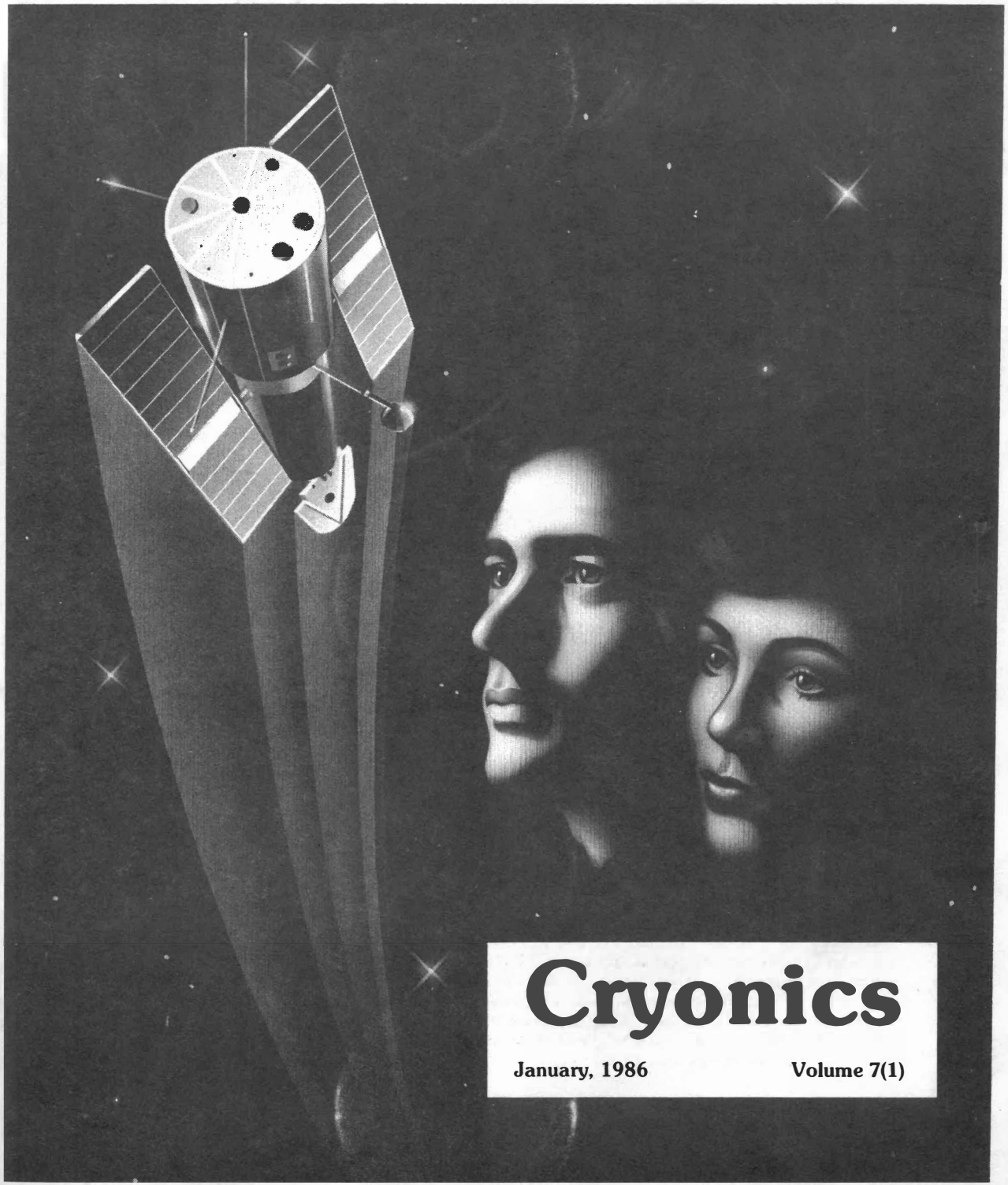

Cryonics

January, 1986 Volume 7(1)

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Contents

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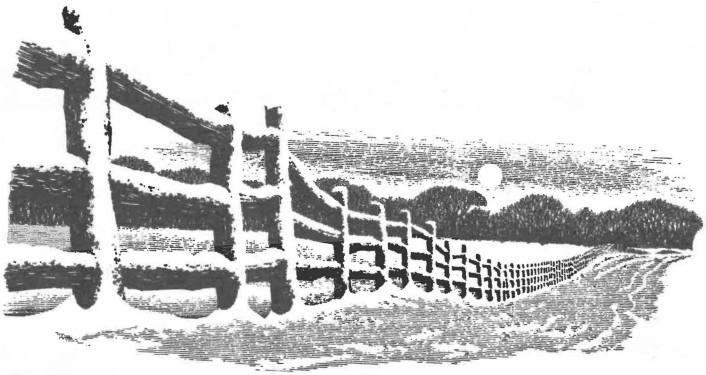


Editorial Matters

AN ALCOR MOTTO

Organizations, like people, are often held together and carried forward by a single, central idea. If you, or we, were asked to sum up what cryonics and ALCOR was about in a few words, could you? That's important, because often all you are able to say is a few words. Advertising copy, radio and TV spots, letterheads, all these media severely limit the length of what we can communicate. This is why companies and organizations have mottos or slogans. Simple, elegant, and small groups of words that paint a powerful picture of what the group is about or what they want.

We have wrestled with the issue of an ALCOR motto for nearly a year. Luigi Warren, an ALCOR member recently arrived from Britain, has provided us with just such a motto. We wanted something that sums up everything we're about; our hopes, our dreams, our whole view of the future. Now we have one. So, share it with us and share the future and our conviction that:

"The Best Is Yet To Be"

ERRATA

We goofed! Last month we ran a map showing the location of ALCOR facilities and coordinators across the US. We got everything right except for one thing: our own location. ALCOR Fullerton ended up in San Diego on the map, instead of in North Orange County in the Los Angeles basin, where it belongs.

Trans Time To Get New Facility

We understand that Trans Time and the American Cryonics Society are going to be moving into new quarters soon. A "building investment consortium" assembled by ACS member and Trans Time Director John Day has reportedly purchased a building near the Oakland airport. Trans Time, and perhaps ACS, will then rent the facility from this consortium.

According to Trans Time president Art Quaife, the building is a 2,300

square foot structure of concrete block construction possibly of 1950's vintage. It has high ceilings (15 1/2 to 16 ft) and several skylights which should be useable to facilitate patient transfers. The building has 3ØØ sq ft for office space, and this should go a long way to easing the crowding in the Trans Time office.

Escrow is expected to close sometime around the first or second week of January, after which Trans Time will be moving in. Trans Time currently has about 6ØØ sq ft of space, so this should be a real improvement. It should also eliminate the problems they have had with hostile landlords and tremendous rent increases in recent years.

Our congratulations to Trans Time and ACS and our sincere best wishes for a smooth and safe move-in!

ALCOR Coordinators: Training and Equipment Deployment

ALCOR has now deployed two of the scheduled four life support kits. Bob Abernathy of Gaithersburg, MD was the first to receive a kit and Fred and Linda Chamberlain of South Lake Tahoe were the second. We had anticipated that the kit for Silicon valley, to be placed with Cathy Woof and Thomas Donaldson would be the first one to be deployed. Unfortunately, a number of scheduling conflicts have prevented us from getting together with the Donaldson-Woof's. We have now set a date for after Christmas to deploy that kit, and hopefully nothing will come up to cause further delays.

Life-Support Kits ready for deployment. Each kit consists of a yoke with 2 oxygen cylinders, a medications box, a heart-lung resuscitator, and a suitcase with additional supplies. A complete kit as it will be deployed is shown (left) and another is displayed unpacked (center).

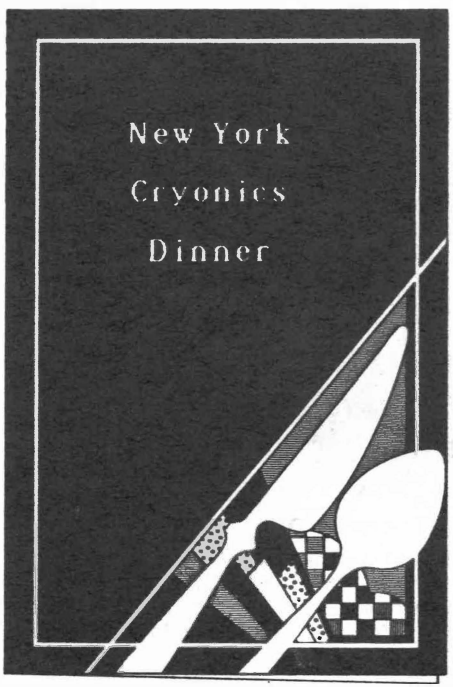
Several people have expressed an interest in "just how much equipment is in these kits". Since a picture is worth a thousand words, we decided to simply show you. As you can see from the accompanying photos the answer is: a lot! Our shipping bill for the Maryland kit alone was $90!

We think it's worth it though. Once these kits are in place and the

Supplies for begining IV administration of stabilizing medications are carried in a "paramedic box" to allow for quick and orderly access in an emergency.

Coordinators have received additional training to polish their skills in using them, our response time in the event of a "remote" emergency should be dramatically cut. The better protection is worth every cent we've spent.

We are also in the late planning stages for a training session and promotional meeting to be held in the New York area on March 1-2 (First weekend in March). We decided to go with a training session on New York's Long Island primarily because of the strong interest shown in that area and because affordable air fares are available to NY (for those who are inter-



ALCOR President Mike Darwin will by in New York to discuss ALCOR's program of cryonic protection on Saturday, March 1st.

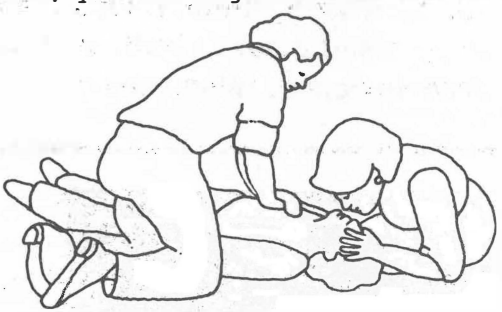
If you are interested in meeting with Mike and learning more about cryonics in general and ALCOR's program in particular, please contact ALCOR by February 15th to confirm your dinner reservation.

esting in coming from other Eastern Seaboard areas). The current schedule is for a training session to be held on Saturday and Sunday during the day starting around 10 AM and wrapping up late in the afternoon. On Saturday, there will be a get-acquainted dinner meeting where local people can come and meet ALCOR President Mike Darwin and Board member and chief of ALCOR Florida, Glen Tupler. A slide presentation giving basic information about cryonics and ALCOR will be given and Mike and Glen will be available to answer questions and help anyone who's interested in getting signed up with ALCOR.

