CRYONICS

AUGUST 1984 ISSUE # 49

Contents:

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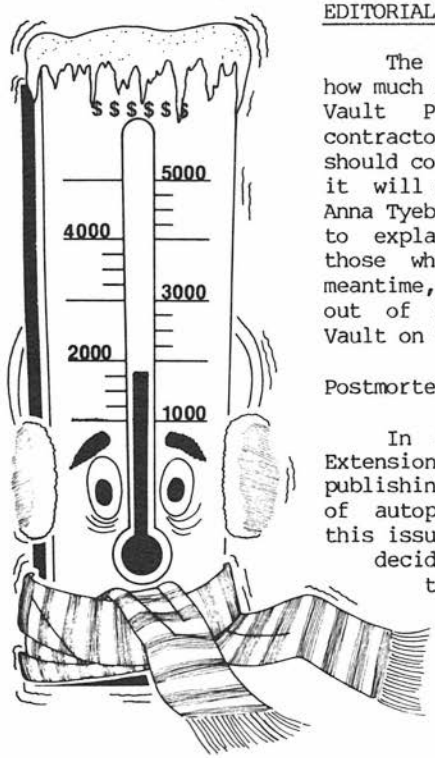


EDITORIAL MATTERS

The thermometer which appears to the left shows how much money we've raised so far for the Cephalarium Vault Project. We recently received a new contractor's estimate for vault construction which should considerably reduce the cost. We now estimate it will cost us about $4,500 to wrap up this project. Anna Tyeb will be in touch with you in the near future to explain recent developments. A special thanks to those who have so generously contributed! In the meantime, let's see if we can bring Frosty Thermometer out of suspended animation and get the Cephalarium Vault on the road!

Postmortem Paper Delayed

In last month's coverage of the Lake Tahoe Life Extension Festival we stated that we would be publishing the technical paper documenting the results of autopsies on three cryonic suspension patients in this issue. Because the paper is an important one, we decided to expand the review committee from three to five and to make a few changes to the manuscript as well. This will probably delay publication until September.

Why Publish Technical Articles?

On a related matter, we know that the last three issues of CRYONICS have had a large amount of technical material in them and that this material may not be of tremendous interest to many of our readers. Several times in recent months I have been asked why we publish technical papers in CRYONICS when it is very likely that only a tiny segment of the readership will find them interesting.

We publish technical papers because in many instances we are the only possible source for publication of this kind of work. A frustrating example of this is Art Quaife's recent experience with a very excellent paper he recently completed on mathematical modeling of heat flow in cryonic suspension patients. Art's mathematical work was both original and valuable, and there is little doubt that had his paper treated heat flow in organs, rather than in whole humans (or human heads for that matter) it would have been accepted for publication by Cryobiology (the journal of the Society for Cryobiology). But because this paper dealt explicitly with issues of concern to cryonicists as well as cryobiologists, Cryobiology rejected it. Why publish a technical paper like Art's when it could probably be circulated informally just as easily? Because publication even in pages as humble as these, serves as a documentary record of work done and puts authors on their toes, providing them with incentive to polish work and carefully defend conclusions before circulating them.

Publication also serves to inform members and subscribers that work is going on. Even if the majority of our subscribers don't READ the technical papers we publish, they are at least aware that research is being done, that it is being written up, and that it is being exposed to commentary both by other

members of the cryonics research community and by outsiders who see our periodical from time to time. When we are asked by hostile scientists or others in the community who might be given to question our status as an educational and scientific organization it is nice to have a stack of published papers to refer to and it demonstrates that we take our commitments in these areas seriously.

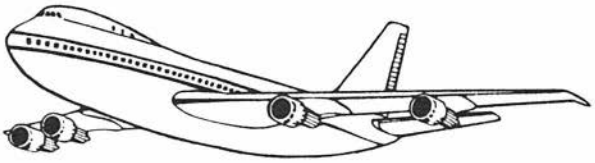
Finally, it should be noted that some (if not most) technical papers should be read by everyone personally concerned about cryonics. What kind of heat exchange fluid we use, what degree of success we have in technical/surgical procedures and what kinds of damage are observed in suspension patients are things every cryonicist should concern themselves with. It is not necessary to understand every word or sentence when reading a technical paper, often the issues involved are simple ones, easily abstracted from a cursory reading. Very often decisions of direct impact on the member/customer for cryonics services will be made on the basis of research findings. Only by making some effort to understand the issues can members make intelligent decisions about which options to choose.

This last point is an important one. Some cryonics organizations in the past (and regrettably in the present too) have decided to keep these issues behind closed doors. They feel there is little to be gained by sharing the frustrations, failures and shortcomings of the program they offer. We feel otherwise. By sharing the rough edges with you, our members, we open ourselves not only to the possibility of criticism but to the much more exciting possibility of better understanding and better hope of a solution to the problems we face.

So, bear with us when technical pieces appear in the magazine and remember that they are the surest and best evidence that we're working to improve things and that we are dealing with you honestly and openly.

TO FLY OR NOT TO FLY?

by Mike Darwin



Many years ago, shortly after I became convinced that cryonics was a good idea, I began to be concerned about some of the things that could happen to me which would make cryonics impossible. Right after global thermonuclear war and uncooperative parents loomed the possibility of an AIR DISASTER. Immediately, I began to wonder if I should eliminate air travel because of the risk of total physical annihilation. Since I was not a stupid child I quickly came to realize two things: a) it is difficult (although not impossible) to live in the modern world if one refuses to fly, and b) flying (on commercial airliners) is an extremely low risk mode of transportation.

Over the ensuing years and particularly recently, I have noticed an increasing number of intelligent cryonicists deciding simply not to fly. The stated reason for this growing immobility? Fear of accidental death and complete destruction of their remains.

Fear of flying is not confined to just the cryonics community. Far from it. As a recent article in the Wall Street Journal (June 4, 1984) indicates, somewhere in the vicinity of 25 million Americans are seriously afflicted with a fear of flying. One of the more fascinating aspects of the Journal article is that it deals in depth with the psychologies of a couple of famous authors (Asimov and Bradbury) and several business executives who refuse to fly. Surprizingly, their reasons for not flying are fairly close to those of

nonflying (or reluctantly flying) cryonicists I've spoken with. To quote Ray Bradbury: "I've had friends who died in plane crashes. I often dream I'm in the plane with them and we wind up tomato soup on the ground."

Why the fear? Is there any real grounds for it? It is certainly true that if you NEVER fly you will never fall out of the sky and be turned into tomato soup. But then it's equally true that if you never ride anywhere in a car the risk of death in an automobile accident becomes vanishingly small. The question is, how big is the risk, and is the risk consistent with other risks we all choose to consider reasonable and partake of in the course of daily life? A quick trip to Statistical Abstracts reveals that the fatality rate per hundred million commercial aircraft passenger miles was Ø.ØØ2 in 1981. The fatality rate for automobile accidents, by comparison, was 2.3 per hundred million passenger miles. In other words, the risk of dying in an auto accident is 1150 times greater, mile for mile, than it is in traveling by commercial aircraft. While it is not possible to determine what percentage of auto accidents result in complete destruction of the remains of people killed in them, that whole issue may be something of a red herring. First, it is certainly fair to point out that a high percentage of people killed in motor vehicle accidents are severely mutilated, with crushing and disruptive injuries to the brain topping the list as a cause of death. Second, it should be noted that ALL accidental deaths in the United States (and most other Western countries as well) result in autopsy. In the United States, individuals dying from vehicular accidents are usually completely autopsied due to the expensive civil and criminal litigation which usually surrounds such accidents. A complete autopsy involves removal and sectioning of the brain and other vital organs into small pieces with samples often retained in formalin for later examination: a procedure which competes quite well with being turned into "tomato soup", to use Bradbury's analogy with the usual result of an air disaster. Autopsy also implies long delay times from when death occurs to when the body becomes available to the cryonics organization. In short, any way you care to look at it, accidental death from ANY cause is likely to be an unmitigated disaster whether it results from a mishap in the air or in the street in front of your own home.

Considering the outstanding safety record of the airlines why are people so frequently transfixed by the possibility of death in an air crash? Air travel is an amazing, and on the face of it, a rather improbable thing. Just the thought of hoisting tons of people, freight and machine miles up into the sky and moving them along at 5ØØ mph gives pause for thought. On the face of it, it seems so risky, so insubstantial to pin our safety on a concept as esoteric as "lift." Nevertheless, the safety figures speak for themselves. Good maintainence, outstanding training, and sophisticated technology have combined to make air travel a very safe bet indeed. By contrast, getting into an automobile seems a positively insane thing to do.

Aside from the "improbability" associated with flying, another major reason people fear air disasters completely out of proportion to the real risk is the media. An individual death or two or even three in an automobile wreck is hardly newsworthy. Such accidents happen every day and are simply an undramatic and accepted background in the culture in which we live. The crash of a jetliner with a couple hundred people on board is another matter altogether. Such accidents, precisely because they are not a frequent occurence and because they represent such a large concentration of human misery for media vultures to feed on, are likely to be made a major story. Much the same kind of "risk distortion" has gone on with nuclear power. Thousands of people slowly dying of black lung or being maimed or crushed in coal mines just aren't as good a story as Three Mile Island--a nuclear "disaster" where no one even died!

Perhaps one of the most interesting things I've noticed about nonflying and

would-be nonflying cryonicists is their willingness to hop into an automobile being driven by someone they have never even met before. Not only an automobile driven by a stranger with an unknown driving record and level of skill, but an automobile which has probably had no routine preventive maintainance of ANY critical components. How many people even bother to look at the tires of a car they are about to ride in? And yet, blowouts due to poor tire condition are one of the most frequent equipment-related causes of serious accidents. It is more than a little ironic that those people too afraid to fly because of the "risk" it presents are unwilling to board a superbly maintained aircraft with highly trained pilots, and yet they will climb into an automobile and allow almost anyone with a valid driver's license to subject them to mortal risk orders of magnitude greater than they would experience, mile for mile, in a commercial aircraft.

The point of all this is that flying is SAFE. And even if it were a lot less safe it carries with it crucial advantages in economies of time and money. When contrasted with the other risk factors people knowingly expose themselves to, such as alcohol consumption, poor diet, cigarettes and automobile driving, commercial air travel has an almost unbelievably good risk-to-benefit ratio. Just stopping to consider that automobile accidents account for 3.3% of ALL deaths is enough to emphasize just how safe commercial air travel is. With that kind of odds, out of 120 or so cryonicists, statistics indicate that four will die in an auto accident!

Flying can be made safer by simply exercising good judgement. While the risk of death from air travel is exceedingly low to begin with, it can be made even lower by not flying when weather conditions are known to be poor (although acceptable by airline standards) and by avoiding carriers which appear to be financially troubled or beset by incompetent management. Even a little research will disclose when and to whom these two situations apply.

To an even greater extent the same general rules of informed ridership apply to surface transportation. Don't get into an automobile with just ANYONE. Simply not riding with drivers who have recently consumed any alcohol or drugs dramatically reduces the chances of being involved in an accident. Looking over a vehicle (including your own) to insure that it is road worthy is another good way to greatly reduce the risk of an accident. Of course, making sure the driver is rested and alert and avoiding travel in inclement weather are also good ways to reduce the risk of an auto accident.

So, don't be swayed by media images of death and destruction in the air, and most importantly, be thoughtful about any transportation you use. Whether you're getting on a bicycle or a jetliner, use common sense to assess the situation and keep your risks low. And remember, what you have to fear most when flying is fear itself.

Special thanks go to Saul Kent for sending me a copy of The Wall Street Journal Article which inspired this piece, and for providing some of the ideas contained in it. —M.D.

"The truth is cruel, but it can be loved, and it makes free those who have loved it"

—George Santayana

"A dead Nature aims at nothing. It is the essence of life that it exists for its own sake, as the intrinsic reaping of value."

—Alfred North Whitehead

NEW ALARM SYSTEM AT CRYOVITA

Early in April ALCOR and its landlord, Cryovita Laboratories Inc. (whom we sublet from), jointly purchased a security alarm service for the laboratory and storage facility. The need for an alarm system has been a long-standing one. While ALCOR is located in a low crime area in an "upper middle class" neighborhood, we have special concerns about the possibility of a break-in. Because we are a research institution we are, to some extent, a target for the ever more active and destructive antivivisectionist groups which have been harassing and raiding large research institutions. We are required by law to obtain a license for our research activities and the list of such institutions is available to the public. