gail McClure said.

Mark McClure looked outside and saw Puffy standing stalk still on a picnic bench, surrounded by about 20 cardboard boxes and two plastic bags.

McClure got a little closer and caught a whiff of the formaldehyde smell that hung in the air. He picked up a plastic bag, noted the squishy feel of the contents and carried it into the light for a better look.

What he saw was a human heart.

"It was all purple. When I found out it was a heart I dropped it."

The boxes and bags, sitting on a picnic table and nearby on the patio, contained human body parts and tissues. Two five-gallon buckets also sat before McClure, one containing a strainer and material that appeared to be human remains, and the other empty.

He said the bags and boxes were labeled with people's names, a series of numbers and dates, including 1987 and 1988, and a description of the contents, such as "stomach and contents" on one container and "heart" on the one he had handled.

The McClures also found a cutting board, a knife and knife blades wrapped in plastic. The remains found in boxes also were sealed in plastic bags, McClure said.

Mark McClure was not in the mood for a mystery. Standing under an olive tree later yesterday morning in his fog-enshrouded back yard, McClure said the couple bought more than they bargained for when they purchased the house.

"I just want to find out what's going on," he said. "The wife, she's so upset she's saying she wishes we hadn't bought the house."

The McClures' back yard was dotted with clumps of hair; it was not known if it was human hair.

After the discovery, the McClures called authorities. Riverside County Coroner's officials determined that the previous owners, Brad and Alendra Birdsall, both deputy coroners assigned to the Riverside office, were cutting up human remains at the house, in connection with part-time work they do for an independent laboratory.

The McClures showed a note hand-written on a paper towel and signed by the Birdsalls. The note was dated Oct. 1 — Saturday — and advised the McClures that some property of the Birdsalls remained at the home.

"We still occupy half the garage, the covered patio, part of the brick patio (under the olive tree) and still have our tools in the shed," the note stated. "Call us if there are any problems."

The note was signed Brad and Didi Birdsall. "Didi" is Alendra Birdsall's nickname, the McClures said.

In response to the early morning call to authorities, Deputy Coroner Rick Bogan removed the materials from the back yard as Riverside police officers

looked on, McClure said.

The bags and boxes filled the trunk, the back seat and part of the front seat of the large sedan Bogan drove, McClure said.

Bogan used the McClures' telephone to contact Brad Birdsall and left a message on an answering machine.

"His exact words were, 'Brad, get your ass up, this is Rick.' Then he just said, 'Call the office,' " Mark McClure said.

The morning visit by police and the coroner's officials was the first of the day. They came back when more remains were found in the garage.

In all, authorities removed what the McClures estimated to be 25 cardboard boxes, two plastic bags and one bucket containing human remains.

The Coroner's Office and Riverside police launched a joint investigation into the grisly discoveries, in part to determine whether any laws were broken.

Supervising Deputy Coroner Dan Cupido said the Birdsalls had been taking remains home from Reference Laboratory in Colton to prepare the tissues for autopsies, in which tests are performed and tissues are studied under microscopes.

The Birdsalls were cutting up, or "sectioning," the remains, Cupido said.

Although the sectioning work may seem macabre to members of the general public, such work is commonplace to the Birdsalls, Cupido said. "What I see every day you might see twice in a lifetime," he said.

The Coroner's Office gives autopsy work to the laboratory because physicians must perform some of the work and the Coroner's Office is not staffed with physicians, Cupido said. Autopsies are performed on bodies primarily to determine the cause of death.

Cupido knew of no policy at the Coroner's Office that would specifically prohibit work on human remains being done at home, but added that the investigation could lead to a change in policy.

Cupido said he did not know whether a backyard setting was sanitary enough for the sectioning work. However, yesterday's discoveries had not thrown into doubt any autopsies previously performed, he said.

Coroner Raymond Carrillo was contacted at his home and expressed concern over the matter, Cupido said. Carrillo launched an administrative inquiry and police joined the investigation later in the day.

No action has been taken against the Birdsalls, Cupido said.

Brad Birdsall, who was contacted as he arrived at the McClure home about 1 p.m. to remove some items, said he had been instructed by his supervisors at the Coroner's Office not to discuss what the tissue samples were doing at the house.

"Suffice it to say it's for legitimate reasons," he said.

"This has nothing to do with the Coroner's Office. If anything, this is a problem for Reference Lab."

Officials with Reference Laboratory could not be reached for comment yesterday afternoon.

Randall K. Tagami, assistant district attorney, said the District Attorney's Office had not been contacted.

"It would be something that our office would look at if it is called to our attention by the Coroner's Office," he said.

Riverside County Health Department officials were unavailable yesterday to comment on the matter.

Officials at the Coroner's Office were unaware that the Birdsalls had been taking their laboratory work home with them, Cupido said. He said yesterday's incident was the first of its kind he had come across.

Lt. Bill Miller, on duty as watch commander for the police department yesterday, also described the incident as unusual. "In 23 years I've never seen anything like it," he said.

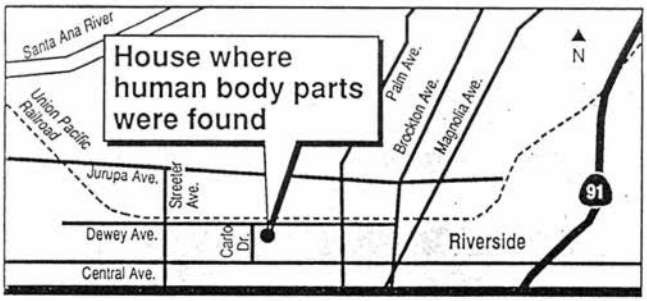
Miller said he tried to contact Chief Linford L. "Sonny" Richardson at home to brief him on the matter but could not reach him.

Authorities would say little about their investigation, refused to list the body parts taken from the home, and declined to identify which corpses were involved.

Cupido confirmed, however, that most of the remains were from bodies of people who had died in 1987 and 1988.

Both Birdsalls work in the coroner's office in downtown Riverside. Brad Birdsall has worked there about five years and Alendra Birdsall for less than one year, Cupido said.

Staff writer Doug Beeman contributed to this story.



BECKY HAGEMAN/The Press-Enterprise

FRED BAUMAN/The Press-Enterprise

Gail and Mark McClure found boxes and bags of human body parts in this backyard picnic area and in the garage of the small three-bedroom house they just bought in Riverside.

MARILYN ODELLO/The Press-Enterprise

Brad Birdsall and his wife, Alendra "Didi" Birdsall, move things from the garage of the Dewey Street house sold to the McClures. Some body parts were found in the garage.

Local

The Press-Enterprise

SECTION B

Tuesday, October 4, 1988

Dan Bernstein

'Moonlighting' in the county: Just another little slice of life

No matter how you cut it, **Brad** and **Didi Birdsall** are Riverside County's Fun Couple 1988.

They've given "part-time job" and "piece work" entirely new meanings.

I thought my wife and I were a wacky duo. Each night, we carve up a few table scraps for little Guido. The Birdsalls? They carve up Uncle Marvin. (I assume that Brad and Didi have gone Cuisinart. It's *the* name in home-autopsy technology.)

The Birdsalls are two more members of the Riverside County Ringling Bros. Coroner's Office. I don't want to get overly graphic about just what it is Brad and Didi do, but if they ever have you over to the house, bring your own hanky. You wouldn't want to ask *them* for a tissue.

• • •

The Birdsalls' in-home whittling came to light when they moved out of their Riverside house and neglected to clean out the picnic area. Yes, picnic area. Weren't they afraid of ants? The Birdsalls' picnic area and garage were stocked with boxes and bags and even a bucket of human leftovers. It was as if Colonel Sanders had been gearing up to unveil a new secret recipe: Bucket O' Parts, just $2.99! (Of course, Colonel Sanders is dead. You don't think . . . Naaaaahh.)

The boxes and bags and bucket were discovered by an apoplectic Puffy the cat, who, at most, has eight lives to go. Puffy belongs to **Gail** and **Mike McClure**, who bought the home from the Birdsalls. You can't say the McClures weren't warned, though.

The Birdsalls left a note, inviting the McClures to call if they ran into any problems. I don't know about you, but if someone left me a note like that, I'd immediately think, "Sounds like human body parts. Guess I'd better have a look."

The Birdsall inventory included a purple heart, but not even Dan Quayle would wear it. There was also a stomach. Which reminds me of another Birdsall social tip: If they ever have you over to the house, take a rain check on the chopped liver.

Last social tip: Make other plans for Halloween.

• • •

The real losers in all this have to be the McClures, who obviously failed to purchase one of those home warranty policies that guarantee all appliances — including stoves, hot water heaters, human hearts, etc. — for 90 days. Otherwise, they could have cashed in.

As for the entrailpreneurial Birdsalls, I'm afraid that when you leave boxes of body parts in a picnic area, some people — even the Riverside County coroner — feel obliged to make inquiries.

If I had to offer a personal note of support for Riverside County's Fun Couple, it would be this: No matter how tough things get, just remember, the couple that flays together stays together.

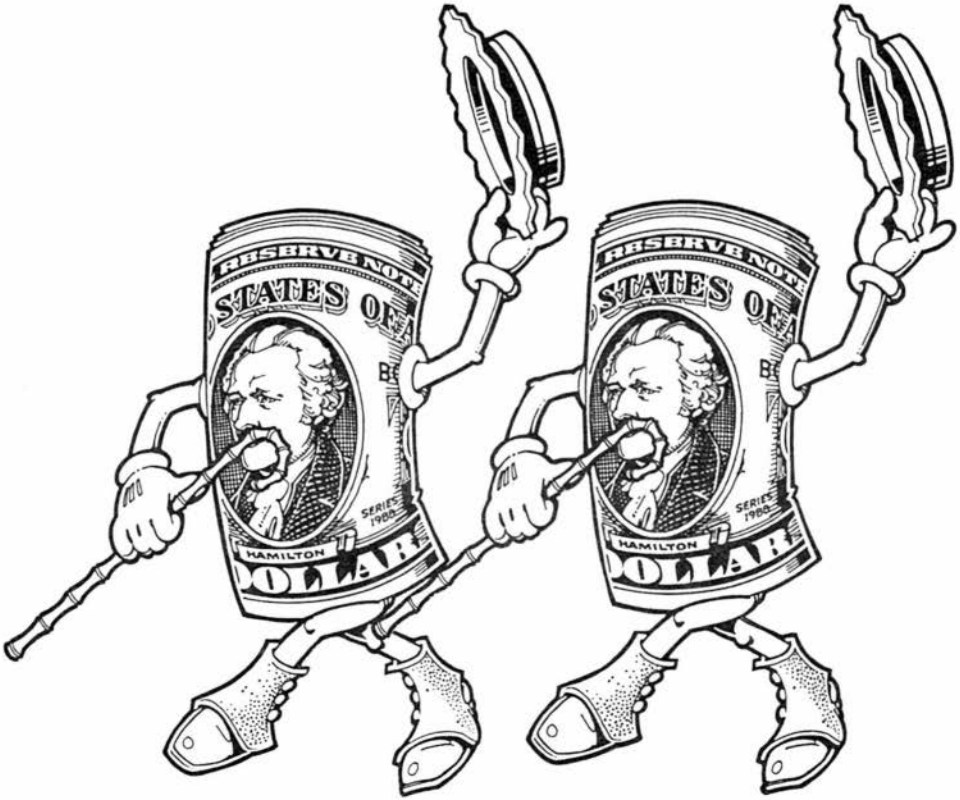
And never forget your sacred matrimonial/coroner vows: Til death we do parts.

DOUBLE SOMETHING?

As we come to the end of the tax year, the issue of contributions in support of Alcor again comes to the fore. As the opening piece in this issue makes clear, we are in urgent need of financial support. One way of effectively doubling any support you give which is often overlooked is "matching funds" programs operated by many large (and even some mid-sized and small) companies. If you are planning on making a contribution, we urge you to check with your employer to find out if they have a matching funds program. Also find out if they contribute *things* to nonprofit, tax-exempt organizations like Alcor.

The latter can be just as important as money. The computer this is article is being written on was contributed to Alcor by Toshiba Electronics, courtesy of Sherry Cosgrove, a Toshiba employee. Toshiba not only had a matching funds program but often contributed surplus or discontinued equipment to employees' favorite charities. As a consequence Alcor got four "loaded" Toshiba T-300 MS-DOS computers as well as three hard drives and a printer. These computers have gone a long way to carry us through the crisis (while the Coroner seized two of them, two others were off site and were not taken).

So, check around and see if your employer will match your contribution to Alcor or has other programs for contributing to tax-exempt organizations from which Alcor could benefit. We can use all the help we can get!



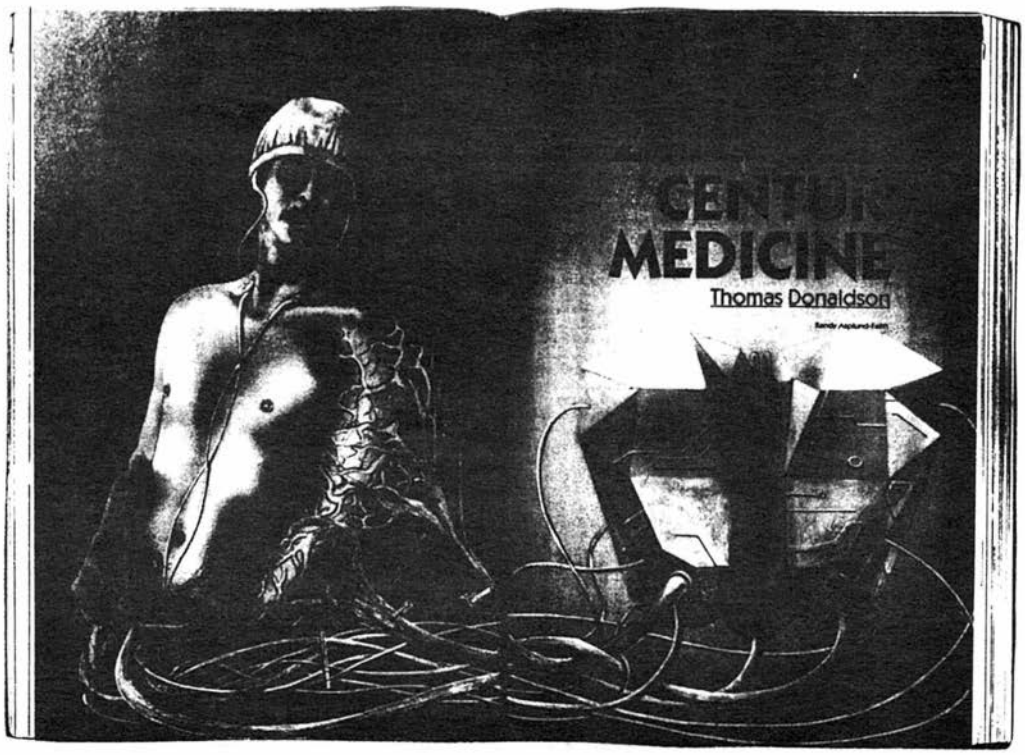
ANALOG as cryonics primer?

by Mike Darwin

Despite all the pain, grief, ignorance and uncertainty, the ideas of cryonics and nanotechnology are spreading and spreading rapidly. In the vanguard of their popular dissemination has been *Analog* science fiction magazine. Over the past 12 months there has literally been a wave of material articulating the cryonicist's worldview in both the fact and fiction sections of the magazine. It started with a review of Eric Drexler's *Engines of Creation* by *Analog* editor Dr. Stanley Schmidt about a year ago. He *emphatically* urged would-be writers for *Analog* to get with the action and read Drexler's book, since this was clearly the shape of things to come. Some months later a lengthy letter from Keith Henson about cryonics and Alcor was published in the *Brass Tacks* letters section of the magazine.