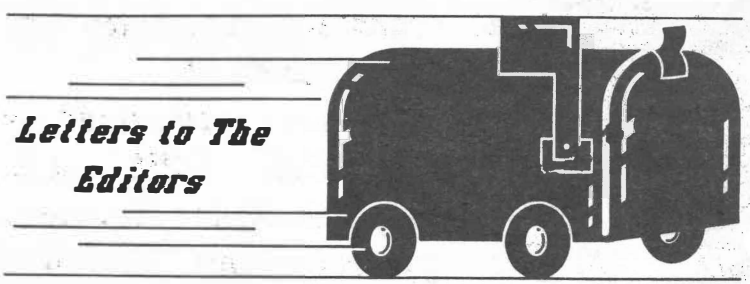
If you are interested in attending **any** of these functions you need to let us know in advance. Dinner reservations are RSVP and training sessions are open only to ALCOR Suspension Members. **We must know by February 15th if you are attending either of these functions.**

Mike Darwin will also be around on Sunday evening on an informal basis to chat with people and help with filling out suspension paperwork for those interested in making suspension arrangements.

This should be a fine opportunity for East Coast people to get together and get things going. Don't miss it! If you want additional information on the dinner meeting or on the training sessions, you need to get in touch with ALCOR immediately by calling (714)738-5569 or by writing to us at 4030 N. Palm, #304, Fullerton, California 92635.



A similar training and promotional session will probably be scheduled for March or April in Northern California. Persons interested in participating in either of those events should also get in touch with us and be watching for our special mailing giving further details.



Dear Editors,

One reason that's been proposed to explain the failure of cryonics to achieve greater popularity is that some people deceive themselves into thinking that the control of aging is likely to come in the near future, and that their false optimism on this issue prevents them from committing themselves to cryonics.

In order to counter this alleged obstacle, cryonicists have often stated that aging control is not likely to be achieved in the near future, and that cryonics offers the best available chance for the achievement of physical immortality.

I agree that cryonics offers the best available chance for physical immortality and that full control over aging may be a long way off. But I am also convinced that telling people that they should sign up for cryonics **because** aging control may be a long way off is a mistake.

In my opinion, no one has ever failed to sign up for cryonics because of excessive optimism about the control of aging. I fully realize that some people have **stated** that they've chosen not to sign up because of their expectations for aging control, but I don't believe these people are giving the true reason for their reluctance to commit themselves to cryonics.

I think these people are, in fact, actually moving **towards** commitment to cryonics, but that they have yet to overcome emotional obstacles that have nothing at all to do with their "optimism" about the control of aging. One of these obstacles may be their inability to face the fact that their own death is not necessarily in the distant future, but rather could come at any moment. Another obstacle may be their concern about what people will "think" about their desire to be frozen after "death".

In any case, their focus on aging as the source of their problems is a major step in the right direction. Unless someone is conscious of the direct relationship between aging and death, they are unlikely to be receptive to cryonics. Once they've become conscious, however, it is only a matter of time until they commit themselves to cryonics--unless of course they die first. I don't know anyone who is a cryonicist who doesn't understand that aging is their enemy. I know many people who DO NOT appreciate the necessity to fight aging; none of them are cryonicists.

Therefore, I think it is counterproductive to dismiss anyone's optimism about aging control as "unrealistic". On the contrary, I think that such individuals should be encouraged to support aging research as a way of making their goal **more** realistic and that cryonics should be presented to them as an ally rather than as a **competitor**. I think such people can be made to understand that we are all concerned about and interested in supporting research to control aging, but that we are so concerned about staying alive and healthy that we also think it's prudent to take out life insurance (cryonics), just in case we should be faced with death before aging control has been achieved.

I think some cryonicists fail to appreciate the value of optimism in attacking aging and death. Although it's foolish to base the prospect of your own survival on blind faith in the future, it is also necessary to have faith in your own ability to achieve major goals in the foreseeable future or else you're likely to be paralyzed by your pessimism.

I'm confident that I can achieve physical immortality. I have to be. I have no other alternative!

For Longer Life,
Saul Kent
Hollywood, Florida

DICK CLAIR, three time Emmy Award winner and creator of television's popular *FACTS OF LIFE, IT'S A LIVING, FLO,* and *MAMA'S FAMILY* talks about why he's an ALCOR Suspension Member:

A flippant answer would be: "To finally finish a jigsaw puzzle." It seems most of our desires in life are cut short because we don't have the time. Ever had an "eternity fantasy?" Like to live in every house on the California coast for a year? Or spend ten years just travelling around Europe, walking? We generally toss these fantasies out, as well as a lot of much more important ones, because of lack of time. And yet, they are the stuff of which that leisurely feeling of "eternity" is made. How many times has the sight of a spectacular sunset been marred by the weird, fleeting thought, "But this'll be around long after I'm not?"

Those are some of the reasons, and what they all boil down to is: *to live,* to survive — without fear or dread or even just "being rushed."

Is being suspended the only way to survive? Maybe not. Maybe there are advances going on today which will enable us to just go on living, to bypass having to be placed in cryonic suspension at all. Optimistic researchers believe that young people might benefit from developments that will extend their lives indefinitely. But at this very moment, for most of us, the odds are too uncertain. It makes sense to hope for the best and prepare for the worst — to have all the preparations in place, to be suspended if the need arises. Even if the odds are a billion to one against surviving suspension, that's better than *no* odds. And in a sense there's no such things as odds. What happens, happens; and the people at ALCOR have every intention of making the *right* things happen. In the case of cryonic suspension, I firmly believe that what man can conceive he can achieve.

I've chosen to make suspension arrangements with ALCOR because the men and women who comprise ALCOR are people of dedication and integrity. They have the most sophisticated equipment, the most experience, and the best judgement. In short, they know what they're doing.

So, fasten your seatbelts, floss your teeth, eat fresh veggies, exercise, and sign up for suspension. With a little luck and a lot of hard work, *all the time in the world may be just around the corner.*

Please send me information on how I can arrange for cryonic protection for myself and my family.

Name _____

Address _____

City _____ **State** _____

Mail To: ALCOR LIFE EXTENSION FOUNDATION
4030 North Palm, No. 304
Fullerton, California 92635
Phone: (714) 738-5569

A Large Chunk Of History

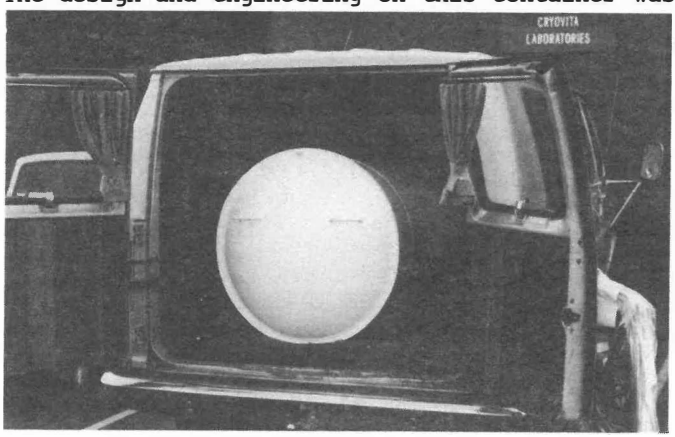
ALCOR is one of the few, and maybe the only, cryonics organization which is actively working to preserve cryonics history. We maintain an archive of literature and artifacts from the past, and we encourage readers and members to send in cryonics-related information, and items both from the past and the present. One "artifact" we've had our eye on for nearly a decade is the Cryo-Care Equipment Corporation "Cryocapsule" in which the first man who was ever frozen was initially placed (he was subsequently transferred to another, more reliable container). It has been slowly rusting away in the scrap yard of a local cryogenics company since 1972.

We have inquired about purchasing the container on and off for nearly 11 years! It has no commercial value and we had offered them several times the price it would bring if sold for scrap metal. They have been reluctant to sell, mostly for the same reasons we were anxious to buy: sentimental and historical reasons.

We were thus quite surprized to hear from them and find out that they had decided to give us the old container as a "Christmas present." A thoughtful and considerate thing for them to do.

On November 25th we picked the old container up and took it to be sandblasted and repainted, since it was covered with corrosion and rust. It cleaned up beautifully, and is now sitting in our facility looking like it's ready to go to the moon. We have only one regret at about this acquisition: They built 'em big in those days, 10 feetlong and 36 inches wide! Space is at a premium for us (we already have 3,000 sq ft of equipment crammed into 1,600 sq ft of space!) and this historic "white elephant" isn't helping any. Still, it was an opportunity we just couldn't pass up.

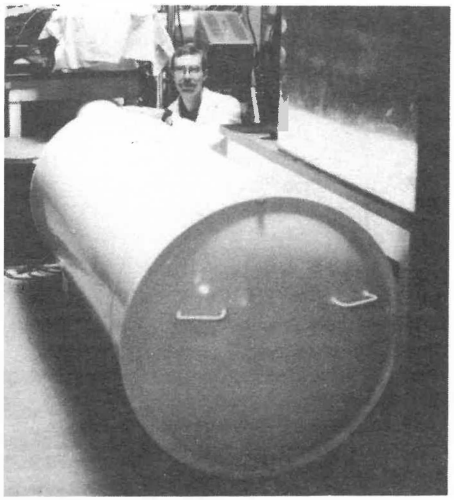
Examining the container has made us appreciate just how far we've come. The design and engineering on this container was unbelievably crude and slipshod. The liquid fill line was positioned so as to spray liquid nitrogen directly onto the patient's head during initial cool down, and the other details of construction reflect a similar lack of concern and thought right down to the Masonite tray the patient was placed on and the end plate held on only by a vacuum that was continuously maintained by a vacuum pump: if the vacuum pump stopped, the whole 150 lb end of the tank fell off! After an examination of the container and the workman-



A "major" historical artifact arrives at the lab.

ship that it reflects, we feel compelled to conclude that the manufacturer should have called itself Cryo-Careless instead of Cryo-Care.

In the near future, the rest of the ALCOR archives will go into a specially prepared dry nitrogen box which will hopefully bring to a halt oxidation of paper products and attack by insects. Decomposition of acid treated paper (upon which much of cryonics history is printed) is a major problem which simply cannot yet be economically solved except by means such as these (which are of course, unavailable to people who don't have liquid nitrogen constantly on hand). We've decided to make our nitrogen boil-off do some work by passing it through an archives vault instead of uselessly venting it directly to the atmosphere. Hopefully this will allow our history as well as our patients to make it through to the future unchanged.



Old Cryo-Care unit in its new home.

Noble Savage? Caveat Emptor!

> "I am a 47-year-old Irishman serving a 20-year Federal Prison sentence for bank robbery. I can't offer any excuses, because I am guilty. Thankfully, I never harmed anyone, but at one point in my life I thought that a great deal of money was required immediately by the life extensionist task force I was creating and I didn't really care how I obtained the funding, as long as it was ethical and humane. My bank robberies were carried out with that in mind."
>
> --Robert DeWitt,
> December, 1985

When Mike Darwin was a tenderfoot lad of 16, he received a letter in the mail from a man named Robert Ray DeWitt. Robert Ray was intelligent, articulate, and a prolific correspondent. He seemed utterly committed to life extension and, in particular, to cryonics. Robert Ray was also serving 20 years for armed robbery in the State Penitentiary in Salem, Oregon. That last little detail good, ol' Robert Ray didn't tell Mike--until long, long after he began to write. Meanwhile, other people in cryonics and life extension, many equally innocent, were also in touch with Robert Ray DeWitt.

