Cryonics

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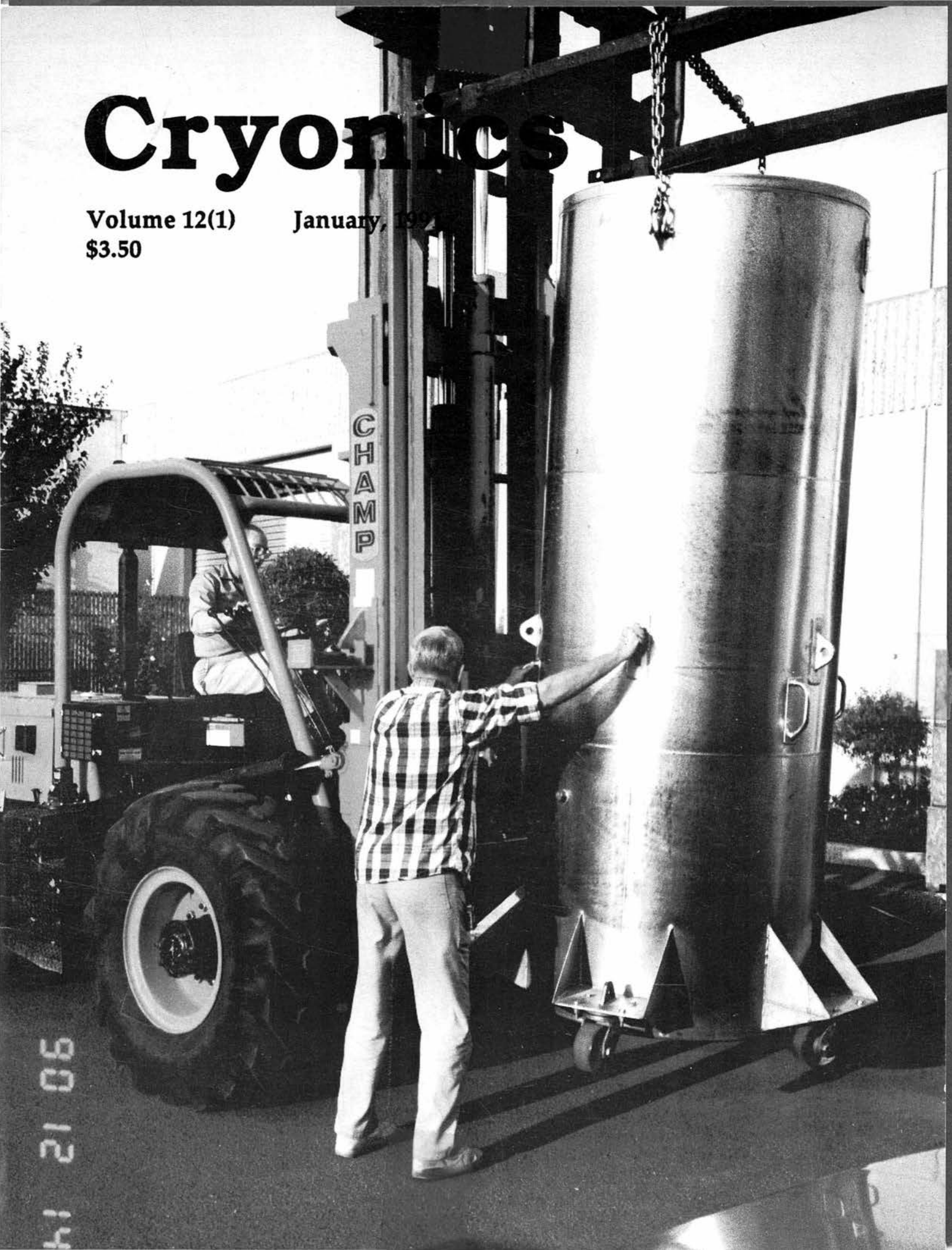

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Cryonics

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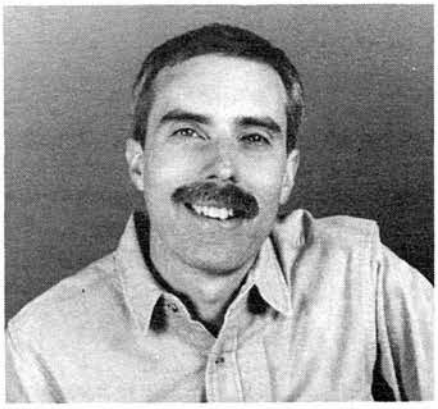
Cover:

Bigfoot arrives at Alcor

We Step on Their Toes, Bauge Steps on Our Toes—But the Real Bigfoots Make a Graceful Entrance

Mike Darwin



Errata

Several readers pointed out to us (some with irritation) that the article "Cryonics and Religion" by Derek Ryan, which appeared in the December issue, was mistitled. Since the article dealt *only* with the relationship between cryonics and Christianity, a better title would have been "Cryonics and Christianity." No offense was intended, and we agree with our critics that the title was overly broad.

Accept No Substitutes

In the midst of the Alcor European Cryonics Conference, in the early hours of the morning of 27 October, a number of Alcor people were wakened by a call from Trygve Bauge regarding the possibility of a cryonic suspension in France. (Trygve Bauge is an American Cryonics Society member whose grandfather, Bredo Moestrel, was placed into cryonic suspension by Trans Time in May of 1990.) Initially, Mr. Bauge wanted to know if the Alcor UK air shipment box could be used to transport the patient back to the US.

As the situation developed, there was not only inadequate funding to cover the cost of suspension with any organization, but the patient had been dead for **months** at above 0C without embalming, and was apparently well advanced in decomposition. Alcor did not want any involvement in this case.

Unfortunately, that did not deter Mr. Bauge, and over the course of the following two weeks he persisted in calling both Mike Darwin and Alan Sinclair (of Alcor UK) (as well as many others) long distance from the United States, often several times a day (and initially in the middle of the night as well, no doubt because phone rates are lowest then!). It was made clear that these calls were futile and unwelcome. Finally, the calls stopped and we assumed we'd heard the last of this unfortunate incident.

Then, a few days ago, we received a 17-page document offering "post-mortem sign-up assistance" from Mr. Bauge. The document is unprofessional and poorly articulated. Beyond that, it purports to offer, for an initial $2,000 fee, assistance in getting non-member suspensions (what Bauge calls post-mortem suspension; a misnomer since all suspension are technically "post-mortem") accepted by all three American cryonics groups. While the document and the approach are crude and unprofessional, none of this would be of direct concern to Alcor were it not for the fact that Alcor is one of the listed cryonics societies for whom Bauge implies he can act as a clearing house, and whom, as he says, he may be able to "talk [the cryonics companies] into changing their rules and requirements before the client can be accepted."

We want to go on record here to say that only Alcor or an Alcor authorized representative may act to "negotiate" for accepting or refusing any person, living or legally dead, into Alcor's suspension program. In short, Mr. Bauge is not such a representative, and we will not deal with him or any other unapproved intermediary.

Nor, apparently, is Mr. Bauge's first "customer" very happy with his service. At the beginning of December we received a letter from long-time French cryonicist Anatole Dolinoff, which states in part (we have edited Mr. Dolinoff's letter for English grammar):

"As a cryonics pioneer I am horrified by the tone of the dealer who sent me the attached document (copy of Bauge's offering). I have not seen anything like this in cryonics since 1967...

"Despite repeated requests made by the patient's son through a translator, Mr. Bauge continues to send faxes and make phone calls...

"No French member will sign with a company subordinating its assistance to any direct or indirect payment to Bauge. For example, Mr. Ettinger confirmed to me by phone that the Cryonics Institute is not at all willing to be involved in anything of that kind."

"The heroic efforts which have been undertaken so far should not be spoiled. The cryonics movement has to be **weeded out.**"

Were the situation with Mr. Bauge not cause enough for concern, even more amazing are copies of a brochure we received in the mail recently from Charles Tandy. Without consulting us (and what's more without **crediting** us), Mr. Tandy took the new Alcor brochure, "Why Cryonics Can Work," edited it slightly, added the names and addresses and phone numbers of the American Cryonics Society and Cryonics Institute, retitled it "Cryonics Can Work?" and began distributing it, in some cases with The Immortalist Society (CI) listed as the return addressee! (We understand this was done without IS/CI's knowledge or consent.)

To say that we do not approve of such actions is putting it mildly. Our purpose here is to advise readers that we did not and do not countenance such activities. Further, we would like to point out that all Alcor literature is copyrighted and that copyright law does not allow for such infringements. Generally, we are relaxed about this and do not mind individuals making photocopies of our literature in order to spread the word. However, we draw the line at editing our literature in any way without our permission, and we particularly draw the line at plagiarism and theft of our intellectual property.

Anyone who doubts our willingness to fight for our rights should look at our track history over the past few years. Please be advised that unauthorized use of our intellectual property, or any representation by anyone other than authorized Alcor personnel that they speak for or in any way represent Alcor, will be vigorously dealt with.

Bigfoots Arrive

Let the debate end! We've seen 'em and we *know* Bigfoots exist! On 14 December a large truck pulled up to the Alcor facility bearing our Christmas present to ourselves (and the patients in storage at Alcor): three 9-1/2 foot tall 4-patient capacity cryogenic dewars.

These dewars were ordered four months ago, with fabrication work proceeding until just before Thanksgiving, when the manufacturer's efficiency tests were completed. The units, christened "bigfoots" because of the 59" base they sit on (the outer diameter of the vessel itself is 42"), are the most efficient patient storage units ever developed. The prototype bigfoot (which can also hold four patients) is currently performing at a WORKING evaporation rate of 12.7 liters of liquid nitrogen per day. **That works out to 3.2 liters per patient per day.** In dollars and cents that means that our liquid nitrogen costs are $1.06 per whole body patient per day. An added bonus is that with the packaging system we are now developing, we can also store up to six neuropatients in the center well. This will result in additional savings once adequate security can be put in place.

Alcor's three new cryogenic dewars.

We are now in the process of evaluating the static evaporation rate (i.e., the efficiency) of the three new units, and expect to have hard numbers on all three units in 2-3 weeks. At the same time, we are prototyping the aluminum "pods" that will house the patients for safe placement inside the bigfoots. As of this writing, a cardboard mockup has been completed and the design will be put out for bid in the next day or two.

Once we take delivery on the first pod, we will then transfer the first patient into the pod and place him in bigfoot #2. Current plans call for that "first patient" to be *the* first patient and the first man placed into cryonic suspension: Dr. James H. Bedford. Dr. Bedford has been maintained in a horizontal unit—fabricated in 1970—that was welded shut after he was placed inside it. Dr. Bedford has had a colorful journey since 1970 (Alcor took over his care in February of 1982) and, while the records indicate that he was maintained continuously at cryogenic temperatures, we intend to look for any indications that he was not. This has heretofore been impossible since he is welded into his current dewar. Our curiosity about his condition notwithstanding, Dr. Bedford is going in first because the antique horizontal dewar he occupies takes up enough space for two 4-patient bigfoot units.

The plan is thus to remove Dr. Bedford from his 1970's dewar, do an external exam on him, and then place him in the pod (all the while keeping him under liquid nitrogen) after which we'll transfer him into bigfoot #2 for continued long term care.

All of this will be something of a technical *tour de force*. It will also be an incredibly historic moment: For the first time in 20 years, men will gaze upon the countenance of world's first "cryonaut."

DHS Update

As we return to another episode of *Kafka Comes To Alcor*, we find the DHS still not issuing VS-9s or death certificates (surprise, surprise, surprise!). The latest round involved them agreeing to issue VS-9s provided that we agreed to be listed as a cemetery. We declined. They countered with an offer to list us as a "cryonics facility" but not allow us to check off the "scientific use" box, which is normally used by organizations that qualify under the California Anatomical Gift Act (CAGA) to accept donees (and under which we believe we qualify). We declined again. Last we heard they were mulling over our refusals and considering how to redesign the VS-9.

They have until 2 January, 1991 to appeal Judge Munoz's ruling affirming our right to use the CAGA and to have the legal right to cryonic suspension. We are sincerely hoping NOT to find that little surprise in our stocking come the New Year.

The D.A.'s Alcor Stocking Stuffer

By the time you read this it will be well into the New Year and the holiday season will be a fast receding memory. But as we *write* this, the holiday season is only just starting and the news we are passing on here is still fresh. Reproduced below is a portion of an article which announces that the Riverside District Attorney has decided to "close" the investigations associated with the Dora Kent case: the "homicide" investigation and the felony-practice-of-medicine-without-a-license investigation.

This article, however long delayed, serves as something of a vindication for all of us who were put through this three-year ordeal. Much of the language Assistant District Attorney Inskeep uses in this article could have been (and probably was) lifted from a letter Dr. Steve Harris wrote to the DA nearly 22 years ago. This article and the D.A.'s comments in it are about the closest anyone will ever come to receiving an acknowledgment that the county didn't have a leg to stand on.

This statement also marks what we sincerely hope is the beginning of a shut-down of the plethora of litigation associated with the Dora Kent case. Closure of the state's investigation clears the way for reasonably prompt resolution of our false arrest suit against the county and "clears the books" on the homicide and practicing medicine without a license case. With luck and caution, by this time next year we should be free of major litigation and able to get underway with more productive undertakings.

DA abandons inquiry into missing head case

By Don Babwin
The Press-Enterprise

RIVERSIDE

As the three-year anniversary of Dora Kent's death — and subsequent removal of her head — approaches, authorities say they are through asking questions about who, if anybody, killed her.

"We aren't actively pursuing any investigation," said Riverside County Assistant District Attorney Don R. Inskeep.

After reviewing the evidence against those present when the 83-year-old Kent died at the Alcor Life Extension facility in Riverside, Inskeep said neither a murder charge nor a felony charge of practicing medicine without a license would be filed.

Come Dec. 11, filing charges of practicing medicine without a license in connection with Kent's death will no longer be an option. On that day, — three years to the day after Kent's death — the statute of limitations runs out, thus prohibiting prosecutors from pursuing those charges. There is no statute of limitations on murder, but Inskeep said that investigation is closed as well.

The decision thus effectively ends a bizarre story that gained international attention. After the Riverside County coroner's office disclosed it had questions about how Kent died Dec. 11, 1987, a legal tug-of-war ensued between Alcor and the coroner over Kent's frozen head — a struggle Alcor eventually won in court. There were even raids on the Alcor facility that netted authorities Kent's hands, but not her head.

Then, more than a year after she died, the coroner's office ruled Kent was killed

Please see **INQUIRY**, **B-5**

DA after Dora, new tort quints, Trafficula at 1

Now that the DA's investigation of **Dora Kent** has taken precisely the same turn as her head — cut off, put on ice — will the uncommonly handsome **Grover Trask** be able to live down the legacy of The Head That Got Away?

DAN BERNSTEIN

This will be difficult. As he pursues his career, possibly to Congress, he will have to avoid certain everyday expressions, lest others be reminded of this troubling, unsolved mystery:

- Even in the aftermath of thunderous anger, the DA should never say, "I guess I lost my head." Someone is sure to retort, "That's two."
- The DA should never complain of a "head cold" or about a "bad headline."
- If the DA seeks re-election, he should refrain from referring to his campaign offices as "headquarters." You never know what might turn up.
- If he does reach Congress, Grover should never, even in the privacy of a GOP caucus, announce that he has been "counting heads." His colleagues would, understandably, demand a recount.

• • •

AIDS: Some Hard Numbers

Last month we ran an article dealing with the issue of AIDS risks and the suspension team. Shortly after we went to press with that article, we received some long-awaited numbers on actual risks from the Centers for Disease Control in Atlanta, Georgia. We also uncovered some other interesting information which we thought worth passing along to all our members, not just those on the Suspension Team.

The CDC currently acknowledges 37 verified cases of HIV transmission via the medical setting. We believe these numbers are unrealistically low, as do many others who have examined this issue. The first thing to keep in mind is that CDC currently "rules out" cases where transmission by other means is possibile at all. Also, many institutions do not want to report or acknowledge cases of HIV transmission for liability and insurance reasons. In a recent New York Times Service story, Dr. Mark Litwin of Harvard's Brigham and Women's Hospital has stated that he feels underreporting is vast and that "knows personally of at least 10 cases where HIV transmission has occurred in a medical setting." Calls I made to three HIV units at hospitals in Los Angeles and San Francisco indicated that several staff members at each institution had become infected as a result of needle sticks or other medical exposure (in one case as a result of blood being splashed in the eyes).

The CDC estimates that the risk of transmission per needle stick is about 1 in 250 and calls this risk "very low." There is some irony in their characterization of this medical risk as "very low" since the risk for getting AIDS from anal intercourse with an *infected* partner is also estimated at 1 in 250 and is characterized as "very high" (by contrast the risk for receptive oral intercourse with an infected partner is judged to be between 1 in 5000 and and 1 in 50,000). You figure it out! Of course, if you are the one stuck, the risk is just plain unacceptably high.

The rate of needle sticks per surgical operation at San Francisco General Hospital is 1.7 per complex surgical operation. The incidence of glove leakage at SF General at the end of surgery is 17.5%.

So far, the Alcor suspension team has been faring no better. We have treated two AIDS patients; in one case a break in technique resulted in skin exposure of a staff member and in another case blood containing pulmonary edema fluid was aerosolized by a ventilator "blow off" valve on a heart-lung resuscitator, resulting in conjunctival exposure of a staff member. We have instituted a number of policies to reduce this risk in the future, but needless to say we cannot eliminate it.

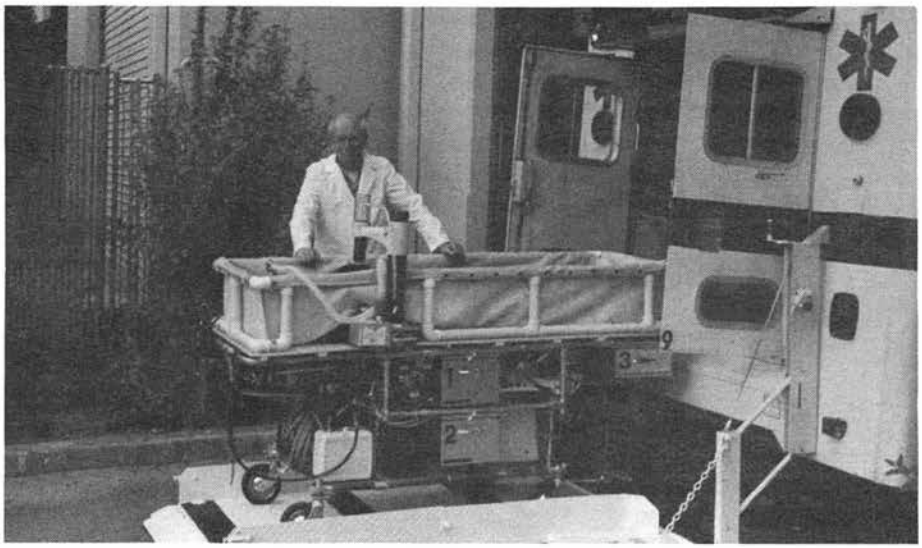
Also, there are now over a dozen cases of gay men who have Kaposi's sarcoma (an AIDS associated malignancy) and who do not apparently have HIV infection; they show no evidence of AIDS viral DNA, nor do they have the defects in immune function characteristic of AIDS. This finding suggests that Kaposi's sarcoma is likely caused by a second and different infectious agent, about which virtually nothing is known other than that it does not appear to be very infectious. This finding goes a long way to explain why IV drug abusers and transfusion recipients infected with AIDS rarely develop Kaposi's, while it is very common amongst gay male AIDS sufferers.

We provide these numbers for several reasons. First, we want our Transport/Suspension Team members to know what the risks are as best as we are able to determine them. Second, we think that knowing about these risks may well make us more careful and help us to *reduce* them. And finally, we want those of you who are NOT on the Suspension Team to appreciate what those of us who are are doing. As someone who has had a serious suspension related exposure to HIV, I can tell you that the anxiety is nontrivial, as is the inconvenience (think about the changes in lifestyle required to protect sexual partners alone!).

Finally, there are some interesting

numbers relating to the safety of our so-called "safe" blood supply. It is currently estimated that between 10% and 30% of people infected with HIV will fail to develop antibodies to the virus for six months to a year. A small number of infected people do not "seroconvert" for years, and it is estimated by CDC that 1% to 2% of infected persons will never seroconvert, even though they will be capable of passing on the virus to others and may even die of it.

The current test for HIV contamination of donated blood is an *antibody* test. This test cannot be screening out everyone who is infected. Keep in mind that some studies indicate that over 1% of college students are now estimated to be infected! It doesn't take a genius to realize that contrary to what your government tells you, *the blood supply is not safe.*



The Cryovita/Alcor Mobile Advanced Life Support System—MALSS.

With Forethought For The MALSS

The Cryovita/Alcor Mobile Advanced Life Support System—MALSS, for short (pronounced *malice*)—has been getting an update. The MALSS has been used for two local suspensions in the past, but it has been nearly two years since it was last used. A lot has happened to improve suspension technology since then. A major advance is the development of the Portable Ice Bath (PIB) and the SQUID. The PIB has allowed us to double our patient cooling rate by submerging the patient in an ice-water bath.

The SQUID is a pump-driven array of perforated tubing that rapidly circulates the icewater over the patient's body. This maneuver too approximately doubles the cooling rate over icewater immersion alone. Thus, we can reduce a typical (wasted) patient's core (deep body) temperature by 12C (22F) in about 30 minutes. We have now generated a much improved version of the SQUID that can run off of the MALSS's batteries or a motorcycle battery. (The prototype required 110 V AC wall current.)

It usually takes 30 minutes to an hour to set up the MALSS and do the surgery necessary to connect the patient to its blood pump and oxygenator (artificial heart and lung). Naturally, we would like to be able to use this interval to cool the patient as efficiently as possible, reducing the rate of metabolism and the rate of damage as well.

Thus the recent upgrades to the MALSS. We have now attached a PIB to the top of the MALSS and installed our new High-Impulse heart-lung resuscitator. A lot of other "minor" upgrades were made to make use of the MALSS more convenient, including an modification which will allow us to use the PIB as the ice water reservoir for the blood heat exchanger, eliminating the need to haul along a heavy picnic chest full of ice and water. And last but not least, we replaced the MALSS batteries for the third time. The special deep draw gel cells the MALSS requires cost $144 each and two are required. (Your Emergency Responsibility dollars at work.)