More recently a spate of stories dealing with cryonics and nanotechnology has been appearing and one of Alcor's own, none other than Thomas Donaldson, has been making his mark. Thomas' most recent feature article contribution to *Analog* was a very excellent piece on the future of medicine entitled *24th Century Medicine*. We have obtained permission from *Analog* to reprint Thomas' article and will be doing so in the December issue of *Cryonics*.

But Thomas is by no means alone in his exploration of the shape of things to come according to the cryonics/nanotechnology worldview. Some are positive, others not so. All of them seem to be agreed about one thing though; for better or worse cryonics and vast extension of the human lifespan are likely to be technically achievable, and in the not too distant future.

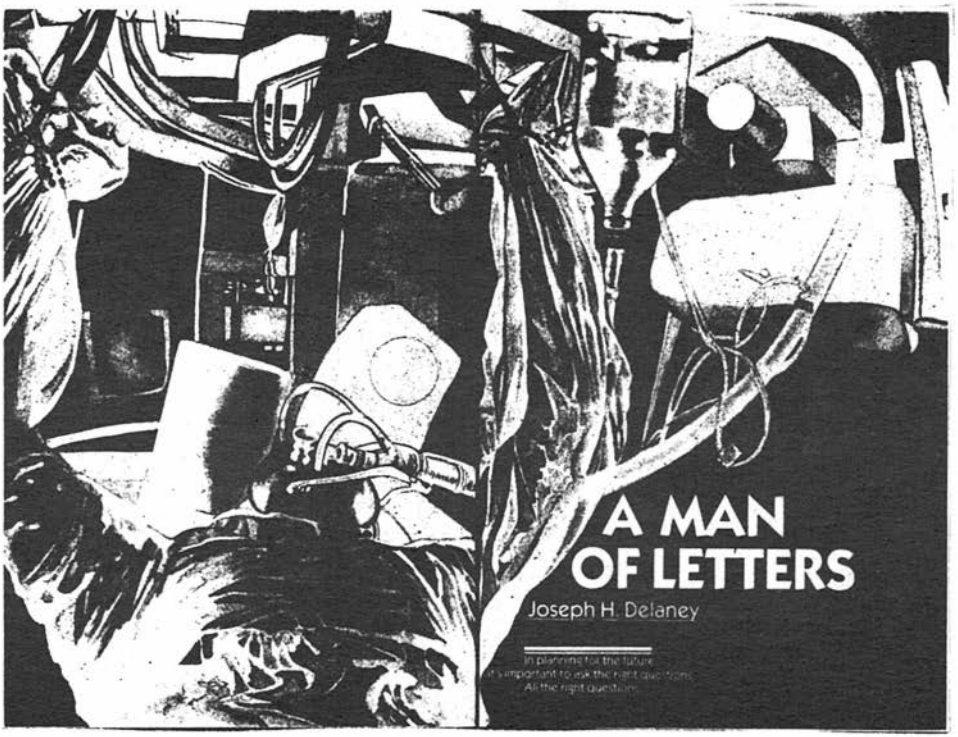


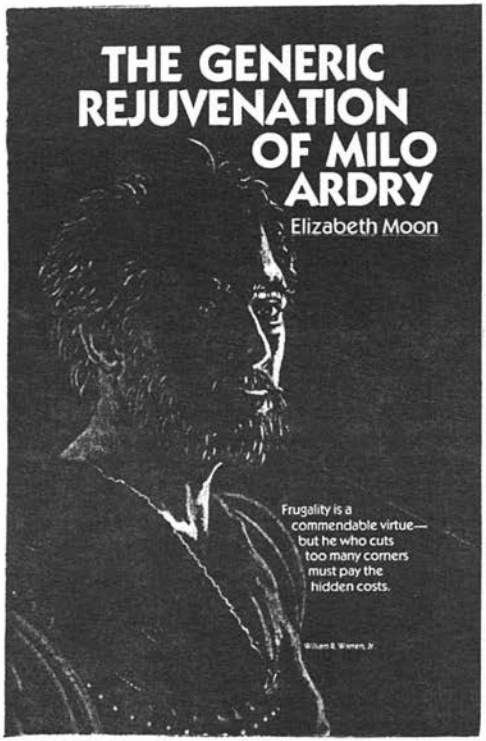
The first of these stories, *A Man Of Letters*, by Joseph H. Delaney, appeared in the August, 1988 issue. The story concerns itself with a greedy and unprincipled billionaire, one Rex Joser, who intends to get control of cryonics and get suspended no matter what it takes and of course, take his billions with him. The other principal in the story is Dr. Kenneth Hanson, Director of the Biostasis Foundation. Dr. Hanson, amazingly, understands what cryonics is all about, as this bit of dialogue between he and Joser demonstrates:

> *Joser*: "As I understand your process," he said, "you preserve the body by freezing and you have some method of undoing the damage to the tissues which freezing causes?"
>
> *Hanson*: "Uh -- that's not entirely correct -- yet -- Mr. Joser. Our present technology isn't that good. But -- we're counting on improvements that will do it, on cell repair machines currently in the rudimentary stages of development. Freezing does no more than preserve the form from deterioration, so that when we do acquire the ability, we will be working from an absolutely reliable matrix. We can take our time, Mr. Joser. No one will be resurrected until we are absolutely certain we can correct the damage -- and also, of course, cure the underlying affliction."

While Delaney has the technology down pat, he goes on to attribute the worst motives imaginable to his characters and has the whole affair end up with the usual cliche ending -- failure.

However, in *The Generic Rejuvenation of Milo Ardry*, we are given a positive scenario about rejuvenation. The story, by Elizabeth Moon, is a lighthearted piece about a penny-pinching oldster who wants to get rejuvenated with increasing frequency and still not go





broke. His solution is to use a cheaper product, a so-called "generic rejuvenation" service. It's a dilemma that anyone who has ever purchased "clone" computer equipment or software can identify with. Sometimes you get more than you bargain for. Moon handles the situation of unexpected side effects cleverly and creatively. And, most important, her story is in no way judgmental or negative. It was a delightful read -- especially so since it deals with life extension in a fictional context without slamming it or trying to deliver any ponderous social messages which we readers of science fiction have all come to know and loathe.

The November issue contains two stories of interest to cryonicists. One, entitled *The Healing*, by W.T. Quick, is about a nanotechnological cure for an unnamed genetic disease. The story, while not very imaginative, is very positive. *The Healing* treats nanotechnology in a strongly favorable light and reads like a piece of propaganda written by the *Foresight Institute* -- if they were in the business of putting out propaganda (except that Drexler would have done it better). Also in the November issue is a very well crafted story built around a powerful suspension and resuscitation technology, entitled *Last Rites*. The story, by Brad Ferguson, deals with a lawyer pleading for the life of a suicide victim being held in temporary suspension in a time when resuscitation is possible, but only permitted in accordance with the law, as a form of population control. The coroners have the client's body and are all set to perform an autopsy unless the attorney can show that court that his client had "social worth," and therefore merits resuscitation. This is taut storytelling with attention to detail and a real surprise of an ending.

Analog has a *minimum* cutoff of nearly six months prior to the time an issue hits the stands. Given the normal to-and-fro of submission, review, editing, changes, etc. that are involved prior to acceptance, these authors must have submitted their first efforts within a month or two of Dr. Schmidt's editorial and announcement of his partiality toward stories on the future as nanotechnology. His authors have delivered and he has delivered.

Based on the performance of *Analog* over the last year or two I would say it is becoming *must* reading for the well-informed cryonicist. Even the noncryonics fiction is better than it has been in a long, long time. I recommend a subscription -- which is something I rarely do.

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AIDS TEST NOW REQUIRED FOR LIFE INSURANCE IN CALIFORNIA

California has joined the rapidly growing list of states which allow insurers to demand AIDS tests before issuing life insurance policies. The new law takes effect

January 1 and does *not* cover health insurance (that is, HIV tests still are not allowed for health insurance policies). The measure, while hotly contested by some AIDS support and education groups, passed with an overwhelming majority. The message here is clear; if you want to buy life insurance and you don't want a HIV test, then you have only a few weeks left to do so.

It is anticipated that insurers will simply deny life insurance coverage to any applicant who tests positive for HIV. Reportedly the law will require insurers to maintain strict confidentiality of the test results, and includes a prohibition preventing insurers from entering test results in industry-wide databases such as the Medical Information Bureau.

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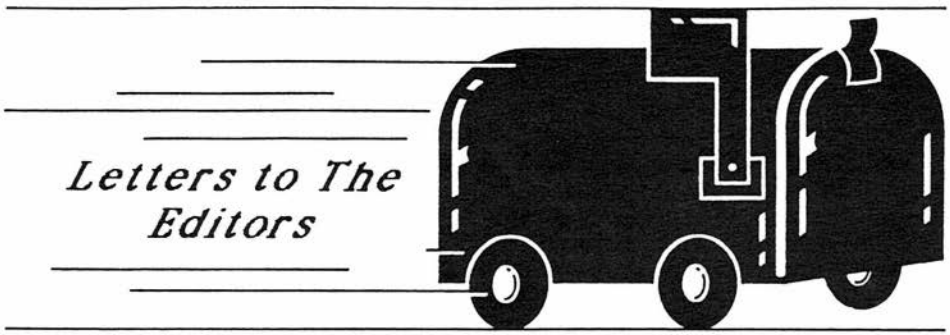

To the Editors:

I have some problems with Thomas Donaldson's account of the "connectionist" and "nonconnectionist" viewpoints on memory in his piece "The Cellular Location Of Memory", in the August issue of *Cryonics*. I offer some ideas of my own, in the hope that I can stimulate a more to-the-point exposition than Donaldson seems to provide.

If I have understood Donaldson correctly the connectionist position, which is apparently "held by several prominent cryonicists", is that our memories are encoded by changes in the number and location of interconnections between neurons in the brain. I have always heard (and Donaldson confirms) that neural connectivity is virtually fixed in adult humans. This would seem to rule out the connectionist position, unless one of those connectionists out there can point to an exception to that generalization.

Thus far I am "with" Donaldson, but when he goes on to define an alternative connectionism, I find the analysis lacking. Even if the connectionists are wrong it does not follow that the connectivity of the neural network can be disrupted without the irrecoverable destruction of memory.

Assuming that the connectivity of the adult brain is basically unchanging, learning and memory must arise from changes in the input-output relations of the individual neurons in the network. This is well established in the primitive animal models which Donaldson discusses. Alterations in a neuron's pattern of response to stimuli presumably come about because of changes inside the cell. Even so, the content of memory is not determined solely by these changing factors -- connectivity is also vital. The contents of a computer's memory only take on meaning given some implicit ordering, and the same applies to the brain (in both cases there is "place encoding"). If we scramble the connections, we in effect scramble the address lines of the computer, and what we have left is not

memory.

Donaldson suggests that the connectivity of our brains may be completely determined by the genome. The numbers he uses to justify the claim that the genome is large enough for that task seem suspect to me (there are perhaps 10^{14} interconnections in the brain, versus approximately 10^{10} bits in the human genome). However, this is really the wrong way of thinking about the problem. DNA is not a map or a blueprint; rather it determines a set of procedures for building an organism. In principle the entire structure of the brain could be determined genetically. But isn't it more likely that the development program codes for only the overall structure while the precise pattern of interconnections is governed by random events. If this is so, then an atlas of the nervous system won't be adequate to unscramble our memories. Maybe our nanomachines will be able to infer what goes where from nongenetic clues, but the moral still seems to be that how you are suspended matters a great deal. Another point in favor of Alcor's high tech approach, I think.

Sincerely,
Luigi Warren
Surrey, England

* * *

Editor's Note: The foregoing caused me to want to put my oar in the water about Donaldson's comments on this and a related issue. I agree that the notion that all the synaptic connections is determined by the genome is absurd. Even *fingerprints* are not identical between identical twins -- although they do show the expected broad-based degree of similarity one would expect. I have not had recourse to a late edition neurophysiology textbook but I remember from the ones I read while in college that the random connection theory was the accepted one.

Donaldson also has gone on record as believing that because protein synthesis is involved in memory, memories may be recoverable from the nucleus of the brain cells. I would like to see even one shred of evidence produced that this could be so.

As to the issue of connections occurring in adult animals, I believe this has been documented and I recall reading a review in *Scientific American* a number of years ago on memory which discussed creation and removal of dendritic spines in adult rats. Perhaps one of our readers can point me towards the reference? -- MD

* * *

I recently attended a lecture on culturing of brain cells, and one of the interesting points to me is that neurons of all ages retain quite a bit of plasticity in cell culture, and presumably also in the brain itself. The conventional picture of the brain as a structure with static connections is an artifact of primitive visualization technology. Additionally, the synaptic junctions appear to have at least a more conductive and a less conductive state, and are mediated by the memory-forming mechanism. As we noted in introducing Thomas's articles, they are abstracts of the state of the art, and not comprehensive at all. You correctly deduce that the idea of a static brain is simply wrong, but our knowledge of the detailed mechanisms is such as to start indeterminate late-night discussions, without visible result. The brain is a product of evolution, which does as it darn well pleases, and refuses to listen to the importunate hypotheses of the experts. For example, there might be *several* mechanisms of memory, each evolved for a specific function. This could lead to a "the blind men and the elephant" situation. Watch this space for further developments. --HH

MATHEMATICAL ANALYSIS OF RECIRCULATING PERFUSION SYSTEMS, WITH APPLICATION TO CRYONIC SUSPENSION

by R. Michael Perry

1. Introduction

The objective of cryonic suspension is to place today's terminally ill patients into a state of arrested metabolism via cryopreservation with as little injury from ischemia (interrupted circulation) and the cryopreservation process as possible. The principal method of reducing cryopreservation associated injury is the replacement of a substantial portion of the cell and tissue water content of the patient with a *cryoprotective agent(s)* (CPA) which acts both to minimize the amount of ice formed during deep cooling and to stabilize cell membranes against freeze-induced disruption.

Replacement of 30% to 40% of a patient's body water with CPA can only be achieved by the circulation of a solution containing high concentrations of the CPA throughout the patient's vascular system. The circulation of a fluid through the vascular system of a patient, organ or tissue is called *perfusion*. In a normally functioning living organism perfusion serves as a vehicle for mass exchange: delivering needed nutrients and dissolved gases to tissues and carrying away waste products. Similarly, cryoprotective perfusion carried out in preparation for cryonic suspension also involves mass exchange: in this case the introduction of cryoprotective agents and the removal of unwanted tissue water.

Unfortunately, the introduction and removal of cryoprotective agents is not a completely benign process. CPA's used in human cryonic suspensions and in solid state organ preservation studies present a number of challenges to tissue viability. These challenges fall into three broad classes: osmotic injury, toxic injury, and mechanical stress (e.g., excessive shear or excessive pressure) caused by injection of fluids during perfusion.

Osmotic injury can occur during introduction of cryoprotectant when the rate of introduction of the agent results in excessive cellular dehydration and/or vascular overexpansion. Injury from osmotic effects can be minimized or eliminated by carefully controlling the rate of introduction of CPA in a manner which prevents buildup of large concentration gradients and allows sufficient time for the agent to equilibrate across the cell membrane, assuming the permeation rate across the membrane is not negligible.

Injury from toxicity occurs due to the direct and indirect effects of the CPA on macromolecules which comprise cell structures. CPA may dissolve out key components, precipitate inorganic ions, remove excessive amounts of water needed for structural integrity or directly bind to macromolecules rendering them nonfunctional. Generally speaking, injury from toxicity is a function of both the temperature and the time of exposure. Another source of injury, which can be viewed as a form of toxicity, is cellular deterioration caused by prolonged ischemic exposure.

The considerable osmotic activity of CPAs and the need to reach high concentrations of these agents in the tissues of the patient dictates that introduction be gradual. This allows time for the agent to diffuse across capillary and cell membranes and slowly exchange with water present both within and between the cells. Too rapid a rate of introduction of CPA will result in dehydration (shrinkage) of the cells and injury due to osmotic stress. Additionally, excessive flow rates will result in elevated perfusion pressure leading to excessive fluid accumulation in the extracellular space, causing edema

(swelling).

On the other hand, CPA toxicity can best be minimized by reducing the amount of time the tissue is exposed to CPA at the relatively high (above-freezing) temperatures required to carry out perfusion. The more rapidly CPA is introduced the shorter will be the time of exposure at such temperatures, and the less the injury from toxicity and other temperature/time dependent deterioration.

Clearly, a balance must be struck between the optimal CPA perfusion protocol designed to minimize osmotic injury and edema and the optimum protocol to minimize toxicity. Such a protocol requires careful control over the rate of introduction of CPA.

The most straightforward way to achieve such control would be to continuously deliver a constant flow of perfusate to the arterial system of the patient while continuously increasing the perfusate CPA concentration and discarding the effluent draining from the venous circulation. In this case (assuming a patient neither dehydrating nor retaining fluid) the incoming (arterial) and outgoing (venous) flow rates are equal, and all the outflow (effluent) is discarded. The more rapidly the perfusate is pumped through and discarded, the shorter will be the time of perfusion. Such a single pass perfusion can be carried out with reasonable speed assuming a moderate rate of withdrawal. It has a serious drawback, however, in that it is likely to induce large gradients in the concentration of CPA, hence large osmotic stresses.

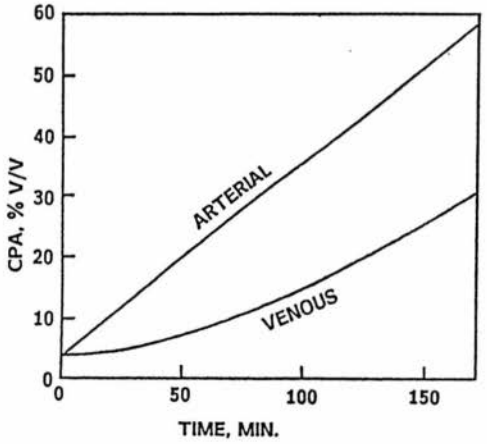

Figure 1. Single-pass perfusion.

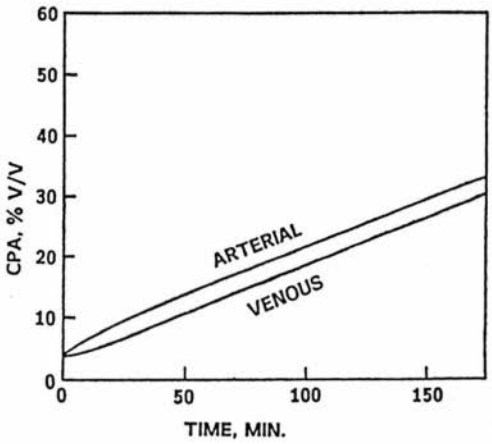

Figure 2. Recirculating perfusion.

A powerful way of reducing the osmotic stresses is to recirculate some of the perfusate through the patient while maintaining a constant rate of withdrawal. Perfusate that is withdrawn is replaced by perfusate at higher CPA concentration as before. The superiority of this recirculating system is illustrated in figs. 1 and 2, which show simulations of a whole-body cryonic suspension giving the increase of CPA concentration with time in volumetric units under different flow rates (further details are given in section 6). Fig. 1 shows a single pass system with an arterial flow rate and effluent withdrawal rate of 0.4 liters/min. (This, it should be pointed out, is shown to illustrate one advantage of a recirculating system over a single pass system; in practice

the single-pass system would also be impractical for other reasons noted below.) In fig. 2 the arterial flow rate is 2.4 liters/min. while the withdrawal rate is 0.4 liters/min. as before, so that a net flow of 2.0 liters/min. is recirculated. It will be seen that the time to reach the desired CPA concentration of 30% is about the same for the two perfusions and in fact, perfusate and CPA requirements are also nearly the same. However the osmotic stresses, as indicated by the difference in arterial and venous CPA concentrations, are unacceptably large for the single pass system, but much smaller and well within acceptable limits for the recirculating system.

The single pass system would offer another serious difficulty too. With such a low flow rate into the patient there would be insufficient pressure to drive the CPA into the entire vascular bed, resulting in inadequate perfusion of tissues. A much higher flow rate, on the other hand, would require a much larger amount of perfusate to overcome non-instantaneous absorption of CPA.

Use of a recirculating perfusion system introduces a number of complications, however. What effluent withdrawal and CPA concentrate addition profiles will yield the desired profile of increase in CPA concentration? How many liters of a given concentration of CPA concentrate will be required for a patient of any given mass? Given a specified per minute rate of CPA concentration increase how long will perfusion last and how much CPA toxicity will the patient experience as a consequence?

When a patient presents for cryonic suspension these questions must be answered rapidly and with reasonable confidence. One highly useful tool for obtaining those answers is mathematical modeling, or prediction of the course of CPA perfusion from given starting or boundary conditions. Such prediction, of course, is always imperfect due to the enormous complexity of the system, but it can still furnish valuable insight.

In this paper consideration is given to a perfusion system consisting of n reservoirs with arbitrary, pairwise interconnections and flow rates that are constant with time. A binary solvent-solute mixture is circulated through the reservoirs, each of which is assumed to instantaneously mix all incoming fluids. We wish to know the concentration of solute in each reservoir as a function of time. This in turn depends on a linear, ordinary differential equation involving flow rates into and out of the reservoir. The equation is solved numerically, using a Taylor's series approximation, and is then generalized to the case in which the flow rates vary with time.

Application of this technique to the problem of CPA perfusion during a cryonic suspension is then considered. A computer program was written to predict the concentration of CPA in a suspension patient as a function of time, assuming constant flow rates into and out of the patient and the reservoirs involved in the perfusion.

This program was recently used during a whole-body cryonic suspension at the Alcor Life Extension Foundation[1]. Rough estimates were obtained, in advance, of time and perfusate requirements under different assumed flow rates, and actual flow rates were adjusted accordingly to reduce anticipated osmotic stress. A more careful study was done after the suspension to try to reconstruct the course of CPA perfusion. Comparison of predicted and observed CPA concentrations sheds light on certain physical changes, such as reduction of patient circulating volume, believed to have been caused by vascular occlusion secondary to ischemic clotting. Other programs have since been written that allow for variable flow rates, to allow optimal perfusion profiles under certain models of cell stress. Calculations from one of these programs are shown. Work is continuing, and possible future applications are discussed, including a computer-driven perfusion system for cryonic suspensions.

2. Background

The pioneering analysis of perfusion systems for cryonic suspension was carried out by Quaife in 1972[10]. All three phases of suspension (blood washout and cooling, CPA perfusion, and freezing) were considered, with modeling of the patient more advanced than that described here. Solutions were obtained for (among other things) concentrations of CPA in a recirculating perfusion circuit as a function of time. Simplifying assumptions, such as fixed or highly controlled fluid volumes in the reservoirs, allowed expression of these concentrations in terms of elementary mathematical functions (mainly exponentials). In addition to the buildup of CPA, the problem of cooling the patient through perfusion was considered, and it was noted that the two problems are mathematically equivalent under reasonable approximating assumptions. Results pertaining to heat flow during cryonic suspension were extended in a later study[9].

Meanwhile Fahy and Harris obtained solutions for a simple though new, variable-volumes perfusion circuit that has no recirculation[4,7]. Fahy has also considered, though not analyzed in full generality, a variable-volumes circuit that does provide for recirculation, with CPA introduced by gravity feed from a concentrate reservoir, which is a close approximation to the circuit now used at Alcor[5,6]. In the present study the problem for this latter circuit is solved as a special case of the more general reservoir problem.

3. The Mathematical Problem

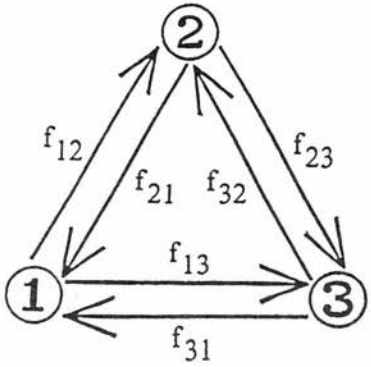

Figure 3. Recirculating system for n=3, showing all interconnections for the three reservoirs.

For the general case we assume n reservoirs, numbered 1, 2, ... n. Each reservoir contains a time-varying quantity $V_i(t)$ of a binary solution of "perfusate" consisting of a volume of "cryoprotective agent" (CPA) dissolved in a solvent. The concentration of CPA in the ith reservoir is also a time-varying quantity and is denoted by $C_i(t)$, given in units of volume for volume (v/v). (A concentration of 0.5 thus denotes an equal volume of CPA and solvent; we assume that volumes add linearly on mixing.) The substances used as CPA and as solvent are assumed to be the same for each reservoir; only the concentration of CPA and the volume of perfusate can vary from one reservoir to another. In a typical cryonic suspension, for instance, the solvent will be water and the CPA glycerol.

Next, for each ordered pair (i,j) of reservoirs we assume a nonnegative, possibly zero flow rate f_{ij} from i to j (see fig. 3). This will allow us to model a perfusion system of great generality; in particular, we can achieve the case of arbitrary connections or barriers between reservoirs accordingly as the flow rates are set to positive or zero values. (One possible advantage of this level of generality is that it could help in modeling an organ or a body itself, both being complicated interconnected systems of reservoirs, although we will assume a one-reservoir model of the body in the application considered later.) It is perfectly possible, for instance, to have two reservoirs i,j interconnected by a pair of flow tubes, with perfusate flowing back and forth between i and j (that is, both f_{ij} and $f_{ji} > 0$). In the present analysis, however, flow from a reservoir immediately into itself is not physically meaningful; thus we set

$f_{ii} = 0$ for all i. Mathematically, the system of reservoirs forms a complete, directed graph on n nodes with nonnegative-weighted edges. As noted above we assume the flow rates are constant with time.

Finally we assume that the volumes V_i and CPA concentrations C_i are given at a starting time t_0. The basic problem then is to calculate these volumes and concentrations for $t>t_0$. Since the flow rates are assumed constant, the volumes are a simple linear function of the time:

$$V_i(t) = V_i(t_0) + (t-t_0)\sum_{j=1}^{n} f_{ji} - f_{ij}. \tag{1}$$

Concentrations, however, will vary nonlinearly. The basic relation governing the behavior of the concentrations $C_i(t)$ can be conveniently determined by considering the total quantity of CPA in reservoir i at time t, $C_i(t)V_i(t)$. Over a short interval of time, the net inflow of CPA into reservoir i will be proportional to the sum of the flow rates into i, times the associated concentrations from the other reservoirs, minus the sum of the flow rates out of i times the concentration in reservoir i. Thus we obtain

$$\frac{d}{dt}C_i(t)V_i(t) = \sum_{j=1}^{n} f_{ji}C_j(t) - f_{ij}C_i(t), \tag{2}$$

while from (1)

$$\frac{d}{dt}C_i(t)V_i(t) = (\frac{d}{dt}C_i(t))V_i(t) + C_i(t)\sum_{j=1}^{n} f_{ji} - f_{ij}. \tag{3}$$

Using (3) it is then possible to express the time-derivative of the concentration $C_i(t)$ in terms of the concentrations $C_j(t)$ and the (known) flow rates f_{ij} and f_{jj}. By repeatedly differentiating the right hand side of (2) we can also express the derivatives of C_i in terms of lower-order derivatives of C_j. For convenience we drop the argument t so that $C_i = C_i(t)$, etc., with the mth derivative denoted by $C_i^{(m)}$. We then obtain

$$\frac{d^m}{dt^m}C_iV_i = C_i^{(m)}V_i + mC_i^{(m-1)}\sum_{j=1}^{n} f_{ji} - f_{ij} \tag{4}$$

$$= \sum_{j=1}^{n} C_j^{(m-1)} f_{ji} - C_i^{(m-1)} f_{ij}, \tag{5}$$

or in other words,

$$C_i^{(m)} = (1/V_i)(\sum_{j=1}^{n} C_j^{(m-1)} f_{ji} + C_i^{(m-1)} ((m-1)f_{ij} - mf_{ji}) \tag{6}$$

Knowing the successive derivatives of C_i at $t=t_0$ will enable us to evaluate C_i for neighboring values of t according to the Taylor's series:

$$C_i(t) = \sum_{m=0}^{\infty} C_i^{(m)}(t_0) \cdot (t-t_0)^m/m!. \tag{7}$$

(For a general reference on numerical solution of differential equations, including Taylor's series methods, see [8].) To obtain a form of (7) that is useful for computation and to investigate the important issue of convergence of the series we consider the normalized derivatives $f^{[m]}$ of a function f, given by

$$f^{[m]} = f^{(m)}/m!. \tag{8}$$

The series of (7) is then expressible as

$$C_i(t) = \sum_{m=0}^{\infty} C_i^{[m]}(t_0) \cdot (t-t_0)^m, \tag{9}$$

while the successive, normalized derivatives are determined from (6) by

$$C_i^{[m]} = (1/V_i)\left(\sum_{j=1}^{n} C_j^{[m-1]} f_{ji}/m + C_i^{[m-1]} ((1-1/m)f_{ij} - f_{ji}\right) \tag{10}$$

In particular note that each successive derivative $C_i^{[m]}$ is determined from (at most) the n derivatives of preceding order, independent of m, a property that makes this scheme attractive for computation, particularly when n, the number of reservoirs, is small. (For the application considered here, there are in effect 4 reservoirs, but only 2 reservoirs of interest in which there is nonzero inflow as well as outflow.)