In particular, DeWitt was a very attentive correspondent to young **female** cryonicists. After he had established a friendship, he explained the tragedy of his former, unregenerate life and how he was putting himself on a new road and "paying his debt to society." He asked for help (money for stationary, stamps, and eventually, even personal items). Once he had gathered enough information,

he selected a lady of Mike's acquaintance and really turned on the romance. When DeWitt was released from jail he quickly jumped parole, and showed up on this young lady's doorstep. Prison officials, like many other bureaucrats, keep lists. One list they kept was of who DeWitt was writing to, and as a result a number of his correspondents spent a very memorable and uncomfortable evening (and night) being grilled by the FBI as to his whereabouts.

Well, it seems Robert Ray robbed another bank and now he's in a Federal Penitentiary in Springfield, Missouri (ahhh, the efficiency of our criminal justice system!).

A few days ago as Mike Darwin reviewed the week's information requests he noticed one from a Robert DeWitt (on what Mike knew to be prison-supplied return address envelopes; they're easy to spot since they have a line for the person to write their name on just above the PO Box number—how many people do **you** know who have printed envelopes so they can **share** a PO Box?). Immediately a red light went off in Mike's head. DeWitt had already received an information package (the wonderful efficiency of the ALCOR staff!) and can be expected to soon be writing every man, woman, and child in cryonics whose name he could extract from the literature we sent. Mike was right. The quote which opens this piece is taken from one such letter—to a female ALCOR member.

We tell this story, in part to warn people specifically about Robert DeWitt (he's dropped the "Ray" these days). This creep was described by the FBI as armed and dangerous and even if you never meet up with him (count on it, they'll let him out again) we can tell you that a chat with a man in a blue suit with a big gun in the Federal Building in the middle of the night is something you can probably do without.

We also tell this story to give you a more general warning. Cryonicists are a close knit community of people, many of whom are isolated from each other and who are hungry for contact with others who feel as they do. We are also involved in something unusual. While the overwhelming majority of people who become involved with cryonics are responsible, conservative, and mature people, some are not. This is true of any human social organization. Churches, computer clubs, skiing organizations, and other "mainline" groups also have their share of creeps. Perhaps the only difference is that in cryonics, at least in the past, we've had a higher tolerance for these kinds of human mistakes, in no small measure because of our own desire to see cryonics grow.

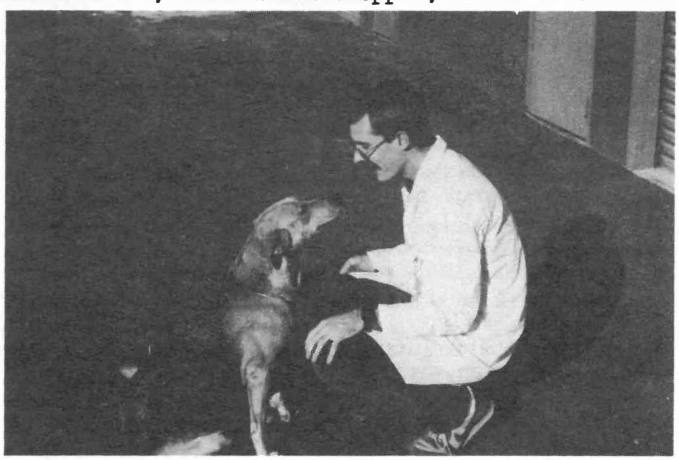
ALCOR has been accused of "elitism" because we refuse to deal with, or allow the participation of, people who do not exhibit good manners and responsible behavior. We have learned the hard way. Let this story of Robert Ray DeWitt serve to put you on guard. Particularly our coordinators: take some time to get to know people well before you become involved with them. If someone is in prison, we

advise you not to correspond with them. It's simply not worth the hassle and potential danger. Be alert to possible freaks or creeps. Frankly, these people **don't show up that often** and that's what makes us all the more vulnerable to them. Crazies are hardly a problem confined to cryonics groups. We probably have a lower than normal incidence of these people coming 'round because in order to find cryonics reasonable you almost have to have a rational and healthy sense of self worth and a desire for self preservation. Most mentally ill folks don't! In talking with people involved in noncryonics organizations we've discovered that the number of sociopaths or mentally unbalanced people who become involved with small groups is actually far higher in their experience than in ours. Many if not most social organizations such as the Masons, the Elks, and the neighborhood Country Club handle this by making membership "exclusive" and by invitation only. Since demand for our services isn't overwhelming we can hardly take this approach.

If someone seems too good to be true, or not on the level, rely on your instincts and use good common sense. Above all, don't hesitate to call or write us for advice or information. Cryonics is starting to grow again, and we are experiencing an enormous upswing in the number of new people coming around (we are now taking an average of two or three people a week through our facilities in Fullerton)! We simply need to keep in mind that with the good may come a few of the bad as well. With a little common sense it is almost always possible to quickly separate the two.

Dixie's Rebirthday

On December 8, 1985, a German Shepherd dog by the name of Dixie made a unique and difficult journey. Dixie experienced the privilege (and the peril) of having all her blood washed out and replaced with a synthetic solution and then being cooled to 4°C. For four hours she was held at this temperature: stiff, cold, with eyes flattened out, brain waves stopped, and heart stilled. Then, she was reperfused with blood, warmed up and restored to life and health. She went on and returned from a small part of the journey we plan for ourselves.



Mike Darwin with Dixie on her rebirthday.

It has been a year since Dixie's trip to near the ice point. The first month or so following the procedure was a rough one for Dixie, but she has made a superb recovery. She lives with us here at the lab and she is a valued member of the ALCOR family. Since many people have inquired about her, we thought we'd snap a few photos on

her "rebirthday" and share them with you.

It's also nice to know that now, 1 year later, Dixie, and ALCOR's other two long-term follow-up TBW survivors are doing well. When we were outside taking these photos of Dixie, a fellow drove up and gave us an unsolicited and unexpected report on Star, our first TBW survivor. It seems Star is doing great--living up in the mountains, running wild and free and providing companionship to a fellow who described him as "the best dog he ever had!" That news made our day!

Nanook, our third long term follow-up dog, is living with ALCOR member Allen Lopp and continues to do very well.

Reflecting Forward:

ALCOR in 1985-1986

By the time most of you receive this issue of CRYONICS, we will be several weeks into 1986. Another year will have gone by, another will be underway. But now, as I sit here writing this, I can take a moment to stop and think where we've been and to give some serious, aching thought to where we're going. Thinking about **both** of those things is important, and I think it's never been more important than now, because I sense that cryonics and ALCOR are moving toward a crossroads, a turning point. The road ahead is going to be difficult under the best of circumstances. The decisions we make this next year will be critical in determining if we make it, not just for another year, but over the long haul. I'm going to try to share my thoughts on these matters and perhaps motivate you to **participate.**

The past year has been very productive. Looking back on it, I hardly know where to begin. There have been so many milestones. We have completed our cephalarium vault and moved our patients into a structure which is both fire and and earthquake resistant. We have wrapped up a series of total body washout experiments which was successful beyond our wildest expectations: with six out of seven animals surviving long term (see DIXIE'S REBIRTHDAY in this issue) and we have presented this work to the Society for Cryobiology. Perhaps our most important research accomplishment of this year has been the completion of the first phase of our research to establish to what degree we are preserving tissue ultrastructure after death and the application of current cryopreservation techniques. This was a monumental project both in terms of time and expense and its completion gives me great satisfaction as to our ability meet difficult new challenges and deliver.

We also carried out the suspension of one of our members. In this there is both sadness and satisfaction. Separation from our friends and loved ones is never easy, that's the hard part. The satisfaction comes from making the best out of an otherwise awful situation. At least we've done the right thing, and we can have every hope of seeing her and the other ALCOR patients again.

The smoothness and professionalism exhibited by the ALCOR Suspension Team during the course of this suspension is one of the most reassuring things about

our continued growth. We have finally **arrived** at skilled, quality care. That's no mean achievement in and of itself.

We have also substantially upgraded our literature and expanded our public education. CRYONICS has continued to grow in scope and has continued to attract quality writing and landmark papers, such as the one by Eric Drexler in this issue (CELL AND TISSUE REPAIR...). Our ads and our media outreach have generated hundreds of new enquiries and the rate of addition of new Suspension Members has been sustained. ALCOR now has 69 suspension members and, as far as we know that's the record and that makes us the largest cryonics organization in the world (for what that's worth!).

We've had an excellent year. The above are just the high points. There have been other more subtle and exciting developments. Several of our new members are high quality, concerned professionals who have decided to make major commitments in time and energy to support our operations. Sherry Cosgrove, our Treasurer, has put us on firm footing in the accounting department and Hugh Hixon has almost single handedly organized administration and fine tuned it to the point where we now know about not only every falling administrative sparrow, but every falling feather as well! Scott Greene continues to look after man and beast (patients and research animals) and continues to show the kind of day to day support that makes any successful organization run. These are big jobs, done by big people.

The continued outstanding support we've received from Jerry Leaf, Fred and Linda Chamberlain, Glen Tupler, Allen Lopp, Brenda Peters, and most recently Luigi Warren has resulted in tremendous growth in our capability over the past year. The Florida group has continued to grow—both in terms of membership and capability. In no small measure this has been due to Glen Tupler who has managed to keep ALCOR South Florida on an even keel, and has demonstrated the invaluable ability to carry out the day to day management required to hold an organization together.

But, it is not the past I want to talk about so much as the **future.** As I said earlier, we're at a crossroads and we have some tough decisions to make. Some urgent and important decisions.

One of the troubling things that we have come across in the past year is the finding that in the cat, at least under the conditions we're currently employing, the brain is not weathering perfusion, freezing, and thawing as well as we would like. Ironically, the kidney and heart show far better ultrastructural preservation than the brain. Why? That's a question we urgently need to know the answer to. The two areas where I feel we've not met our responsibilities are in reporting these developments and proceeding with research. Obviously, we've been busy. But I think we can never be too busy to undertake this kind of work. One of the things we **must** do is to get this complex body of work assembled into a meaningful technical article and share our findings with a wider audience (this work was presented at the 1985 Lake Tahoe Life Extension Festival).

The researchers who participated in this project think it likely that the problem lies with the cryoprotective agent. Choice of cryoprotectant has been somewhat arbitrary, and the cryoprotectant that we have been using (glycerol)

may simply not be getting to where it needs to go or may be wrong for other as yet undetermined reasons. We need to start down the path to answering these questions.

As president of ALCOR I have taken a tremendous amount of pressure to "push cryonics" and to concentrate more on growth and public relations. This is good, and it has its merits. But we must always be aware that in the midst of all this screaming "Let's go to the moon!", there is a quiet voice saying "Houston, we have a problem . . ."

We can't in good conscience promote something we're not confident in. At this point, none of the competent cryonics researchers (including a procryonics professional cryobiologist) who've looked at our brain electron microscopy feel it's anywhere near where it could or should be. As one cooperating cryobiologist (who must remain anonymous here) put it, "If the brain EMs looked as good as the kidney and heart, I'd say we were home free. As it stands, I just don't know. And that is a crime, because this is probably a relatively minor **technical** problem rather than a really serious theoretical one."