A Heck of a Night

Ralph Whelan

For those of you who couldn't make it and didn't hear about it, the "Donaldson Legal Defense Fund Dinner" was tremendously successful. Specifically, donations raised by and at the dinner—along with donations toward it by people who couldn't attend—totaled out to $18,200. Yes, that's eighteen thousand two hundred dollars. This breathes new life into our efforts, and allows us to continue—at least for a while—what we feared we'd have to end.

Many thanks go to Dave and Trudy Pizer, who did much to set this up in their

community. They entertained the guests at their house both before and after the actual dinner, and Dave "em-ceed" the ceremony with eloquence.

Thomas spoke sincerely of his situation, emphasizing his understanding that we may—for any number of reasons—not pull this off. He expressed both optimism and realism, explaining that we must commit ourself to winning *the* case, not *his* case. He enjoined us to pursue and defend the rights of anyone in his situation, both now and after his personal crisis is past. This of course wouldn't be surprising to anyone recognizing Thomas' pioneer status as a cryonicist, but I know that I was moved anew by his courage and commitment to an idea.

As far as the exchange of information is concerned, the highlight of the evening was an extensive and *very* enlightening address by our attorney in this case, Chris Ashworth. He gave a brief history of our court experiences to date, then launched into a lengthy succession of if-thens describing what we should attempt, what we should hope for, and what we can expect. He put a lot of time and effort into encouraging us to attack our problems *legislatively*. He believes that lawyers and court cases can ease the symptoms, but only lobbyists and legislation can cure the disease. His emphasis was particularly meaningful in that he is our lawyer, and thus stands to gain the most from our being at odds with current legislation.

Lastly, let me acknowledge the heroic efforts of Arel Lucas and Keith Henson in pulling this dinner together. Arel was presented with a near-disastrous situation when her catering arrangements fell through only hours before the dinner. To my unending amazement, she packed her car full of food, drove down from Northern California, and catered the dinner herself, with the extensive assistance of Keith Henson, Maureen Genteman, Marce Johnson, Naomi Reynolds, and a few others who I'll be expecting nasty-grams from directly. The same folks, as well as a few others (Fred and Linda Chamberlain and a few more nasty-grams) stuck around to clean up. No small thing, that.

Many thanks to everyone who attended the dinner and everyone who gave support but couldn't attend.

The Cost Of Cryonics

Mike Darwin responds to Dave and Trudy Pizer

In the December, 1990 issue of *Cryonics* Dave and Trudy Pizer took issue with my criticisms of Dave's proposals to recover operating costs by raising the suspension fund minimums. Since the Pizers' criticisms overlap to some extent, I would like to respond to both together.

First some factual corrections for Trudy. Trudy indicates that cardiac bypass surgery costs $150,000+. I believe that the real numbers are closer to $35,000. Similarly, dialysis, which Trudy also mentions, typically costs about $25,000 to $30,000 per year. Cardiac transplants by contrast often do cost $150,000 to $250,000 and as a result are basically not affordable by middle class Americans; this is one of the reasons so few are performed. (Cost figures were obtained from American Heart Association and National Kidney Foundation literature.)

I did not attribute to Dave the notion of taking money out of the Patient Care Fund (PCF) on an on-going basis. I am sorry if my article (*Cryonics*, Nov, 1990, page 16) created that impression. However, regardless of how money is taken out of a member's suspension fund, $35,000 WILL be taken out under Dave's proposal and that's what really matters. Either way, it's money that the patient won't have "working" for him or her over the long haul.

I stand by my statement that "patients do not benefit directly from overhead such as recruitment, marketing, public education, and so on." *Direct* is a very simple word and I reproduce, below a slightly abridged definition from Webster's:

direct 1a: proceeding from one point to another in time or space without deviation or interruption: straight, b: proceeding by the shortest way. 2a: stemming immediately from a source.... c: without an intervening agency or step.

I mean what the dictionary says. The problem with billing indirect expenses is that there is no easy way to demark or limit them. Is redecorating the facility so we look better and get more members and thus become stronger going to benefit patients in storage? Well yes, quite probably it will. But the problem is that it is hard to quantify this kind of thing, let alone determine what percentage the patients should bear. It is also hard to exercise self-restraint. Much like the "voluntary" income tax, once the camel has its nose in the tent, the rest of the camel is very likely to follow in short order.

The problem with assessing patient suspension funds for indirect expenses is that there will be a strong tendency to try to address operating shortfall by RAISING the amount of this assessment. This is not an idle, dark, Mike Darwin Fantasy. Let's take a concrete example: the sign-up fee. The sign-up fee started out as a mechanism to allow us to recover our direct costs associated with signing up new members. Its introduction was accompanied by solemn promises by all concerned that it would *never* be used to address operating shortfall. It started out at $150 and quickly went to $300. Over the past two years there has been vigorous lobbying by Dave Pizer, Saul Kent, and a number of others to *raise* this amount to $600 or even higher to address operating deficits. After all, as the argument goes, "people will have no choice but to pay it since Alcor doesn't really have any serious (quality) competition." I will, mercifully, let the person who made this remark remain anonymous.

I believe I know human nature well enough to know what will likely happen in this situation. I also know that patients in suspension cannot go out and earn more money. The money they (read: *we*) have put aside in insurance or other suspension funding represents all there is going to be for a very long time. Tapping that money to amortize start-up costs, operating expenses, and so on, is not a wise thing to do.

Dave points out, "There is no universal figure that any two persons at Alcor will agree on as our exact cost for each part of the total cryonic suspension program." I assume what Dave means by this is that no two people are going to agree on what *fraction* of the total operating overhead should be allocated as a surcharge to suspension funds. I heartily agree and that's why I argue that only the objective, direct costs of caring for patients be charged.

Dave then goes on to pull the rabbit out of the hat and suggest that $35,000

represents the cost of overhead that should be added to the suspension minimums. Guess what—the disagreement Dave alludes to over what the surcharge to address operating shortfall should be is about to begin. *Where* did he get this number from? How can he assert that it is the same for whole body patients as it is for neuros? I can and would argue based on my own past experience that neuro members are easier sales and require less marketing and less attention during the sign-up process. Of course, much like Dave, "this is only my best estimate at this time." And, as such, it too is **meaningless**.

It took me over a month and 13 pages of billing just to objectively establish the marginal costs for suspension procedures (see "The Cost of Cryonics" in the August, 1990 issue of *Cryonics*). I did not start out by blindly asserting, "it costs this much 'cause I think this is what it costs." Dave is proposing an 80% increase in the cost of neurosuspension and he is doing so on the basis of a hunch. WHERE ARE YOUR NUMBERS, DAVE?

Regarding Dave's estimates, it is not at all clear where the figures for perfusion and storage minimums in each case come from. Certainly they are not related at all to my real cost figures as published in the August, 1990 *Cryonics*.

Let's start at the beginning.

First, Dave states that the costs to prepare and perfuse whole body and neuro patients are respectively $20,000 and $22,000. Where did he get these numbers from? The published figures in *Cryonics* are $27,469.67 for whole body and $18,908.76 for neuropatients, and these are the numbers actually being used to BILL suspension members.

Then we come to yearly storage costs. Current storage costs for neuropatients are $150.76, and $854.38 for whole body patients. Alcor has long had a policy of figuring the "reserves" needed to generate sufficient cash flow to cover these annual costs by assuming a (realistic) 2% rate of interest (subtracting out inflation) and then multiplying the amount of capital required to generate this interest by a factor of two. If we carry out that calculation we get the following numbers:

WHOLE BODY

$27,496.67 = preparation costs
$85,438.00 = trust fund requirements

$112,934.67 = Total required minimum suspension funding

NEURO

$18,908.76 = preparation costs
15,076.00 = trust fund requirements

$33,984.76 = Total required minimum suspension funding

The current Alcor minimums are $120,000 for whole body and $41,000 for neurosuspension. If we subtract the marginal costs given above from the current minimums, we find that for whole body patients there is a surplus over marginal costs of $7092.33—or 6.3%—and for neuro patients $7015.24, a whopping **20.6%**! Thus, looking at storage costs alone, as usual, neuropatients are paying well over their marginal costs and, as usual, further supplementing the "surplus" in the Patient Care Fund. However, this isn't the whole picture because left out of this analysis has been any discussion of *revival* costs, and presumably they would be the same for both (although this is a hot point of contention among many within the Alcor community).

However, it remains that if anyone should have Dave's proposed surcharge *added* to the suspension funding minimums on the basis of not pulling their weight in terms of current costs, it should be the whole body patients, not the neuropatients. But the fact is, *no one*, not whole body patients and not neuropatients, should have to pay one cent of any surcharge until it has been objectively demonstrated that such costs are; a) present (and objectively quantifiable), and, most importantly, b) justified both philosophically and from a business standpoint.

Perhaps the most compelling reason not to recover such costs from the suspension funds is that it won't really work. Most Alcor members are young and healthy. If we increased the minimums tomorrow to cover Dave's suggested assessments of $35,000 for both neuro and whole body, the fact is, we would not see *any* significant amount of that money for *decades*. As we are all (I think) agreed, **our problem is cash flow now** due to our small membership base and lack of economies of scale. How is Alcor going to benefit from these increased minimums when the people paying them will not enter suspension for, on average, over 35 years?! (Keep in mind that the "new members" Dave speaks of are virtually **all** in the 25 to 50 age range, with the mean being about 35).

The idea, I suppose, is that last minute cases will have to pay these fees and this will generate cash flow. And by last minute cases I do not mean just those who are already legally dead at the time they are accepted, but also those who sign up in the last few years or months of life.

The problem is, most of this class of people that we have suspended in the past would not have been able to afford it if these surcharges were in place. In fact, in most of these cases cost breaks (with our *old* minimums) were given in order to make these suspensions possible at all. From what I can see, nothing has changed. And the same is true of other highly expensive medical techniques: each year thousands of people die because they cannot afford heart transplants. Period. Dialysis and kidney transplants are paid for by the government and open heart surgery is reimbursed by some insurance and government medical aid plans.

In other words, exactly as I said before (contrary to Dave's challenge to me on this point), it will be the ill and the old who will bear the brunt of this surcharge and the insurance companies will be the only ones who see near-term benefits from the increased suspension funding minimums paid in premiums by younger members. Keep in mind that the insurance companies aren't going to give Alcor another $35K out of the goodness of their hearts. They are going to charge for that extra $35K of death benefit and **they are going to make a handsome profit on it in the bargain.** A profit, I might add, that Alcor will never see since it will go into the insurers' pockets instead of ours, and at a time when **we** need it most.

I detest having to tell people, "I'm very sorry, there is nothing we can do for you. You will have to die because you do not have enough money." I have to do this all too often now. I do not intend to have to do it even **once more than is absolutely necessary.** I particularly am opposed to having to do this when the suspension charges truly are paying the costs associated with their part of our operation.

Dave and Trudy both indicate that they feel I am opposed to recovering the real costs of operating Alcor. I am not. If it is the judgment of the Alcor Board and the membership that these costs need to be recovered directly and now, then we have a mechanism to do that: emergency responsibility dues, and yes, even the sign-up fee. Raise the dues and sign-up fees to pass on the real, on-going costs. That way people can see right now, today, what those costs are and, more to the

point, we will get the money *now*, when *we* need it.

Patients in suspension do not benefit directly from our emergency response capability, our marketing literature, or our conferences or social events, and they certainly don't read *Cryonics* magazine. **Living members do benefit directly from all these things and they are the people the money is being spent on.** Therefore, it only stands to reason that they should be the ones who pay for them. All money set aside by the member for suspension should go to pay for that member's suspension. ER dues are there to address the costs of operating Alcor. Therefore they are the proper mechanism to use to address the operating shortfall.

If we do this, my thumbnail calculation is that the sign up fee will go up to $1K and the dues will go up to between $700 and $1000 per person per year (including discounts for family members). With current rates of sign-up and membership this would provide $250 to 300K per year to cover our operating costs. Of course, the rub here is the caveat "with current rates of sign-up and membership."

Dave and Trudy are quite right: If there there is no alternative, the costs of operating Alcor will have to be recovered by directly charging what it costs to each member. However, I think we should think VERY carefully before we decide there is no other way. We are growing right now at an unprecedented rate. Sign-up checks roll in the door on a daily basis and in the last month alone 44 people have begun the sign-up process, 10 in November. In short, we have a successful program which is growing very rapidly. In the not too distant future that growth alone will address our operating shortfall as we begin to experience more of the economies of scale we have been waiting so long for.

Arel Lucas, Naomi Reynolds, Steve Bridge, and our other sign-up Coordinators have repeatedly observed that a major barrier to signing up more people is the sign-up fee and the yearly dues. Indeed, in nearly half a dozen cases Arel has waived her fraction of the sign-up fee to facilitate getting the member. In many cases the sign-up fee alone has resulted in people either not signing up or delaying sign-up. This doesn't help us. And further increasing the sign-up fee and dues isn't likely to help us either. What it is likely to do is slow growth, destroy our financial competitiveness, and wreck a wildly successful program (at least by cryonics standards). With the country moving into what appears likely to be a serious recession, this is not the time to radically increase prices for our program.

I think that the most important thing we can do in the interim, until we broaden our membership base, is contain costs and encourage voluntary giving. Indeed, universities and virtually all hospitals, including the for-profits, rely heavily on volunteers and contributed money. Health care costs—which in the U.S. already consume 10% of GNP and outstrip *food* costs—would be far higher were it not for the large voluntary component already present.

We also need to start recovering our costs by actually having members pay for those services they receive. To this end, a remote standby program needs to be put in place as soon as possible. Finally, we need economies of scale. The fact is that part of the cost of operations is paid for by suspensions, since labor is reimbursed to the operating fund at cost. Last year this amounted to about $30,000 in revenues to the operating fund.

Dave argues that he doesn't want to see these costs recovered via dues because (quite correctly) he observes, "If we were to raise dues enough to recover our overhead, the dues would be so expensive that most of our members would not be able to afford them." That's exactly right. But what Dave seems to fail to understand is that you can't get something for nothing. Life insurance isn't magic. You don't get that cash payoff down the line for **nothing**. Raising the suspension minimums is just another way of raising the total cost of cryonics because one way or another **the member is going to have to pay that cost.** The foolish things about doing this through higher suspension minimums are (once again):

1) Alcor will not get the money for most members until many years later.

2) The insurance company **will** get the money, get it right away, and furthermore make a handsome profit on it in the bargain!

3) Many terminally ill or aged people will be excluded from the program, resulting in loss of life and a reduction in the number of suspensions done and thus in the cost reductions the attendant economies of scale would bring.

Dave says that "Mike's analogy of other cryonics organizations that went broke to try to support my position of losing money on suspensions is a reversal of the facts." Actually, I was not referring to organizations that "went broke," but rather to one that is still around and has tapped out their patients' funds to address operating shortfalls. I think Dave knows all too well what I am talking about.

Dave also asserts that cryonics is out of the start-up phase and implies that my statement that we are still in start-up after 20 years is unreasonable and perhaps more than a little potty. I have this to say in response to that: Any idea that is in court fighting for its very right to exist is still in start-up. Any idea which, after 25 years and near constant media saturation only has 350 to 400 adherents *world wide* is still in start-up. Anyone who has examined the history of any revolutionary new idea or product from antisepsis to life insurance to the Copernican system would blush with embarrassment at the assertion that start-up could take **any less** than 20 years. In the case of the insurance industry it took **50 years**. I recommend Dave and anyone else who doubts me read Zeisler's *A History of Life Insurance* and Nuland's *Doctors: The Biography of Medicine* for a little education on the duration of start-up in disciplines as revolutionary as cryonics.

Nor is this a passing point to quibble over. Thomas Donaldson has written at length, eloquently and well, on the dangers of too much optimism regarding the growth and acceptance of cryonics. I believe he is right and I believe it is important that we not expect vindication any sooner than it will likely come. And if history counts for anything, it will be a long time yet in coming.

Dave seems to imply that I find the notion of recovering our real costs frightening. This is not the case at all. In fact, I expect that the day will come when staff will be well paid and revenues generated from services offered will meet and even exceed the costs of operating Alcor. Such a time will come when we have grown to the point that we experience the economies of scale we need. That time will not be hastened by capping growth with big price increases.

The budget must be balanced; on this Dave and I agree. But unlike Dave, I feel the best way to do this is to offer a family of "extra" revenue generating services such as Remote Standby, strongly encourage voluntary giving, contain our costs (if necessary by cutting back on staff and some services), and above all continue to sustain the current rate of **growth** or in-

crease it further still. Racking up the neurosuspension minimums and effectively condemning people to die, many of whom will be the mothers and fathers and spouses of our existing and future members, will only fuel resentment and damage our growth.

If we can just sustain the rate of growth we have been experiencing for a few more years, we'll do quite nicely. And I have numbers to back up my statements. In fact, using Dave's own gloomiest budget projections, we will be able to sustain the current level of operations and avoid any cutbacks if we meet our 1991 membership growth projections and experience a 40% compounded rate of membership growth in 1992, '93, and '94. If this sounds unrealistic, keep in mind that our rate of growth over the past three years has been 38%. Is there anyone (including Dave and Trudy Pizer) who does not believe that sharp increases in the minimums will not cut into that growth rate, delaying "break-even" and costing human lives in the bargain?

Finally, I want to make some general observations about this whole debate. Dave Pizer is Alcor's Treasurer and chief financial officer. As such, he has a responsibility not to offer unsupported financial opinion or pull numbers out of thin air. Cryonics is a suspicious enough undertaking both with the public and with cryonicists already, and for good reason. We are taking large amounts of money from people who will be totally helpless for a highly speculative venture. Added to that, we do not need unsupported calls for higher prices. What we do need is a careful, well-documented and rational analysis of any proposed cost increases in any area of the program. So far, Dave has failed completely to provide such an assessment. That does a disservice to everyone.

Immortalist Philosophy

The Third State

Max More

Wider acceptance of cryonics will require new conceptual categories. As cryonicists, it is our responsibility to use terminology and concepts that reflect our understanding of the rationale behind the suspension procedure. Sloppy use of terms will not effectively communicate our ideas to others. Despite Brian Wowk's important article, "The Death of 'Death' in Cryonics" (*Cryonics*, **9(6)**, (June, 1988)), too many cryonicists are still using terms like "death" inaccurately. Here I will re-present and build on Brian's suggestion, hopefully reinforcing the point for long-time cryonicists and introducing it to recent participants.

Traditionally, biological organisms have been classified as either alive or dead. Two basic reasons explain this simple categorization. Firstly, until very recently, when heartbeat and respiration stopped there was no way to return a person to life. It seemed that there was a point beyond which life had permanently ceased, and so it was natural to assume that life suddenly turned into death.

Secondly, most people have believed in the existence of a non-physical carrier of consciousness and personality. The body was considered merely a vehicle for this "soul." Again, it seemed natural to understand death as the point at which the soul left the body—a sudden event rather than a gradual process. A dualist (one who believes mind or soul is separate from matter or brain) should really say that though the body dies, the person survives in another form. On that view, the exit of the soul is only a physical death, not the true death of the person.

We now know beyond any reasonable doubt that personality is a function of a physical brain process, expressed through an attached physical body. We also now know that the cessation of heartbeat and respiration does not force us to conclude that the person has died. If "death" is to mean the permanent loss of personality, then a person does not die until there is no possibility of recovering his/her personality.

Dying can no longer be thought of as a sudden event. Since the personality is encoded in the structure of the brain, dying is a gradual process of degradation in the neural structures embodying personality. The possibility of halting the dying process demands a new term to describe the condition of someone in the stages between the first state of normal conscious function and the second state of death. This Third State (in historical, not logical order) is the condition cryonic suspension patients are in.

Strictly speaking, the Third State is a collection of states. Cryonicists have often referred to suspension patients as having "deanimated," or as being "in suspension." I propose a set of terms—some already in use—that will clarify the possibilities lying between life and death.

The general term I propose for a person who is in a stable condition between life and death is "inactivate." I prefer this to "deanimate" for two reasons: (a) "Deanimated" connotes a lack of observable movement. People who are not animated in the normal sense may be sleeping, comatose, resting, and so on. Saying that they are inactivate more strongly implies that biological activity at the cellular and molecular level has ceased; (b) The movie "Reanimator" has, for some people, produced negative con-

notations regarding "reanimation" and "deanimation." Talk of inactivate, inactivation, deactivating, and reactivating avoids these difficulties.

"Inactivate" is a general term subsuming several possibilities, of which cryonic suspension is only one. Since survival of personality involves continuation of a certain functional process (I will explain and defend this claim in an upcoming column), there are several ways of being inactivate that allow for possible future restoration to life and consciousness.

Inactivate may mean; (a) biostatic (or "in biostasis"). This means that the person's original body is being preserved with the intention of eventual repair and reactivation. Biostasis itself may take at least three forms: (i) cryostasis, or cryonic suspension, which is the only method currently used; (ii) vitrification, in which very low-temperature storage is accomplished without formation of ice crystals; (iii) various forms of chemical fixation, such as the use of cross-linking to prevent biological activity.

Inactivate may mean; (b) surviving in a non-biological form. From a functionalist viewpoint, personality persists so long as the same functioning can be restored. This means that personality is to its physical implementation (normally the brain) as software is to hardware. This does not mean that any software can be "run" on any hardware, but it does mean that there may be kinds of hardware other than the brain capable of supporting the kind of functioning that produces personality and consciousness.

If the structure of a person's dying brain were thoroughly analyzed and the information specifying that structure reliably stored, it would be possible, in principle, to later build a new brain functionally identical to the old one (except for the rejuvenation of the cells). Someone existing in the form of stored information would not be dead, since there would be no irreversible loss of the information necessary to restore function. If the information is later embodied in a new brain, or uploaded into a suitably designed computer, the personality of the original person would be restored, and s/he would be alive once again.

In the debate following Brian's article, Jerry Leaf and Hugh Hixon rejected Brian's suggestion that we refer to suspension patients as being in an "ametabolic coma" or in an "ischemic coma," on the grounds that these terms already have defined senses incompatible with our desired usage. Instead then, we can refer to such patients by the general term "inactivate," or the more specific terms "biostatic/in biostasis," "cryostatic/in cryostasis," or simply "suspended."