To carry out an actual computation involving eq.(9) we need to know where to truncate the series, which requires an estimate of the size of the successive terms $C_i^{[m]}$. Such an estimate can be obtained from (10); it is not difficult to show, for example, that

$$|C_i^{[m]}| \le Q^m \max_{1\le k\le n} |C_k|, \tag{11}$$

where

$$Q = \max_{1\le k\le n} \frac{1}{V_k} \sum_{j=1}^{n} 2f_{jk} + f_{kj}. \tag{12}$$

This means that the series of (9) will converge whenever $|t-t_0| < 1/Q$, a quantity lower-bounded by an expression that is linear in the reservoir volumes and reciprocal in the sum of certain flow rates. A better idea of the behavior of the successive derivatives $C_i^{[m]}$

can be had by considering the (column) vector of mth derivatives $\mathbf{C}^{[m]}$ given by

$$\mathbf{C}^{[m]} = \{C_1^{[m]}, C_2^{[m]}, \ldots C_n^{[m]}\}. \tag{13}$$

The successive derivatives can then be determined by matrix multiplication, starting with the vector $\mathbf{C}^{[0]}$ of concentrations C_i. From (10) we obtain

$$\mathbf{C}^{[m]} = (\mathbf{D} + \frac{1}{m}(\mathbf{M} - \mathbf{Z}))\mathbf{C}^{[m-1]}, \tag{14}$$

where **D** and **Z** are diagonal matrices whose nonzero entries, d_{ii} and z_{ii} respectively, are given by

$$d_{ii} = \frac{1}{V_i}\sum_{j=1}^{n} f_{ij} - f_{ji}; \quad z_{ii} = \frac{1}{V_i}\sum_{j=1}^{n} f_{ji}; \tag{15}$$

while the entries m_{ij} of (nondiagonal) matrix M are given by

$$m_{ij} = \frac{1}{V_i} f_{ji}. \tag{16}$$

In particular note that **D**, **Z** and **M** are independent of the order of the derivative, m. Among the properties that follow from (14) is a refinement of the radius of convergence of the series of (9), which can in fact be shown to converge whenever

$$|t - t_0| < \min_{1\le k\le n} 1/|d_{kk}| = \min_{1\le k\le n} V_k/|\sum_{j=1}^{n} f_{kj} - f_{jk}|. \tag{17}$$

In the application considered here, values of the concentration $C_i(t)$ are computed at 1-minute intervals, from the previously computed derivatives $C_i^{[m]}(t_0)$. Since $t-t_0$ is only 1 min., rapid convergence of the series is usually assured, the only exception being when one of the reservoirs is nearly empty. Once the concentrations C_i have been determined for time t, the successive derivatives can then be evaluated, and the computation can be extended to another minute. Although we have considered only the case of constant flow rates f_{ij}, it is nearly as easy to deal with nonconstant flow rates, provided these do not change too much over the 1-minute interval; one merely substitutes the new flow rates at each 1-minute step. (Updating more frequent than every minute could be used to improve the accuracy for the nonconstant flow rates, but this has not proved necessary.) In fact it is possible to *adjust* the flow rates to achieve some desired "perfusion profile" or increase in concentration as a function of time. This is considered in section 6, following the material relating to the recent suspension.

4. Application to Cryonic Suspension: General Principles

During a cryonic suspension it is necessary to circulate cryoprotective agent through the patient prior to freezing. The circulation of CPA is a *second* perfusion operation that occurs after "total body washout" or replacement of the blood with initial or base perfusate, which contains little or no CPA. (The reason for removal of blood before CPA introduction is that red blood cells undergo changes which affect their rheology during CPA and low temperature exposure seriously impeding perfusion of the capillary bed.) The circuit now used at Alcor for this second perfusion is shown schematically in fig. 4. The

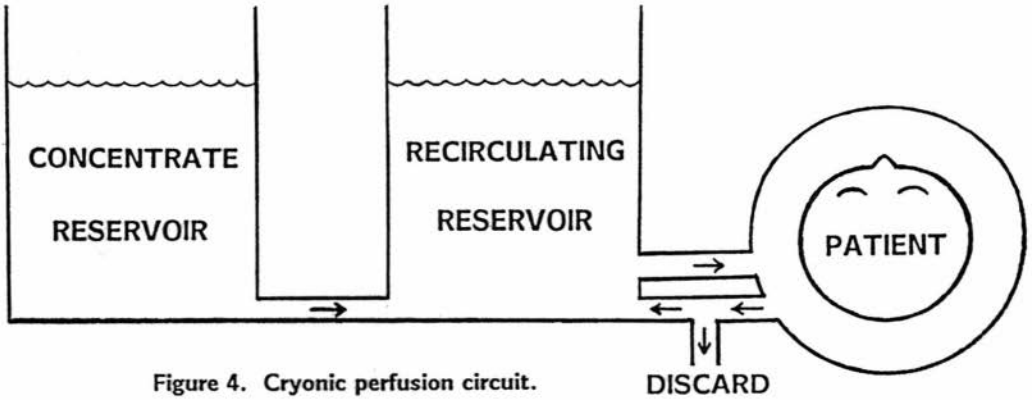

Figure 4. Cryonic perfusion circuit.

perfusate, an aqueous solution containing CPA, is introduced into the patient's arterial circulation via the aortic root and withdrawn from the venous circulation via the right atrium, after circulation through the capillary bed. The solution is delivered to the patient from the recirculating reservoir and venous effluent from the patient is partly discarded and partly returned to the recirculating reservoir, where it will again be cycled through the patient. Since the flow rates into and out of the patient are nearly equal, the flow discarded results in a net loss of fluid from the recirculating reservoir. This in turn causes a flow by gravity from the concentrate reservoir, increasing the CPA concentration in the recirculating reservoir. A consequence of this is the delivery of an increasing amount of CPA to the patient. A greater flow discarded will thus result in a greater flow of concentrate, hence a more rapid increase of CPA in the patient.

In order for CPA perfusion to be biologically safe and effective we need to know in advance what levels of CPA in the patient can be expected from a given set of starting conditions, how much difference in arterial and venous concentrations of CPA there is likely to be and finally, how much perfusate will be required. We thus are interested in a time development for a simulated perfusion circuit.

To obtain a first-order approximation for such a simulation, we assume constant flow rates into and out of the patient and out the discard, and treat the patient as another reservoir with instantaneous mixing (rapid mixing already occurs in the recirculating reservoir). With a further simplifying assumption about the the flow rate of CPA from the concentrate reservoir, all flow rates will be constant. This assumption is that the densities of perfusate in the concentrate and recirculating reservoirs are equal, which would cause liquid levels in both reservoirs to be equal throughout the perfusion. In fact, glycerol has a density (1.26) significantly greater than that of water, but the gravity-feed flow from the concentrate reservoir is restricted by the viscosity of the glycerol concentrate in such a way as to largely counteract the expected effect of the greater density. (The level of concentrate is generally slightly *greater* than that of recirculating perfusate, not less as would be expected from the greater density.)

With these assumptions the theory of section 3 can be applied so that volumes and concentrations in the different reservoirs can be computed as a function of time. In effect we have 4 reservoirs (n=4): (1) the concentrate reservoir, (2) the recirculating reservoir, (3) the patient and (4) the discard. Note that for reservoir 1 there is no inflow and for reservoir 4 there is no outflow (f_{j1} and $f_{4j} = 0$ for $j = 1, 2, 3, 4$). In

fact the only nonzero flow rates are f_{12}, f_{23}, f_{32} and f_{34}. The two reservoirs which are of primary interest are the recirculating reservoir (2) and the patient (3) which, as suggested earlier, model respectively the arterial and venous CPA concentration in the patient. Knowing these two concentrations allows us to calculate their difference (the "a-v difference") and thus to estimate the osmotic stress. It is found in particular that the a-v difference varies dramatically with the choice of values of starting parameters, thereby shedding light on the problem of selecting an "optimal" perfusion profile that will minimize injury or "cost" to the tissues being perfused.

5. Modeling the Cryonic Perfusion Circuit

In modeling the cryonic perfusion circuit it is convenient to introduce certain notation as follows.

C_0 = CPA concentration in concentrate reservoir, assumed constant.

$V_{REC}(t)$ = volume of recirculating reservoir as a function of time t.

a(t) = CPA concentration in recirculating reservoir, the "arterial" concentration.

f_{IN} = flow rate into patient from recirculating reservoir.

V_{PT} = volume of patient, assumed constant.

v(t) = CPA concentration in patient, the "venous" concentration.

f_D = flow rate from patient to discard.

f_{REC} = flow rate from patient back to recirculating reservoir.

(18)

In comparing this circuit with the generalization of section 3, certain simplifications are evident. Volumes in the concentrate and recirculating reservoirs are equal at all times, due to the gravity-induced flow between them. Due to the assumption of constant patient volume we have $f_{IN} = f_D + f_{REC}$, so that the flow of perfusate into the patient results in a net loss from the recirculating reservoir at the rate f_D. Gravity feed from the concentrate reservoir will replenish half of this loss, or enough to equalize the liquid levels in the concentrate and recirculating reservoirs, which will require a flow rate of $f_D/2$. The quantities relevant to modeling the circuit, previously expressed in the generalized notation of section 3, are then given by

$V_1(t) = V_{REC}(t)$

$C_1(t) = C_0$

$f_{12} = f_D/2$

$V_2(t) = V_{REC}(t)$

$C_2(t) = a(t)$

$f_{23} = f_{IN}$

$V_3(t) = V_{PT}$

$$C_3(t) = v(t)$$

$$f_{34} = f_D$$

$$f_{32} = f_{REC} = f_{IN} - f_D \tag{19}$$

With these conventions, the crucial equations for modeling the circuit, which are obtainable from (1) and (10), become

$$V_{REC}(t) = V_{REC}(t_0) - (t-t_0)f_D/2 \tag{20}$$

$$a^{[1]} = [a\cdot(f_D/2 - f_{IN}) + vf_{REC} + C_0 f_D/2]/V_{REC} \tag{21}$$

$$a^{[m]} = [a^{[m-1]}\cdot(f_D/2 - f_{IN}/m) + v^{[m-1]}f_{REC}/m]/V_{REC},\ m \geq 2 \tag{22}$$

$$v^{[m]} = (a^{[m-1]} - v^{[m-1]})f_{IN}/(mV_{PT}),\ m \geq 1, \tag{23}$$

where the time arguments are dropped as before. The programs that have been written to model this circuit are given starting values of a, v, C_0, reservoir volumes and flow rates (or some of these quantities are computed from other initial conditions). Values of a and v and their derivatives are then computed at 1-minute intervals from values determined on the previous time step (so that in eq. (9) we have $t-t_0$ = 1 min.). The 1-minute updating is convenient for monitoring the course of the perfusion and also insures convergence of the series, eq. (9). In particular, from (17) it can be shown that the series, eq. (9), for a and v will converge, assuming the following hold:

$$V_{REC}/f_D \geq 1.5 \text{ min.};\ V_{PT}/f_D \geq 2 \text{ min}; \tag{24}$$

conditions which normally are amply exceeded in practice.

6. Computational Results

This section deals with computations of the predicted course of cryonic perfusions, assuming the circuit of the previous section. The most important quantities are the arterial and venous CPA concentrations calculated as a function of time. Comparisons between calculated values and those observed during a recent cryonic suspension show that the method is able to account reasonably well for the actual values observed, despite the uncertainties of modeling a whole-body suspension patient. Another useful feature is that perfusate requirements can be forecast with reasonable confidence. A further advantage of mathematical modeling is that whole-body perfusion can be compared in detail with the neuro (head-only) variety. It is found that, when flow rates are adjusted to equalize perfusion times for the two procedures, a reduction in osmotic and other stresses is achieved through neurosuspension, the improvement resulting from the decrease in effective patient volume. A third area of interest is use of nonconstant flow rates to achieve an "optimal" perfusion profile. One very simple implementation of this idea is considered, a program in which the discard flow rate is adjusted to maintain a constant ratio of a(t)/v(t) throughout the perfusion, so that this perfusion is the fastest possible subject to the constraint that the given ratio must not be exceeded. These limited results are suggestive only of course, but hopefully will furnish a starting point for more ambitious future studies and applications.

Some computational results were considered briefly in section 1, in which a single-

pass and a recirculating system were compared. Further particulars for these simulated perfusions, which will serve as an introduction to the cases considered later, are given below.

Starting volumes, recirc. and conc. reservoirs	40 liters
Patient fluid volume	45 liters
flow rate into patient (f_{IN}) single-pass system	0.4 liters/min.
f_{IN}, recirculating system	2.4 liters/min.
Discard flow rate f_D	0.4 liters/min.
Concentration of CPA in conc. reservoir C_0	67%
Starting concentration of CPA, recirc. reservoir	4%
Starting concentration of CPA, patient	4%
Time requirement, single-pass system	176 min.
Time requirement, recirculating system	179 min.
Perfusate requirement, single-pass system	70.2 liters
Perfusate requirement, recirculating system	71.4 liters

Thus in both cases about 3 hr. was required to reach a final venous CPA concentration of 30%. (This percentage of glycerol is needed to achieve "Smith's criterion" under which it is believed that tissues can be frozen without mechanical damage from ice.) About 75% of the available perfusate was required, leaving 9-10 liters each in the concentrate and recirculating reservoirs.

These statistics can be compared with data from the recent Alcor whole body suspension, as follows[11].

Starting volumes, recirc. and conc. reservoirs	41 liters
Patient fluid volume, estimated	45.7 liters
Flow rate into patient f_{IN}	0.8-1.4 liters/min.
Discard flow rate f_D	0.1-0.3 liters/min.
Concentration of CPA in conc. reservoir C_0	67%
Starting CPA concentration of CPA, recirc. reservoir	4%
Starting CPA concentration of CPA, patient	0%
Time requirement	252 min.
Perfusate requirement	66.6 liters

This, it should be noted, was nearly a worst case scenario due to the inability to provide a normal transport protocol and the long period the patient was ischemic (about 24 hours) before the suspension protocol could be started. This resulted in reduced flow rates and increased perfusion time. It will be noted that otherwise most of the statistics of the simulated perfusions agree fairly closely with the actual counterpart.

Very likely the true circulating patient fluid volume was also less than the estimated value of 70% of the body weight of water, due to vascular obstruction from ischemia and other problems.[1] (The flow rate into the patient was adjusted periodically to maintain an approximately constant pressure of 50 mm Hg, considered a safe value for perfusion.) A more accurate simulation of the actual perfusion was obtained by (1) using the actual flow rates shown in fig. 5, and (2) assuming an effective patient volume of 29 liters (63% of the estimated fluid volume); fig. 6 shows a and v concentrations for this perfusion (solid curves) versus values measured experimentally (dots). The time of the simulated perfusion (terminated at v=30%), 252 min., agreed precisely with the actual value. A still better fit to the clinical data has been obtained by modeling patient edema and leakage of perfusate from the body, both of which were significant though not overwhelming influences. A larger effective patient volume, 38 liters, or 83% of the

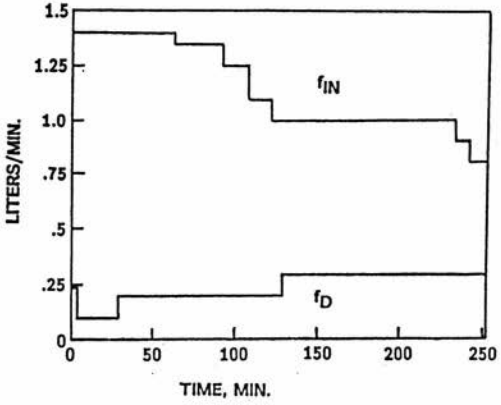

Figure 5. Flow rates for actual perfusion.