Compared to the past, a large amount of money has been spent on cryonics research in the last two years. A tremendous amount of the money (the overwhelming majority) has been spent on flashy "quick results" projects: those which are easy to understand and offer immediate gratification. That needs to change. ALCOR needs more support in the area of basic research. First, to solve the immediate problems of patients fracturing into pieces and the demonstrated poor ultrastructural preservation of the brain, and then to begin a full scale evaluation of vitrification.

These two things are related. We cannot hope to apply vitrification to the brain until we have a reliable, nontoxic, vitrifying cryoprotectant that will **permeate** the brain. We suspect that the DMSO-propylene glycol mixtures currently in use in vitrification solutions will permeate brain tissue (we've some very preliminary research to document this). If this does turn out to be the case, then we may be very, very close to developing a fully reversible technique for cryopreservation of the brain. Or at least a technique which simply does a few, very minor and potentially easily reversible kinds of injury.

Why do we believe this? **Because we have recent information that at least one organ, the liver, can successfully tolerate the introduction and removal of vitrifiable concentrations of cryoprotective agent.** The kidney tolerates introduction and removal of similar quantities of CPA with only slight injury. Embryos, a range of white blood cells (including some which are completely

destroyed by any known freezing protocol), and a variety of cells in tissue culture have now been successfully vitrified with little or no loss of viability.

What all this means is that we are probably very, very close to a quantum jump forward in the quality of suspension techniques. This is profound. **It means that we are very near being able to do almost NO damage to the brain with the preservation technique we employ during cryonic suspension.** It means an elimination of the tremendous mechanical disruption tissues experience due to ice formation, and it means the possibility of recovering some patients treated with suspension (those who are young and suffering from single rather than multiple organ failures) in something approaching real time!

In the 17 years I've been involved with cryonics I have never felt more optimistic or excited by the prospects. And I've never felt more frantic and frustrated at the slow pace of progress. We've simply got to attract and commit funding to this area of work. We here at ALCOR cannot emphasize enough that rather than spending $50,000 or $100,000 on promotion, it makes more sense to use every available resource to put cryonics on a sound scientific footing. Near perfected or perfected suspension techniques will sell themselves. We are now tantalizingly close to being able to realize just that goal and to do it with a relatively trivial expenditure of money.

We estimate that a full-scale vitrification project could be supported on as little as $100,000 a year. Very significant progress could be made at a $50,000 per year commitment. That kind of money is being spent right now in other areas of cryonics and life extension research. The same level of funding needs to be applied to brain cryopreservation and vitrification. It needs to be applied now.

In the coming year ALCOR is going to continue to expand its nonresearch programs. We have responsibilities to people who are signed up now and we will move forward with our Coordinator program and with our public education and suspension team training programs. But we are going to make, as our number one priority, the advance of brain preservation and vitrification research.

We have taken plenty of heat and criticism in the past. We are not afraid to take it again. We intend to be vocal and committed on this issue. We ask you to stand with us, and to support us. **We ask you to share our vision.** Take the time to look carefully and to move with deliberation and patience. We all want, and are desperate for, quick results. Anyone past 20 who looks in the mirror can easily understand why.

However, we simply have to realize that the obvious route isn't always the best one or even the workable one. We'd best listen to that quiet voice saying "Houston, we have a problem . . ." before its too late.

The past year has been a magnificent achievement. With your help the coming year can be even better. Stick with us, share our conviction: The best is yet to be.

Mike Darwin, President
ALCOR Life Extension Foundation
December 6/7, 1985

THE MYTH OF THE GOLDEN SCALPEL

by Mike Darwin

Both Ettinger's THE PROSPECT OF IMMORTALITY and the cryonics movement as a whole have been accused of being unscientific, of offering unrealistic hope. In view of the history of cryonics since THE PROSPECT, this criticism appears justified. Ettinger wrote THE PROSPECT as an **extrapolation** of research observations, without further recourse to experiment. The cryonics community THE PROSPECT has spawned has continued to act on the basis of that original hypothesis. Historically, we have been more concerned with preserving hope than with real examination of the problem of preserving biological structure.

A major reason why nine patients were allowed to thaw out and rot in Chatsworth was because the relatives (and in some instances the patients themselves) were more interested in buying hope than in buying a real chance at revival. In hospitals, nursing homes, and other agencies where people are cared for in a framework where they cannot speak out for or defend themselves, society at least attempts to set up feedback mechanisms in the form of watchdog agencies and ombudsmen to set standards and **evaluate** care. In the absence of such precautions, anyone can claim anything, and it becomes impossible to sort out reality from fantasy.

One of most difficult and dangerous aspects of cryonics has been the absence of feedback. If you enter a hospital for surgery, take your car in for repair, or contract for the addition of a room to your home, you will have little doubt as to the quality of the work or the desirability of the outcome. The reason this is so is because of **feedback.** The task undertaken yields results in a meaningful time frame—and the results can be evaluated. This has not been the case with cryonics. We have proceeded by speculation in a time frame of hundreds of years. In consequence, our society (which is not composed of total fools) has peered around the edges of our hope and speculation, noted the absence of substantial evidence, and dismissed cryonics as a viable alternative to death. To put it mildly, the absence of feedback on our procedures, in the form of real research results, has created a severe marketing problem.

This lack of feedback has affected every technical question in cryonics. Which freezing technique is best? What is the safest temperature to store at? How much and which kind of cryoprotective agent should be used? How can "outsiders" verify that a patient is really being maintained in storage and that the quality of that storage is adequate and everything it was promised to be? These are serious questions and they cut to the core of our program and often are at the root of divisions and dissension within the cryonics community.

There is a significant and growing contingent of people who accuse ALCOR and "Southern California cryonics" of being "too high tech" or more precisely too "chauvinistically high tech." John de Rivaz, commenting in the September, 1985 issue of THE IMMORTALIST has stated that "the organizers of cryonics and other immortalist societies should offer members as many options as are conceivable, from high technology, high cost California style cryonics on one

hand, right down through interment in the Arctic or peat bogs or storage in a deep freeze as practiced by Dr. Martinot in France on the other." The thrust of this kind of commentary is that cryonics and hope ought to be affordable to everyone. A noble sentiment, and one which we share. But the question is how do we rationally, realistically get there? Are we just trying to provide hope or are we trying to do something that will realistically result in our continued **survival**?

Cryonic suspension as practiced by ALCOR is expensive because we are trying to offer more than empty hope. We know what our objective is: to preserve structure and viability under the best possible conditions. To this end we spend a fair amount of time and energy trying to insure that the care given meets our objectives. Tossing someone into a peat bog or dropping them into a vat of formaldehyde on the grounds of providing some hope not only isn't going to work—it is cruel and immoral as well. Proposals such as Mr. de Rivaz's cross our desk all too often. What about freeze-drying people? What about chemical fixation? What about any alternative to spending time, effort, and money? In short, what about a Cosmic Automatic Road to Immortality?

The fact of the matter is that techniques other than cryogenic storage following "high tech" perfusion **may** offer some hope, may even be superior to cryonics, but we **don't know** this! We selected cryonic suspension on the basis of conservative criteria because we **don't** know how memory is stored or how much molecular structure needs to be preserved to conserve identity or allow for reanimation. We chose cryonic suspension because on the basis of the best available evidence it is the **best** technique around for achieving biopreservation.

ALCOR has not been content to let the matter rest there. We realize that Ettinger's original hypothesis needs a great deal of additional evidence before we can rest comfortably or even be assured that cryonics is good enough to achieve the goal of continued survival. It was nearly 20 years after publication of THE PROSPECT that ALCOR undertook the first basic research to examine the premise of cryonics. That research consisted of systematic electron microscopy to evaluate the extent of cryoinjury both under "optimum" conditions and after 24 hours of death with simple refrigeration. In 1983, ALCOR performed the first postmortem examination of frozen-thawed suspension patients' remains (following conversion to neuropreservation) and discovered the presence of massive fracturing in most organs—including the central nervous system. For nearly 20 years patients have been suspended without anyone doing evaluations on animals, let alone on people, to determine what even the simplest gross effects of cooling to liquid nitrogen temperature were. For 20 years we've been freezing people without **really knowing** what kind of damage we were doing, or how we might improve things to minimize that damage!

Using conservative criteria, such as state-of-the-art medical and cryobiological technology, provides us with a benchmark and a framework against which we can measure progress. Such technologies are "expensive" because they involve feedback. When we suspend someone at ALCOR we conduct sophisticated laboratory evaluation of every step of the procedure. We do bacterial cultures on our perfusates and perfusion circuits to act as a check that good sterile technique is being employed (not only to protect the patient, but to protect the staff as well -- contamination goes both ways!) We run chemical analyses on the

perfusate to make sure that it was mixed and formulated properly. We also take tissue, blood, and perfusate samples to evaluate the state of the patient before, during, and after suspension. In cryonics we don't have the "luxury" of waiting a few weeks to see if our patients recover from the surgery, or develop an infection from "sloppy" technique. Unless we provide the feedback in the form of quality control and laboratory evaluations, there just won't be any.

And, as the history of cryonics has sadly shown, without both positive and negative feedback there is no way to know whether you're on the right track. Opinions then hold the same weight as facts, and anyone is free to speculate and peddle false hope and empty promises. And empty promises can kill.

Not very long ago, I spoke with the family of a suspension patient who was unable to afford continued whole-body cryogenic care (the patient was suspended before current funding criteria were in place). They had been told and apparently believed that simply removing their relative from suspension and immersing the patient in formaldehyde solution promised some chance of eventual revival. No amount of trying to explain that the brain would be completely autolyzed and digested before formaldehyde (or peat bog acids, for that matter) could diffuse in was of any avail. We have actually conducted experiments to evaluate this, and we could thus speak with certainty that the brain would be decomposed long before formalin could diffuse through many millimeters of skin and bone and reach even the surface of the cerebral cortex. Despite the fact that neurosuspension was offered **free of charge** they preferred to believe that chemical preservation "offered some chance."

This same kind of attitude characterizes many of the people who have accused ALCOR of wielding a "golden scalpel" and of being unwilling to offer a family of low cost alternatives or even "anything the customer wants." What they fail to understand is that, in the absence of the same kind of evidence that exists for cryonics, the various low cost options they tout might be simply no better than empty ritual or hopeful prayer. If it doesn't matter how effective the preservation is, or even if it works at all (such as in the case of the peat bog suggestion) then why even bother with the business of preservation at all? Why not just believe in a merciful God and a bountiful Heaven and be done with it? Why even go to the inconvenience of opening a hole in the moss of a bog?