All these terms are applicable to persons who are in the stable third state between life and death. But how should we describe those who are in the process of decay toward death (apart from "in need of suspension!")? Calling them "partially alive" is misleading, since it suggests that certain parts of them are dead. If we describe then as degenerating or deactivating, we are accurately stressing the point that they are in the midst of a process that is heading in an undesirable direction. This has the advantage of implying the possibility of halting the process. Accuracy demands that we reserve the term "dying" for a process that begins some time after degeneration has begun; a person does not begin to die until degeneration has reached the point where information essential to personality functioning is being permanently lost. This happens only after the degenerative process has been proceeding for some time.

Reanimation

Uploading: An Alternative to Metamorphosis

Ralph Merkle

In the May issue of *Cryonics* there appeared a piece by Thomas Donaldson entitled "Metamorphosis: An Alternative to Uploading," in which he suggests that the human brain might be fundamentally different from more conventional hardware because it is capable of re-configuring itself. It is possible to provide a solid response to this: No! The ability of a physically realizable computational device to re-configure itself does not endow it with fundamentally greater abilities than a conventional computer provided with sufficient memory, speed of operation, and appropriate peripheral devices.

At the simplest level, consider a program that models the laws of physics as they pertain to chemical and biochemical reactions (e.g., the behavior of atoms in the brain). This program, when provided with the description of some structure (the initial conditions) will then model the actions of that physical structure in accordance with the laws of physics. Whether the initial conditions specify a block of concrete, an integrated circuit, or the human brain (re-configurable or not) is a matter of complete indifference to the program. It merely treats the description of the object as input data, to be manipulated in accordance with certain formal rules and procedures.

If the brain obeys the laws of physics, and the laws of physics can be described by a computer program, and we have a computer big enough to hold the computational model of the brain, then the logical consequences are obvious: the behavior of the human brain can be modeled on a computer.

Of course, the presumptions stated above can be questioned. However, the

ability of the human brain to re-configure its circuitry is not a significant obstacle to modeling its behavior, at least in principle.

A more subtle argument would be that, while the ability to re-configure itself on the fly does not provide fundamentally greater abilities, it so improves the efficiency that this merely quantitative difference will result in a qualitative improvement in abilities.

Again, the argument is false. The potential performance improvement that might be provided by dynamic rewiring to a computer consisting of "devices" connected by "wires" is no better than the log of the number of devices. The argument is simple: disconnect all the devices from the original Dynamically Re-configurable Computer (DRC) and re-connect them to a "switching network" that connects any device to any other device (much like the telephone network). Then, set up the switching network in accordance with the initial connections pattern of the "dynamic wires" in the DRC. Finally, initiate computation. When the original DRC wishes to re-configure itself, our new version will instruct the switching network to alter the connectivity of the switch.

Now, there are about 10^{12} neurons in the brain, so a "telephone switching network" that would let every neuron "call up" any other neuron would have roughly (log-to-the-base-2 of 10^{12}) x 10^{12}, or 40 x 10^{12} switching elements. So our fixed-wiring computer (FWC) would be about 40 times bigger than the original, and run 40 times slower (because of the 40 extra stages of switching between every pair of devices).

(Those familiar with switching theory might notice that I have glossed over some subtleties that would modestly increase the advantage that might theoretically be provided by dynamic reconfiguration. These do not substantially affect the argument in any fundamental way; they merely imply that a number somewhat larger than 40 might be used as the absolute bound on the efficiency improvement provided by a dynamically re-configurable system over a fixed-configuration system.)

Of course, the mechanism that the DRC uses to dynamically re-configure itself will extract some price. There's no such thing as a free lunch, which means the DRC won't really be 40 times better. Furthermore, the brain's ability to re-configure itself is rather limited. Once it has adopted its adult configuration, neurons simply don't re-connect themselves to arbitrary other neurons. The actual re-configurations that are known to occur are rather modest in extent (barring injury and other unusual processes). Connecting and disconnecting synapses between neighboring neurons just doesn't require a general purpose switching network.

A more general observation is that modeling any real three-dimensional entity (whether it be a rock or a brain) only requires that we have a three-dimensional network of computers. We don't really need an arbitrary switching network at all....

The brain's ability to re-configure its neuronal wiring poses no significant problem to uploading. More generally, there are no fundamental technical obstacles to uploading that are known, and it seems unlikely that any unexpected fundamental problems will arise. Whether or not a suitable computer running a suitable program can pass the Turing Test, or model the behavior of a given individual with no significant deviation in behavior is an empirical question. Eventually, either the answer will prove to be "yes" or "no." At the present time, the betting by most scientists who study such issues would be "yes." Whether or not such a computer simulation would then be considered conscious, human, the same human as the person uploaded, legally entitled to the rights and privileges of that person, etc., are questions that are often disputed (and I will not attempt to answer them here!).

However, the more limited technical question of whether a computer can in principle accurately model the behavior of the brain hinges on only two questions:

(1) Can the laws of physics be modeled by a suitable computer program?

(2) Do the laws of physics describe the behavior of the brain?

Most scientists today would say "yes" to both.

Whether such a computational model can be built within practical computational constraints depends on how big a computer you've got and how many computational "short cuts" you can take and still retain an accurate model of neuronal behavior. So far, there is no good technical reason to believe it won't be done within about 100 years (and perhaps sooner).

For The Record

Franklin as Pioneering Immortalist

Mike Perry

"I think it fair to say that Benjamin Franklin was the most versatile genius in all of history, with notable accomplishments in an even wider range of fields than the renowned Leonardo da Vinci." So states Michael Hart (a cryonicist himself, interestingly enough) in his fascinating book, *The 100: A Ranking of the Most Influential Persons in History*.[1] (Franklin, incidentally, misses the roster of the "100"—he was not considered influential enough to rank with such individuals as Jesus, Newton, and Queen Elizabeth I—but is given honorable mention anyway.) Franklin, who lived from 1706 to

1790 and helped transform the American colonies into the United States, had highly successful careers in at least four divergent fields: business, literature, politics, and science. He was also successful as a promoter and organizer of innovative public institutions in the developing colonies, creating in the American colonies the first circulating public library, the first scientific society, and the first fire department, for example. He showed that lightning was electricity (and developed the lightning rod as a by-product), signed the Declaration of Independence, drew political cartoons, invented a better way to heat homes, invented and marketed a musical instrument, and left many well-remembered sayings in his famous almanac.[2]

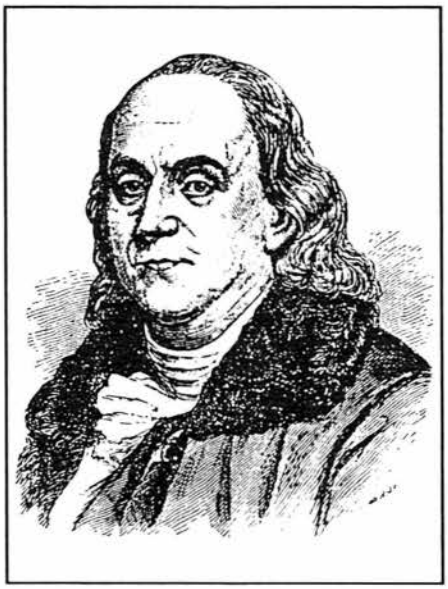
It is no surprise that such a versatile intellect should have pondered over the place of man in the cosmos, the issues of life and death, and what the future might hold in store. In fact, Franklin was far ahead of his time in ways that will be understandable to immortalists, being among the very few who thought lifespans would (and should) be greatly prolonged through science, and who regretted that he would not live to see this and other marvels:

"The rapid progress *true* science now makes, occasions my regretting sometimes that I was born so soon. It is impossible to imagine the height to which may be carried, in a thousand years, the power of man over matter. We may perhaps learn to deprive large masses of their gravity, and give them absolute levity, for the sake of easy transport. Agriculture may diminish its labor and double its produce; all diseases may by sure means be prevented or cured, not excepting even that of old age, and our lives lengthened at pleasure even beyond the antediluvian standard."[3]

Franklin never specifically proposes freezing as a way to preserve a person for later reanimation, but does raise the possibility of some form of suspended animation for this purpose. His speculation was based in part on an uncritical appraisal of reports of the alleged revival of organisms in a seemingly lifeless condition. A toad which became petrified in sand and rock could, he thought, live for "we know not how many ages"[4], while flies drowned in wine could be "revived by the rays of the sun"[4]. In discussing the question of life prolongation Franklin wrote to a friend, Jacques Duborg, in April 1773:

"Your observations on the causes of death, and the experiments which you propose for recalling to life those who appear to be killed by lightning, demonstrate equally your sagacity and your humanity. It appears that the doctrines of life and death in general are yet but little understood. ... I wish it were possible ... to invent a method of embalming drowned persons, in such a manner that they may be recalled to life at any period, however distant; for having a very ardent desire to see and observe the state of America a hundred years hence, I should prefer to any ordinary death, the being immersed in a cask of Madeira wine, with a few friends, till that time, to be then recalled to life by the solar warmth of my dear country. But ... in all probability we live in an age too early and too near the infancy of science, to hope to see [such] an art brought in our time to its perfection ..."[5]

Though somewhat fanciful, Franklin's speculation had a basis in the known science of his time. The discovery of "anabiosis," a condition in which an organism is deprived of all signs of life yet can still be resuscitated, is credited to the 18th Century microscopist van Leeuwenhoek, who in 1702 noted that dried rotifers would resume activity upon being moistened.[4] Further studies were made, and an attitude grew up of death as a phenomenon understandable through science. From this it was a natural assumption that it might be *preventable*, once our knowledge of the requisite processes had advanced far enough.



This thinking was in part an outgrowth of the idea of *progress* which had been developing since the days of Francis Bacon and René Descartes a century earlier. Before that there had been interest in life extension, but the interest had been founded on a belief that longer life had been achieved in the distant past. (For example, the Bible reports men living nearly a thousand years in the "antediluvian period" some thousands of years earlier.) With the rise of science that hope, in the minds of a few farsighted individuals, became focused on the future. A goal was being sought that had *not* been achieved before, and moreover, the methods to be used in attaining it were founded on reason.[6]

To carry this doctrine of "meliorism" to the point Franklin advocated required courage. On the one hand, while there was no final break with religion (Franklin doubted the validity of "revelation" but nevertheless believed in a God), its importance was downplayed, and the virtues of human accomplishment extolled. On the other hand, by accepting that radical extension of the human lifespan would lead to a better state, a break was made with ancient schools of thought founded on reason. For example, the Epicureans (famous for their materialist philosophy several centuries before Christ) had held that only a limited number of happy experiences were possible, so that superhuman lifespan must be superfluous at best.[7] Franklin said no, and accepted an immortalism whose realization he knew he would not live to see.

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1. Hart, Michael H. *The 100: A Ranking of the Most Influential Persons in History.* Galahad, 1982, pp. 524-525.

2. Hart, *op. cit.*, p. 525 and Wright, Esmond, *Benjamin Franklin, His Life as he Wrote It*, Harvard University Press, 1990.

3. Franklin, Benjamin, letter quoted in *A History of Ideas about the Prolongation of Life* by Gerald J. Gruman, Trans. Am. Phil. Soc. Philadelphia, Dec. 1966, vol. 56 part 9, p. 74.

4. Gruman, *op. cit.*, p. 84.

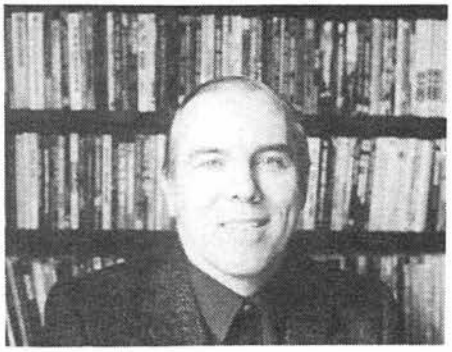
5. Franklin, Benjamin, letter quoted in Gruman, *op. cit.*, p. 84, and also in *Engines of Creation* by K. Eric Drexler, Doubleday, 1986, p. 130.

6. See Gruman, *op. cit.*, pp. 74-75, 77-82.

7. See Gruman, *op. cit.*, p. 84

Trivial Nanotech (Con't)

Keith Henson



Last time I talked about what might be done with the infrastructure of living. This time is mostly about what nanotech could do to our interstructure.

Even those who maintain a human configuration will want improvements. Nobody likes going to the dentist. Self-repairing teeth, perhaps reinforced with diamond, are the minimum improvement. We are already reshaping eye lenses with crude surgery. Actively controlling lens shape for focus and better accommodation is obvious.

A less obvious modification would be to reverse the retinas of our eyes. Why evolution wound up putting vertebrate nerve circuits on the *front* side of the light receptors is not well understood. Ancestral eyes may have started as reflector surfaces, concentrating light on sensitive nerve patches. Lenses seem to have come along later. The optic nerves block light and must plunge through the light receptor surface, causing a blind spot. (Octopus eyes are wired the sensible way, with the nerves all coming out the back side of the retina.) Nanotech reconstruction could turn the retina over "in place," getting rid of "unsightly" blind spots. "Floaters" could be cleaned out of the eye fluid as well. A more difficult problem would be giving sight to a person blind from birth. Considerable rewiring of the brain might be required.

Human health problems, current ones anyway, seem to go away with nanotech. The same will be true for our pets. Given the rate at which new treatments are approved, our pets may get it first. I think there will be a demand for animals which can be switched on and off. ("Honey, did you remember to turn off the dog?") The biggest difference between horses and cars is that cars don't need attention every day, and horses do. Members of the Society for Creative Anachronism in particular need switchable animals. Their battles and pageants require horses, but few of them want to take care of a horse between events. Besides that, the people get so banged up in mock battles that the SPCA would object if real animals were subjected to the same beatings.

This leads to another trivial use of nanotech-based healing. *Real*, dripping-with-gore, Conan-style battles. After the performance is over, the chunks of the participants would be stuck back together, Valhalla style. Not my idea of a good time, but I don't much care for football either.

While there is no limit to the level of realism that could be achieved, vast amounts of dung in the streets need not accompany even unmodified animals. Eric Drexler has suggested (I don't think in print) "the doggy afterburner." This would be a device (critter?) which inhabited the lower intestine and burned all the organics out of whatever came alone. The non-organic elements could be used to make ceramic marbles, which would be excreted at rare intervals. (A long time ago I was left for a weekend with a nasty little monkey which had the run of a house. Not wanting to clean up monkey dung, I fed it nothing but cheese and crackers that weekend. 'Long about Sunday evening—after considerable effort—it excreted something nearly as hard as a marble. Cleanup involved kicking the excreta into a fireplace.)

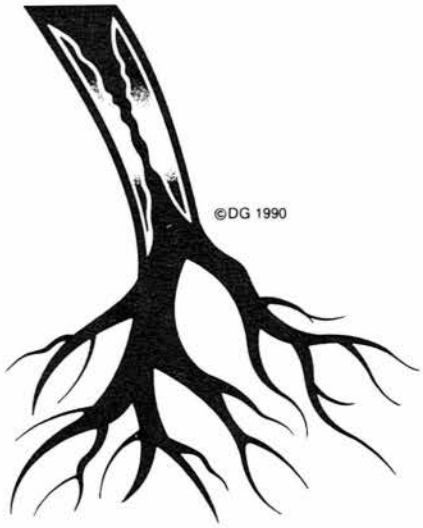
Human relations with engineered "domestic animals" might get really weird. Nomads in Africa drink the blood of their cattle. A less messy method would be to grow plugs on the animals which could be connected to humans and supply energy and materials directly to the human bloodstream. Instead of killing the sheep, you bring in a batch and "recharge" from them. A "lower on the food chain" alternative would be to have a "backpack" which would unfold when you lay down in the sun into a large photosynthetic area. Assuming the nomads' sheep didn't trample you, a few hours a day soaking up rays on 30 square meters of surface would eliminate the need to eat animals *or* plants. This is getting far afield from the simple uses of nanotechnology, but being modified this way would allow living the "simple" life par excellence. Such people would really leave "nothing but footprints."

Next time, cleaning the house, striped paint, the bookshelf, and digging out.

Note: A fairly long article of mine, "Nanotechnology and MegaScale Engineering" was published in Jim Baen's *New Destinies Magazine*, Fall 1990. It is about reviving dinosaurs, star travel, moving galaxies, and the Far Edge Party. Look in the Science Fiction section of your local bookstore.

Beta Carotene Supplementation: "Eh... what's up, Doc?"

Steven B. Harris, M.D.



Introduction

For an advocate of laissez-faire like myself, one of the disappointing realities about an "information society" is that often information makes a lousy classical commodity. The problem is that an item of simple and useful information self-replicates at no expense (our brains do it automatically when we give each other social advice) and is therefore worth little on the market. (As a physician, I'm acutely aware of this; not only would people resent a bill for simple health advice given in social situations, but they even resent being billed for pure advice in office situations.) In a free market, this devaluation of simple and useful information has the unhappy effect of squelching the profit-motivated development or discovery of more of the same, for no one wants to invest money to create something that they cannot then control well enough to sell. The only effective defense found so far against the research-stultifying effect of *de facto* "information socialism," has been the even more dubious practice of "research socialism." Which seems here to stay. Like it or not, there is a lot of extremely important basic research which, if the government did not do it, would not get done at all. The rub, of course (as with all socialism) is that when government does (or funds) research, it does it inefficiently.

The usefulness of beta carotene, the subject of this month's column, provides an illustration of the information devaluation problem as it applies to medicine. Vitamins are well-known substances which are impossible to patent and relatively easy to manufacture and sell. A finding such as "vitamin X supplementation has beneficial effect Y" is a simple one that may cost millions to obtain, but once known, may in a large and competitive vitamin supplement market have almost no effect on the long term sales of any given vitamin manufacturer or distributor. The result of this is that relatively little private vitamin supplementation research funding goes on in the United States, because available capital is siphoned off by much more lucrative patentable-drug research or marketing. What therapeutic vitamin research is done, therefore, is usually done by the government (directly or indirectly), and that isn't much. The upshot is that we often know more about the long term effects of many drugs on human health than we do about most vitamins.

The Physician's Health Study

This being the case, we should expect a number of surprises still to come in the poorly understood vitamin supplementation field, and last month we were presented with one of them (*Science News*, Nov. 17, 1990). The particular research project in the news was The Physician's Health Study (PHS), a government-funded study of the effect of either long-term aspirin or beta carotene supplementation, or both, on spontaneous disease incidence in 22,071 healthy older men (in this case, a group of cooperating Harvard Medical School alumni aged 40 to 84). The aspirin arm of the trial had been terminated after about five years of study, in December, 1987, when it was discovered that the physicians who took aspirin had far fewer myocardial infarctions ("M.I.s" or "heart attacks") than those who took a placebo.

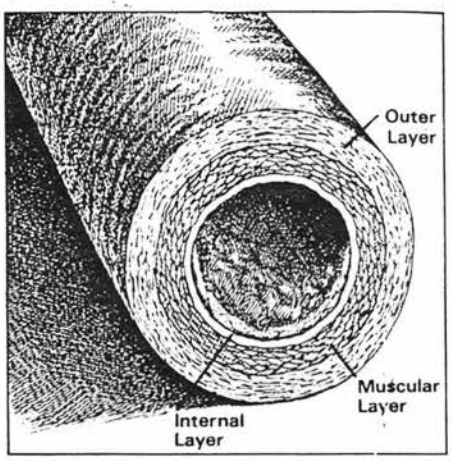
[Unfortunately, however, the study also showed a near-significant increase in hemorrhagic stroke ($p = .06$) in the aspirin group, and was terminated before this trend became clear, and also before any mortality data (from any cause) became significant (*N Engl J Med 1989*; **321**:129-35). This made the study's expensive findings worthless to all those who worry about the possibility of trading non-fatal M.I.s for strokes (like cryonicists!); but recall my earlier comment about government-funded research inefficiency. Because of such problems, neither Thomas Donaldson nor myself now recommend routine aspirin supplementation for people who have no reason to believe they have heart disease. See Donaldson's *Science Updates* column, in the April, 1988 *Cryonics*.]

The beta carotene arm of the study, however, was continued after the aspirin arm was halted. Last month, this part of the study showed some unexpected results: It was found that in the small group of physicians (333 men) who had prior evidence of having heart disease (such as chest pain), those who had been taking beta carotene over six years had half as many strokes and heart attacks as the physicians who had been taking placebo. These findings were statistically significant and independent of blood cholesterol or the use of aspirin.

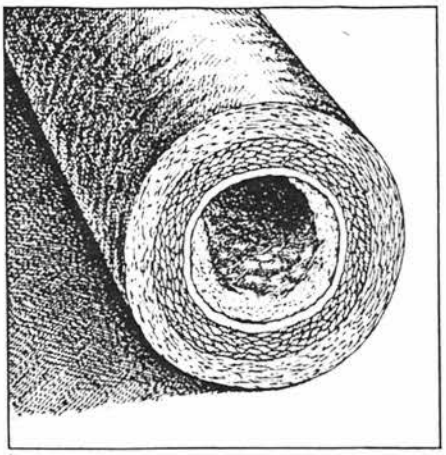
The beta carotene results were particularly surprising because, unlike the aspirin part of the study, the beta carotene trial was not being conducted to look at the effect of this vitamin on the heart; instead the hypothesis was that beta carotene would inhibit the spontaneous development of some cancers. Vitamin A is necessary for the health of epithelial tissues, and various epidemiological studies had previously suggested that high intakes of beta-carotene (which has vitamin A activity) might be protective against epithelial cancers, particularly those associated with smoking.

In the matter of cancer, however, the chosen study group caused the PHS designers to hit a familiar snag. They had chosen for their subjects a group of Harvard-educated physicians, most of whom not only did not smoke, but who also followed a raft of other healthy practices resulting in a depression of their mortality rates to the point that not enough deaths were occurring to do statistics within the originally planned time frame (in fact, it was calculated that the study would have to run until the year 2000 to get any good mortality results for

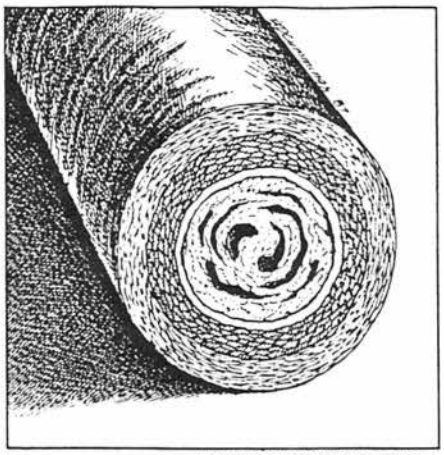
CHOLESTEROL CLOGS AN ARTERY



1. Only a minor amount of cholesterol is sticking to walls of the artery, the vessel through which blood is pumped from the heart. Normally, the artery swells with each heartbeat.



2. With cholesterol buildup can come the onset of atherosclerosis, a disease in which the arterial walls lose elasticity. The heart must work harder to force blood through.



BARBARA CUMMINGS / For The Times

3. The artery now has almost closed because of the buildup of cholesterol and the development of calcium in the vessel. The condition can result in heart attacks and strokes.

just heart attacks). Death rates in the overall study sample were only a quarter of what were planned for when the study was designed.* This turned out not only to be a factor in deciding to terminate the aspirin trial before mortality statistics became available, but also (one suspects) a factor in the discovery of hitherto unsuspected beta-carotene effects before enough data was gathered regarding cancer in the beta carotene trial.

How Does It Work?

Faced with the preliminary results of the beta carotene study, scientists have begun to fashion a few *ad hoc* hypotheses about the effect beta carotene seems to be having on the cardiac arteries. One possibility is that atherosclerosis is initiated in part by free radical oxidation of cholesterol into artery-toxic products (there is evidence for this from other studies), and that beta carotene, as a "free-radical scavenger," helps to inhibit this process. The difficulty with this hypothesis, however, is that the kind of radical generator which beta carotene mops up most efficiently ("singlet-oxygen") has not been definitely associated with the oxidation of cholesterol (all free radicals are not alike). Further, the relatively short length of the PHS study as compared to the course of development of atherosclerosis makes mechanisms which involve inhibition of atherosclerosis proper less attractive than those mechanisms which inhibit the final common pathway of thrombosis (clotting in the heart), which is what is (usually) the immediate cause of heart attack. Perhaps beta-carotene plays some role in supporting or modifying the delicate epithelium which lines the coronary arteries, the derangement of which is some way appears to be a prerequisite to the development of vessel spasm and clot?

Practical Aspects

Who might benefit from taking beta carotene? The PHS study data at this point indicates the only group the vitamin benefits for sure are men who already have evidence of atherosclerotic disease (such as those who suffer from angina/chest-pain). Still, it seems likely that any substance which protects against M.I. or stroke in people with symptomatic atherosclerosis will eventually prove to protect in the (much larger) group of people with silent disease as well. Aspirin was recently shown to do exactly this, but has problems with side-effects which make its application in asymptomatic people problematic (when you treat a lot of people without disease to get at the few that have hidden disease, side effects become a big problem). Unlike aspirin, however, beta carotene has not been found to have any side effects (other than to turn people temporarily orange-yellow at too-high doses), and has never been found to have any oral toxicity in extensive animal testing (plus a lot of less closely monitored human experience). Thus, for people who are entering the age where M.I. is more frequently seen (men over 40, women over 50) beta carotene supplementation seems a worthwhile gamble.

The beta carotene dose used in the Harvard study was 50 mg. (about 80,000 units) taken every other day. The "every other day" schedule is entirely a hangover from the defunct aspirin part of the study, and is not really essential. Most people will find 15 or 20 mg once a day easier to comply with, and beta carotene pills in these standard doses are sold by many mail order suppliers for as little as two cents each. (Caution: fair-skinned people may find that even this dose causes an orange complexion after a few months, so careful monitoring is advised. The soles of the feet show color first, then palms, then the face around the nose and mouth. Experiment until you find the dose that shows in your palms in good light. All skin changes are reversible in a few weeks on stopping the vitamin).

A word needs to be added here about the rationality of deciding to gamble on the disease-prophylaxis effect of supplements, drugs, or diet and exercise regimens, when one is healthy (i.e., in deciding to practice certain kinds of preventative medicine). My own bias is that this kind of thing can do more harm than good unless the regimen being considered is either:

1) one for which there is a great deal of experience and safety evidence (such as for exercise, or modest vitamin supplementation equivalent to what one could get by eating selectively), or

2) is one for which overall benefit has been adequately demonstrated in controlled

* Detractors of allopathic medicine have suggested that the average medical doctor knows nothing of consequence about preventative medicine, and that what little he knows, does not believe applies to himself. Here is at least some evidence against both notions.

human trials.

Aspirin here does not quite meet either criteria, but one should be aware of the natural bias which physicians have in favor of drugs (which they prescribe routinely), and against vitamins in pill form (which their competitors like chiropractors prescribe routinely).

It's hard to find a better example of this bias than in the Physician's Health Study itself. On one hand, when the aspirin findings were released, so many healthy study physicians voluntarily switched to taking aspirin that it was no longer possible to find a group which was taking beta carotene only. This, despite lack of mortality information and the fact that the aspirin group was known to have a significantly higher incidence of serious side effects (like gastrointestinal bleeding requiring hospitalization). On the other hand, when beneficial results showed up for beta carotene, which has never been found to have any serious side effect, one of the physician co-authors of the PHS study nevertheless counseled even against men with heart disease taking beta carotene (!). The reason given was that, in this physician's view, people might begin to view beta carotene as a "quick fix" for coronary heart disease, and thus be less likely to make important life-style changes like eliminating smoking and high levels of dietary saturated fat. The gonzo nature of this latter advice becomes clearer when one considers that it is akin to suggesting that people not wear safety-belts in their autos because it might make them feel less vulnerable, and therefore less attentive to the more important business of traffic safety.

New Directions

Scientists have been feeding animals controlled doses of vitamins and looking at consequent effects on natural disease incidence for more than half a century (I'm one of them), but to my knowledge the PHS is the first study to commit to do a very long term (10 year) controlled vitamin supplementation experiment in a large group of healthy and well-monitored humans. The fact that this first study has turned up interesting and completely unexpected results is a clue that there is lot we don't know about the very important pharmacological and disease-preventative actions of the micronutrients. What excuse to we have for this deplorable ignorance? There are thirteen classical vitamins and an even larger number of minerals necessary for life, and we should have been doing long placebo-controlled supplementation experiments with them, one at a time and in various combinations, ever since they were discovered. We haven't done it. Our failure is the more embarrassing when we consider that this group of substances make potentially almost ideal pharmaceuticals, since at appropriate doses they all seem to be nearly side-effect free.

What to do about the vitamin study problem merits an essay in itself, and I won't address it here. In the meantime, it is enough to note that those of us who are interested in vitamins, drugs, and foods as potential disease preventatives are forever faced with navigating between the Scylla of nihilism (i.e., "I'm not going to take pills if I'm not sick"), and the Charybdis of fadism ("If there's a pill and a claim, I'll take it"). Our task is to find the middle way with imperfect information to guide us. In future columns I will do my best to give my best reasoning (and my best guesses!) at to what that way may be.

Letters To The Editors

Dear Sirs,

I am writing to you about your newsletter, which is always late. By the time you send it most of the month is over and it's three weeks late. Why the hell can't you send it the *first week of every month* like every other group does. I enjoy coming to the group, but never knowing what's going on with you people is pure ignorance on your part. I know you're very busy with your legal problems and other issues at hand, but I am letting you know how I feel about this matter. Also, your general business meetings are way too long. It's so much _____ and not enough socializing. Also, you do not come to the San Fernando Valley often enough, as far as I am concerned.

Alan Bethanis

Dear *Cryonics*,

Ralph Merkle's cold start scenario would really start things off with a bang, literally. At one instant you'd have a strain-free brain sitting there at 140 Kelvin. A few microseconds later, it would be occupying the same volume at physiologic temperature. Unfortunately, as we've cause to know, nerve tissue changes its volume over those intervening 170 Kelvins. Even a few percent volume change in a few microseconds could have explosive consequences.

A couple of solutions occur to me. Since vitreous water presumably expands on warming, while ice contracts on thawing, the reconstructed brain could be a mosaic of vitreous solution (around macromolecules and membranes) and normal ice, proportioned to occupy the same volume at 140K and 310K. Of course, since even ice expands as it warms, there would be transient effects during the warm up, and even the ice might show a net expansion from that low a temperature to water.

Alternately, you could incorporate enough cryoprotectant to reduce the crystallization velocity, and get you out of the explosive warming regime. I've no objection to being thawed in a thousand microseconds rather than 5 to 10. It wouldn't even be out of the question to reconstruct the brain with adaptations increasing cryoprotectant tolerance, so that you could include enough cryoprotectant to get a stable glass, and thaw the patient at your leisure.

Well, I'd best close this letter, lest I wind up hand-carrying it to the Turkey Roast. Congratulations on the legal win!

Brett Paul Bellmore
Capac, MI

Cryonics,

Recently in his column Ralph Merkle gave some ideas toward a solution to the problem of warming up a brain once it has been reconstructed at cryogenic temperatures. Quite simply, he suggested that we embed highly energetic pellets throughout the reconstructed brain. Setting them all to heat up at the same time, voila, the reconstructed brain warms up very rapidly. Problems of how to prevent ancillary damage or poisoning by the products of this reaction were left unsolved.

Here is a method which solves the problem completely. It will also allow far

simpler suspension if suspension is needed at any later time. It's simple: we already have designs for animal brains which would be quite resistant to freezing. For instance, if warming causes cracking of nerve connections, storing a list of each neuron's connections in its DNA gives all the information needed for swift repair. What about temporary loss of circulation due to a disrupted vascular system? Provide energy storage within each cell, or at least each brain cell (not just neurons, but glial and other cells too) sufficient to allow reconstruction. Storage might consist of quite standard molecules like ATP, possibly sequestered in a special matrix. Since we know embryonic brain tissue already survives freezing, design changes might no even be so extensive as these.

After all, aren't we supposed to turn ourselves into supermen after we revive? If we're going to reconstruct a brain (cryogenically or otherwise), here is an ability any futuristic superman might very well want: resistance to cryogenic temperatures! And if our supermen do not want it after revival, no laws keep them from redesigning themselves again to remove these abilities.

Thomas Donaldson
Sunnyvale, CA

Ralph Merkle responds:

Some good points have been raised about rapid heating and how to deal with any problems that might arise. As Brett points out, volume changes during very rapid heating can cause problems. His basic solution, making sure that the structure occupies the same volume at 140K and 310K, looks quite effective. His second suggestion, slowing down the heating rate, looks even more attractive. While less dramatic, slow heating is simpler to design and build and just as effective.

The more general approach taken by Thomas is to redesign the original system so that it can actively repair itself even in the face of fairly severe damage. As he points out, we'll want to build greater tolerance into the damaged structure anyway: why not take advantage of this greater self-repair capability to repair the damage that might be inflicted during thawing? This, too, sounds like a good idea.

Nothing (other than a desire for a parsimonious design) prevents us from combining these various techniques, so it seems safe to forecast that this problem can be solved!

Cheers!
Ralph

To the Editors:

My group is now meeting every second Sunday at 3:00 P.M.

I also completely agree that since neuros are 120% overfunded and whole bodies are 2% overfunded that if any procedure should be raised in price it is whole body suspension. But since $120,000 is a lot of money, I think we can live with being only 2% overfunded for now. The only Alcor fee that could be raised at this time would be the annual maintenance fee.

Sincerely,
Eric Klien
Chelmsford, MA

Dear Editors,

In a recent issue of *Cryonics*, Thomas Donaldson made the comment that if his petition for pre-mortem cryonic suspension is denied he will "simply starve himself to death." Apparently, he believes starvation would be a way to hasten death which would not inflict severe damage on his brain. Dr. Donaldson, and the staff of Alcor, might want to do some research on that issue before making that assumption. Neurologists probably would contradict Dr. Donaldson, and they might provide some vitally important evidence that should be considered by any court reviewing the legal petition.

In particular, there is a process called "excitotoxicity," which involves the release of glutamate by nerve cells. Glutamate is the ionized form of glutamic acid, one of the primary amino acids the body uses to make protein. Normally, glutamate cannot pass through the blood-brain barrier, and it is present in the intercellular fluid in the brain only in very limited and carefully controlled quantities.

Glutamate is a vitally important messenger molecule which neurons in the brain use to transmit signals across a synapse that separates two adjacent neurons. Normally, when a molecule of glutamate is released by one neuron into the synapse, it lands on and triggers a glutamate receptor (also called an "excitatory amino acid" or EAA receptor) on the surface of the adjacent neuron. This triggers the opening of an ion channel in the cell membrane.

As soon as the glutamate messenger molecule has triggered the receptor which opens the ion channel, the glutamate disengages from the receptor molecule, to free up the receptor to receive another glutamate molecule. Normally, as soon as the glutamate molecule disengages from the receptor, it is taken back inside one of the neurons by a transport mechanism which requires energy. However, under various conditions such as hypoglycemia (low sugar), which can be caused by malnutrition, the glutamate return system doesn't have enough energy to keep pumping the glutamate molecules back into the neurons.

When that happens, excess glutamate begins to accumulate in the fluid between the neurons. And when the build-up begins, the system goes into a runaway mode that goes faster and faster. Glutamate floating in the synapses keeps returning to the glutamate receptors, triggering them and exciting the neurons. This causes the neurons to begin releasing more glutamate, which excites the adjacent neurons even more, triggering the release of even more glutamate. This snowballing cascade effect is referred to as "excitotoxicity," and it can kill neurons by exciting them to death, in a manner comparable to death from strychnine poisoning. It becomes one of the primary causes of neuronal death, which results in severe and permanent brain damage and often the death of the entire person in patients having strokes, heart attacks, and certain types of poisoning such as domoate poisoning.

I can't say with certainty whether that type of excitotoxic process happens to someone who dies of malnutrition. However, there's every reason to suspect that it does, since it's triggered by insufficient energy to run the glutamate uptake system. Since the processes of excitotoxicity can lead to and/or severely aggravate irreversible brain damage in stroke patients, Alcor and Dr. Donaldson should have some serious and detailed discussions with some neurologists before they assume that self-starvation is a neurologically harmless way to hasten death.

Indeed, I suspect that excitotoxicity and its resultant neuronal death is only one of the neurological problems that might be caused by self-starvation. Starvation is a gruesome and prolonged way to die, and the wide array of adverse symptoms it causes should warn cryonicists that it is inflicting severe damage on the entire body, including the brain.

There was a recent story in *Cryonics* by a woman who starved herself to death so she could be cryonically suspended. If any pictures or videotapes were taken of her during the advanced stages of starvation, they should be shown to the judge and formally entered into evidence in Donaldson's petition. If no such pictures or videotapes were taken, they should be taken of the next cryonicist who starves himself or herself to death. If any cryonicists or judges need to be convince that starvation is not an acceptable option, those pictures or videotapes would make far more gruesome and convincing evidence than any words about biochemistry.

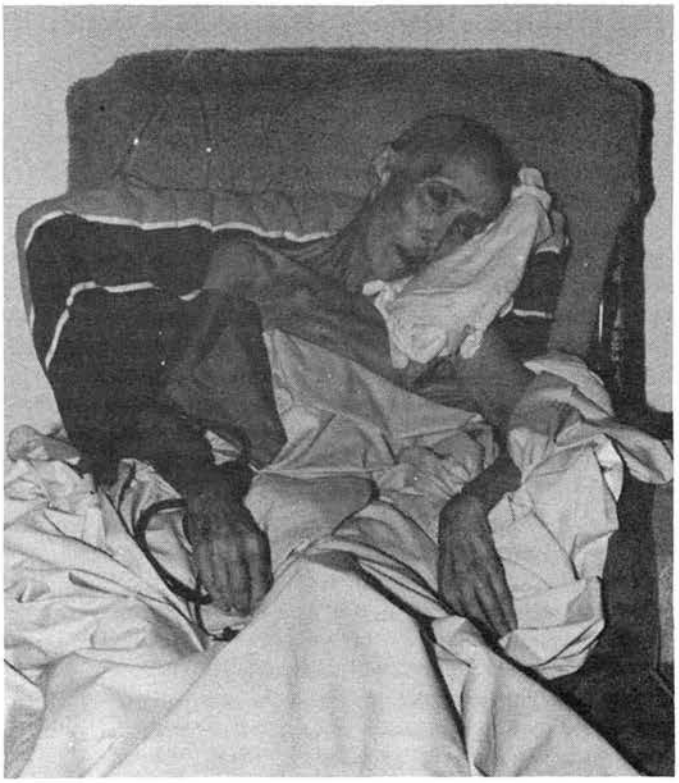
Chet Fleming
St. Louis, MO

Mike Darwin responds:

Thank you for your letter and your concern. A couple of points need to be made right away. First and foremost is that cryonicists who "starve themselves to death" are really dying of dehydration rather than starvation. When a person "starves to death" we usually mean he or she dies from lack of nutrients (protein, calories, and micronutrients). Even in a "wasted" person (who is bedfast and therefore inactive) this process will usually take weeks or even months. The damage from excitotoxicity which you allude to may well be a contributing factor to death from this kind of starvation.

By contrast, cryonicists who decide to enter suspension before their disease takes its "natural" course in reality experience cardiac arrest from *dehydration.* Dehydration can cause legal death by at least two possible mechanisms: shock, due to inadequate blood volume, and cardiac arrest due to electrolyte imbalances. The latter is reasonably innocuous as insults go, the former far less innocuous since the patient usually experiences several hours in deep shock where circulation is inadequate and usually at least an hour with *very* poor circulation (**systolic** blood pressure of 50 mmHg are the norm). This kind of insult does inflict damage, and ischemic injury with an excitotoxic component is quite probable.

While cryonicists who experience legal death from dehydration do enter cardiac arrest as a result of fluid/electrolyte imbalances, it is also worth pointing out they are also "starved" as well since if you are not taking and fluid, in practice it becomes impossible to take any food either. You can't really swallow anything when your mouth and throat are dry. Also, most food has water in it, and carbohydrates are metabolized to water; this can drag out an already unpleasantly long process.



The result is pretty horrible by any standards you care to apply. You have a situation where a person who is already severely catabolic (i.e., rapidly wasting) from disease is subject to 7 to 15 days of no food or fluid. This is grotesquely inhumane to both the patient and the family and staff caring for the patient. It takes real fortitude on everyone's part to get through it.

As to your suggestion that video and other materials made during this patient's illness and suspension be provided to our counsel for evidence in Thomas' case, this is being done. In fact, Arlene Fried, the woman whose case you mentioned in your letter, specifically made videotapes during her illness in support of Donaldson's case. Videotapes and high-quality still photos were made not only of her decline through illness, starvation, and dehydration, but of her suspension as well.

It was Arlene's passionate wish that no one should ever have to suffer what she suffered through in order to end his/her life or enter cryonic suspension with an intact brain. She specifically requested that we share with the court, and the public, documentation of what happened to her. Both her daughter and son-in-law strongly supported her in this position as well.

Accompanying this letter is a photograph of Arlene made approximately 12 days after she began refusing food and water and shortly before she experienced cardiac arrest. The pain from her cancer could be eased with morphine. Her terrible air hunger and the indignity and discomfort of her situation are beyond both description and "amelioration" by any medicine. All of us who were with Arlene her last days would have liked to have forced the medical/ethical pollyannas who prattle on about control of pain and "making the dying patient's last days meaningful" to endure the ordeal that Arlene suffered through.

We hope the accompanying picture of Arlene will help to make our membership aware that this is what Thomas is fighting against, and this is what awaits most of us if he loses. We would be jailed if we subjected a dog or a cat to this kind of agony. To see a human being subject him or herself to it is unconscionable.

And, keep in mind, Arlene was conscious and reasonably lucid up to a few hours before her heart mercifully stilled and the formalities of the State of California were met so that she could enter cryonic suspension.

Dear Mike,

FM-2030 may promote some socialistic ideas while displaying a taste for the meretricious, but I fail to see why he deserves to become the Salman Rushdie of cryonics. What happened to the "kinder and gentler" editorial policy implied by recent conciliatory articles toward religion and Al Lopp's critique of the Faustian cryonicist in his review of the *L.A. Law* episode?

Long life,
Mark Potts

Dear Santa,

We Alcorians have been good all year... well, er... pretty good. Therefore, I would like to ask for the following:

1) Our new building, fully equipped... $1,500,000.

2) An Operating Fund Endowment to create the yield to operate the new building and run Alcor's many programs like membership, public relations, and education... $1,000,000.

3) A research grant to allow us to do experimentation to learn how to better suspend our patients so that there will be a better chance that we might be able to bring them back some day... $1,000,000.

4) A legal fund donation to allow us to litigate to try to establish that all Alcor suspension members have the right to an immediate suspension upon legal death, with that right to suspension having priority over any coroner's right or obligation to perform an autopsy on any of our members.

5) A way to express my sincere thanks to all the Alcor members who have so generously supported Alcor through their donations of money, volunteerism, and (for the staff) subsidy of working for below-market wages, to let them know how much I appreciate the efforts and sacrifices that they have made.

David Pizer
Treasurer

Dear Sirs,

Brian Wowk, in his essay on *The Death of "Death" in Cryonics* makes the point that we should no longer accept the term "dead" when applied to suspended members of our organization. I agree. I suggest, in fact, that we let reporters and interviewers know that we consider use of the term "dead" extremely insensitive, and that we would prefer to refer to the condition of suspended members in our care as "metabolically disadvantaged."

Although this use of progressive-speak is slightly tongue-in-cheek, it should be immediately understood by any who listen, and even in humor should still serve to get the point across that we consider what society regards as "fresh corpses" to be the ultimate discriminated-against group. Remember that the metabolically disadvantaged are labeled as nonpersons in our society, and as a consequence subject to an immediate trip to the crematorium. The historical chord that strikes should sound familiar to anyone.

Steve Harris
Los Angeles, CA

Dear *Cryonics*,

Mike Darwin's November 1990 article on *Communicating with Suspension Patients* introduces a shift in perspective comparable to that of Brian Wowk's essay on *The Death of "Death" in Cryonics* (*Cryonics*, June, 1988). The shift is, however, more subtle, being in this case a correction of an omission rather than a commission. Whereas Brian enjoins us to *speak* of suspendees as patients rather than corpses, Mike encourages us to *act* toward suspendees as patients rather than corpses. That means communicating with them.

Mike devotes almost his entire article to explaining the most apparent benefit of communicating with a suspension patient: upon reanimation, s/he will appreciate it. He also hints at benefits for the communicator, too:

1) It feels good ("You'll find it a surprisingly enriching and satisfying thing to do."), and

2) It allows us to express things we wish we had said earlier (such as, "I love you, I'll miss you, you were a great father...")

One may also add:

3) It helps keep our memory of the person fresh.

The most important benefit, however, and the reason for this letter, is:

4) "You'll be communicating with yourself."

Mike may have intended (4) to mean "You'll also be communicating with your *future* self," but an even greater benefit of communicating with a suspension patient is that it sends a powerful, affirming message to you right now.

Our actions speak (much louder than words, of course) not only to others but also to ourselves, often at a subconscious level. If we do *not* treat a friend or loved one in suspension as a patient (i.e., do not communicate with him or her), then the message of our (in)action to our subconscious is: "This is a dead person whom we can forget about because s/he isn't coming back."

The sorry consequence is that then we are just fooling ourselves when we talk about how cryonics can work; we are just playing "let's pretend that cryonics can work even though, deep down, we do not really believe it." Thus, for our own sakes, when we have a friend or loved one in suspension, we will want to treat that person as we do a sick friend or loved one in a hospital, which means that we communicate with him or her. To not do so would be a breach of our integrity.

Sincerely,
Kevin Q. Brown
Stanhope, NJ

Dear Editors:

I want to comment on several issues relating to cryonics services and costs, both inside and outside of Alcor.

First, readers will remember that the August, 1990 issue of *Cryonics* contained an article by Mike Darwin on the published statistics of Cryonics Institute regarding the amount they charge for services, the performance of their storage units, and other such matters (see p. 7). The main point of the article was that, while Alcor charges more, they have better performance (generally) on their dewars too, and have considered more issues in assessing the cost (e.g., storage space). The article also contained a major oversight, an overestimation, by a factor of six, of the boiloff rate on the main CI storage unit that was apologized for in a later issue (see *Errata*, *Cryonics*, Oct. 1990, p.1).

All in all, it is no overstatement to say that, even when the corrected figure is taken into account, CI is not presented in a very favorable light, and I know this has led to additional bitter feelings on the part of Ettinger and no doubt others involved in the Michigan enterprise. (I say "additional" because there is already a long history of antagonism involving certain members of the various competing cryonics organizations.) While this, I think, is unfortunate, on the other hand, one should not withhold or dismiss criticisms simply because certain individuals are not happy. I am not challenging the (corrected) figures Mike presents, but I would like to offer some of my own impressions on the CI operation, hoping it will create a more balanced perspective that I think is now lacking, and also inspire some constructive thinking.

First, I think there is one issue that is not mentioned, that ought to be pointed out, as an additional area of concern I would have if contemplating signing up for CI. (Yes, this amounts to a "criticism" of my own, but I offer it without rancor, as one more personal opinion, and acknowledge that there will be differences of

opinion on this issue.) According to their published literature, the amount CI charges for a whole-body suspension, $28,000, includes $8,000 for the short-term costs (perfusion, encapsulation, etc.) and $20,000 for indefinite storage. The $20,000 is expected to earn $1,000 per year, which works out to an annual capital growth rate of 5%. This, of course, must reflect real economic growth, after inflation is factored out.

As of January 1, 1991, Alcor will be charging $120,000 for whole body suspension. (As far as I know, CI plans to stick to their rate of $28,000 as they have for many years, so I'll assume this is their rate.) Most of the price difference between Alcor and CI does not come from different estimates of short-term or even storage costs but from the assumptions made about what rate of real capital growth one can reasonably expect. Alcor, in fact, assumes only a 2% real growth rate, and imposes an additional "safety factor" of two (that is, it charges *twice* the amount that would be needed, assuming the 2% rate, to provide additional security). If CI did this, it would have to charge a total of $108,000 for its suspensions ($50,000 would earn $1,000 per year at 2%; multiply the $50,000 by two, and add the $8,000 for short-term costs), which would be much closer to Alcor's figure. Personally, I feel more comfortable with Alcor's approach, since among other things I think the real growth of the U.S. economy in the present century has been in the ballpark of 2-3% rather than 5%, and I like the additional safety factor too. (It is not so great a hardship with the neuro option that I am signed up for, which at the time I signed up cost $35,000.) For the record I know that there is more than one opinion on this subject, however. Someone I know in Alcor, for example, who has considerable experience in financial matters, thinks the 2% assumption is too low and the safety factor of two is too high. I don't agree (though I'd like to be proved wrong) but I think this individual is well-intentioned, and so too, as far as I can tell, are the people at CI. (One thing that is badly needed is some actual data on earnings from funds allocated for long-term storage. Isn't this obtainable?)

I have had dealings with CI and their supporting organization, the Immortalist Society, for many years and I believe that, while not perfect, they are sincerely committed to cryonics and do not practice willful deceit. I was able to visit their facility in October, 1989. It is small, but neat and well-kept. Their fiberglass/epoxy dewars certainly have drawbacks but it is remarkable that they were able to construct them in the first place, and in some ways (e.g. boiloff) they compare favorably with some containers that are still in use at Alcor. Their suspension procedures are not up to Alcor's standards but they don't charge as much for them, either. I think there is a serious need to consider a lower-cost option for suspension than Alcor now offers, since many people, particularly newcomers to cryonics who suddenly find themselves with a terminal illness, are hard-pressed for cash.

There is some sentiment in Alcor for offering a lower-cost alternative (a cheaper neuro option, for instance) but also resistance. Some are firmly opposed to what they see as the "substandard" care we would then be offering. On the other hand, if a dying relative of mine agreed at the last minute to opt for cryonics, I would much rather see this person get a neuro straight-freeze than the grave or the furnace. It may be that some organization other than Alcor will have to take the initiative on lower-cost suspensions of this type. It could be a dangerous undertaking, of course. Not charging enough money has been a major factor in the collapse of cryonics organizations before (as with Nelson's operation in the 1970's). Also, if the quality of the suspension is lower, there is increased (but unknown) risk that it just won't be good enough. Finally, it may be that the major factor in the cost is simply what rate of capital growth you assume (together with the estimate of annual storage cost) so that offering a cheaper suspension won't save you that much. (This certainly seems true of whole body suspensions, at any rate.) Anyway, while mistakes have been and probably are still being made, I would like to encourage sincere and realistic efforts at offering lower-cost cryonics options, whichever organization is involved.

I am also aware that Alcor and other cryonics organizations have generally followed a policy, over the past few years, of not commenting directly on each others' operations. Generally, this makes good business sense; however I think all would agree that it should not be a hard-and-fast rule, never to be broken under any circumstances. I don't think it should have been broken, however, in the present case involving CI. (And despite arguments to the contrary, after careful consideration I still don't think it was the best policy in this instance.) However, given that the rule was broken once, I have taken the liberty of breaking it again (in the form of a letter) to offer what I feel is justified commentary.

So, with that out of the way, I will now comment on Dave Pizer's latest piece on (not lowering, but) raising the price of some suspensions in Alcor, that is, the neurosuspensions (*Cryonics*, Dec. 1990, pp. 13-15).

First, I should take the blame (and not Mike Darwin) for a misuse of terminology in an earlier issue (*Cryonics*, Oct. 1990, p. 13). I said "Dave Pizer wants to start charging Alcor's Operating Expenses to the Patient Care Fund." What Dave really meant was that money contributed by a member at legal death for suspension-related expenses would be partly allocated for operating expenses, and partly for the Patient Care Fund. The reason for the confusion on my part was that, under current policy, all the money for suspension-related expenses goes into the patient care fund. So it was natural for me to think of this as "patient care fund money," even though in theory it could be allocated, right at the start, for something else.

Second, Dave discusses the issue of possibly using a portion of suspension funds for anticipated legal expenses. He expresses the view that, if this is done, both neuros and whole bodies should have to pay the same amount for these expenses. He then notes that someone he talked to recently advocated charging whole bodies more for this because they are bigger! That latter position, I admit, is pretty ludicrous, and it teaches a special lesson in humility to me, inasmuch as I was the one who, in the heat of a conversation with Dave some weeks ago, for a while was advocating it! Yes, I can be downright stupid, particularly in verbal confrontations (one reason I tend to shy away from the same, and prefer expressing my thoughts in writing). In any case, let's keep those legal expenses low, from now on, if at all possible. By the same token though, it is clear that the amount of resources needed to support a whole body patient is much greater than for a neuro. (This is especially plain to me, since I have been Alcor's Patient Caretaker for the past several years.) This would lead, realistically, to charging less for many services involved in the care of neuros, as opposed to whole bodies. One is operating expenses. One facility with, say, ten bigfoot dewars and a certain size staff could support 540 neuros but only 40 whole

bodies. The individual overhead for each patient is low, because, as a rule, there are no separate accounts (as Carlos Mondragón, our President, recently confirmed). Of course, we are not yet anywhere near to the point of having 540 neuros, but the ones we do have could be interspersed among the whole bodies in bigfoot dewars. In this way we could probably come fairly close to the saving of resources per neuro that we would realize if we could pack a whole bigfoot with them. On this basis then, if patients are to be assessed for operating expenses, whole bodies should be charged substantially more than neuros.

Finally Dave, in his article, includes some estimates of cost, both for neuros and whole bodies. I would like to see more detail, as is shown in Mike's article in the September *Cryonics* (pp. 15-36). Over 10 pages of that article are devoted almost exclusively to cost estimates. I think it is very bad to have to raise suspension prices, and we need a detailed breakdown of cost estimates that others can examine, ponder, and question, if we are to take such a step again. Although it might be a lot of work, and would probably result in some delay, I believe it is better to carefully weigh the evidence than act hastily in a case like this.

Mike Perry,
Alcor Foundation

Mike Darwin responds:

Mike Perry has done a fine job in analyzing the situation with CI. In particular, I think he has done a real service in pointing out the difference in the basic assumptions CI and Alcor make regarding financial security, long-term figures for the real cost of money (2% vs. CI's 5%) and so on.

I really only have a couple of comments to make. First, anyone with financial acumen or a grasp of economic history will know that over a very long period of time 2% has been the real rate of return on money. Yes, it is possible to do far better, but only by taking increased risks. The reasons for this are complex and beyond the scope of discussion here. Suffice it to say, this knowledge is not arcane and can be had by opening any basic economics text. Things may change in the future, hopefully for the better. But we'd rather not bet on it. We're already counting on the future plenty more than we want to already.

Also left out of the CI costs equation is any thought or provision for resuscitation costs. These may well be nontrivial. Certainly prudent people would not want to leave that issue completely unaddressed.

Finally, a word about "bad-mouthing CI" and leaving critical things unsaid. My article was hardly *ad hominem*, and aside from the calculating error, laid the facts out as they are. A central, much touted part of CI's program has been the delivery of storage at rates lower than that which could be obtained by purchase of commercial cryogenic storage units. They have also repeatedly, publicly (and in print) challenged Alcor on **our** assumptions about interest rates (*Longevity Report 22*) and I quote Bob Ettinger: "Incidentally I'm not sure why Mr. Sinclair [of Alcor U.K.] allows only 2.5% anticipated interest. It has been a long time since rates were that low; if they ever become that low again it would seem to imply a deflation bringing reduced costs of many kinds."

This kind of statement reflects a serious misapprehension about how the world works. CI's claims of lower cost storage never materialized. So we get questions from members and potential members about CI frequently and we are not going to blindly refer them to CI for answers where we feel the quality of information they are likely to receive will be wanting. Neither Alcor nor *Cryonics* has ever had (and I hope never will have) a policy in which objective criticism and commentary on any aspect of cryonics (as practiced by Alcor or others) is forbidden. Debate and open **dialogue** are critical to growth and achievement in any sphere. The notion that there should be no interaction or criticism between cryonics groups over important issues of technology, economics, and policy is both unrealistic and counterproductive.

I believe that my article, and even more so Mike Perry's letter (since he makes the point even better than I), does everyone a real service, including CI.

Book Review

"Let's Not Get Physical"

Review by Valerie Alison

(*Physical Evidence* by Thomas T. Noguchi, M.D. and Arthur Lyons. G. P. Putnam's Sons: New York, 1990.)

In the last several years, I've succumbed to an entertainment I always wondered about when I was a librarian—mystery reading. Although I was first hooked by Sherlock Holmes when a preteen, the addiction lay dormant until I began seeing the new British version of Holmes with Jeremy Brett. However, with little time to read, I've stuck mostly to the classics.

So I missed Arthur Lyons's "Jacob Asch" series for lack of a recommendation to it, and Noguchi's and Lyons's first book, *Unnatural Causes*, though I had read and liked Noguchi's two nonfiction books, *Coroner* and *Coroner at Large*. When a friend gave me this book to read, I was curious enough about how typical it was of its authors to read four of the Jacob Asch mysteries and the earlier Noguchi-Lyons work. It seems to me to be unlike any of them, but maybe I'm biased because I got so infuriated reading the book that it was very difficult to finish it. The reason? Like many novels based on real headlines, this one's main plot concerns cryonics, the Dora Kent case in particular.

It's like stepping into an eerie alternate universe. Many of the people are somewhat recognizable, a sort of Truman Capote gallery: Alcor members, Noguchi himself, and members of the Riverside Coroner's Department, for starters. Some details of places and events also remain in the sometimes thinly disguised fictional portrayals, while others are shockingly twisted. Were all the exaggerations and twists done for dramatic effect? To distance the fictional from the real? Or were some the effects of ignorance or opinion?

Like Noguchi himself, protagonist Eric Parker is an ex-medical examiner

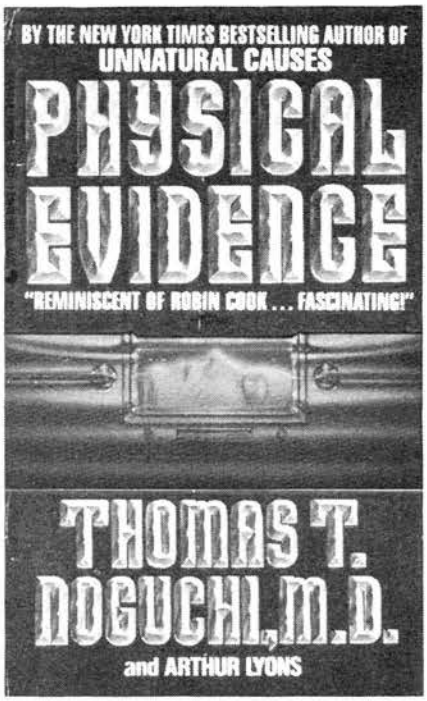
ousted from the LA County ME Department (a point lamented again and again during the novel). His partner Mike Steenbargen was a subordinate of his in that department, and now the two of them are private investigators whose specialty consists of Parker's forensic abilities, and his access, negotiated in the last pages of *Unnatural Causes*, to the LA County Forensic Medicine Department. Unfortunately for my ability to sympathize with Parker and Steenbargen in this second novel, this technique of leaving all the explanatory details in Novel #1 is quite typical. Parker's first name isn't even mentioned until page 29 of this book, and little time is given to his characterization. The first novel is really quite a worthwhile read about forensics and the politics of coroners. The details are carefully done and I found myself utterly convinced of Parker's sincerity, integrity and warmth. Even the sex seemed appropriate and not just thrown in for the teen-age male readers. In the second, he is (again like Noguchi) a university lecturer as well as a PI.

I think I've read enough of both authors as separate stylists to venture the opinion that much of these novels is Noguchi. My feeling is that Lyons acts as an editor, giving the prose an IV push of humor and filing off some of the rough edges. Rough edges do, however, remain. The second novel in particular seems to feature choppy writing, stereotypical descriptions, and awkward prose, whereas Lyons' mysteries are smooth, funny and sophisticated.

For instance, Lyons doesn't go out of his way to put down women in the old tradition of Sam Spade, but in *Physical* they seem to be either bitches or sexpots, with sometimes rapid transitions between the two. There is also bad proofreading (not as visible in *Unnatural*), which twists medical terms ("neutrophils" into "neutral fields," "Stryker" into "striker"), and a sort of bad-language generator, which inconsistently puts four-letter words into Steenbargen's and others' mouths, as though Noguchi believed that detective novels ought to have swear words, and randomly inserted them.

I warn you that I'm not going to be squeamish about giving away the plot of the book, since I don't recommend you read it. Noguchi is probably trying to create The Great American Forensic Novel, and has melodramatic tendencies which Lyons has not managed to damp —they worked better (at least for me) in the first book. So *Physical* begins with a clumsy description of a cryonic suspension at a fictional amalgam called "Freeze Time." One of the two—Noguchi or Lyons—must have taken a tour of the Alcor facility (or had a very good report of it), so the security and secrecy surrounding "Freeze Time" cannot possibly be anything the authors would attribute to Alcor in this universe.

In their universe, Alcor's one-time pets Slinky and Dixie (friendly German shepherds) become "Freeze Time's" vicious Rottweilers, bouncing their bodies off the outer fence, their hostility cut suddenly at the command of zombie-like personnel. The picture of the man in a World War II uniform still hangs alongside other black and white photos, and the steel



dewars still tower above the tour guide in the patient-care bay, but Mike Darwin's "nickel tour" has become a "sixty-cent tour" conducted by a giant of a man named "Gabriel" (!), who looks like Andy Warhol and behaves like Jim Jones. When I read the description of the suspension, I was sure that Gabriel would be a thinly-disguised Mike; however, although the character is introduced in the beginning, no physical description is given until he meets Parker, almost halfway through.

It was a relief to find Gabriel unrepresented in our universe, although it's a temptation to see him as some kind of weird combination of Mike Darwin and (Trans Time president) Art Quaife. Some of the phraseology Mike and other Alcor members tend to use is put in Gabriel's mouth, but Gabriel is a believer in the Wagnerian, Shavian, Nietzschean "Superman." This is an apparent distortion of the speculations by various cryonicists that future human beings will be very different due to basic changes in the human genome, control of the environment, et cetera, brought about by straight-line extrapolations of current medicine and engineering technology.

Just as the old Orange County facility (Alcor has been moved back for the novel) did not have the name on the door (neither did the new one at first), Freeze Time has no name, just a number. The five-digit address is about right—a dead-end street in an industrial ghetto, with a chain-link fence surrounding the yard. The authors describe a pamphlet Gabriel gives them, "Case Study of Patient #B-123" as "a mishmash of technical mumbo jumbo." In their universe, facility staff have had their cars vandalized by animal-rights activists. Whereas Alcor keeps no animals except pet fish in an aquarium, Freeze Time has wall-to-wall cages full of plaintive, suffering animals (kittens and puppies of course), on which it spends the hundreds of thousands of dollars in gifts, creating "the Island of Dr. Moreau," or, alternatively, a "House of Pain." A third characterization is "a canine Auschwitz." It is Steenbargen who is particularly shocked by this, and spits the word "traitors" at the Rottweilers as he leaves the facility. There have already been enough bad words about cryonics, but as if to deliver the crowning blow, the authors crank up their bad-language generator as Parker and Steenbargen climb back into their car:

"I'm sure glad to be out of there. That place is f---ing Weird City." He shook his head. "I can't believe he seriously thought you might endorse his nutsoid operation."

"Maybe he didn't," Parker said, starting up the BMW [!]. "Maybe he was just testing my reaction."

"You give him that much credit?"

Parker shrugged. "Even if he's crazy, it doesn't mean he's stupid."

Steenbargen grinned broadly. "No. He has to be smart to go from giving enemas [Gabriel formerly worked in a colonic clinic] to producing the f---ing Superman. You think he really believes that horse s---?"

Jerry Leaf's "square-jawed, handsome face" belongs to an incompetent doctor by the name of Katsilometes, dominated, like

all the rest of "Freeze Time's" members and payees, by the messianic Gabriel and the wealthy son of the woman suspended on the first pages of the novel, Bruce Wechler (Saul Kent). In the alternate universe of Freeze Time, Saul/Bruce lives on Wilshire Boulevard, but his house looks much the same. His effervescent personality has apparently turned to putty in the hands of, first, his mother (now "June Wechsler"), then Gabriel, although at the end we see this was for appearance's sake only.

Saul's display of keepsakes of his mother, the photos on his mantelpiece, have become a "shrine," his portrait (obviously cribbed from TV coverage—but where did they get the inside of the house from?) washed out and unflattering, and he has acquired a greedy sister who inexplicably and unconscionably turns from bitch to sexpot by story's end. Dora Kent herself, whose suspension (as June Wechsler) opens the book, and whom, in this universe, was defended and cared for despite threats of murder prosecution, has become an apparent victim of Alzheimer's, and for real a victim of her son's scheming.

The Chatsworth disaster is referred to as an out and out "fraud" instead of an extreme case of a common set of mistakes made by early cryonics organizations. (The circumstances of the case are described as definitely due to its founders' loading up on cocaine and cars instead of cryoprotectant, and there is no recognition of the fact that one person frozen by the old CSC is still cared for by Alcor.)

There is little said about the Riverside coroners, their office having moved to Orange County, but the Orange County coroner's first name is "Ray." The authors sympathize with their problems generated by publicity surrounding events which actually followed the Kent case in this universe—the release of the wrong corpse for cremation (it belonged to a suspected murder victim), and a scandal involving moonlighting staff. Interesting that the moonlighting staff in the alternate universe, instead of indelicately storing pathological specimens on a backyard picnic table and leaving them there for a subsequent occupant, was selling pituitary glands removed from decedents who happened to be passing through.

A most frustrating touch for me is that, after bridling at the characterization of an autopsy as a mutilation, the authors then describe one, replete with typos and unmedical, unprofessional documentation. Later they describe another one, and use the word "macabre" when presenting a spinal tap on a "hollowed-out, headless corpse," after which Parker has to hold himself back at having autopsies described as "butchery." What other word would you use for cracking someone open with a pair of pruning shears, ripping out and slicing up all the internal organs, and peeling the face off to get at the brain?

Speaking of frustrating, one of Parker's students, after the first autopsy, gets the hots for him, as though that were the most erotic act a man could perform (later she breaks into his apartment, confronts him nude in his bed, and poor Eric has to turn this sexpot down). I know the descriptions of autopsies are more or less accurate because of my work experience, and I've done full-color research on them. The methods are ancient, nauseating, and (I can't help thinking) largely unnecessary in these days of high-accuracy imaging techniques. Of course, magnetic-resonance imaging (otherwise known as nuclear magnetic resonance imaging) and computerized axial tomography are still too expensive to be done on every decedent, but worth it in the case of a cryonics patient.