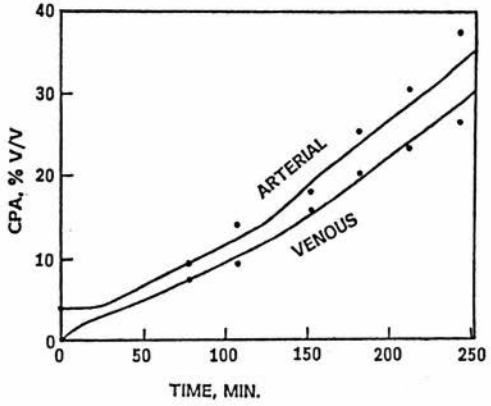

Figure 6. CPA concentrations for actual perfusion (dots) and values calculated from model (solid curves).

estimated total, was found to give the best fit, suggesting that circulation was not so restricted as it otherwise appeared to be. In general it is expected that a more elaborate theoretical model will provide a better fit to the empirical evidence, and if the extra fitting power is well-coupled to observable complications, more insight as well. (It is also worth mentioning that to model edema requires a departure from the simplified theory of section 5 since flow out of the patient, $f_{REC} + f_D$ is now less than the flow in, f_{IN}. But the more general theory of section 3 still applies.)

The above, then, will serve to illustrate how the perfusion circuit theory can be applied to model an actual cryonic suspension, leading to a better understanding of the course of events. The results are preliminary and suggestive, not conclusive; more elaborate studies of this and other suspensions are planned.

7. Whole Body versus Neurosuspension

One significant issue that perfusion modeling sheds light on is whole-body versus neuro- or head only suspension. Typically the latter is performed by tying off vasculature thus directing circulation to the head and neck only. Effective patient volume is thus reduced to approximately 10% of the whole-body value or less. After perfusion the head is surgically removed from the body and frozen.

Neurosuspension may be justified on grounds that care of the brain, the seat of the patient's personality, can be optimized if the bulk of the body is not also involved. (It is anticipated, of course, that eventually the technology will exist to regrow a new body and repair and reintegrate the brain). A full discussion of the rationale for neurosuspension is beyond the scope of this paper and is treated elsewhere[2].

By opting for neuro- as opposed to whole body suspension it is possible to greatly reduce both perfusion time and osmotic stress, though it is not known how significant this reduction will prove in terms of ultimate patient recoverability. Fig. 7 illustrates the potential for osmotic stress reduction. The difference between arterial and venous concentration is plotted as a function of time for (1) the simulated whole body perfusion of fig. 6, in which the effective patient volume is 29 liters, and (2) a simulated neuroperfusion in which the effective patient volume is 5 liters. Flow rates for the

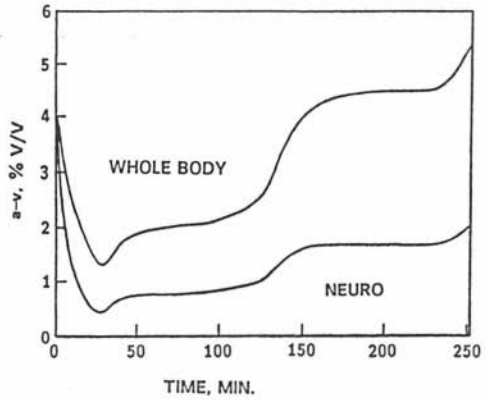

Figure 7. a-v differences for simulated neuro vs. whole body perfusion.

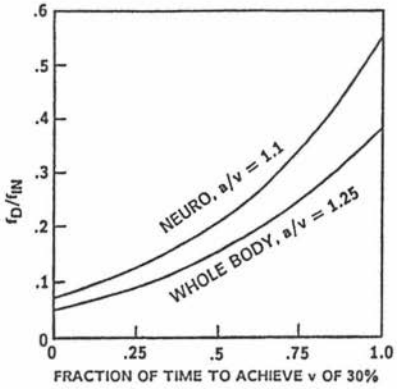

Figure 8. Flow rate ratios for constant a-v ratio during perfusion.

whole body perfusion are those shown in fig. 5.

The neuroperfusion flow rates are obtained by multiplying the whole-body rates by a proportionality constant, 0.426, to normalize the perfusion time for comparison purposes. (This in fact results in flow rates in the neighborhood of 0.5 and 0.1 liters/min. for f_{IN} and f_D respectively, which are within the expected range for a neurosuspension; for example, see [3].) Starting volumes of 25 liters in the recirculating and concentrate reservoirs of the neuro are assumed, consistent with contemporary practice at Alcor. The generally smaller values of the a-v difference for the neuro case is striking, though it should be pointed out that the larger differences for the whole body case are considered well within safe limits. (The starting values of 4% for the a-v differences resulted from a minor oversight on the original perfusion; the patient was to have been flushed with 4% v/v glycerol solution but the glycerol was omitted.) It should be noted that the a-v differences plotted are for an idealized system with instantaneous mixing; in practice these differences could well be larger as shown in fig. 6. The time of the neuroperfusion could also be significantly reduced by increasing the flow rates; generally a neurosuspension can be more quickly done at the same level of mechanical stress or pressure[3].

8. Steps Toward Vitrification

One very important goal is to arrive at a perfusion protocol that will inflict minimal damage; damage so slight as to permit resuscitation of a major organ or system from solid-state hypothermia. This goal in fact may be achievable through a process of vitrification, in which ice crystal formation is avoided due to the introduction of very high concentration of CPA during perfusion. For example, vitrification can be achieved by addition of 52% v/v glycerol at atmospheric pressure, 47% at 1000 atm., and 41% at 1000 atm. with 6% polyethylene glycol[6].

A serious limitation to application of vitrification to complex mammalian organs such as the kidney or brain is the need to introduce such high concentrations of CPA in a manner that minimizes injury from osmotic stress and toxicity. Thus what is needed is a perfusion protocol that will load the organ or system with CPA as quickly as possible thereby minimizing the time it must remain at a high enough temperature for toxicity to

occur. In developing such a protocol it is also necessary to keep osmotic and mechanical stresses to a minimum. An adequate theory of "overall stress" has yet to be formulated but vitrification research could provide valuable insight. Mathematical modeling, on the other hand, could suggest promising areas of research and accelerate progress.

One very simple measure of osmotic cell stress during perfusion is the ratio a/v of arterial and venous CPA concentration. To a first approximation, a and v can be taken, respectively, as the CPA concentration outside and inside a cell. If the cell membrane is much less permeable to CPA than water the cell would eventually shrink in volume by a factor of v/a to equilibrate or equalize the CPA concentration inside and outside the cell. Excessive cell shrinkage (by more than a factor of 2) is likely to be lethal, and cell membranes are significantly less permeable to glycerol, the most commonly used CPA, than water. One possible rationale for an "optimal" perfusion profile would be to choose a "safe" upper limit for the ratio a/v, and try to achieve the fastest possible perfusion such that this ratio is not exceeded. This would also require a "safe" upper limit for flow rate into the patient. In general the shortest time is achieved by the fastest discard flow rate, which means that f_D must be adjusted to constantly maintain a/v at the "safe" level. Strictly speaking, this means that a/v must initially be set at the "safe" level but this would be easy to achieve by briefly running a single pass circuit.

A program was written to calculate discard rate profiles for a perfusion achieving a constant ratio between arterial and venous concentrations. This involves increasing the discard flow rate f_D relative to the incoming flow rate f_{IN} continuously, so that the appropriate increase in arterial and venous concentrations is achieved. (In practice the updates occur at 1-minute intervals, as before.) It can be shown that the f_D that will maintain a constant ratio a/v is determined from other parameters of the circuit as follows:

$$f_D = f_{IN} \frac{2(a-v)(aV_{REC} + vV_{PT})}{vV_{PT} \cdot (a-2v+C_0)}. \qquad (25)$$

(In particular note that f_D is proportional to the flow rate f_{IN}.)

Two f_D-profiles are shown (fig. 8) one for a whole-body perfusion (patient volume 45 liters, starting reservoir volumes 40 liters) the other for a neuro (patient volume 5 liters, starting reservoir volumes 25 liters), The quantity graphed is the ratio between f_D and a hypothetical f_{IN} (only the ratio is significant). For the neuro case a/v is 1.1 corresponding to a modest, 3% a-v difference at the terminal venous concentration of 30%. For the whole body case a/v is larger, 1.25, because perfusion takes inordinately long for the smaller value of 1.1 (396 minutes for f_{IN} = 2.4 liters/min., with starting a of 4%. On the other hand, maintaining the larger ratio of 1.25 for the neuro case proved impossible — it would require f_D to become larger than f_{IN}!) Other brief statistics will give an idea of the sort of perfusions expected in the two cases. We assume that a=4% at the outset so that v=3.2% (whole-body) and v=3.636% (neuro). f_{IN} for each perfusion is constant throughout, 2.4 liters/min. in the whole-body case and 1.0 liters/min. for the neuro, both typical values. Time requirements then are 168 min. (whole body) and 106 min. (neuro) while perfusate requirements are 70.4 and 24.8 liters, respectively.

Other programs have been written to optimize other measures of cell stress; the main problem is not in the optimization but in selecting which measure to optimize, which requires insight available only through experiment. In general, however, we expect improvements in perfusion protocols to result from the use of nonconstant flow rates, though a computer-driven interface would be required for any accurate implementation.

9. Conclusions

Cryonic perfusion, undertaken to protect tissues from damage during the freezing process, is nonetheless not a completely benign process. Cells and tissues can suffer damage during perfusion from (1) toxicity of cryoprotective agent(s), (2) osmotic stress, and (3) stress resulting from mechanical forces under excessive fluid pressure. For this reason the perfusion process must be carefully controlled so that CPA is introduced rapidly but without extreme concentration gradients or excessive pressure. Perfusion circuits currently in use by Alcor allow careful control of CPA buildup through control of the flow rates into and out of the patient and other fluid reservoirs involved in the perfusion. How to control the fluid flow rates to achieve an effective perfusion is a complex problem, but one that can be addressed through mathematical modeling of perfusion circuitry. It thus becomes feasible to predict with reasonable accuracy the rate of increase in CPA concentration for cryonic perfusion circuits now in use. The method shows promise in elucidating what is happening to a patient during perfusion, in comparing different perfusion protocols on the basis of quantities related to cell and tissue stress, and in selecting protocols to achieve optimal perfusion under given models of stress.

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[11] Based on preliminary, unpublished figures. Minor corrections may be made before a final report is published.

The author thanks Michael Darwin, Jerry Leaf and Corey Noble for technical assistance in preparing this paper, and Thomas Donaldson and Art Quaife for additional useful suggestions.

SOME PEOPLE WORRY

by Patrick A. Heller

Some people worry
About their next meal
And life's a raw deal
And death near and real.

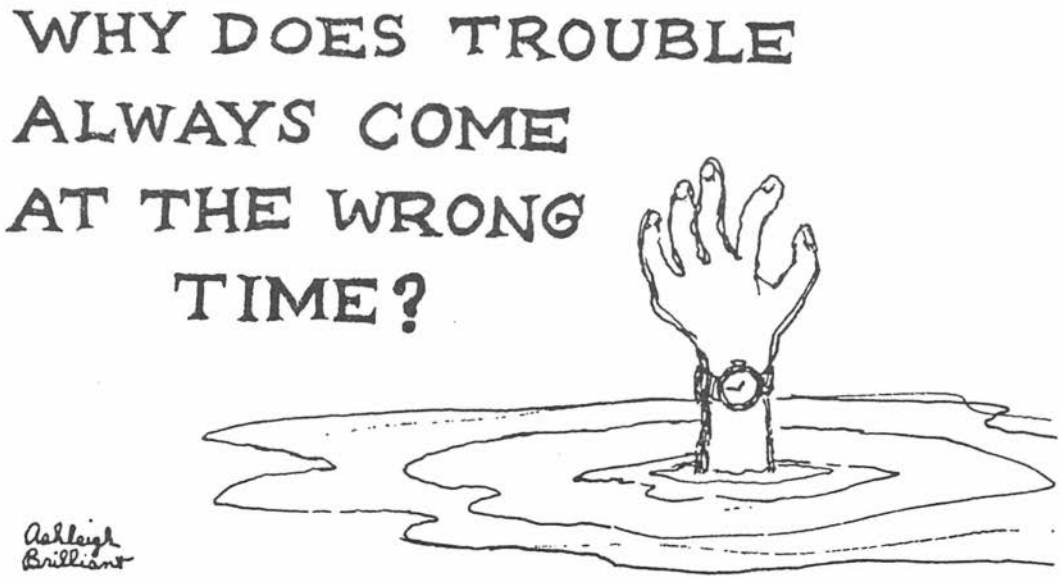
Some people worry
About the home teams
And new music themes
And their clothing schemes.

But if that's why they live and they grow,
They can't help me work on tomorrow.

Some people worry
About a free place
An immortal race
And conquering space.

They are my soulmates.

POT-SHOTS NO. 370



But What Will The Neighbors Think?!

A Discourse On The History And Rationale Of Neurosuspension

by Mike Darwin

* * *

"You cannot do just one thing.

--Zen proverb.

* * *

The article which begins on the next page expresses my own views and opinions and not necessarily those of Alcor. This article came about as a result of urging by Dr. Mike Perry to respond to an article on neurosuspension by Dr. Paul Segall of the American Cryonics Society, which appeared in the March, 1987 issue of the ACS Journal, *the relevant portions of which are reproduced below.*

From the *American Cryonics Society Journal*, March, 1988

The Neuropreservation Controversy

Owing to the lack of public acceptance of neuropreservation, ACS and Trans Time biomedical scientists are advising the small number of their clients who are opting for this service that at the present time it is a much less secure method of preservation than whole-body freezing. While the public image of whole-body suspension is improving, neuropreservation is widely regarded as both ridiculous and gruesome, despite scientific arguments to the contrary. This unfavorable image and its consequences are very real, regardless of the validity of the supporting evidence.

There are also, however, some good scientific reasons to preserve the whole body rather than just the brain. The most important derives from cloning experiments in amphibians, which suggest the possibility that not every adult cell contains the entire genome, but merely most of it. Early stage embryos have nuclei that can give rise to adult organisms following nuclear transplantation, but transplanted adult nuclei have never allowed development past the early tadpole stage.