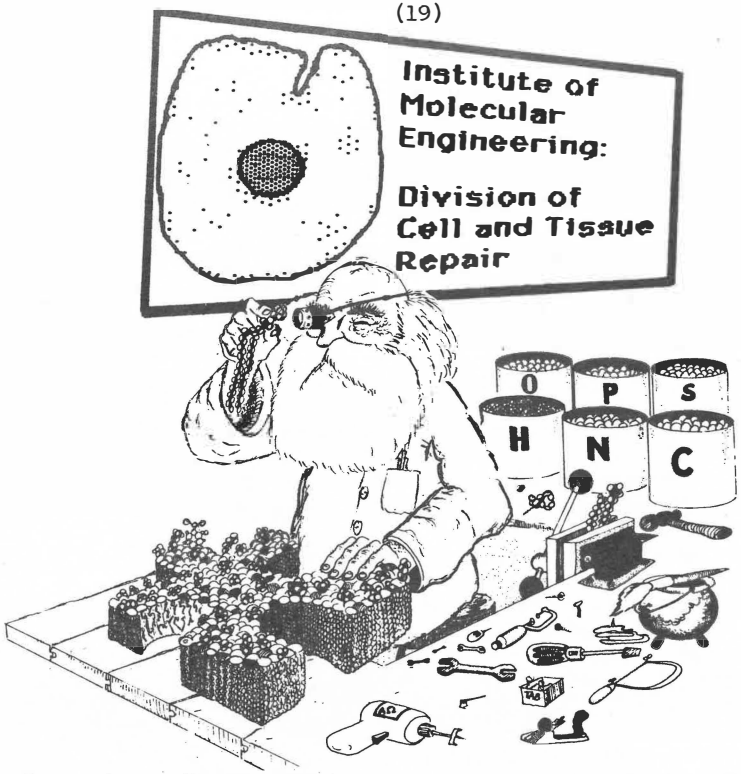
Offering ineffective or totally unsubstantiated forms of treatment just because a patient cannot afford cryonic suspension is not something that ALCOR (or any **cryonics** organization) should rationally be expected to become involved with. An instructive analogy would be a hospital which offered to have a witch doctor chant over a cancer patient because he couldn't afford chemotherapy or to offer to remove someone's gall bladder using kitchen utensils and no sterile technique because they cannot afford state-of-the-art surgery. For anyone who is truly in need, ALCOR has been and is willing to go out of the way to be accommodating and hold costs down. But we also realize that any procedure costs something, and that those now in suspension as well as those who have made suspension arrangements with ALCOR depend on us. Our first responsibility is to them. That means that standards will have to be set and operating criteria established to protect everyone from litigation and false expectations, as well as false promises.

There may be adequate or superior alternative techniques to cryogenic storage. But it is going to cost something to investigate them and to establish quality control and other criteria to see to it that they are adequately administered. 20 years after cryonics was suggested we are just now beginning to put into place the framework to demonstrate whether or not existing freezing techniques are effective in preserving most of the molecular structure of the patient. It has been a long, hard battle to lay that framework. We are heavily committed to it, and our expertise is in that area. Those who would rush into chemically fixing patients or storing them in department store freezers should be prepared to do the groundwork themselves to establish the safety and reliability of those techniques in preserving ultrastructure over long periods of time. And they should not expect us to follow until this has been done.

Even so, the fact is ALCOR has had a long standing commitment to the pilot evaluation of fixatives and imbedding schemes for preserving structure. As far as we know, we are the only organization in the world which has already examined tissue at intervals after fixation at room temperature to evaluate loss of structure. (We've looked at brain tissue stored in aqueous fixative for up to three years and the results are not good.) We are also storing imbedded tissue (which has all its water replaced by plastic compounds, and which should minimize entropic damage) and will be examining that at intervals as well. In the meantime, we have no intention of offering any preservation procedure which we do not have reasonable confidence in, and we are not about to abandon costly quality control and feedback for wandering around idly and "hoping" everything went as we intended.

Our commitment to quality control and feedback has already paid off. In a recent suspension we discovered that a potentially serious error had been made in perfusate preparation, an error which fortunately did not result in harm to the patient. We also detected a break in sterile technique during pump set-up as a result of doing perfusate cultures. This kind of feedback alerts us to trouble spots and helps ensure that a consistent and high quality of care is delivered. The **majority** of cryonics organizations have conducted suspensions in the past without reference to or even concern about quality control or good care. We have been told over and over again that it doesn't matter how you get frozen as much as **if** you get frozen — all the errors on this end will be sorted out on the other. This kind of attitude has resulted in patients being perfused under filthy conditions with embalming equipment or not being perfused at all and with patients being stored at high subzero temperatures while armchair arguments are advanced to wish away objections and information that contraindicate this approach.

These advocates of hope and hype, no matter how good their intentions, sooner or later will confront the fact that this a rather inflexible and altogether too real world in which we live. If we are to survive we must keep our eyes open and never lose sight of the hard realities. Cryonics cannot and will not save everyone. Money, circumstances, and just plain bad luck have and will result in some painful defeats. For the time being we have to learn to live with that. Retreating into fantasy or becoming merchants of empty hope is **not** going to result in our long term survival. Progress will come only through feedback and rigorous reexamination of our premises and practices in the light of growing knowledge. Anyone who thinks otherwise is invited to peddle or purchase salvation at the church or charlatan of their choice. The rest of us will continue on to the hard business of dealing with reality.



Molecular Technology and Cell Repair Machines

Part II

by Eric Drexler

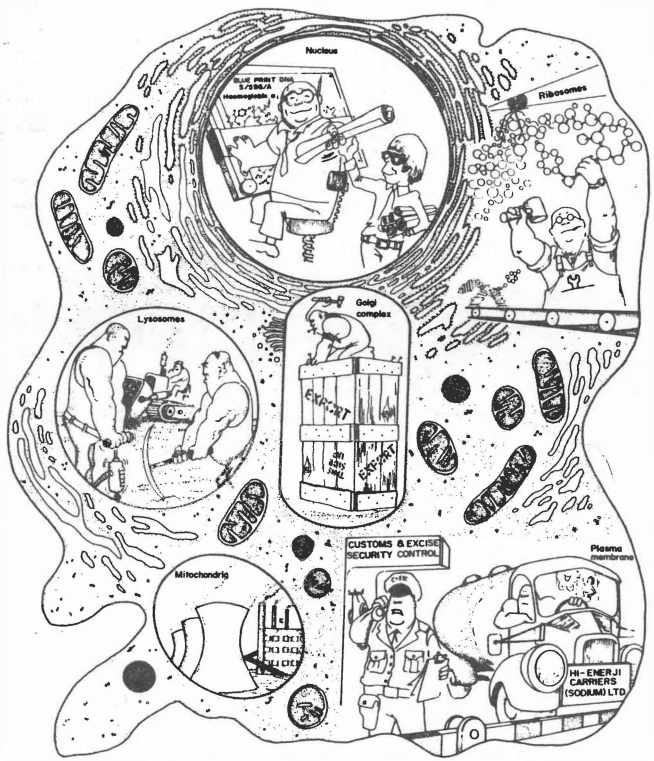
But I'm beginning to discuss this in terms that start to sound like the topic that I'm **not** talking about, that is, life extension. But, this is a natural size comparison to make. I've already talked about another life and-death issue—replicating assemblers that might not be subject to the ecological constraints of bacteria. This same technology-base will also provide an industrial base that can very rapidly let us make huge quantities of products with unheard-of performance. And because this industrial base will rely on self-replicating machines, all of a sudden the relationships between labor and capital and rate of economic growth change by orders of magnitude. So we're already talking about things that are very important **economically**, and things that are very important **strategically** (you could program replicators to be a much more useful and nasty form of germ warfare). So there are issues of life and death importance that I've already discussed, without saying a word about life extension.

Now I proceed to say, as I do in talks to space audiences, "Well, gee, if you can put a computer into roughly a millionth of the volume of a human cell (and give it a lot of memory and still only use a fraction of the volume of the cell—using about five cubic nanometers per bit for random access memory, and

Ø.Ø2 cubic nanometers for "tape") then in the volume of one cubic micron (about one-thousandth of the volume of a typical human cell) you can put as much information as there is in the cell's DNA." So you can put a lot of information **and** a lot of computational capacity into a cell. Molecular machines will be able to sense molecular structures and decide what to do: "Gee, this crosslink shouldn't be here--what should be done about that?" Well, it can then use molecular tools to cut the crosslink, repair the molecules, and set things back the way they're supposed to be.

So it's pretty clear that some kind of cell repair machine is possible. And it's pretty clear that bringing something like surgical control to the molecular scale will mean a dramatic breakthrough in medicine. The life extension implications are obvious. But in my general space talk, I don't mention them. I **have** asked how many people are interested in signing up for the MIT Nanotechnology Study Group, and most people say yes. Interest has been strong; people would come in and we'd talk about these things further. So here we have a set of ideas that makes it clear that there will be tremendous breakthroughs in life extension, but this conclusion follows from a complex of arguments that are important for their own sake. In short, you don't have to directly ask people to worry about questions of "Can they avoid dying?" And that turns out to be a good way to avoid resistance in selling life extension.

To make effective cell repair machines, it seems we really do have to have computers sitting in to direct operations. The molecular machinery of a cell can build a cell from scratch without having to recognize the details of a complex situation--it's in a comparatively simple situation. It gets chemicals from outside its membrane and it has an internal program that directs it to go through a series of operations, build a bunch of things, and expand itself to form a larger cell with two sets of chromosomes which eventually divides into two cells. That doesn't take a whole lot of smarts. The cell doesn't have to recognize a detailed, three-dimensional pattern of molecules and then



"The molecular machinery of a cell can build a cell from scratch without having to recognize the details - it's a comparatively simple situation."

do something about it. But to repair a damaged cell, you **do** have to recognize a complicated pattern of molecules and decide what to do about it. Therefore, if you want to have a general, powerful cell repair capability (there are certainly some useful capabilities short of this), then you're going to need on-site computers. Fortunately, as we have seen, these turn out to be possible.

A small, historical note: back when I was in college, I was interested enough in cryonics (I had read science fiction and so on), that I got as far as saying, "Well, I wonder if they've looked at the phase diagram of water, and at what would happen to an organism if you go to a high pressure, cool without freezing, and then suddenly increase the pressure a lot?" I got as far as finding out about baroinjury (pressure damage as opposed to freezing damage) without getting far enough to hear about baroprotective agents. At that point I said, "Well, these cryonics people are probably wrong, because there probably aren't enough variables to play with. It's a nice idea, but it probably won't work. They're probably a bunch of crazies."