Worst of all, the patient and careful attention to detail evident in the first novel is missing from the second novel. While Noguchi argues eloquently for his causes—forensics in the public interest, including DNA-typing admissible in court—he is sloppy enough to allow June Wechsler to come to consciousness at 11 degrees Centigrade! (When it was pointed out to him that this was quite impossible, he conceded that he had not known this!) There just wasn't enough research into cryonics to make for a believable book on it—at least to those knowledgeable in it.

The most dramatic example of this is the death (NOT deanimation) of Gabriel himself toward the end of the book. Action drama: Parker is cornered in Freeze Time's patient-care bay, backed up against a liquid-nitrogen delivery dewar, Gabriel's semiautomatic weapon pointed at his middle. Gabriel is in the hall, several feet away. Parker feels the valve just over his left shoulder. In a flash, he reaches up and turns the valve a split second before hitting the floor. After the spray of bullets, he gets up to find Gabriel frozen in place, a statue with a gun too cold to hold, instantaneously dead from the rush of liquid nitrogen!

It's obvious from their description that the authors knew what a liquid nitrogen delivery dewar looks like—at least vaguely. BUT . . . Recently, the American Cryonics Society ran a lengthy article in their newsletter explaining how liquid nitrogen is used to keep patients cold. They featured their LN_2 technician, and published three different photos showing exactly how delivery dewars look, including what happens when the valve is turned, spraying LN_2.

Now, the pictures in the ACS newsletter make it very clear that when the valve is just over the shoulder the spray from the dewar would go no higher than a man's throat—especially on someone who's 6 feet tall. It's also very clear from the picture that spray from the valve is too diffuse to cause much damage, even at close quarters. The very idea of spraying to death someone who is several feet away, and taller than the dewar, is comical. It doesn't do much for any knowledgeable person evaluating whatever else the authors have to say about forensics. [Actually, until the line is cooled down, all you get is cold gas. This will take at least a few seconds. -Ed.]

By report, Noguchi himself is not hard on cryonics, having told an irritated Alcor member that he thinks it will probably work. But his protagonists and their associates do a really nasty job on it, and the cryonicists implicate themselves in blatant murder, fraud, and forgery. My personal mystery consisted of trying to figure out why Noguchi believed such things were possible or probable in cryonics—the assumptions behind the plot. I finally came to the conclusion that the authors' thought processes went like this: what if a client of a cryonics organization wanted to use them to murder his wealthy mother, and, while he had control of her nursing home, harvest a few other wealthy clients by forging their signatures on cryonics contracts? It involves hiring an incompetent doctor who will play along, and taking advantage of laws which make cryonics legal (Roe *et al* v. Mitchell, for instance) and do not require autopsies if a doctor will sign a death certificate and there is no immediate evidence of foul play.

The authors make a number of assumptions which lead me to the conclusion that they may have even once believed that some scenario like this led to the Dora Kent suspension:

1. They believe that cryonics cannot be profitable without a larger membership base and large gifts of money. They're right there, and this goes against the usual popular assumptions. In many ways, a

cryonics organization is much more like a health-maintenance or insurance organization than it is like a clinic or a store. In the case of the latter, the more treatment or goods you can sell, the better off you are. In the case of the HMO or insurance company, however, the healthier you keep your patients the better off you are. Treating them, operating on them, and so on are costly, whereas taking their dues and practicing preventive health measures keeps the organization on an even keel. Cryonics groups are mutual-protection societies which hope to heck they won't actually freeze people, but have to live with the sad fact that they often do. We don't rub our hands with glee at the thought of a member's "deanimating" (yes, Noguchi and Lyons pick up this terminology). It's a sickening event which must be dealt with in a fast, professional, and businesslike manner, but drains the organization both emotionally and financially every time it happens. The only exception to the financial drain is the rare occasion on which a member leaves more than a suspension fund to the organization. Which brings us to our second point.

2. They represent the cryonics leader as a cult leader. The accusation is not new. Because many of the answers cryonicists give to questions have been carefully thought out, and are often repeated to respond to the same queries, the authors consider them canned replies given by fiat by a guru—in this case a white-haired giant with a Messianic complex. Having such a leader would allow a cryonics group to prey on the minds of grieving relatives, and take advantage of their incompetent, terminal parents to make new wills leaving substantial amounts of money to places like "Freeze Time." Of course, the truth is the other way around—as we know from the Dick Jones case, it is the relatives who take advantage of 11th-hour wills to void ones leaving money to cryonics organizations. (Freeze Time, by the way, was incorporated in Texas.)

3. The authors believe that legal decisions favorable to cryonics are boxing coroners and medical examiners into a corner from which they will not be able to protect the public interest. One particular case in point mentioned by them is the Roe v. Mitchell (State Department of Health) case, of which they predicted the outcome. They apparently feel that the decision for Alcor (not mentioned by name, but as "a cryonics outfit like Freeze Time . . . in Riverside") would block autopsies from being performed on cryonics patients unless strong evidence could be raised for foul play. They also mention the refusal of an injunction to hand over Mrs. Kent's head. The book suggests that the "Physical Evidence" of the title could not be dug up by the standard, overworked coroner's or ME's office, even in the face of the gross malignancies of "Freeze Time."

4. The authors believe that only certain people are "legally empowered" to declare legal death, with the implication that anyone else must have some dark reason for doing so. (There is no law I know of which so states.)

5. The authors state that they think Gabriel is talking nonsense when he explains the use of pentobarbital (a long-acting barbiturate) in suspension patients:

"We have found that the patient can continue to have agonal spasms up to forty minutes following cardiac arrest. The pentobarbital quiets this, as well as reducing brain damage from reduced circulation."

Parker thought that to be nonsense, but said nothing. Giving a dead person pentobarbital would be about like giving him a high colonic. It wouldn't do anything, but it wouldn't hurt him.

Apparently Noguchi: (1) doesn't know about the research which gives the indications for the use of barbiturates in drowned persons, research which shows the reduction of brain metabolism by 30%; and (2) believes that there would be no effect of any kind on a person who had been declared legally dead. Yet not two paragraphs before Gabriel had explained that the patient is placed on a "heart-lung resuscitator" before the administration of drugs. Later on (at the autopsy of the headless body), Noguchi explains that "whatever drugs were administered even after death would be pumped into her tissues," but apparently does not believe that this would have any effect. Incidentally, Parker says that a spinal tap would tell whether the pentobarbital was administered before or after "death" because "theoretically, it would take at least half an hour of perfusion to get drugs into the spine. If we find pentobarbs in the fluid, it would indicate the woman was still alive when the drug was administered."

Later, the officiating pathologist (one of Ray's employees) protests that the woman might have been on the machine more than half an hour, and that they would need her head (which was frozen) to "determine for sure whether she was alive when the drug was given to her," and Parker concludes that "if she was still alive when the drugs were administered—one would expect to find significant amounts of pentobarbital in the brain tissue." This despite Parker's statement that the drug "would be pumped into her tissues" by the heart-lung machine and that, even though it might leak more slowly into the cerebrospinal fluid, long enough on the heart-lung machine would do it.

Could this have been the rationale behind wanting Mrs. Kent's head? The pathologist involved in the Kent case, now himself deceased from spongiform encephalopathy most likely caught from brain autopsies, came to the conclusion that pentobarbital had caused Mrs. Kent's death, and there was a brief effort to get the head to prove it. Conspiracy theory #5,842.6: was there a connection between the conclusion of the pathologist and the theory advanced in the book, or was it just a case of two pathologists—neither of whom knew very much about cryonic suspension—coming to the same ignorant conclusion?

6. The authors feel that a "major conflict of interest" would result if someone having an interest in a nursing home housing people signed up for cryonics were to also have any kind of financial interest or control over a cryonics organization. This is distressing considering the Venturists' eventual plans to build a nursing home complex expressly for cryonics patients. In the book, this "major conflict of interest" produces involuntary cryonics patients as well as murder on the outside when discovery is threatened.

7. The authors seem to feel that much of cryonics is just bogus. When the protagonists are in Gabriel's lair he describes some of the events leading up to the suspension of "June Wechsler":

". . . I went immediately to the lab and got the equipment and crew ready to transport the patient."

Patient. Parker tried not to show a reaction to the terminology. . .

This shocks me. Surely Noguchi knows the procedure for organ donors. Here it is, from my experience: in California there are very stringent requirements for organ donors involving a neurological countdown. A patient must be examined using a set of neurological guidelines. Twenty-four hours later those same guidelines must again be used to determine "brain death." The patient is then declared

legally "dead," and discharged from the hospital. But the discharge is purely administrative, just paperwork, because s/he is not removed from the hospital, but merely readmitted with the California Transplant Network as his/her attending physician. The Network, having already been notified, will have at least one team on its way, while the donor is kept on whatever resuscitation equipment is necessary to maintain the viability of the heart, lungs, kidney, corneas and/or liver—all of which are currently transplantable organs. The legally dead donor is characterized as a *patient* throughout this second hospital admission, until the organs are removed, and the "remains" are released!

So Noguchi should be familiar with terminology concerning a legally dead person as a patient until transplantable organs are removed. This common situation differs from the circumstances of cryonic suspension only in that the transplanted organ in the case of a cryonics patient is the brain—and that, because of that, criteria different from "brain death" must be used to determine readiness for a suspension protocol. So why would he react so negatively to terminology which simply mirrors everyday medical practice?

Probably because Noguchi may feel strongly that cryonics lends itself to abuses of the grossest kind. His opinion does have some redeeming value, despite the continuous, irritating put-downs. There are no legally recognized criteria except "brain death" for declaring an organ donor ready for organ removal. What could prevent a cryonics organization from stretching the limits of legal death in order to freeze someone who didn't want to be frozen —yet? Where are the definitions? Where is the protocol?

I think this—and not the hatchet job the authors did on us in their book—is what we ought to focus on. Noguchi and Lyons raise legitimate questions which ought to be addressed, and addressed soon in order to quiet the fears the book could raise. Even if Noguchi isn't ready to be "converted" by Gabriel and his "nutsoid" group, perhaps he would be willing to work with real-life cryonicists to avoid the kinds of abuses he seems to feel are possible. I wonder what he would do if someone said, "OK, Noguchi, you brought it up—you've got the job."

Valerie Alison has published poetry in Cape Rock Quarterly, a play and other poetry in other "little magazines," and drama reviews under her married name of Manchester.

Questions (And A Few Answers) About Memory

Part One Of Two

Thomas Donaldson

This is a transcription of the talk I gave at the 1990 Asilomar Conference in Lake Tahoe. This is not so much an attempt to give answers as it is an attempt to draw boundaries between what is known and what is not known, in hopes of using these boundaries to guide our actions. Although I believe that there are many solutions to the problems we face as cryonicists, I think that postulating solutions to these problems is premature. I describe these problems only to help bring us to the point where we can *solve them. What possible solutions I* do *describe are only sketches of solutions: ideas of directions in which we can work. They may be interesting even so.*—TKD

[The figure numbers are an artifact of the talk and will not correspond to their sequence here. —Ed.]

The Questions

The first question is very hard to answer. This hasn't inhibited speculation by cryonicists at all, but since it serves as a basic assumption for this talk, I should clarify it and discuss it a little.

Question 0: *Are we the same as our memories plus our physical structure?*

Perhaps so brief a statement begs far too many questions. First of all, what is meant by "same" in this question? I'm not the same as I was yesterday. Or again, what is our "physical structure?" Just our bodily form and composition? Or should we count the setting in which this body exists? We all have a strong sense that our identity is neither arbitrary nor dependent on what other people think of us (is this feeling accurate?). If some exact copy of you is at your home right now, are you in two places or is one of you an impostor? Or could you wake up one morning with the same body and memories, and feel that you are now a totally different person, unrelated to that complete ass whose life you remember?

All such questions, even the question about identity ("the same"), depend partly on hard physical facts, but they also depend on our own and other peoples' reactions to them. My own response is that we'll simply have to see how we feel and act when such experiences actually happen.

Question 1: *How does memory work?*

Since we always remember something in the context of doing other processing, Question 1 comes close to asking how the brain itself works. A lot has happened on this question over the last few years.

Because of the work of Thompson (R.F. Thompson and D.A. McCormick, *Science*, **223**, 296 (1984); **233**, 941 (1986)), some distinctions have become very important. Any normal memory will involve many different regions of the brain. It therefore cannot be destroyed by any local injury. Thompson himself also points out that a small local region in his terms may contain many neurons. What Thompson has shown, however, is that at least one single learned reflex will disappear if the animal is injured at one very small brain site. We should therefore think of our memories as made up of small pieces scattered through all the different regions of the brain involved in processing it.

Experimental techniques have progressed a lot. This means that we can

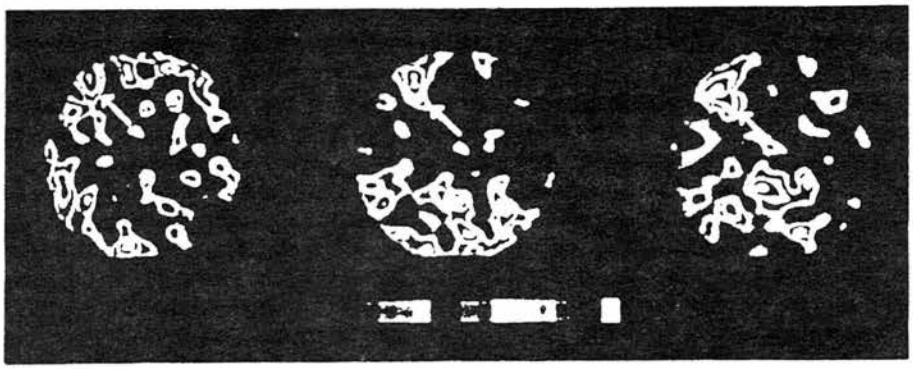


Fig. 6. A normal human brain in action. (From MI Posner, et al, *Science* 240 (1988) 1627.)

actually view a brain working on a problem (and presumably remembering any experience it has relating to that problem). I've managed to get some pictures of this kind of processing going on. Clearly processing goes on in many different locations (Figure 6).

It's commonplace among cryonicists to say that we may face "some" damage to our memories and so to our identity. Careful work with pictures of this kind may allow us to actually specify likely losses.

This is all very well, but it leads to lots more questions.

If our memories exist in fragments scattered throughout our brains, how are they integrated, in our behavior or in our awareness?

This is really at least two questions. It asks about behavior and awareness separately (many of our memories —riding a bicycle, typing, playing the piano—differ from others, which we can call our conscious memories: i.e., who was Tolstoy). It also (to use an analogy which *may* not hold) asks about the computing methods used, versus the data structures. Or, to use another analogy, what is the grammar our brain uses to link together all these different responses?

At first, questions at such a high level may seem unrelated to cryonics. But they are extremely practical. We've just seen that sufficiently small responses localize very precisely to special brain regions, and we all agree that we may suffer some brain destruction. But that need not mean that the information contained in these destroyed regions is gone forever. If we knew enough about how the brain works, we might infer it from other memories still remaining. That is, if we knew enough about memory, we could work it out from what we had.

Unfortunately, we're still far from that point. It's one thing to believe that neural nets may imitate our brains' computing, quite another to describe precisely what kind of algorithms these neural nets use and how their separate processors are linked together. I believe study of this issue has gone farthest with visual processing (Figure 2). However, wiring diagrams should not be identified with algorithms.

So far as I can see, the solution of problems on this level depends only weakly on the precise "hardware" involved. We're not talking about memory on the level of individual neurons and their chemical functioning. But some of general features must be important.

For instance, can neurons act as AND-NOT gates (firing if one input is plus while another is negative)? One paper shows that neurons in the visual cortex do not fit at least one model for how such a gate could work (R.J. Douglas et al, *Nature*, **332**, 642 (1988)). My own sense of the matter is that more electrical engineers should enter this field (but when they do they should constantly remind themselves that they aren't working with a computer, that they shouldn't just search for computer parts in the brain). We need better ideas of how neurons process impulses.

Usually, papers on operation of neurons and the synapses connecting them discuss only the transmission of signals through the synapse itself. Usually a neuron has many different inputs. Numbers on the order of 3000 aren't unusual (this puts them one order of magnitude ahead of the best current computer chips). We know that some synapses to other neurons tend to inhibit the other one from firing, and others tend to promote firing. On this basis, Hopfield and others have produced small simulated networks which behave

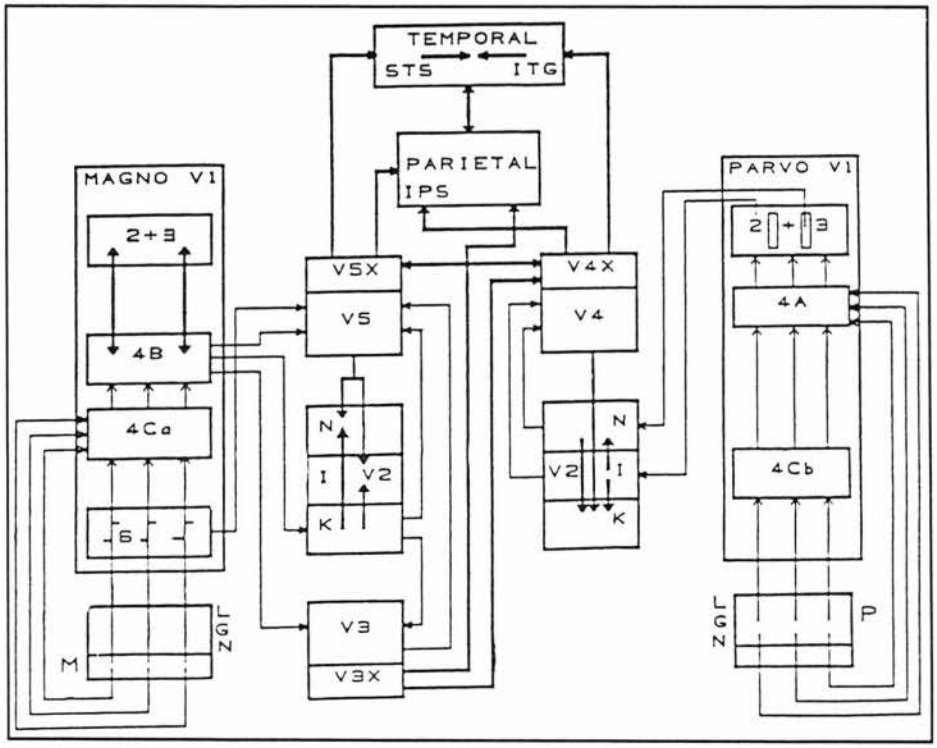


Fig. 2. The visual circuit as worked out from experiments.

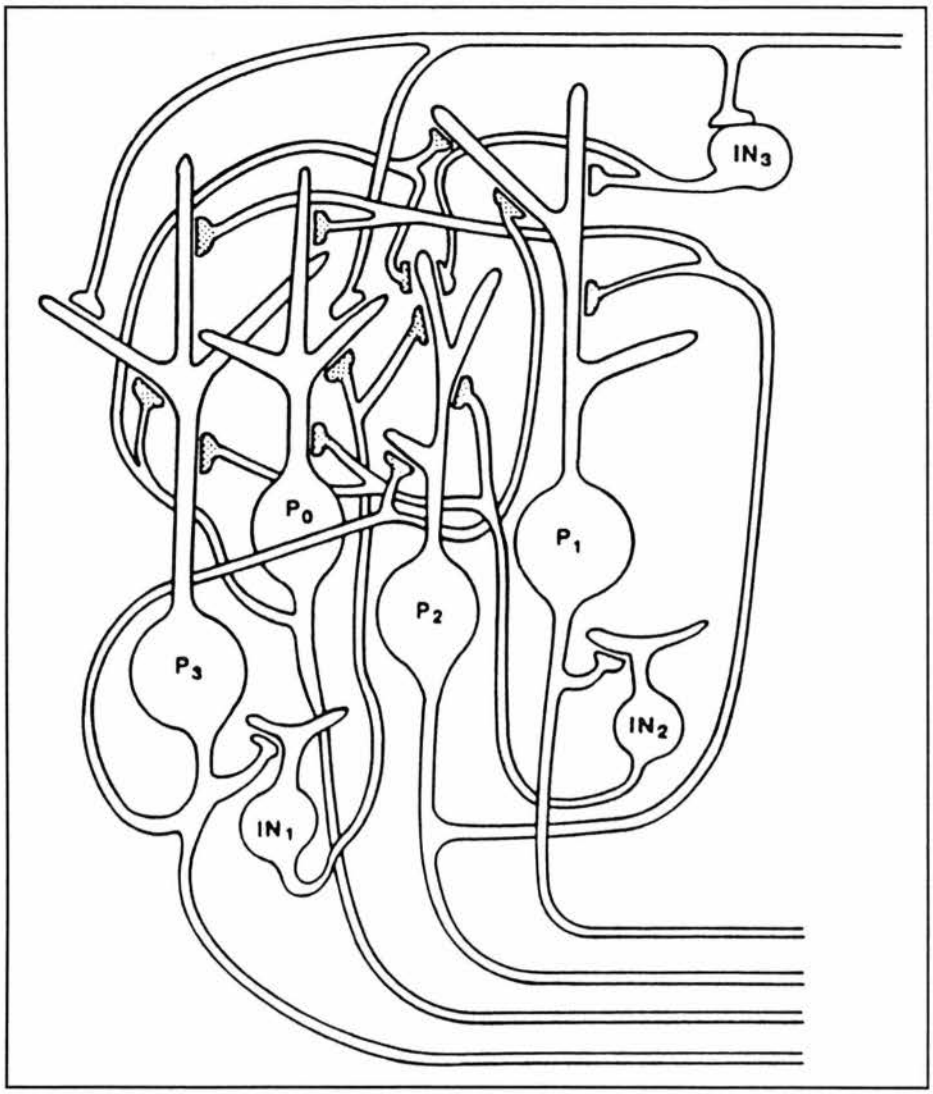


Fig. 14. Hopefield and Tank's model of a learning circuit. (From JJ Hopfield, DW Tank, *Science*, 233 (1986) 625.)

plausibly like neurons (J.J. Hopfield and D.W. Tank, *Science*, **233**, 625 (1986) and Figure 14).

To understand actual neuron behavior in an actual network raises intense experimental problems. These will probably first reach solution in small invertebrate nervous systems. An understanding of how our brains actually work—as opposed to simulations—will be needed for cryonics because far too many different ways to model the same behavior are likely. For repair, we want the real nitty-gritty. Clearly this is a problem which may take decades of time, great computing capacity, and probably even biochemical (or nano) devices to work out. (These devices would make instruments, not medicines.)

There is a second question stemming from Question 1. Any practical cryonicist can see its importance: How and to what degree does brain operation follow methods unique to individuals rather than common to everyone?

This question has virtually no answers as yet. If, in revival, we can reliably assume that every individual follows the same pattern of processing as every other, the problem of revival is far less. We need only understand that one common pattern. If every person's brain has totally different anatomy and connections, revival becomes far more difficult.

However, we must expect that at some level individual differentiation will occur. Any system for revival must cope with this. For instance, the exact pattern of regions responsive to different classes of stimuli in the visual cortex of monkeys differs from one monkey to another (G.G. Blasdel and G. Salama, *Nature*, **321**, 579 (1986)). Since we are reviving an individual, frozen under current (or even earlier) conditions, we'll need some way to detect this individuality.

Differing response between one region and another must depend finally on their chemistry and anatomy. We may even now have the knowledge of how to distinguish. It doesn't exist, however, in any easily accessible form, but is scattered through many different papers, none focused on providing an answer to this question.

Further, how well does the connectivity of our brain survive cryonic suspension? This question has many sides. Unfortunately, a lot of these sides simply haven't been looked at. For others we have suggestions of an answer, sometimes even strong suggestions, but nothing I would consider firm proof. But we cannot avoid asking it.

The first obstacle is that very little experimental work on freezing brains has been published. Isamu Suda published pathbreaking work on this issue in 1966 (I. Suda et al, *Nature*, **212**, 268 (1966)), and then seven years later, in 1974 (I. Suda et al, *Brain Research*, **70**, 527-531 (1974)). Houle and Das have studied how embryonic brain tissue responds to freezing (G.D. Das, J.D. Houle et al, *J Neurosci Meth*, **8**, 1 (1983)). Greg Fahy has done experiments on preservation of rabbit brain, suggesting almost total preservation (G. Fahy et al, *Cryobiology*, **18**, 618 (1981); *Cryoletters*, **5**, 33 (1984); *Cryobiology*, **21**, 704 (1984)). The hostility toward cryonics of many cryobiologists may very well have played some role in the lack of published experiments about this key issue. Until very recently, cryonicists themselves have had to deal with even more basic issues (like short-term survival!), so little has been done.

So let's look at Suda's work. First, he only froze his brains to -20C; apparently for quite unknown reasons recovery was worse (though still not zero!) at still lower temperatures. He made microscope slides to judge the integrity of the cells, and found that the neurons were quite undamaged. (Tangential evidence supports him. One

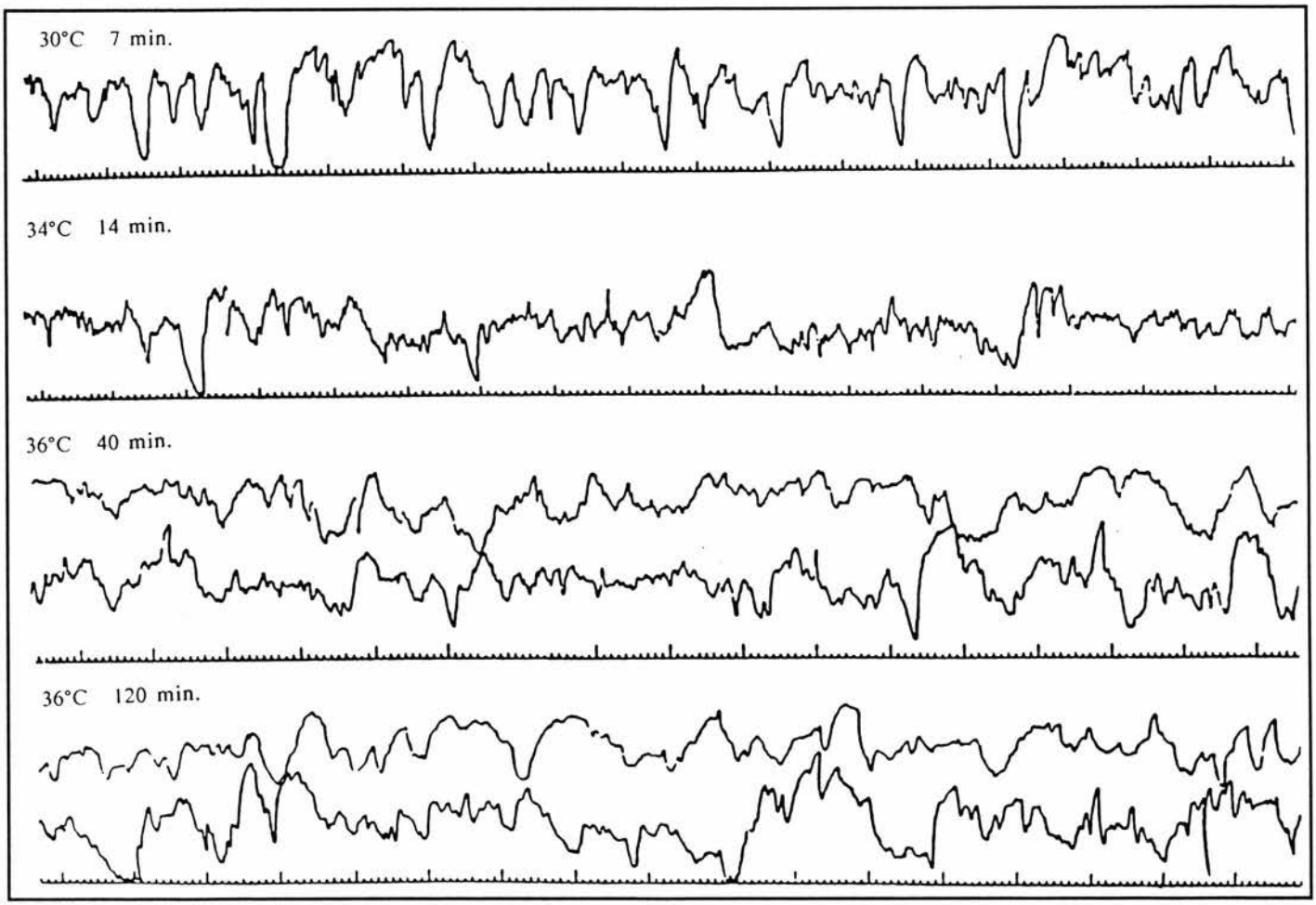


Fig. 5A. Isamu Sada's brain waves *after* freezing and revival.

prior scientist froze adult cervical ganglia (J.E. Pascoe, *Proc Roy Soc B*, **147**, 510 (1957)). Other scientists since have shown that individual fetal neurons survive freezing (V. Silani et al, *Brain Res*, **473(1)**, 169 (1988)). Revived brains would not work for very long; small hemorrhages apparently started and things went downhill. But for a short time he got almost normal electrical activity from his brains (Figure 5A; a normal EEG pattern for humans is in Figure 5B).

Just as with other organs, the main problem seems to be disorganization at a level higher than individual neurons. Suda suggests that his freezing process produced a multiplicity of tiny cracks. The cracks clearly weren't enough to destroy electrical activity. This means that very many nerve connections must have survived.

What about those that did not? Here some form of biochemical/nanoscale repair would likely serve. We can specify quite precisely the problem such devices must solve. The frozen tissue has cracked, which means that at the face of the crack it has moved. From Suda's example, it cannot have moved far, no more than width of a few cells (5 to 10 mm). The problem consists of recognizing the opposite face of the crack and moving it back.

The recognition problem, computationally, is complicated, but we have no reason to believe it can't be solved (though the computational power needed may defeat attempts to make repair devices of nano size). The volume of repair device needed is also not an essential problem. Once we have the brain, we can if necessary physically disassemble it, keeping a record of original locations of everything, and put it together again without the cracks. However, no amount of computation can succeed on this problem without DATA. Repair devices must sense this data too. We actually have quite a good idea of data which would work; I will discuss this later.

The problem is likelier to turn out far easier than this. First, Suda also observed (from looking at slides taken before and after) that a high proportion of cracking happened on thawing, not freezing. The main problem with cracks looks like hemorrhage, not an issue of nerve cell connectivity. If the repair devices can deal with hemorrhage by rapid reconstruction of a jury-rigged vascular system, we are done. Unlike nervous connectivity, we needn't even pay attention to restoring precise connectivity of the vascular system). Again, this phase of repair might happen at cryogenic (or even just subfreezing) temperatures, so that the nerve cells don't lack sufficient oxygen and nutrients while it goes on. Furthermore, after thawing the brain doesn't consist of rigid matter. Macrophages and even neurons (as we'll see later) move around through intercellular space.

However, this does not dispose of the issue of repair of connectivity. Brains and neurons are not pieces of

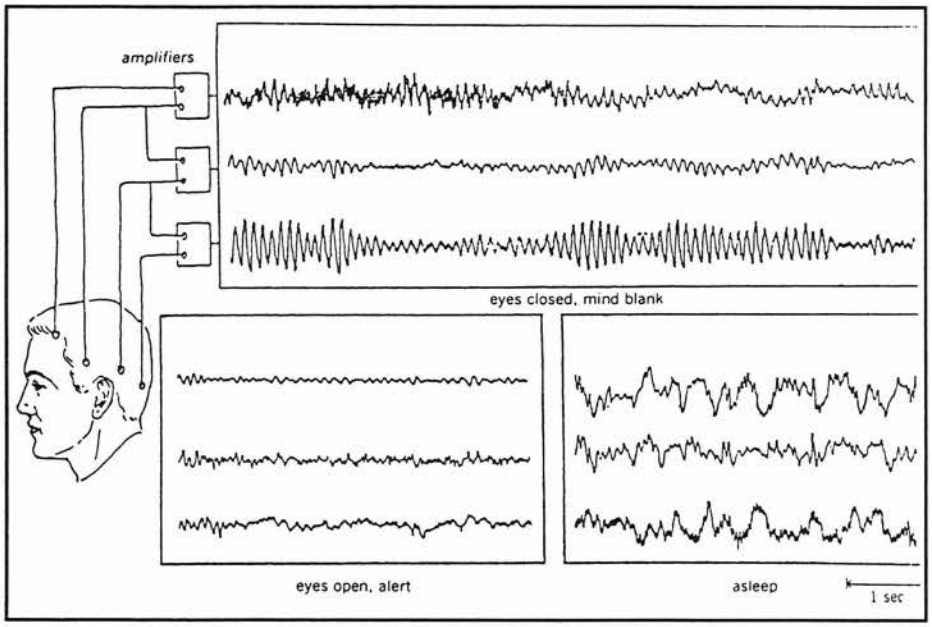


Fig. 5B. Without a *lot* of searching for cat brain EEG's, these pictures should help to provide a look at the appearance of a *normal* EEG. The one labeled "asleep" approximates Suda's cat brain most closely.

electrical machinery with no ability whatever to respond and repair themselves. If we assume that, we can rapidly make an easy problem into a very hard one. For myself, I would go even farther and say that if we try to look at brain repair this way we deal with a quite false problem. Ultimately we'll see it as quite irrelevant.

Recovering connectivity really consists of two phases: first, we try to infer what the connectivity should be; second, we return the brain to that state.

That first inference phase is the hardest. (It's not the same as working out the connectivity of a healthy brain, so the calculations of Merkle simply don't apply). But then, plans for connectivity may very well exist elsewhere than in the actual physical connectivity of the brain. If so, the inference phase is simply unnecessary. So we have another question:

Do plans for brain connectivity exist in the brain?

To get answers to this question, we can look at what we know about how brains grow, develop, and repair themselves. As it turns out, we know a good deal phenomenologically, even if we still know very little about how to control these processes.

First, is everybody's circuit diagram the same? This is a question about the development and plans for our nervous system as a whole. Clearly the exact location of connections between two neurons shows individuality. And unlike wires, axons and dendrites look floppy. But that doesn't affect the primary issue of circuit diagram.

Currently we have very strong evidence that invertebrates of a given species all end up with identically connected nervous systems. This evidence comes first of all from an explicit tracing, neuron by neuron, of the circuit diagram, all 900 or so neurons, of *Caenorabdis elegans* (Sulston et al, *Dev Biol*, **100**, 64 (1983)); even invertebrates, however, despite identical circuit diagrams, show individual patterns of nerve branching). (Figures 9,10)

For vertebrates, and human beings,

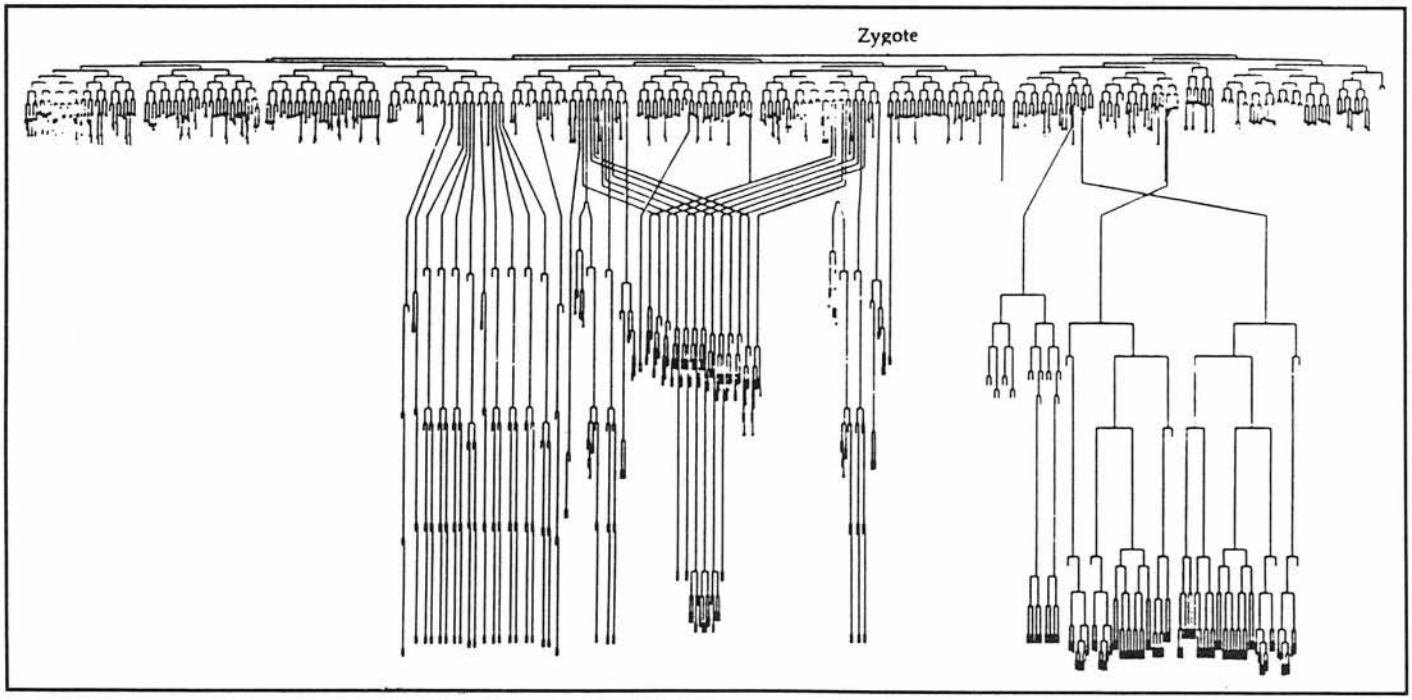


Fig. 9. Result of a tracing of every cell in roundworms.
(From reprint in D Purves, JW Lichtman, *Principles of Neural Development*, 1985.)

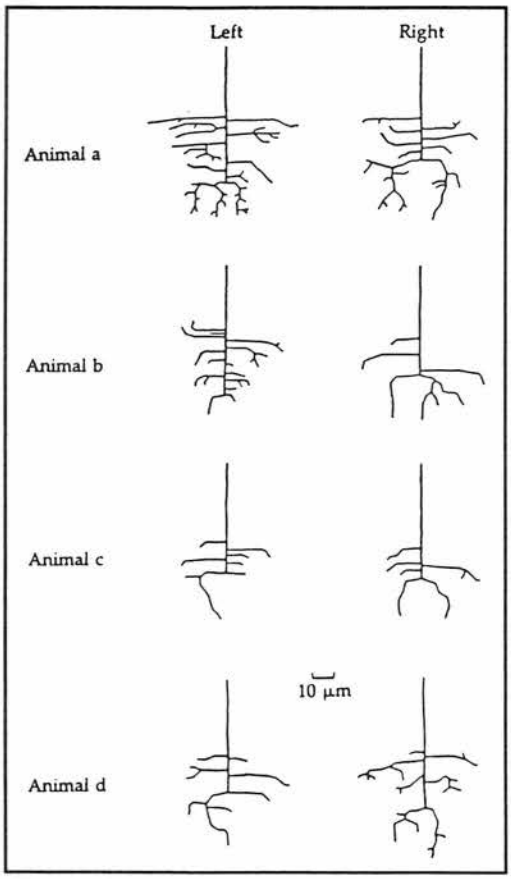


Fig. 10. Just to show even fleas have individuality.

experimental evidence becomes far more vague (we have too many neurons to trace directly, as yet). However, some points deserve making. First, the gross plan of everyone's nervous system is the same. Some evidence even exists that—like invertebrates—we develop in compartments (M. Jacobsen, *J Neurosci*, **3**, 1019 (1983)). Detailed studies of chick limbs show the nerves reaching every muscle in the same pattern (REFERENCE Smith and Hollyday, 1983). As in invertebrates, very low concentrations of trophic chemicals control nerve branching and direction; the chemical processes by which development happens in invertebrates, compared to vertebrates, don't differ.

One major difference, however, is that cells do become committed to their fate much earlier in those invertebrates studied than in vertebrates. This may, or then again may not, suggest that the final outcome creates an identical circuit diagram. It definitely tells us something, though: vertebrate nerves may remain less fixed in connectivity through their entire life. The kind of recovery from brain injury that salamanders show seems impossible with invertebrates.

So, what information will be available for deciding connectivity? There's also an issue of how a repair system might deduce connectivity, if it can't simply read existing plans. For large cracks we do know a lot about connectivity, all of which should be used. One major cause of cracking may be the thawing itself, so that a repair system might work more by preventing cracks than by fixing them.

But for small cracks (micrometer range) another method becomes possible. Both dendrites and axons of a neuron carry a very large amount of chemical traffic between the nucleus and the nerve endings. Almost all substances needed are made in the cell body and transported outward, even many centimeters. They are NOT made locally. (Figure 8: Transport in dendrites). Any attempt to reconnect severed dendrites or axons, so long as they haven't moved far, can use this information. It can do so because two different dendrites (or axons) are virtually certain not to be carrying identical chemical loads when frozen. Reconnection is a chemical detection problem. (This method, unlike those I shall discuss later, does NOT depend on any special system to preserve connection information, but only on well established facts about the inner workings of neurons!)

(As a side comment, a good deal more can be said about this long distance transport in neurons. It may even play some role in memory: among the chemicals transported is a special kind of mRNA known only in neurons.)

In any case, so far as we know the wiring diagram from other information, its repair after damage becomes far easier. This remains true for repair of freezing injury. It's also clear from work on our visual system (with circuitry discussed above) that we must have very great similarity, even if not identity. Repair methods can use all this information about our circuitry, including and especially information not yet discovered.

But that's only one way connec-

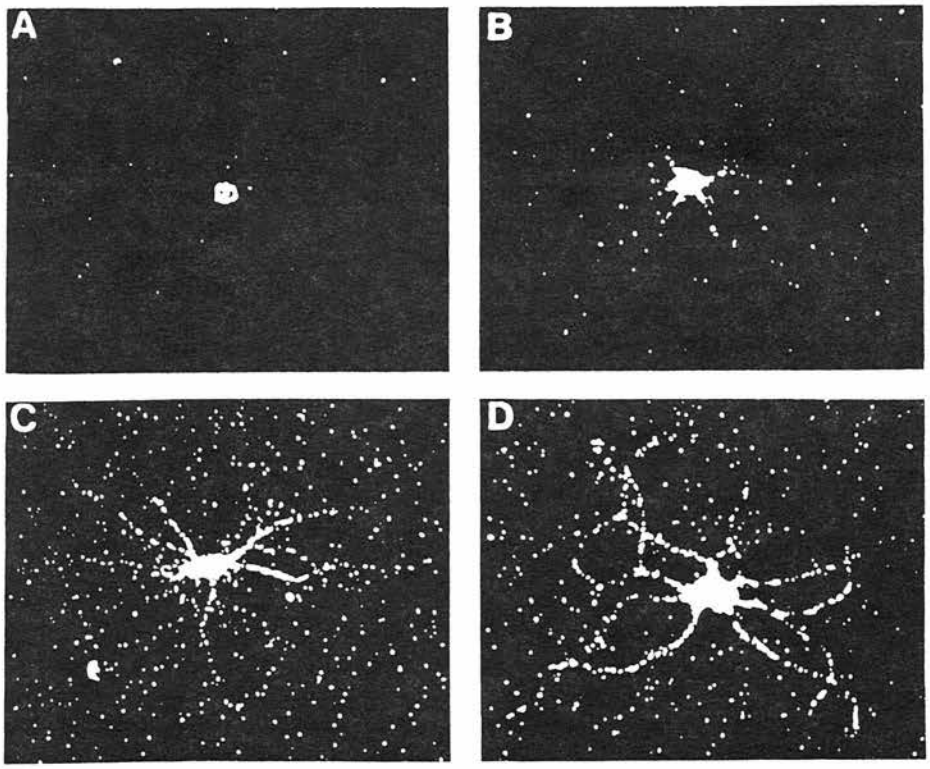


Fig. 8. All pictures are of the same neuron. They show stages in transport to the dendrites. (From Steward, O., *Principles of Cellular, Molecular, and Developmental Neuroscience*, 1989.)

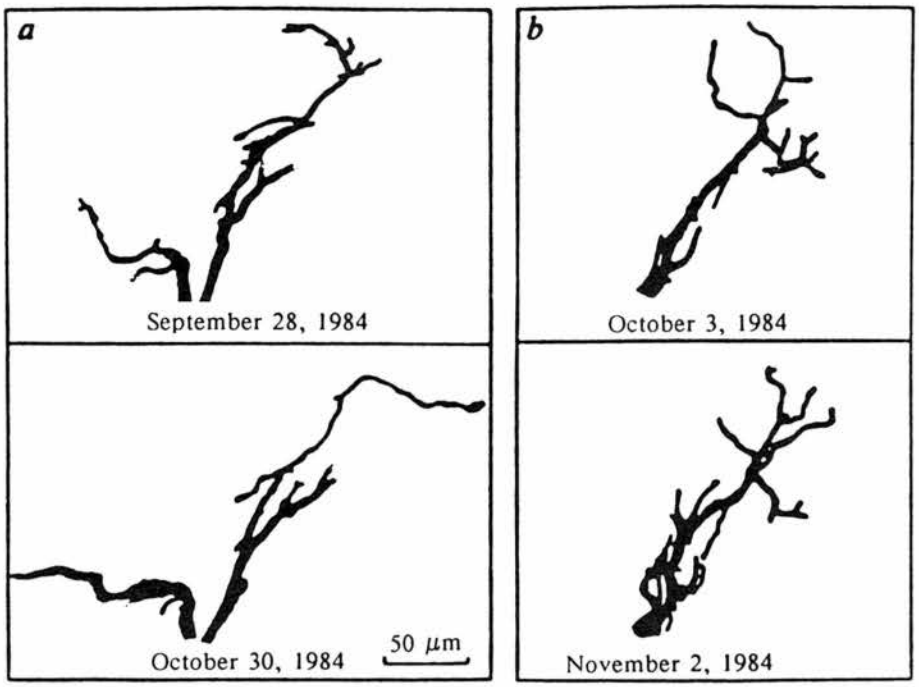


Fig. 11. Change in dendrites over time.
(From d Purves, RD Hadley, *Nature* 315 (1985) 404.)

tivity information could exist independently of our physical connectivity. An extremely significant body of evidence suggests that even adult brains contain the same trophic chemical information they had during development. Since this information consists of chemical cues, even crude freezing could not disrupt it. This evidence also raises serious questions about the workings of memory itself.

Are synapses stable? First of all, the assumption that specific nerve connections remain stable throughout life clashes with significant experimental evidence. At the simplest level (and the technically easiest to perform), the exact connections of our nerves and our muscles constantly form and reform (A. Wernig et al, *Neurosci Lett*, **21**, 261 (1981); *Neuroscience*, **11**, 241 (1984); and others by these authors). Even though the same nerve always innervates the same muscle, the exact points where this happens change. (Even without other evidence this should prick up our ears. If the only case of nerve cell connections we have isn't stable, why should we believe that the others *are*?)

Furthermore, several investigators have pointed out that close study of brain slides suggests a pattern of dendrites (on which there are synapses) constantly forming and reforming (C. Sotelo and S.L. Palay, *Lab Invest*, **25(6)**, 653 (1971)). Again, despite the experimental difficulty, some investigators have studied nerves much closer to the brain in a living animal. They find again that neurons, including their connections, seem to move about constantly (D. Purves and R.D. Hadley, *Nature*, **315**, 404 (1985)). To verify this constant forming and reforming of neurons by direct observation raises lots of problems. That's why work on it is so sparse (Figure 11).

There is also another approach. By now several teams of scientists have transplanted parts of embryonic rat brain into the brains of adult rats (A. Bjorklund et al, *Brain Res*, **199**, 307 (1980); T. Arendt et al, *Nature*, 332, 448 (1988)). These experiments are particularly interesting when analyzed. Here is what happens: the recipient brain is damaged. The transplant, sometimes as a minced suspension of cells and sometimes as a block of whole tissue, is placed in the brain. *The transplanted cells (neurons) then start growing new connections or even migrating to their proper positions.* They don't just grow randomly in place! Instead, they behave as if they know where to be and the neurons to which they should connect.

This tells us something quite significant. Either the recipient brain or the new cells understand where they should go. The problem with the new cells is navigation: they would need not only to know where they should be but where they were at start. Regrowth of connections needs active guidance from the recipient brain. These experiments therefore tell us that the trophic system guiding neurons in embryos remains largely still in place. If anything this also provides one more bit of evidence that synapses constantly form and reform: what else would this trophic system be doing? Our brains haven't evolved in the expectation of receiving embryonic transplants.

Among other animals experiments have pointed to this conclusion far more strongly. Experimenters have transferred learning between salamanders by transplanting brain fragments (M. Hershkowitz et al, *Brain Research*, **48**, 366 (1972)). The new fragment could only act effectively if the recipient brain could guide its connections to link up correctly. The old experiments of Pietsch, in which he actually scrambled the brains of his salamanders and saw them recover, desperately need not only verification but continuation (P. Pietsch, *Shufflebrain*, 1981).

We may conclude that connectivity information exists in our brains in chemical form. Synapses are probably not stable. New memories ultimately must end up inside the brain in another form.

Clearly these processes can't repair a frozen brain without help, at least in mammals. (Salamanders or other non-mammals may prove interesting experimental subjects, though. . .). The point is that the information about network connectivity needed for repair remains inside the brain, in chemical form, even if our brains are disrupted.

***Question 2:** How does neuron memory work?*

To be continued next month. . . .

Supercooling and Cryoprotectants

Ralph Whelan

The December issue of *Scientific American* presents a remarkably interesting and readable account of how certain reptiles and insects "overwinter"—that is, survive the winter through partially or (in insects) totally freezing. The report was penned by Kenneth B. and Janet M. Storey, two researchers at Carleton University in Ottawa, Ontario.

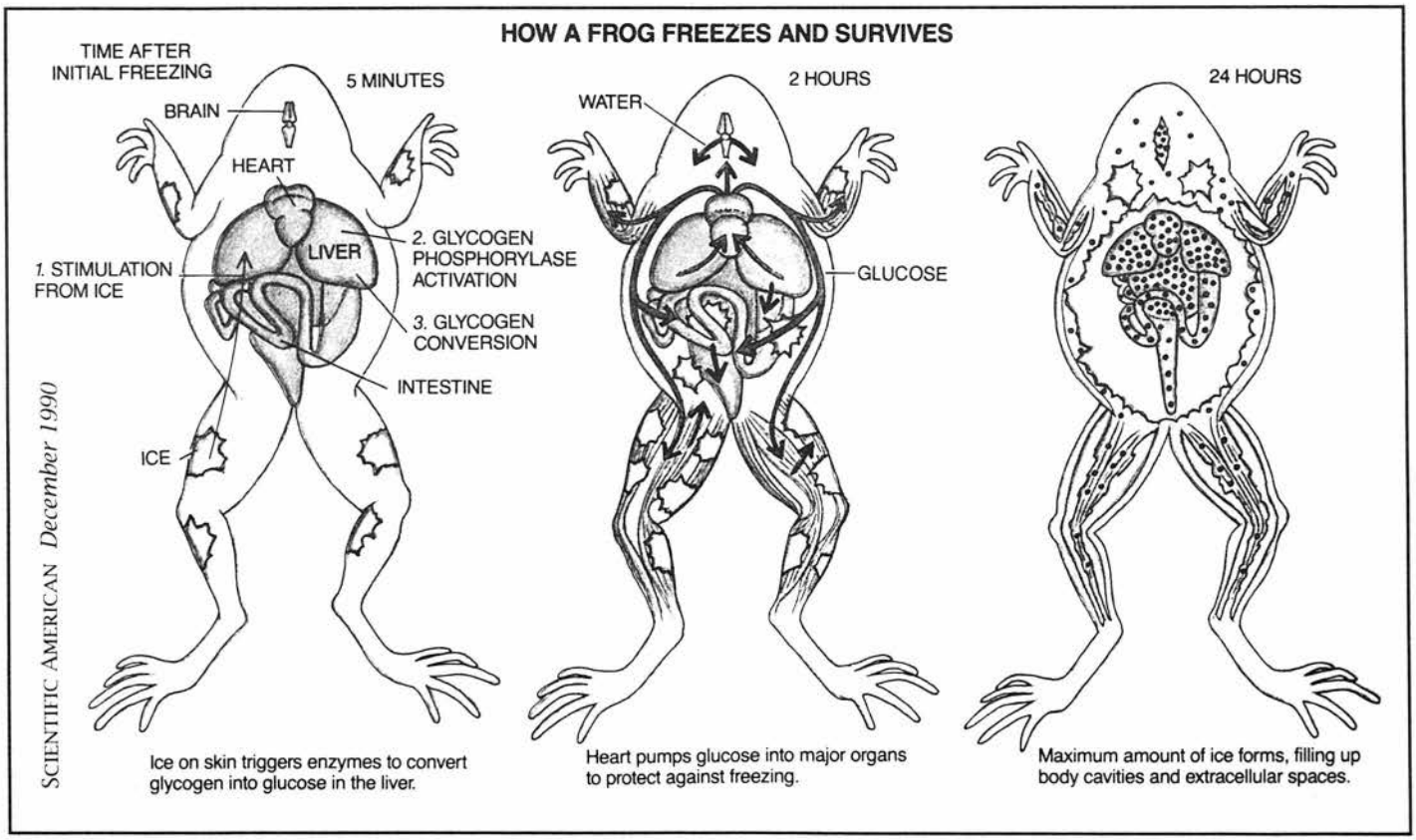
The authors describe two approaches (utilized in "nature") to dealing with below-freezing temperatures: supercooling, and freezing. Although many of the specimens that they studied cope with the extreme cold by allowing huge portions of themselves to freeze solid, many manipulate their blood chemistries such that they can operate well below the equilibrium freezing point of the given medium. "Human plasma, for example, has a freezing point of -0.8C but, if chilled in a controlled manner, can be supercooled to -16C."

They go on to describe that this ability to supercool blood can be hindered by "nucleators," compounds that act as footholds for ice formation. The process of nucleation is rapidly compounded in that ice itself is the best nucleator, so that once started, the process can be runaway. However, if animals can prevent nucleators from forming, or "stunt" them as soon as they do form, they can dramatically widen the gap between the equilibrium and the actual freezing points.

Some of the animals reported on, for instance the polar marine fish, utilize "antifreeze proteins" to this end. Since ice exists as a highly ordered lattice structure, these proteins can impose themselves on the surface of developing crystals, stopping the ice formation before the crystal can get large enough to damage the organism. "In many cases, insect antifreeze proteins are so potent that they can prevent ice formation at temperatures as low as -15C, enabling many insects to remain active under the winter snowpack." For even greater supercooling, some insects employ polyhydroxyl alcohols to the same end.

But supercooling has drawbacks. Foremost is the tendency toward "flash freezings," which can result from unanticipated cooling below the supercooling limit or contact with nucleators resulting from skin injury. Hence, many animals have chemistries that allow them to freeze in a slow and controlled manner. The Storeys describe "specific biochemical adaptations that satisfy three basic conditions."

The first condition is that ice formation must be tremendously controlled. It must begin in fluids outside the cells, and it must proceed without large conglomerations of ice crystals forming. To accomplish this, freeze-tolerant animals can actually *generate* nucleators and use them to their advantage. By supplying nuc-



leators—usually "ice nucleating proteins"—in a controlled fashion, they facilitate the formation of ice crystals when, where, and to an extent that the organism can handle them. "The action of ice-nucleating proteins ensures that the initial freezing process results in the dispersal of thousands of small ice crystals throughout the extracellular spaces of the animal."

Experiments by John G. Duman and colleagues at Notre Dame presented the puzzling evidence of both ice-nucleating and antifreeze proteins. Although this at first seemed to them contradictory, experiments soon showed that this was the organisms manner of controlling ice crystallization: ice-nucleating proteins would seed the creation of ice *outside* the cells, while antifreeze proteins would keep these crystals small and manageable.

"The second condition for freezing involves the protection of cell structure and function." Specifically, a dangerous situation begins when ice forms outside the cells: as crystallization occurs, solutes in the extracellular fluid such as salts, sugars, and proteins increase in concentration, since they are excluded from the crystals. This stresses the cell wall, since the solute concentration *inside* the cell hasn't changed. To balance the concentrations, water flows out of the cells, and continues to do so until the solute concentration is too high to allow for further ice formation.

Unfortunately, this outflow of water causes a decrease in cell volume, and if it proceeds too far the cell membrane ruptures, allowing the ice to propagate into the cell. *"Most freeze-tolerant animals reach the critical minimum cell volume when about 65 percent of total body water is sequestered as ice."*

To counter unmanageable stresses, most freeze-tolerant animals build up high concentrations of—guess what?—*cryoprotectants*. Usually, the cryoprotectant build-up begins in the autumn months, long before it's actually necessary. Interestingly, both freeze-tolerant and freeze-resisting (supercooling) insects use the same polyhydroxyl alcohols to accomplish this. "During the Autumn months. . . stored glycogen, making up about 8 to 12 percent of the total body weight of the larvae, is completely converted into two polyhydroxyl alcohols: glycerol and sorbitol." In the Spring these cryoprotectants, having outlived their usefulness, are converted back into sugars and used as fuel.

Maintaining the viability—the operability—of the cells is the final condition. Specifically, discounting the prevention of freezing damage, the organism must still be prepared to endure days, weeks, or even months of a limited or absent oxygen supply. Obviously, the dramatic decrease in metabolic rate figures in strongly. "A tenfold drop in metabolic rate, for instance, gains for the animals a tenfold extension of the time that a fixed store of body fluids can sustain life." But even this can't account for the viability of cells and the continuance of cell activity during the complete absence of any oxygen supply. Rather, most freeze-tolerant animals ferment glycogen and glucose to fuel cell activity while the oxygen supply is interrupted.

This research could have tremendous returns for cryonicists. Naturally, the winter environments of these animals are lush resorts in comparison to the liquid nitrogen environment of our patients. "But the injuries caused by freezing and the principles of circumventing them are the same in cryopreservation as in natural freeze tolerance, and some answers are identical."

Recent Abstracts of Interest

Harris SB Weindruch R Smith GS Mickey MR Walford RL

Dietary restriction alone and in combination with oral ethoxyquin/2-mercaptoethylamine in mice.

J Gerontol (1990 Sep) **45(5)**:B141-7

To investigate effects of dietary caloric restriction (DR) combined with antioxidant feeding, long-lived hybrid mice were divided into four dietary groups at weaning, and followed until natural death. Groups "C" and "R" received control (97 kcal/wk) and restricted (56 kcal/wk) diets respectively. Groups "C+ alpha ox" and "R+ alpha ox" received C or R diets supplemented with an antioxidant mixture (2-mercaptoethylamine plus ethoxyquin). R mice (mean life span 41 months) significantly outlived the other three groups (mean life span 30-34 months). Hepatic degeneration and increased hepatoma in the R+ alpha ox group suggested unusual hepatotoxicity of this regimen. Antioxidants had little effect on splenic cell mitogen response in similarly fed mice sacrificed at 12-15 months. Gompertz analysis suggests that the beneficial effect of DR may be due to reductions in initial vulnerability or rate-of-aging parameters, or both, and that the relative influence of each factor may vary with animal strain and DR protocol used.

Goodrick CL Ingram DK Reynolds MA Freeman JR Cider N

Effects of intermittent feeding upon body weight and lifespan in inbred mice: interaction of genotype and age.

Mech Ageing Dev 1990 Jul;**55(1)**:69-87

Beginning at either 1.5, 6 or 10 months of age, male mice from the A/J and C57BL/6J strains and their F1 hybrid, B6AF1/J were fed a diet (4.2 kcal/g) either ad libitum every day or in a restricted fashion by ad libitum feeding every other day. Relative to estimates for ad libitum controls, the body weights of the intermittently-fed restricted C57BL/6J and hybrid mice were reduced and mean and maximum life span were incremented when the every-other-day regimen was initiated at 1.5 or 6 months of age. When every-other-day feeding was introduced at 10 months of age, again both these genotypes lost body weight relative to controls; however, mean life span was not significantly affected although maximum life span was increased. Among A/J mice, intermittent feeding did not reduce body weight relative to ad libitum controls when introduced at 1.5 or 10 months of age; however, this treatment did increase mean and maximum life span when begun at 1.5 months, while it decreased mean and maximum life span when begun at 10 months. When restricted feeding was introduced to this genotype at 6 months of age, body weight reduction compared to control values was apparent at some ages, but the treatment had no significant effects on mean or maximum life span. These results illustrate that the effects of particular regimens of dietary restriction on body weight and life span are greatly dependent upon the genotype and age of initiation. Moreover, when examining the relationship of body weight to life span both between and within the various groups, it was clear that the complexity of this relationship made it difficult to predict that lower body weight would induce life span increment.

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The Alcor Life Extension Foundation *and* Cryonics *reserve the right to accept, reject, or edit ads at our own discretion and assume no responsibility for their content or the consequences of answering these advertisements. The rate is $10.00 per line per month (lines are approximately 90 columns wide). Tip-in rates per sheet are $90 (already printed and folded); or $180 (printed one side) or $270 (printed both sides), from camera-ready copy. Tip-in ads must be clearly identified as such.*

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MARY NAPLES, CLU and BOB GILMORE – CRYONICS INSURANCE SPECIALISTS. New York Life Insurance Company; 4600 Bohannon Drive, Suite 100; Menlo Park, CA 94025. (800) 621-6677.

EXTROPY: Vaccine for Future Shock. #6 available, $3 per copy. Futurist philosophy, avoiding the heat death of the universe, neurocomputation, reviews of futurist and transhuman books, and much more. EXTROPY; c/o Max More; P.O. Box 77243, Los Angeles, CA 90007-0243.

Membership Status

Alcor has 200 Suspension Members, 477 Associate Members, and 17 members in suspension.

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.

The **SUN, FEB 3** meeting will be at the home of:
Bill and Maggie Seidel
10627 Youngworth Rd., Culver City, CA

Directions: Take the San Diego (405) Freeway to Culver City. Get off at the Jefferson Blvd. offramp, heading east (toward Culver City). Go straight across the intersection of Jefferson Blvd. and Sepulveda Blvd. onto Playa St. Go up Playa to Overland. Go left on Overland up to Flaxton St. Go right on Flaxton, which will cross Drakewood and turn into Youngworth Rd. 10627 is on the right (downhill) side of the street.

The **SUN, MAR 3** meeting will be at the home of:
Virginia Jacobs
29224 Indian Valley Road, Rolling Hills Estates, CA

Directions: Take the Harbor Freeway (US 110) south to Pacific Coast Highway (State 1) and get off going west. Go along Pacific Coast past the Torrance Municipal Airport to Hawthorne Blvd. Turn left (south) on Hawthorne and go up into the hills past the Peninsula Shopping Center (Silver Spur Rd.). Hawthorne takes a long curve around to the left. Indian Valley Road is a little over two miles beyond the Center, on the left. 29224 is about 0.2 mi up Indian Valley Rd., opposite Firthridge Rd.

The *Alcor Cryonics Supper Club (Southern California)* 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 P.M.

SUNDAY, 20 JANUARY
Souplantation
555 N. Pointe Dr., Brea, CA
Tel: (714) 990-4773

Directions: Go to Brea on the 57 Freeway and get off on Lambert going east. Pointe Dr. is one block east on Lambert.

There is an Alcor chapter in the **San Francisco Bay area**. Its members are aggressively pursuing an improved rescue and suspension capability in that area. Meetings are generally held on the second Sunday of the month, at 4 PM. Meeting locations can be obtained by calling the chapter's Secretary, Carol Shaw, at (408) 730-5224.

The **SUN, JAN 13** meeting will be held at the home of:
Ralph Merkle and Carol Shaw
1134 Pimento Ave., Sunnyvale, CA

Directions: Take US 85 through Sunnyvale and exit going East on Fremont to Mary. Go left on Mary to Ticonderoga. Go right on Ticonderoga to Pimento. Turn left on Pimento to 1134 Pimento Ave.

The **SUN, FEB 10** meeting will be held at the home of:
Keith Henson and Arel Lucas
1794 Cardel Way, San Jose, CA

Directions: Take the 17 South (880) and get off going east on Camden. Stay on Camden as it turns south and go to Michon Dr. Turn right onto Michon and go to Harwood Rd. Turn left on Harwood and go south to Almaden Rd. (1st street on right). Turn right on Almaden and right again onto Elrose, then left onto Cardel. 1794 is near the end of the street, on the left.

The **SUN, MAR 10** meeting will be held at the home of:
Joe and Connie Tennant
1467 Don Ave., Santa Clara, CA

Directions: Take the 82 (El Camino Real) through Santa Clara to Scott Blvd. Go north on Scott to Warburton (next street) and turn right on Warburton. Don Avenue is the first street on the left (Triton Museum on corner).

The **SUN, APRIL 14** meeting will be held at the home of:
Ralph Merkle and Carol Shaw
1134 Pimento Ave., Sunnyvale, CA

Directions: Take US 85 through Sunnyvale and exit going East on Fremont to Mary. Go left on Mary to Ticonderoga. Go right on Ticonderoga to Pimento. Turn left on Pimento to 1134 Pimento Ave.

There two Alcor discussion groups in the **Greater New York area**. Details may be obtained by calling either Gerard Arthus, at (516) 474-2949, or Curtis Henderson, at (516) 589-4256.

The *New York Cryonics Discussion Group of Alcor* meets on the the third Saturday of each month at 6:30 PM, at 72nd Street Studios. The address is 131 West 72nd Street (New York), between Columbus and Broadway. Ask for the Alcor group. Subway stop: 72nd Street, on the 1, 2, or 3 trains. Meeting dates: **January 19, February 16, March 16, April 20.**

The *Long Island Cryonics Discussion Group of Alcor* meets on the first Saturday of every month, at the home of Gerry Arthus. The address is: 10 Jefferson Blvd.; Port Jefferson Station, L.I., telephone (516) 474-2949. Meeting dates: **February 2, March 2, April 6, May 4.**

There is a cryonics discussion group in the **Boston area**. Information may be obtained by contacting Eric Klien at (508) 663-5480 (work) or (508) 250-0820 (home). Tentative meeting date is December 30.

ALCOR LIFE EXTENSION FOUNDATION
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