Perhaps certain genes are eliminated during maturation in a given cell, and these may be different for each cell type. Although there are arguments to the contrary, until we can clone a human (or at least a vertebrate) from a single cell, or until we can read the entire human genome and compare it to that of a fertilized human egg, the question cannot be entirely resolved.

While it is certainly better to preserve the brain or head rather than nothing, whole-body preservation means more biological information is rescued, and that it will be there when and if needed. Since it has not yet been determined exactly how much information is needed to revive or reconstruct an individual following cryonic suspension, whole-body suspension makes more sense from a strictly scientific point of view.

Coupled with public revulsion at the idea of neuropreservation, this makes whole body preservation even more desirable. Of course, it is more expensive. One way to offset the expense is to obtain a life insurance policy for the additional cost of whole body as compared to neuropreservation. This policy might cost only $10-$30 a month, depending on the age and health of the member, and could be abandoned once cryonics established a greater degree of public acceptance, and it is ascertained scientifically either that a whole human could be constructed from a single adult cell, or that the human genome as it exists in a single adult cell is as informationally complete as that in an early-stage human embryo.

If techniques for whole-body reversible cryonic suspension are developed, one could convert to a whole-life insurance policy despite any unfavorable changes in health. Those insured only for neuropreservation could find themselves uninsurable should reversible cryonic suspension become closer during the next ten to fifteen years.

Promoters of neuropreservation contend that it is easier to cool and perfuse just the head rather than the whole body. However, because the circulatory system is designed to deliver a maximum amount of flow to the brain, one can cool the head by both core and surface cooling. Since the attachment of the head to the body does not alter the rate at which the head can be frozen, it makes little difference, using current cryonics techniques, whether or not the head is attached.

-- Paul Segall, Ph.D.

* * *

INTRODUCTION

Cryonics is not just a technical or scientific undertaking completely isolated from social, political, and emotional considerations. In fact, there are no disciplines which are isolated from human considerations. On the other hand, some areas of scientific and technological endeavor touch human values far more intimately than others. Of all human undertakings, cryonics is one of the most sensitive and powerful. It deals with the the fundamental and basic values upon which human civilization rests: personal immortality, health, well-being, the quality and quantity of life, and the structure of powerful human institutions such as religion and philosophy. Above all, cryonics deals with the most frightening and unsettling area of human experience: death.

Until recently, the public perception of cryonics was that of preserving one's body (as a unit) for rescue and repair by the presumably more sophisticated medicine of tomorrow. Recently, this perception has been shifted somewhat by the controversy surrounding the suspension of Alcor member Dora Kent. A difficult and alien idea, namely

that of having one's body frozen at "death" was perhaps made even more difficult and alien by suspension of just the patient's brain (contained within the head).

The fundamental questions raised by Dr. Segall would seem to be: "Should we carry out neurosuspension?" and, "Is the social cost worth the benefit?"

I will state at the outset that I don't think it is possible to answer those questions in any objective way. We simply don't have sufficient information to make any hard and fast assertions, since the outcome will be determined by enormously complicated social and political processes about which we have little information. However, this is not to say that we cannot discuss the pros and cons in a thorough and thoughtful way so that everyone can draw their own conclusions from the information now available.

SOME HISTORY AND BACKGROUND

It is ironic that the intellectual seed upon which modern cryonics has been built was a "neurosuspension" story by science fiction writer Neil R. Jones (1). Robert Ettinger, the father of the cryonics movement, was no doubt significantly influenced by Jones' story "The Jameson Satellite" in which the hero, Dr. Jameson, has his body rocketed into earth orbit after death for perpetual, deep-frozen preservation. After millennia in orbit, Jameson's body is happened upon by a technologically advanced race of immortal beings with robot bodies, known as the Zoromes. The Zoromes *remove Jameson's brain from his body*, install it in an immortal Zorome body and invite him to join them in their never-ending interstellar adventures. Jameson's terrestrial body is *discarded*.

It was the publication by Doubleday of Ettinger's *The Prospect Of Immortality* in 1964 that launched the cryonics movement. The scenario for cryonics presented in Ettinger's book is almost exclusively that of preservation of the whole body, although Ettinger does acknowledge the primacy of the brain as the repository for personal identity and does discuss treatment of the brain in isolation in passing (2). The extent to which Ettinger considered and perhaps discarded the option of neurosuspension when he conceived of cryonics as a practical program is unknown. In any event, the cryonics movement began as a program focused exclusively on preservation of the entire body, not just the brain or head. How and why did neurosuspension evolve as an option -- an option which accounts for ten of the sixteen patients now in suspension and for nearly one-third of those signed up for cryonics protection?

The idea of suspending just a patient's brain is an obvious one. All of modern neurophysiology and neurology indicate that the brain is the repository of memory and personality. High spinal cord injuries demonstrate that neurological disconnection of the brain from the body does not destroy either consciousness or identity. The startling head transplant and isolated head perfusion experiments conducted by Dr. Robert J. White at Case Western Reserve University have demonstrated that consciousness, learned tasks, and personality are preserved intact in the isolated head (3a, 3b). It therefore stands to reason that the brain constitutes the critical respository for memory and identity. Preservation of the brain should thus be sufficient to preserve the individual.

However, the obviousness of this proposition is a long way from a decision to implement it in a practical way. In the early 1970's a handful of cryonicists began to have deep and troubling concerns about the logistic feasibility of cryonics in the absence of broad public acceptance and particularly in the face of public indifference and even hostility. I was one of the people who was most deeply affected by these concerns and I was certainly among the most vocal in expressing them. I was not alone.

CRYONICS SOCIETY OF NEW YORK INC

My concerns were based on years of first-hand involvement in cryonics from a practical rather than a theoretical standpoint. At the age of 13 I had become involved with the Cryonics Society of New York (CSNY) and I remained involved with CSNY throughout its decline and ultimate disintegration.

All of the CSNY patients were ultimately removed from suspension and disposed of by burial or cremation. This was an extremely demoralizing and frightening experience. When I first became involved in cryonics, I had a great deal of confidence in the solidity and workability of existing organizations. This confidence was based in large measure on an inadequate understanding of the enormous difficulties involved and on an unrealistic appraisal of the size, resources, and competence of the organizations then in existence, on the basis of their literature (4).

As I grew to understand the magnitude of the task of maintaining patients in suspension over a period of decades or centuries in a world beset by cyclical military and economic catastrophes, I became even more demoralized. Cryonics was a fundamentally new undertaking. Not only was it faced with the basic problems of economic, social, and political instability over a long time course, it must also confront many unknowns of a more mundane nature including potentially catastrophic short-term problems resulting from errors in legal, financial, or administrative judgments. Many of these judgments would necessarily be made in a vacuum -- without the invaluable resource of past experience to draw upon.

Indeed, the failure of CSNY and the Cryonics Society of California (CSC) were case studies in how *not* to run cryonics organizations. While the failure modes of each organization were radically different, both suffered from errors in administrative and technical judgment which are obvious only in hindsight. Some of those errors are worth recounting because they were very important in subsequent cryonics efforts which led to creation of the neurosuspension option.

A major error that was not at all obvious at the time was accepting patients for suspension who were already legally dead and for whom the next of kin were pursuing suspension. The relatives of such individuals rarely, if ever, had a full or even adequate understanding of cryonics and were making their decision on the basis of emotional pressures and misinformation, and almost always in the absence of adequate financial resources. Such patients created almost unimaginable problems of every kind and their suspension accomplished nothing so much as to create bitterness, bankruptcy, and ruined lives.

In the early days of cryonics it was not at all obvious that this would be the case. No one could (or at any rate no one *did*) foresee that the relatives of these patients would become embittered and hostile when the reality of the situation fell short of their expectations. Lack of sound business sense and the failure of economies of scale to materialize put an enormous burden on early organizations. There was virtually no cash flow and absolutely no political or financial leverage to provide insulation from powerful outside forces.

Care of the patients was difficult -- more difficult than anyone had imagined. The early horizontal units which were designed for mobility and ease of handling proved an engineering nightmare requiring extraordinary maintenance and delivering abysmal economy. The second generation vertical MVE units which replaced them were reliable, but very difficult to handle and almost impossible to transport safely or economically. The MVE

units also required specialized quarters and handling equipment -- a building with high overhead ceilings, appropriate zoning, and a gallows or overhead crane.

The upshot of all of this was that cryonic suspension was a labor-intensive and costly undertaking with a number of unusual and inflexible requirements. In short, it had high start-up costs both in terms of technology and labor.

My awareness of these problems made me realize that in the absence of broad acceptance of cryonics (and the resource base such acceptance represented) very large amounts of money would be required on an individual basis to insure any reasonable chance of long-term survival for a patient in suspension. Additionally, easy transport and low visibility would be impossible for patients in suspension, and over a long time course, hostility and adverse conditions of one sort or another might necessitate many moves. The decline of a civilization (such as the decline of the Spanish and British Empires) can occur within the space of several decades and the outbreak of war would necessitate even more rapid relocation. From my perspective in 1974 such untoward events seemed not at all unlikely over a time span of 100 to 200 years (my personal timescale for possible revival of patients frozen under good conditions at that time). My evaluation of the world in the intervening 18 years has served only to increase my concerns about the likelihood of these potential problems.

Sometime during the summer of 1974 I came to the conclusion that the chance represented by cryonics was simply not worth the tremendous effort demanded. Too many things could go wrong and while the things we knew about and had experienced already seemed bad enough, the problems we *hadn't* yet experienced and *couldn't* anticipate were probably much worse. Youthful optimism notwithstanding, I was ready to throw in the towel.

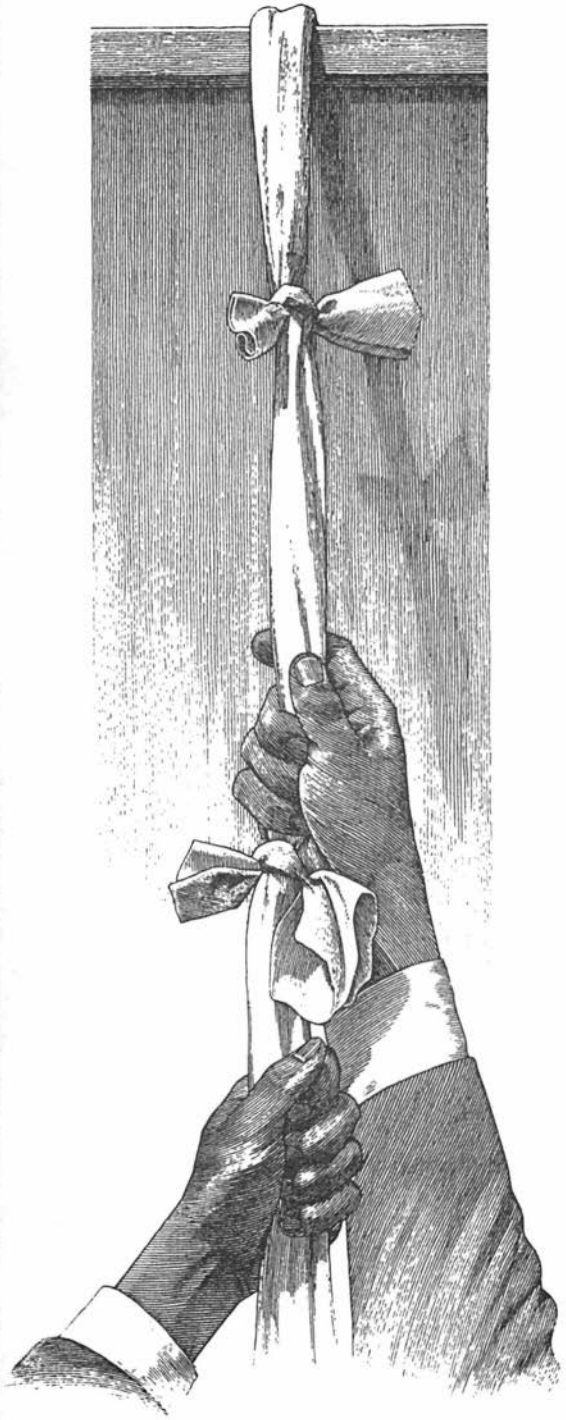
I shared my doubts and fears with a valued colleague. Shared is a misnomer -- delivered as a raging statement of frustration and despair probably better sums up the communication. My colleague, being a thoughtful and rational man, made a powerful and simple suggestion. He prefaced it by asking a number of leading questions which caught my interest.

> *What if there were some way to decrease by orders of magnitude the logistic problems associated with cryonics, while at the same time greatly reducing the cost -- perhaps by as much as an order of magnitude? Furthermore, what if it were possible to make cryonics flexible and bring its execution within the realm of "do-ability" by even a single individual? Would I reassess my decision to abandon ship?*

His solution to the problems was to cut to the core of what cryonics was really all about -- personal survival. And the bare essential for personal survival is the brain. I wish I could say I was immediately persuaded of the rationality of this idea, but the truth is it took me several days to think over the implications and lock onto it. I did not reject it out of hand, but I do not recall enthusiastically embracing it either.

My introduction to neurosuspension took place in Augusta, Georgia. Unbeknownst to both my colleague and myself, others in the cryonics community were arriving at the same conclusion for many of the same reasons nearly 2500 miles away.

During the summer of 1974 my colleague and I journeyed to Southern California to assess the state of cryonics there. We planned to meet with Robert Nelson, President of CSC, and tour CSC's facilities. We also planned to meet with Fred and Linda Chamberlain of the Alcor Foundation and Manrise Corporation.



The meeting with Nelson did not go well -- he was evasive and deceitful and we were not allowed to tour CSC's storage facilities. Evidence I gathered on that trip strongly suggested that CSC had already succumbed to the problems that plagued CSNY and that our solution to the logistic and financial nightmares had arrived too late to benefit any CSC patients.

The meeting with the Chamberlains went far better. We had corresponded with them at length and thus were somewhat prepared for what we found: two energetic and highly competent people who had virtually singlehandedly revolutionized cryonics by developing the first perfusion system, the first training and procedural manual, and the first real scientific approach to perfusate design.

Our meeting with the Chamberlains was at their home in the foothills of the San Gabriel mountains, north of L.A. The house was secluded and tucked away amidst dense foliage and the grounds were patrolled by two well-trained German Shepherds. During the course of our outdoor meal we began to discuss the problems associated with cryonics in earnest. Gingerly we broached the issue of neurosuspension. This was the first time we had discussed this idea with anyone else. What would the response be?

Fred and Linda seemed to take the idea in stride. They evinced no reaction other than to discuss the pros and cons calmly and add to a number of points we made. As we finished our meal, Fred and Linda looked at each other knowingly and then Fred said that he had something he wanted to show us before the sun went down. We were led to a small storage shed at the back of the property. Inside was the prototype of their first perfusion machine (already obsolete) and a number of other odds and ends used in developing the suspension capability they had put together.

Immediately inside the door and to our left were two nearly waist-high cardboard boxes, one of which Fred proceeded to open. Deftly he extracted an LR-40 cryogenic dewar. This, he explained, was the storage unit his terminally ill father was going to

be placed in. Both Fred and Linda eyed us expectantly. It was very clear at that moment that not only had they considered the problems in the same light we had -- and arrived at the same conclusion -- they had every intention of *acting* on that conclusion.

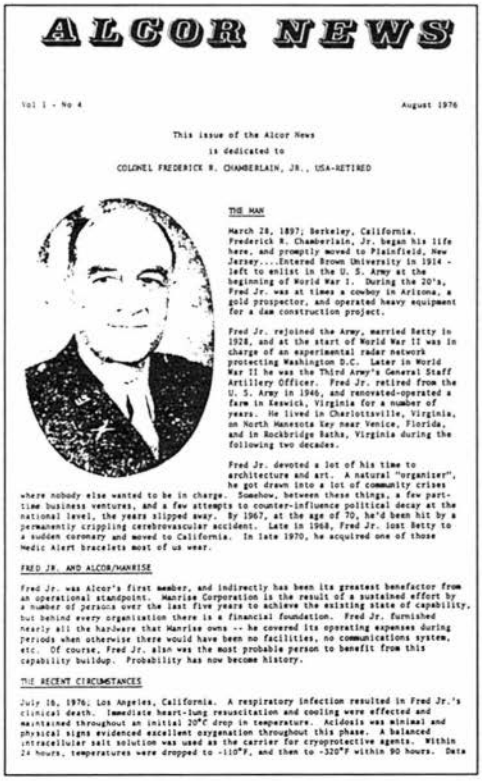
I cannot speak for my colleague, but I was both dumbfounded and excited. Here was the answer to so many problems. Here was a workable way to practice cryonics.

For Fred and Linda there was little choice but to pursue the neurosuspension option for Fred's father. The financial resources were simply not there to allow for whole body suspension. If Fred Jr. (Fred's father) was to have any chance at making it into the future, this was going to be it.

Two years later, in July of 1976, Fred Jr. became the first cryonics patient to be placed into neurosuspension (5).

The Chamberlains' decision to pursue neurosuspension for Fred Jr. and for themselves was based not only on the logistic considerations I have outlined above but also on financial and cryobiological considerations. Treatment of the patient's brain (head) in isolation meant an opportunity to better control the introduction of cryoprotective agent (CPA), to minimize exposure time (and thus toxicity) to the CPA, and to achieve better control of cooling (again with the consequence of less CPA toxicity and less damage due to prolonged exposure to high subzero temperatures while the whole body is cooled).

Treatment of just the patient's brain



ALCOR NEWS

Vol I - No 4 August 1976

This issue of the Alcor News
is dedicated to
COLONEL FREDERICK R. CHAMBERLAIN, JR., USA-RETIRED

THE MAN

March 28, 1897; Berkeley, California. Frederick R. Chamberlain, Jr. began his life here, and promptly moved to Plainfield, New Jersey....Entered Brown University in 1914 - left to enlist in the U. S. Army at the beginning of World War I. During the 20's, Fred Jr. was at times a cowboy in Arizona, a gold prospector, and operated heavy equipment for a dam construction project.

Fred Jr. rejoined the Army, married Betty in 1928, and at the start of World War II was in charge of an experimental radar network protecting Washington D.C. Later in World War II he was the Third Army's General Staff Artillery Officer. Fred Jr. retired from the U. S. Army in 1946, and renovated-operated a farm in Keswick, Virginia for a number of years. He lived in Charlottsville, Virginia, on North Manzanita Key near Venice, Florida, and in Rockbridge Baths, Virginia during the following two decades.

Fred Jr. devoted a lot of his time to architecture and art. A natural "organizer", he got drawn into a lot of community crises where nobody else wanted to be in charge. Somehow, between these things, a few part-time business ventures, and a few attempts to counter-influence political decay at the national level, the years slipped away. By 1967, at the age of 70, he'd been hit by a permanently crippling cerebrovascular accident. Late in 1968, Fred Jr. lost Betty to a sudden coronary and moved to California. In late 1970, he acquired one of those Medic Alert bracelets most of us wear.

FRED JR. AND ALCOR/HANRISE

Fred Jr. was Alcor's first member, and indirectly has been its greatest benefactor from an operational standpoint. Hanrise Corporation is the result of a sustained effort by a number of persons over the last five years to achieve the existing state of capability, but behind every organization there is a financial foundation. Fred Jr. furnished nearly all the hardware that Hanrise owns -- he covered its operating expenses during periods when otherwise there would have been no facilities, no communications system, etc. Of course, Fred Jr. also was the most probable person to benefit from this capability buildup. Probability has now become history.

THE RECENT CIRCUMSTANCES

July 16, 1976; Los Angeles, California. A respiratory infection resulted in Fred Jr.'s clinical death. Immediate heart-lung resuscitation and cooling were effected and maintained throughout an initial 20°C drop in temperature. Acidosis was minimal and physical signs evidenced excellent oxygenation throughout this phase. A balanced intracellular salt solution was used as the carrier for cryoprotective agents. Within 24 hours, temperatures were dropped to -110°F, and then to -320°F within 90 hours. Data

Linde LR-40 Cryogenic Refrigerator

The First Neurosuspension Storage Unit

Height	32 inches
Diameter	17-1/2 inches
Weight	
Empty	45 pounds
Full	128 pounds
Boiloff	2.13 liters/day

also meant that storage and long-term care could be pursued without high overhead and exorbitant start-up costs. There would be no delay in going to liquid nitrogen storage while a costly custom whole-body dewar was ordered and no need to pursue storage in a specialized structure. There was economy and flexibility of an unprecedented degree.

OBJECTIONS AND ANSWERS

The above is, I think, a fairly reasonable evaluation of how and why neurosuspension came to be. And yet, despite the many advantages cited above, neurosuspension has not become the exclusive or even the dominant method of suspension in the cryonics community as a whole. Why is this? In the following pages I will attempt to answer that question by critically evaluating many of the objections to neurosuspension that have been made since the procedure was first implemented in 1976.

The most frequently cited objection to neuropreservation is aesthetic. People associate decapitation with death and generally regard invasive or dismembering procedures as repugnant.

This is a largely irrational objection. It does, however, have strong roots in past human experience. Traditionally, decapitation or removal of the brain has been associated with the end of life rather than its beginning. Additionally, human beings, as they are currently configured have a very limited capacity for self-repair. Mutilating or amputating injuries in higher vertebrates are not reversible. There is thus strong social pressure present to avoid such injuries. In addition to being catastrophic when they do occur, they are also uncommon.

Such injuries are catastrophic because they cause profound functional losses and these losses translate into loss of sense of self. If a man can no longer work due to a dismembering injury, his social self is profoundly injured as well as his somatic self.

An answer to this objection is relatively easy. Clearly any technology capable of reversing extensive cryoinjury (as currently experienced by suspension patients) by making molecular-level repairs should be able to rebuild or regenerate any dismembering injury, including replacement of the entire body. As a minimum, transplantation of the patient's brain into an anencephalic clone should be possible. Much recent work supports the ability of the spinal cord to be regenerated, and clinical treatments for transecting spinal injuries are acknowledged by many experts to be no more than a decade or at most two decades away.

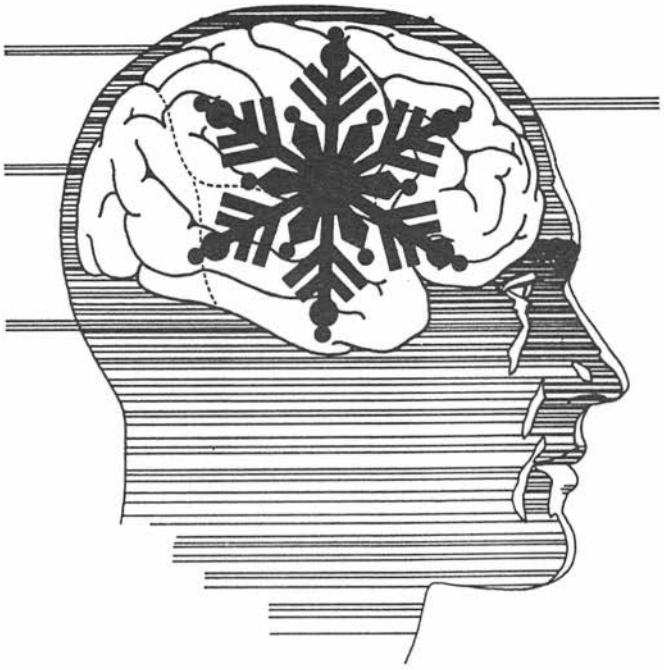
Closely related to, and perhaps even an extension of the aesthetic objection is the social objection. In short, what will other people think and what impact will this have on cryonics and cryonicists?.

Will society tend to view neuropatients as hunks of tissue rather than as people? Will the seemingly gruesome or outlandish nature of neurosuspension polarize people against cryonics who would not have been hostile otherwise? This is a difficult question to answer. On the surface the answer would seem to be: "Yes." Most people find the notion of storing isolated brains, or worse still, isolated heads, gruesome. And yet, there was and is no widespread, grass-roots reaction against Alcor or any neurosuspension, including that of Dora Kent. Despite all the recent publicity, much of it luridly orchestrated by the local press, there has been *not one single piece of hate mail received by Alcor.* Early on in the media circus, Chief Deputy Coroner Dan Cupido said the

Riverside Coroner's office had received exactly zero complaints or calls from concerned citizens (6).

The mood in the national media seemed to be one of humorous japing. Neurosuspension was simply too outrageous to be taken seriously. That may well be an unexpected bonanza. One thing is very clear: there was no widespread public outrage or outcry.

Where the courts and the educated person or professional is concerned, the case seems clearer. Alcor's February 1st victory in the Dora Kent case (7) is proof that competent, thoughtful people can and will respect neuropatients as more than just specimens. The declarations of the scientists who came forward to support Alcor also attest to this.



A more subjective but perhaps more valid assessment is the reaction of the local community to Alcor staffers when they make purchases using Alcor checks or are otherwise recognized. In every case people have been supportive, have recognized the Coroner's actions as a witch-hunt, and have often remarked to the effect "Why don't those people just leave you alone...?"

Paradoxically, neurosuspension in the form of the Kent case may have acted to increase Alcor's overall level of credibility with the people that count. Since the publicity surrounding Dora Kent's suspension and subsequent disappearance, a number of politically powerful and intellectually influential people have become associated with Alcor. This has been in no small measure because Alcor had put the brass tacks aspects of patient care ahead of harder-to-quantify social considerations.

What the long run will hold is impossible to know at this point. But two things are clear: First, if Dora Kent had been a whole-body patient she would have been autopsied long ago. Second, due to economic considerations most cryonics patients today (not just those at Alcor) could not have been placed or maintained in suspension if it had not been for the neurosuspension option.

The first and simplest of the scientific/technical objections to neurosuspension raised by Dr. Segall is that "since the attachment of the head to the body does not alter the rate at which the head can be frozen, it makes little difference, using current cryonics techniques, whether or not the head is attached."

This statement is true only if a decision is made to disregard the proper cooling of the patient's body during descent to -79°C. Unless the patient is allowed to freeze

uniformly, he or she will experience shell freezing. Shell freezing occurs when the outside of the patient freezes solidly *before* the interior of the patient freezes. Subsequent freezing and expansion of the interior water deforms the frozen, rigid outer shell of material, causing it to crack and promoting intracellular freezing.

The mass and diameter of the head allow it to be cooled far faster than the mass of the patient's body, and to avoid shell freezing careful control between surface and core temperatures is required. A decision has to be made as to whether or not this will be between oral and brain surface temperatures or between rectal and abdominal surface temperatures. Dr. Segall fails to make this clear in his article.

Dr. Segall also leaves unaddressed the issue of the longer perfusion times required to introduce (and presumably remove) cryoprotective agent (CPA) in whole body patients. As Dr. Perry's paper elsewhere in this issue indicates, whole body patients will experience roughly a 60% longer exposure of the brain to toxic CPA because of the "high flow" nature of cerebral circulation as compared to the remainder of the body (8). Additionally, the logistics of handling whole body patients and the thermal inertia they represent to the cooling bath mean that they will experience even longer periods of relatively high temperature exposure to CPA than their neurosuspension contemporaries.

Another common technical objection to neurosuspension also voiced by Dr. Segall is that not all of the information necessary to reconstitute the individual is present in the brain or head.

This objection can take any of a number of forms. The most common and perhaps the most valid is that the body is somehow possibly a respository of critical but currently unappreciated identity information. There are two broad categories of the argument. The first and the simplest is the "discarded genome" argument which states simply that not all of the genetic information needed to reconstitute the individual is present in somatic or body cells.

In other words, some of the genes involved in development and differentiation are discarded or lost in body cells and are present only in embryonic tissue or sex cells (some nematodes are known to discard up to 70% of their genome in this way (9)). This argument is fairly easy to dispose of. The only "evidence" that adult mammalian somatic cells *don't* have the full genetic complement is that efforts to clone mammals and other vertebrates from adult body cells have so far failed. Of course, this does not necessarily mean that the information is not there -- it may be simply be turned off or otherwise made inaccessible.

By contrast, there is a considerable body of evidence that human (and other vertebrate) somatic cells are totipotent (i.e., contain the organism's entire genetic blueprint). Unlike the previously mentioned nematodes who discard most of the genome in body cells, adult human cells show the same number of chromosomes as do embryonic cells or fertilized ova and a number of studies have shown relative constancy of DNA content in a wide range of somatic and embryonic cells. (10), (11). Several decades of extensive genetic manipulation of adult somatic cells have also not disclosed any noticeable absence of information. Additionally, the results of Gurdon with the cloning of frogs also suggest strongly that most somatic cells are totipotent (12). The view that adult somatic cells contain all of the genetic information necessary to reconstitute the individual has thus become widely and generally accepted (13).

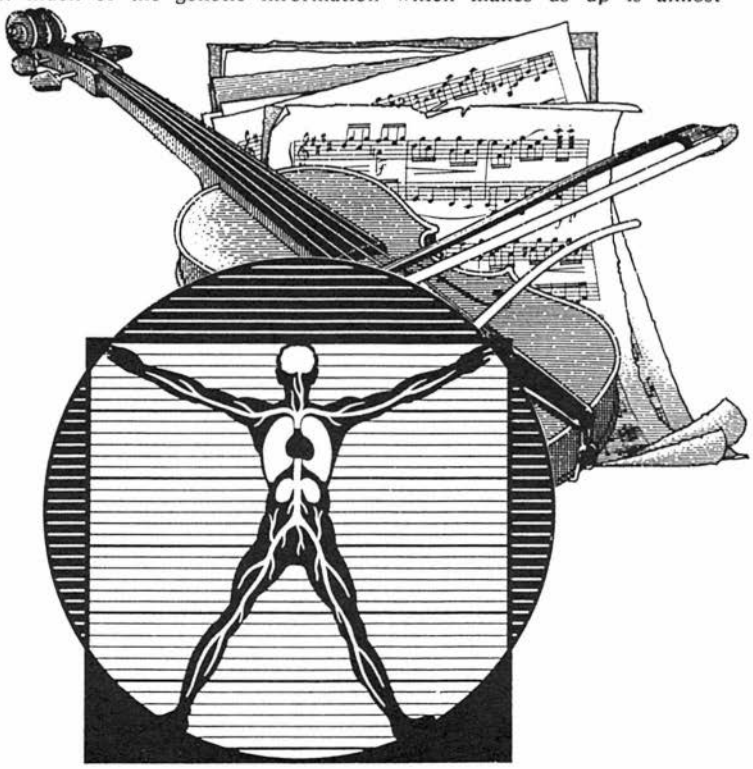
Additionally, certain disease states such as cancer often lead to the expression of fetal genes in somatic tissues. Colon cancers will often produce fetal proteins, and

fetal hemoglobins are produced in other types of malignancies similarly unrelated to the blood producing tissues (14). These abnormalities suggest that the genome is conserved in adult cells, but is not normally expressed. In other words, the information is there but, like a book on a shelf in a library, is not currently in use.

But even if there were wholesale loss or deletion of genetic information from brain or other body cells, is this a serious obstacle to resuscitation of neurosuspension patients? The answer is a resounding "No!" The problem could be addressed in any of a number ways. The simplest would be to take samples of various organs and tissues (including reproductive organs if they are available) and preserve them with the patient. This is done almost routinely by Alcor when carrying out neurosuspensions (14)).

The second solution is to get such "generic" genetic information from other people. Clearly that part of the genome necessary to carry out day-to-day operation of the brain has to be in the patient's brain cells. Recent experiments with various nerve growth factors have also demonstrated that aged, adult nervous tissue can be induced to undergo cell division, sprouting, and remodeling with stimulation by relatively simple chemicals (15). This indicates that genes coding for growth, development, and differentiation of brain cells are also present in adult neurons -- even *aged* adult neurons.

If other critical body genes are missing, copies can be obtained from other people. Indeed, this may even be desirable in many instances. I, for one, would like a number of new genes including ones for stronger muscles, nondefective veins, a much better looking face, improved cholesterol metabolism and so on. In fact, I hope for a *much* better body all around. The point is that much of the genetic information which makes us up is almost certainly *not* essential to conserving our identity. It is not identity-critical. Much of our genome is probably not only not essential to survival, but contrasurvival.



These objections and their answers bring us to the second class of "loss of identity-critical information" objection. That objection can best be best summed up as the Stradivarius Objection (SO for short). SO enthusiasts believe that body may be like a Stradivarius violin. Very easy to understand and reproduce in outline, but possessed of subtle and identity-critical properties which are not yet appreciated.

In this worldview bodies are like violins played by masters (or

yokels for that matter). They are not just their genome, rather they are the complex interaction of genome with environment and brain with body with environment... In other words, a person's peripheral nervous system, immune system, heart, lungs, and so on all interact with each other in complex ways to produce the person.

A simple example of this would be someone with a hyperactive thyroid. Such a person will be temperamentally different than someone without a hyperactive thyroid. Similarly, someone with exceptionally fine peripheral nervous connections may have certain skills and abilities that others lack. SO people believe that such subtle and possibly random connections and interactions all go to shape or make up the essence of the person. Many of the connections and positions of cells in the body which determine the character or function of the brain may thus be lost if the body is discarded. For instance, it is known that the interconnection of nerve cells in the spinal cord and brain are *not* determined completely by genetics but by other, "random" influences. The most visible evidence of the randomness of some of our features is that fingerprints are not identical in identical twins. Similarly, sexual orientation, aggressiveness and so on are also sometimes at variance in animals or people with exactly the same genetic make-up.

SO advocates argue that there may be subtle, as yet unappreciated identity-critical information present in the body. They view the organism as a unit, not as any one of its parts.

The SO objection is a more difficult one to answer and in fact can probably not be answered with 100% confidence given the state of today's knowledge an experience. Am I to any significant degree my kidneys or my little finger?

Despite the fact that no one has undergone a head transplant or been fitted with a regrown body, the questions raised by the Stradivarius Objection proponents are not totally unanswerable. As usual, a host of modern pathologies and medical treatments provides some indirect, but very powerful and persuasive insight.

People with high spinal cord injuries do not suddenly cease to be themselves or experience changes in their personalities unrelated to the disability inflicted by such a currently irreversible medical catastrophe. Despite the fact that their brain is disconnected from their central nervous system, such people are obviously still the same people. Multiple organ transplant recipients also demonstrate continuity of memory, personality, and identity. Such patients do not take on the character or personality of the donor of the tissue. While they often experience profound improvement in well-being, they do not cease to be who they were. Indeed, it can be argued that such changes enhance their personhood and allow them to be more of who they are (15).

Less conclusive are the results of primate head transplants, such as the work conducted by Dr. Robert White of Case Western Reserve University in Cleveland, Ohio. I have spoken with Dr. White about the results of his monkey head transplants and he has told me that not only do the animals regain consciousness but their ability to repeat learned information (such as sound-eyeblink responses) is intact (16). Obviously, monkeys are not people and they cannot verbalize any more subtle emotional or cognitive problems.

In short, nothing in contemporary medical experience suggests that replacement of the body with a healthy, functioning duplicate or even with another "generic" human body will have any catastrophic impact on personal identity. But there is a deeper point here. It is the brain that senses and responds to the body. It is the brain that holds memories of what was and what is. And it is the brain that *decides*. If we awake with a body that is not the Stradivarius we remember, we will be able to fine tune and to make changes. Indeed, for many of us the nightmare is not that we will waken without the body we had,

but rather that we will waken with it. We want *more* and will be disappointed (but grateful) if what we have now is all we get.

Yet another objection is that neuropatients may come back without bodies at all or otherwise with substandard hardware.

This objection can be answered easily and straightforwardly: If tomorrow's medicine cannot regrow or replace the body, revival won't be possible in the first place. Existing preservation techniques cause serious damage which will require nearly complete control over life at the molecular level to repair. Any technology capable of repairing and rebuilding individually damaged brain cells will be able to clone or regrow a new body around the existing (repaired) brain. Concerns about the inability to regrow bodies are like concerns about being unable to build a bottle rocket if you can build a Saturn Five. As a worst case, new bodies could be produced the old-fashioned way, by fusion of gametes and production of an anencephalic infant body which could then be supported until it had matured to a sufficient degree. (The brain is immunologically privileged, so rejection would not even have to be solved to overcome this problem.)

A variant of the previous objection is that it may not be possible to reconnect spinal cords.

A variety of lower vertebrates such as the salamander, *A. Punctatum*, can reconnect severed spinal cords (17) and there is a growing body of evidence that higher mammals can do the same (18). Limited experimental regeneration of the spinal cord is already a research reality. Even mainstream popular science magazines such as *Discover* are beginning to run review articles summarizing recent progress in this field (19). Today's whole-body suspension patients experience complete, multiple severance of the spinal cord and brain due to cooling-induced differential contraction and the resultant fracturing. Ice formation in the brain may also occasionally sever long processes. These injuries

must be reversible by any technology that seeks to revive today's patients. A corollary of such a capability is the ability to repair severed spinal cords.

Finally, there is the delayed revival scenario.

This scenario holds that the technology required to revive some (if not all) suspension patients will be equal to reviving whole body patients *first* since "all of them is already there". In other words, it is easier to *repair* than to *replace.* This argument has both strengths and weaknesses. First, let's look at the strengths. For a patient who is young, suffering from a "simple" disease like leukemia or muscular dystrophy, and who is suspended using only slightly damaging techniques, revival might occur decades or even a century or so sooner than if he went the neurosuspension route.

This argument may very well be valid. For this reason both Alcor and I recommend that people provide for the likelihood of improved suspension techniques and suspension while comparatively young. Unfortunately, such a scenario does not describe the average person entering suspension. Current suspension techniques are damaging, and the vast majority of people who need suspension are old and suffering from multiple organ system failure. To act as if this were not the case *now* would seem very foolish. It makes sense to prepare for the worst (and most likely) scenario and hold the best (and currently least likely scenario) as a contingency to be exercised when it is appropriate to do so.

But for those suspended now or in the foreseeable future, a case could be made that neuropatients will be revived *first* because it will be much more difficult to "repair" than "replace". Many people object to regeneration of the body because it will be made up of different material. Repair thus implies that the original molecules are retained, the original "stuff" which makes the person up. What will happen in the case of an elderly person in need of enormous structural overhaul? Having to deal with complicated repairs laden with philosophical issues may greatly *delay* revival! Certainly no one today tries to repair worn out and broken parts in either complicated or simple equipment -- they are replaced because it is cost-effective and faster by far to do so.

CONCLUSION

The foregoing objections to neurosuspension are all that I have commonly heard. Despite the prevalence of whole-body suspension members in the cryonics movement as a whole (2/3rds as a best guess) there has, to my knowledge, never been any thorough argument for the rational basis of the procedure. The many challenges offered by advocates of neurosuspension over the years have gone unanswered.

Two of the three existing cryonics organizations have dealt with the issue by simply not offering neurosuspension and restricting its discussion.

Where does all of this leave us? Clearly the Dora Kent case demonstrated that the Judiciary will take the issue of a frozen patient's rights seriously -- even if the frozen patient happens to be an isolated head. Nowhere in all the media coverage was Dora Kent *ever* reduced to the status of a tissue specimen. Nor were the reporters, many of whom were not the brightest or most reflective of creatures, unable to grasp the essence of what we were doing. Most surprisingly, the reporters failed to raise the host of so-called "insurmountable objections" they were expected to raise. It was a "given" that if science could thaw out and rejuvenate an 83-year-old lady's diseased and damaged brain, it could find or clone a body to put it in. Clearly, the absence of Dora Kent's body hasn't hurt her brain. Not with the media, not with the courts, and not with the scientists who

stepped forward to support Dora Kent and Alcor.

The recent positive reaction of media to the announcement by Dr. Timothy Leary of his plans for neurosuspension (20, 21, 22) also attest to the fact that neurosuspension presents no overwhelming public relations obstacles.

Finally, what the whole issue of neuro vs. whole body reduces to is a decision about *what's important*. Cryonic suspension has been likened to escaping from a burning building. This analogy is a correct one, with an added condition being that the escape is being made from a fourth-story window using a rope of knotted towels and bedsheets. In such a situation a decision has to be made about what's important to save. The antique bedroom furniture, the grand piano, even the family jewels must all be weighed against the urgency of the situation. Obviously, what is important to save in such a crisis is *yourself*. Everything that we know about biology and medicine indicates that the human brain is the human being. When an individual decides to take more than that (particularly in light of the uncertain legal, financial and political status of cryonics today) they are taking a potentially very large added risk. Each individual must weigh this risk and decide. For some of us it has been an easy decision.

Alcor and I started down the neurosuspension road because it was the rational and moral thing to do. It offered us an opportunity to save the lives of those we loved when we would otherwise have been unable to do so. If history later demonstrates that it was the wrong thing to do from a "political" or "greater good" standpoint I hope we are not judged too harshly. For the fact is, it was really the only thing we could have done and still remained human.

It's strange how things work out. Who would have ever dreamed that cutting off your mother's head could be the ultimate act of caring love and the best chance of saving her life?

It *is* a strange, strange world.

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Science Updates

by Thomas Donaldson

COUGH SYRUP TO TREAT ISCHEMIA

Only a few years ago scientists discovered an important fact about ischemia. The fact was that when blood flow was restored to ischemic neurons, they would fire convulsively until exhaustion. Since ischemic neurons typically have lost the ability to make new proteins, their exhaustion easily becomes fatal. They can't recover from their condition. Overloaded, they decline still more.

The main nerve transmitter responsible for this convulsive firing may be known. It is NMDA (N-methyl-D-aspartate). The importance of NMDA only became clear last year (S.M. Rothman, and J.W. Olney, *Trends Neuroscience*, **10**, 299-302 (1987)). Even in 1984 it was known to be involved (R.P. Simon et al, *Science*, **226**, 850-852 (1984)). Once we know the nerve transmitter involved, of course, we can try to stop its action.

Several experimental attempts to do this using different drugs have already been made. They have involved experimental drugs such as MK-801 (A.C. Foster et al, *British J Pharmacology*, **90**, 9 (1987)) and others such as AP7. Unfortunately, however, for NMDA these attempts have all consisted of applying drugs before the ischemia rather than after. These have certainly protected neurons from destruction both in vitro and in vivo. But for clinical purposes, we really need drugs which work after rather than before.

A recent paper by Gary Steinberg and others at the Stanford University School of Medicine (*Neuroscience Letters*, **89** 193-197 (1988)) has repaired this gap. Steinberg and his coworkers tested dextromethorphan, a drug known to block receptors for NMDA. They gave the drug to rabbits after one hour of ischmemia to their left brain. After letting them recover for four more hours, Steinberg and his coworkers then killed them and looked at their brains.

This experiment is a model of stroke, not of total brain ischemia. Furthermore, it did not look at what may have happened to the rabbits over the long term. Still, results were very good. In treated rabbits, treatment reduced the extent of neuronal damage by more than 90% compared to controls. These authors believe that the most likely effect of dextromethorphan is in blocking receptors for NMDA. This would greatly lower the excitability of neurons after ischemia, giving them much more chance to recover.

Unlike the other experimental drugs, dextromethorphan is a component of many cough syrups. We may even be able to obtain it for use in suspensions. However it is still too early to say exactly how effective this drug may be for total brain ischemia, and also too early to say just how helpful it would be in suspension. Although neurologists have definitely made progress against brain ischemia, hopes in the very early 70's that cures for the problem were imminent have not been borne out. The row we have to hoe is much longer than expected. Still, we can see the length we have covered. We are not going backward on this problem.

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Meeting Schedules

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.

ALCOR

The NOVEMBER meeting will be held at the home of:

(SUN, 6 NOV, 1988) Brenda Peters
8150 Rhea
Reseda, CA

The DECEMBER meeting is the Annual Turkey Roast, at the home of:

(SUN, 4 DEC, 1988) Saul Kent and Jo Ann Martin
16280 Whispering Spur
Riverside, CA

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* * *

The Alcor Cryonics Supper Club is an informal dinner get-together in the Greater Los Angeles area. These meetings are for newcomers and old-timers alike -- just an opportunity to get together and talk over what's happening in cryonics -- and the world!

If you've wanted an opportunity to ask lots of questions about cryonics, or if you just want a chance to spend some time with some interesting and nice people, pick a date and come! All dinners are scheduled for Sundays at 6:00 PM.

Sunday, October 23, will be hosted by Marcelon Johnson at her home.

Marcelon Johnson
8081 Yorktown Ave.
Huntington Beach, CA

A $5.00 contribution to Alcor is requested.

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* * *

The New York Cryonics Discussion Group of Alcor has recently formed.

The group meets on the the third Saturday of each month at 7:30 PM. The November 19 meeting will be held at the **El Paso** restaurant, in Manhattan's Greenwich Village. The address is 134 West Houston St., between McDougal and Sullivan. Telephone (212) 673-0828. Ask for the Alcor group at the rear of the restaurant. Subway stops: Houston St. on the 1 train; Spring St. on the C, E, or K trains.

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) 273-3201
Al Roca	(201) 352-5268
Curtis Henderson	(516) 589-4256

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