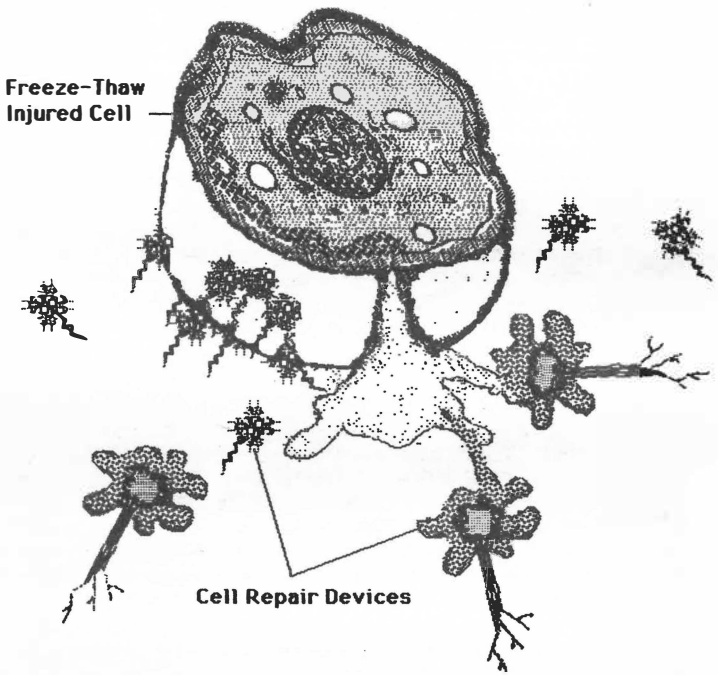
Then, years later, I was exploring molecular technology. And, of course, if you're studying molecular technology, you study the molecular systems of life, as well as novel molecular machines. It wasn't too long before I said, "Hey, you could do cell repair with this. I'll bet you could even repair frozen tissue with this!" And I proceeded to construct an argument that this was in fact possible; what you're hearing today is part of a much-refined version of that argument, which now rests on a lot more numbers and detail. So then I went and dug out a copy of Ettinger's The Prospect of Immortality from the MIT library, and there, lo and behold, I found out that these crazy cryonics people not only were right, but they even knew **why** they were right, that in the future we're going to have molecular repair technology. Ettinger wrote of repairing cells molecule-by-molecule if need be. Of course, he didn't have the numbers to demonstrate this, and there was still the question of how we would get there. But he had the basic physical perception that we'd develop molecular-level repair machines, and that doing this doesn't conflict with any physical law.

So, from molecular technology, to cell repair, we arrive at questions of cryonics. Now, as I said, we're really talking about two things simultaneously. One is how I present these ideas when I address audiences with general technical interests, and what their responses are. The other is the technical content itself. Regarding the first, let me give an example. I gave an MIT seminar, four days on nanotechnology, one of them on cell repair machines. Somehow, the conversation that day naturally turned to freezing damage. In answer to such questions, I would of course say, "Yes, it seems that such damage could be repaired." People would ask about the nature of memory, and I would answer, "Well, it seems to be embodied in fairly robust structures." We had a retreat up in New Hampshire later, in which it turned out that, yes indeed, people were highly motivated by the more conventional life-and-death issues in nanotechnology, but by this time they were also intellectually convinced immortalists, **as a side effect.** A number of people in this nanotechnology study group later reviewed the most recent draft of my book--Engines of Creation, which I'm working like mad to try to finish for the end of the month for Doubleday. It has three chapters on life-extension and cell repair machines—the last of which discusses cryonics. And the reviewers made suggestions like, "Give this chapter a more explicit title—emphasize it! It's important, and it will help sell the book." Now, I'm not sure that it would help sell the book to people who hadn't been exposed to the same ideas as they had. But the interesting thing is that after going through that process, they were indeed

thinking that way. Remember, these are technically oriented people, who weren't out looking for approaches to life extension. But they became interested in this new technology, with its implications for computers, materials, spacecraft, and economic production--bringing new strategic dangers and new strategic opportunities and a host of familiar kinds of life-and-death issues. And they found that life extension was a natural part of it, and they soaked it up without ever being prodded with the question, "You do want to live forever, don't you?"

Initiation of Cell Repair Sequence

(Cutaway View)



My expectation is that as knowledge about this field spreads, and as concern about its consequences spreads, many people will find their interests hooked. I plan to spend the next few years making that process go—as much of my time as I can free up from less useful ways of making a living. As this happens, we're going to find there's an expanding community of people who naturally think that life extension is inevitable, and who as a matter of course recognize that cryonics makes sense. Look forward to this. Think about what to do in this situation. I think the best strategy, from your point of view, is to let these conventional life and death concerns motivate interest in molecular technology, and then to reap the resulting harvest of interest in cryonics.

Let's return now to the more technical aspects of really thorough tissue repair. In the paper I've been working on, I go into a lot of detail regarding a more-or-less worst-case example of total-body cell repair. The assumption is that you have to rework all the molecular structures in every cell bit-by-bit, and that you aim to do this with systems that are entirely inside the cells. (I also discuss how to relax this second constraint.)

In a cubic micron, you can construct the equivalent of a mainframe computer with a gigabyte of memory (I already mentioned that this is about as much information as the cell uses to construct itself in the first place). It turns out that you have enough computational cycles within the volume, time, and heat-dissipation constraints to identify all the macromolecules of the cell (even if

they're moderately damaged), by using certain algorithms that can already be specified in fairly great detail. Since you can identify all the molecules, you can map the cell structures: the patterns that you recognize are type-tagged by the molecules they contain (i.e. if it contains tubulin, it's a microtubule). Since this tells us the type of structure, it makes it easier to know how to probe and further characterize the structure.

You can get the machines into cells: white blood cells demonstrate that systems of molecular machinery can move through tissues. Viruses demonstrate that systems of molecular machinery can move through cell membranes to enter cells. The mobility of organelles inside cells demonstrates that systems of molecular machinery can move around inside the cell. The fact that cell biologists can stick needles into cells and do surgery on chromosomes and sometimes have the cells survive shows that things can enter cells and do even very crude manipulations without doing permanent damage in many cases. So you can get repair machines to the site of the damage.

You can identify, take apart, and put back together molecular structures. Identification is demonstrated by molecular structures that can identify each other, as antibodies recognize proteins and so forth. For the "take apart" function, we have the direct analogy of digestive enzymes. As for assembling molecular structures—well, these things were made by molecular machines in the first place, so again we have a direct analogy. So, again, and again, and again, you can go to a biological analogy and say, "We already know a process like this." If the overall process is orchestrated into a computer (which you can design to some degree of detail using direct calculations and scaling relationships) then it seems you have everything necessary to repair cells. I have, of course, only sketched the case here, but even these facts are enough to make the idea plausible.

Since I've been talking straight through here for quite a while, I'd like to stop and ask for questions.

AUDIENCE: Could you say a few words about the electron-tunneling or scanning-tunneling microscope (STM)?

DREXLER: Yes. In 1982, some researchers at IBM-Zurich came up with a device which has a very fine needle point (positioned by piezoelectric crystals) that is held very close to a conductive surface in a vacuum chamber. When you move the needle very close to the surface, electrons tunnel across the vacuum gap. The current becomes very substantial when the needle is very close to the surface and drops off when the needle is further away. And it turns out that you can move this needle to a precision that's a fraction of an atomic diameter. Well, the ability to do that looks a little bit like what's needed to build an assembler, since an assembler is something that manipulates reactive groups to atomic precision, and this is something that moves a needle around to atomic precision.

I looked at this in '82, and I said, "Oh, no! This just **might** be a shortcut to a technology that strikes me as being very dangerous," so I said nothing about it. After all, we can already save lives with this technology simply by having people **understand** it: if they understand it, then those who really care are going to sign up with cryonics societies and save their lives. Outside this though, this technology can be used for mind-control systems, and

things like programmable germs for germ warfare. These are possibilities that I'd rather see develop later rather than sooner because I think that you'll live longer that way, and have a greater chance of living indefinitely that way. With more time to think, we'll be better prepared. There's room for disagreement on that, but that's my analysis.

STM technology may get us to nanotechnology faster—it's hard to say—but I don't use this in my explanation of nanotechnology because by using the protein design route I can say, "Look, there already are molecular machines. We can learn how to build similar machines and use them to build better ones." It's a more compact, concrete discussion and it also, I think, is more persuasive. I can really nail down every point in the scenario. The STM may be a shortcut to the same goal, but if so, it's not obvious how it will work. What is important today is to make assemblers and their consequences credible. The protein-design route does that.

AUDIENCE: One thing that I think should be pointed out about the scanning tunneling microscope is that it does not work **just** in a vacuum. They are now getting pictures back from air, and water, and oil, I believe. And there was a picture just recently in Scientific American of the surface of a silicon crystal and you could see all the atoms. It really has atom-level resolution. This was all done at IBM-Zurich. There are a few others around, but they're fairly cumbersome machines. Very quickly we're going to have the ability to machine things on that level. It's here.

DREXLER: This stuff is coming right along. Watch out.

AUDIENCE: Could you elaborate on your scenario--what you meant by you hope later rather than sooner?

DREXLER: First of all, I believe that the emergence of this technology is inevitable (barring some worldwide devastation or totalitarian state). There are competitive pressures, there are many different roads to it, and there are no sharp lines between this technology and what we're doing right now—just a series of steps. Between now and then we can try to build institutions and a climate of opinion that makes it more likely for these developments to lead to a world where people are free to choose how to live within very, very broad limits, as opposed to their being dead or enslaved. One of the requirements is that we stay ahead of the efforts of less pleasant governments elsewhere in the world. This is a big reason for **not** trying to hold it back. I argue that forcefully in my book. What can make it desirable that we don't rush is the value of gaining a better understanding of what we're doing. This is a technology where considerable foresight is both possible and profitable. Much more so than we've seen, I think, in previous technologies. We already understand the physical laws behind these machines. By biological analogies and calculations, we can already see a lot of what they can do. So you can look at the kinds of safeguards needed to control replicators and use them to do what you want, instead of having a disaster happen. We can develop the institutions that are needed to handle this stuff without something nasty happening.

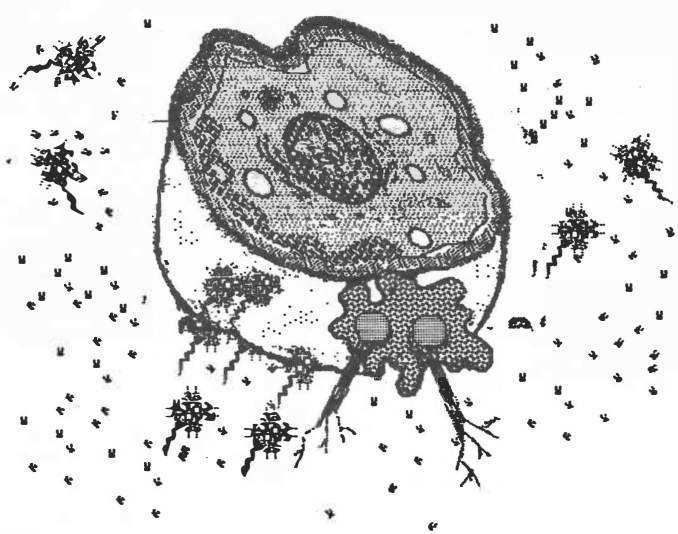
It's clear, I think, that the defense department is going to play a big role in this. The strategic implications are greater than those of nuclear weapons. There is at some point going to be an effort as urgent as the Manhattan Project; there's going to be a race. When that happens, it would be best if people understood that this race can lead to a situation where we can

have vast material abundance, long life spans, and a lot of freedom—if we play our cards right. Rather than saying, "What this means is that we've got to stay ahead of the Japanese," or something silly like that. We don't want to race **against** people who ought to be our allies in carrying through and handling these breakthroughs. It would be nice if people understood the consequences of this so they won't just let the Pentagon do it. The military dimension of this must be kept firmly in mind, but we really need a set of institutions that ties this into the civilian world. We're really talking about a genuinely unprecedented concentration of power in the hands of the groups that carry through certain breakthrough steps, and we have to prepare to deal with that, if we want to keep our lives and freedom.

AUDIENCE: You mentioned the problem of predicting the natural folding of a protein and that it would take an incredible amount of computer time to work it out. You also said that it's a simpler problem to design a protein to make a particular shape. Do you have any numbers which can give you confidence that this is possible? After all, if it takes a billion years of computer time to predict the folding of a natural protein and designing it is a hundred times easier, we'd still be dealing with something impractical.

DREXLER: It depends on "a hundred times better" along **what** dimension. If it were a hundred times better just along this computer-time dimension, you'd lose badly. But if it were, say, a factor of two better in the degree to which the energetics favor a particular folding pattern, that factor of two could be enough to eliminate all possibilities except the desired one. And in fact, what you're adjusting, what you have direct design control over, are matters of geometry and internal interaction energy that affects the exponent of the relationship that gives you the billion of years of computer time. So a little bit of change here, and the time required drops by orders of magnitude.

Cell Repair Underway With Molecular Repair Devices



The argument that I made in the Proceedings of the National Academy of Sciences was subsequently picked up by an author in Nature, who said, in effect, "Drexler argues that protein design is possible, and here is how we might go about doing it." My paper was also referenced by an author in Science who was writing about molecular engineering, who said, in effect, "We're making progress in protein design, and it will lead to the ability to structure matter to atomic precision." Progress is being made in protein engineering, and at an increasing rate.

With respect to the protein-folding problem, there's an evolutionary argument for why engineers should be able to do a lot better. The argument is that nature hasn't even been **trying** to do a good job at what we need to do. What nature is "trying to do" in the evolution of protein molecules is to make proteins that, in fact, under ordinary physiological conditions, fold to the right shape with almost 100% probability. As long as it's very close to 100%, then from the point of view of natural selection, the folding process works essentially perfectly. Now, imagine that you had a protein molecule that folded by a really well-defined, obvious, predictable, energetically favored mechanism. On a computer, it would be very clear at each step what the next step would be. But if that protein were allowed to evolve, you'd see random substitution of amino acids--and most substitutions will make the folding less predictable. There won't be any selection pressure to keep this from continuing until the protein gets right to the edge of stability (or whatever the analog to "stability" would be for following a desired folding pattern). And at that point the protein would fold correctly in nature, but in a way hard to predict from its structure.

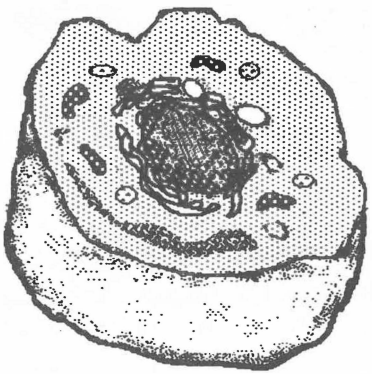
AUDIENCE: How close is present day research and technological practice to what could be described as molecular technology?

DREXLER: My understanding is that people are now, in micro-electronics, doing experimental work on laying down fine patterns on crystal surfaces, some only a few dozen atoms wide, something in that range. They're working on the right scale, but they don't have control of where the atoms are, and therefore, it's not molecular technology. Now, in another area, the scanning tunneling microscope does give you atomic resolution of position, but so far only for measurements. In a third category is synthetic organic chemistry, where people do make all sorts of interesting molecular structures, and biotechnology, where we get back to protein design.

AUDIENCE: I'd like your views on a possible alternative to cryonics for preserving people: morphostasis. What are the trade-offs between morphostasis and cryonics?

DREXLER: Morphostasis is a term I think Ettinger coined in response to some of my ideas. Cryonics is a form of morphostasis. Basically, morphostasis is nailing everything down at the molecular level and holding it in place. Freezing does this just by lowering temperature: everything solidifies and molecules are held in place, and this is nice because you're in a position to apply future technology to present day medical problems. Cell repair machines are primarily (if you look at the tools they use) molecular repair machines. The only reason that it's reasonable to call them cell repair machines is that, if you can repair and rearrange molecules, then since a cell is a pattern of molecules, you can repair it too. One of the implications of this is that if you're using cell repair machines to reverse a suspension process, then you find that you don't care about minor covalent modifications to the protein molecules, DNA molecules, and so forth, in the cell. Crosslinking is a terrible thing if you want to run around and be active and healthy. But, as soon as metabolism is shut down, having a whole bunch of cross links to hold molecules in place with nice, solid covalent bonds becomes a way of preserving structure and information. From all I've seen in the literature, you'd still prefer to cool tissue down to liquid nitrogen temperatures. But stabilizing by crosslinking does give you another degree of freedom that becomes reasonable, once you plan for cell repair machines.

Repair Sequence Complete: Cell Restored to Function



Incidentally, regarding the reversing of suspension procedures, any way that you preserve people with near-term technology seems likely to require cell repair to reverse. Even if you could get to the point where you could cryopreserve a mammal through freezing or vitrification or whatever and then revive it, I think—barring some really amazing breakthrough--that you're going to have a very sick mammal. I for one, if I were in a cryo-preserved state, would want to put in my contract, "Please wait until you develop good cell repair machines. And don't wake me up to be a very sick mammal, possibly with neurological damage that is such that I'm going to lose information." It would be better to stay in liquid nitrogen until the cell repair technology matured. (An auxiliary argument is that, in fact, by the time we get to cell repair machines, technical progress will be amazingly swift because we'll also have automated engineering systems that work about a million times faster than human engineers. That factor of a million is not chosen arbitrarily, but comes out of physical calculations comparing neural and electronic systems.)

AUDIENCE: This is probably not the actual type of damage that occurs during freezing (crosslinking is probably more likely and less of a problem), but I want to throw it at you anyway. Let's assume that you have a 1ØØ-amino-acid chain. Each recognition site requires a specific recognizer. There may be five different kinds of injury that could occur at each site, each requiring a different effector to repair. All of this information has to be transmitted and manipulated. All of this requires a tremendous amount of paraphernalia over and above the just brute amount of information that you're talking about. Does that trouble you?

DREXLER: You're absolutely correct, and it doesn't trouble me because I've gone through the design exercises and calculations on a relatively detailed level on how to do that. Basically, the molecular machine goes along and "sees" the chain by touch and reads the sequences into central memory. It only needs recognizers for the twenty-odd amino acids (or it just probes shapes). After reading the sequence, we're in data processing land instead of molecular machinery land. Mechanical signal transmission elements with a diameter of a few nanometers will transmit information at about a billion bits per second (this comes out of mechanical calculations), so the information can be shipped to a central computer in the cell. (The data rates and volumes all work out OK.) So now the information is in data processing land, **and** in a central computer. It turns out that you can work out an algorithm that basically works down a tree structure that encodes possible normal protein structures. You can work out the details of what it takes to do an identification of a protein molecule in machine cycles on an 8Ø8Ø chip. With this you can figure out how long you have to calculate and what degrees of damage you can tolerate in the protein. Once you know the protein, you can just look up what it's supposed to look like and just go from one end to the other, pull out the parts that don't match, and put in the right ones. The steps involve stereotyped sorts of bond-breaking and bond-formation, requiring only a small set of tools.

AUDIENCE: Why not just trash the whole thing and put in a new one?

DREXLER: The problem is that it **sounds** radical: "What happens to personal identity if you replace the molecules?" and that sort of thing. Actually, I'm inclined to agree with you: but to be conservative, I've studied a scenario where you don't throw away, you repair. That's not quite as easy, but it's feasible, and it's maximally acceptable in terms of raising the fewest possible issues of personal identity.

AUDIENCE: You should be able to take whole cells and just trade them in. Especially if you do it cell by cell.

DREXLER: I'm sure you could set up a machine that could just go through your brain like that, that could work its way from one end to the other, and you'd never notice the difference.

AUDIENCE: In a sense, that's just what your body does. It identifies bad cells and then junks them. The problem is, it doesn't put new ones back!

AUDIENCE: I can foresee situations where the molecular machines won't be able to proceed autonomously, but will need to collaborate. How will they be able to be coordinated in large numbers?

DREXLER: Yes, in many cases you're going to want to have a whole bunch of molecular machines in communication. The conceptually simplest way of doing this is to set up a serial data channel that works by pushing and pulling rods. You just have a little jointed cable about two nanometers in diameter that goes from one machine to the next and carries data at a gigabaud or so. In fact, if you get really hard up for computational capacity inside cells, it turns out that you can ship a complete molecular description of the entire body **out** of the body through data channels that occupy only a tiny fraction of the volume of the skin cells they pass through. Then you'd have all the information externally, where you could process it using computers that are far less volume-limited and heat-dissipation-limited. Finally, you'd ship the instructions back to direct the cell repair machines.

COMMENTATOR: I'm sorry we're out of time. Thank you very much. [Much applause.]

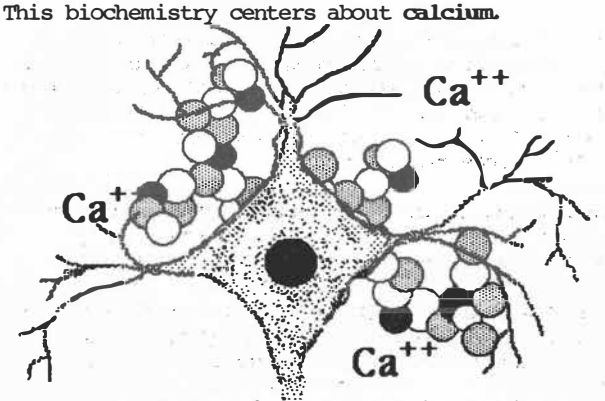
Science Updates by Thomas Donaldson

CALCIUM AND THE CHEMISTRY OF MEMORY

Unfortunately, as yet we don't know how our memories are stored. If we did know this, our work as cryonicists would become far simpler. We would know immediately just which structures and chemistry we MUST preserve, and which we can if necessary allow to disappear completely. It is certain that our present methods are spending too great effort on the preservation of many cellular structures which in 100 years we'll know have as little to do with memory and personality as the heart or the liver.

However, scientists have come closer and closer to understanding memory. Recent ideas on the subject center about two related themes, **long-term potentiation** and **calcium.** In the last few years, scientists have discovered that high frequency electrical stimulation of the brain will improve learning ability. The electrical stimulation lowers a threshold for passage of impulses from one synapse to the other. This effect allows an animal to learn more quickly. It's called **long-term potentiation** (LTP for short).

This isn't a practical method to improve our own memory. It involves implanted electrodes. Once the effect was discovered, however, these scientists could even verify similar effects in nerve cells in culture. This has been very important because it has allowed us to study the **biochemistry** of the process. This biochemistry centers about **calcium.**



A major review paper by G.S. Lynch and M. Baudry on this work appeared in 1984 in SCIENCE (224, 1057-1063 (1984)). We reviewed it in CRYONICS. Their hypothesis of memory was very testable, suggesting many experiments. Recently, a large number of papers have continued to explore relations between long-term potentiation (LTP), calcium, and memory.

At the 1985 conference on brain physiology several scientists, including Lynch and Baudry, presented their work on LTP and calcium metabolism in brain cells. E. Anderson, M. Baudry, and R.G.M. Morris showed that one drug, APV-5, in one of its forms, would block long-term potentiation, and that this would actually block learning in rats. Since the same drug blocks LTP in brain slices kept in culture, this work strengthens the idea that LTP relates to memory.

M. Lynch and others studied LTP in Brattleboro rats. Brattleboro rats are a particular strain of rats with inherited low levels of **vasopressin.** Vasopressin also relates to memory. In the late 1970's, in fact, scientists discovered that vasopressin could even help restore memory in amnesiacs. Brattleboro rats of course have a problem with learning. When Lynch et al looked at LTP in these animals, they found that LTP worked just as well in Brattleboro rats as in normals. This tells us that vasopressin and LTP work on memory quite independently of one another.

Lynch and others also reported a study of the biochemical effects of calcium and LTP. One relation between calcium levels and LTP is that calcium can cause the same effects as high frequency electrical stimulation. Flooding the brain tissue of a rat with a calcium solution will stimulate their learning and cause LTP. Lynch and others have pursued this fact. Calcium will also cause the increase of several chemicals, among which are **aspartate** and **glutamine.** These suggest that LTP involves some chemical changes in those cells **sending** a nervous impulse as distinct from those receiving it.

Lynch was addressing a central question: What is the chemical change which happens with long-term potentiation? Another paper in NATURE (315, 503 (1985)),

by D.A. Ewald et al at Brandeis, presents evidence that the fundamental chemical change with LTP consists of attachment of phosphate groups to proteins on the synapse walls. The proteins in question are **gating** proteins. They control the passage of electrical impulses from one synapse to another.

This mechanism isn't new. Our cells control the action of a number of enzymes by attaching phosphate groups to them. The attachment happens because of a particular **catalyst** chemical, which Ewald and his colleagues called simply CS (for **catalytic subunit**). What they have done is to study the effects of CS on the actual membrane proteins themselves, attached to patches of synapse membranes from the land snail.

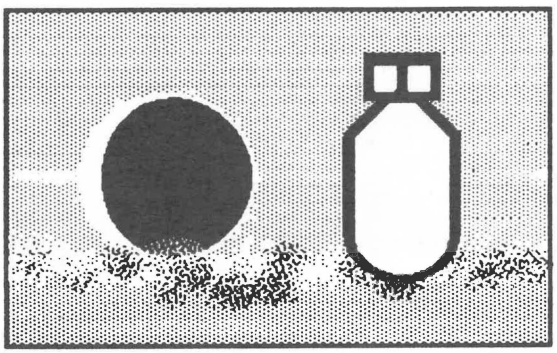
The crucial question they asked was whether this attachment of phosphate groups was just one step in a long series of processes which enhance learning, or whether it was the MAIN step. If it is only one step, we'd expect that CS wouldn't enhance transmission through the cell membranes. If it IS the important step in the process, CS would attach phosphates to the gating proteins, and this would directly enhance transmission.

Ewald et al found that CS did indeed directly enhance transmission. It follows that LTP very probably works by this means. A chemical change in the gating proteins causes our synapses to transmit impulses more easily.

It's still premature to say that these steps relate to LONG-TERM MEMORY. **Long-term memory** (in YEARS) is far more long-term than long-term potentiation (minutes). However, if we fully understand memory processes of this nature, we'll also know how they translate into long-term memory storage.

This work raises some important suggestions about proposals for cryonic suspension. Eric Drexler has suggested that we should use a chemical fixative such as glutaraldehyde before freezing in liquid nitrogen. The essential problem with such proposals is that we don't yet know what their chemical effects will be when we apply them to cells on a mass scale. In particular, chemical alterations coding for memory may leave very ambiguous traces in the structure of the cells. Glutaraldehyde is far less well characterized even than freezing (not that we would claim that freezing is **well enough** characterized!). A chemical treatment such as fixation may well wipe out many valuable **chemical** clues to memory. It's known, of course, that we must freeze even the fixed tissue, because otherwise it deteriorates with storage.

On the other hand, as a statement of what cryonic suspension will someday become, Drexler is very perceptive. First, there will never come a time when it isn't needed. People will always get injured in some way for which we know they are still "in there" but we lack the technology to bring them out again (at that time). Even if a technology is available at a central point, explorers or workers far from that point (say the outer rim of the Solar System) will have to be stored, often by jury-rigged, improvised methods, until transport to that location. The technology may not even exist yet! Second, the best form of storage would allow us to leave the patients at room temperature with no special equipment to maintain them. Some form of very advanced fixation is exactly what we need. Of course it may take molecular machines to place someone into fixed form just as much as it does to get them out again.



NUCLEAR WAR AND NUCLEAR WINTER

Readers of cryonics may remember a small flap last year about the possibility that SMOKE from a widespread nuclear war might cause a catastrophic winter everywhere on earth. This issue isn't really settled yet, but the first of the **detailed** counterarguments has just appeared in **SCIENCE (229,** 465 (1985)). Two scientists, R.D. Small and B.W. Bush from the Pacific Sierra Research Corporation have presented a detailed accounting of the sources of smoke in a nuclear war. They find that for at least one kind of nuclear war, smoke production even at its greatest is less by a factor of 1Ø than is needed to produce a nuclear winter.

What they did is simple. The earlier studies (by Sagan, Turco, et al) assumed that the vegetation burned in a nuclear attack was largely forest. These authors point out that most military installations (which would be struck in a massive attack on **military** targets) are either in grassland or cropland, where the amount of burnable material is far less. In fact, it's so much less that smoke production simply cannot come near the amount estimated by Sagan, Turco, and the other proponents of nuclear winter.

This study isn't a complete answer. After all, it only discusses the effects of a massive attack on military targets, not on cities. However, it seems to be the first to actually support its conclusions with facts and figures rather than relying on "possible" effects such as turbulence leading to rainfall.

It's very unlikely that this study will attain the **publicity** of the original nuclear winter claim. Possibly the idea of nuclear winter has now found its way permanently into public folklore, like the war on cancer and the existence of Arcturians ready to assist us in our rise to a higher level of civilization. However, for those who feel helpless about what we could do in the event of a major war, take heart. It may be awful, but it's not the end of the world. LIFE WILL GO ON!

MOVIE REVIEW: "STITCHES"

Reviewed by Mike Darwin

Do you find yourself with lots of holiday time on your hands? Do you want to go to a movie but nothing about cryonics is showing? Well, wait no longer. Now there's a movie out which is about cryonics (as much as it's about anything) and it's call "STITCHES". And guess what, it will probably have you in stitches too, after you assault the theatre manager and are subdued and arrested by the police. What can I say about this foolish, juvenile, sex and medical comedy

which isn't libelous? Don't go see it, that's what. At least not unless your sole motivation is to see a little technicolor soft core pornography, because that's really all that's even remotely worthwhile about this movie. And, frankly, you'd probably be better off spending your money on PLAYBOY, PENTHOUSE, or HUSTLER than on this grade D failure (at least you'll be able to make **sense** out of the nonsexual content of those other forms of entertainment).

This is not to say that STITCHES doesn't have a funny moment or two. It does. There is a sophomoric scene where the senior medical students (male) have tricked the freshman (female) medical students into disrobing in a room normally used for psychiatric evaluation and "examining each other's chests". Naturally the "guys" are on the other side of the two way mirror lapping up the show. And it's a show which I suspect more than a few of our masculine readers will find worth watching. There is an equally funny scene where the girls have their revenge by similarly relocating the boys--this time into the hands (literally) of a homosexual hairdresser who is masquerading as the physician in charge of annual physicals. Other than these humorous high (or low) points, the film has little to offer. It is as disjointed and unfunny as any recent offering of SATURDAY NIGHT LIVE. It's simply impossible to follow the plot or characters because they are almost totally atrophied--used as mere props to support the slapstick and sex, instead of the other way around.

Where does cryonics fit into all of this? Not very well. Cryonics is first mentioned a minute or two into the film when Eddie Albert, who plays the dean of the medical school, begins talking about the cryonics foundation which will soon be endowed by an elderly millionaire who is dying of heart disease in their school's hospital. Cryonics, and this elderly (and of course, lecherous) millionaire are recurring themes throughout the film. The movie winds up with a grand finale consisting of the "encapsulation ceremony" of the "deceased" millionaire (who is really not dead) complete with a red robed choir, a big "Forever Flask" and a passle of LS-16Ø liquid nitrogen containers.

In the midst of the encapsulation media production, the students burst in, dressed as various medical implements and parts of the anatomy (they were having a costume party) accompanied by the millionaire who is not really dead (or frozen for that matter) after all. If all of this doesn't make any sense to you, don't feel bad, it doesn't

make any sense to me either, and I actually sat through this turkey!

Eddie Albert gives his most sensitive and thoughtful performance as the egotistical, nasty, fun-spoiling, and greedy dean since his GREEN ACRES days. Unfortunately the real supporting talent he had in GREEN ACRES which would have made his performance shine just wasn't there for this film: reportedly Arnold the Pig was unavailable due to a prior engagement with Oscar Meyer.

Cryonics is treated moderately badly, as usual, with one particularly tasteless scene where the old millionaire has supposedly died and the attending physician walks in, prods at him a few times with his foot and on this basis pronounces the millionaire dead and the school rich. The cryonics related special effects are awful, and the movie is full of remarks such as "Who cares if it works or not, we get the money and that's what matters."

Oh well, maybe next year.

JANUARY—FEBRUARY 1986 MEETING CALENDAR

ALCOR meetings are usually held on the first Sunday of the month. Guests are welcome. Unless otherwise noted, meetings start at 1:ØØ PM. For meeting directions, or if you get lost, call ALCOR at (714) 738-5569 and page the technician on call.

ALCOR

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The JANUARY meeting will be at the home of:

(SUN, 5 JAN 1986) Hugh Hixon
289 Cerritos Avenue
Long Beach, CA

DIRECTIONS: Take the Long Beach Freeway (US 71Ø) to Long Beach, and get off downtown at the Broadway exit (goes east). Continue on Broadway to Alamitos, where Broadway turns into a 2-way street. Bearing to the right, continue two blocks on Broadway to Cerritos and turn north (left). 289 is in the old apartments on the SE corner of 3rd and Cerritos.

The FEBRUARY meeting will be at the home of:

(SUN, 2 FEB 1986) Allen Lopp
13354 Veracruz St.
Cerritos, CA

DIRECTIONS: Take the Artesia Freeway (State 91) to Cerritos. Get off the 91 at Artesia, going east. Go 3/4 mile to Carmenita Road and turn right on Carmenita. Veracruz St. is the first street on the right, opposite the shopping center. 13354 is on the southwest corner of Carmenita and Veracruz.

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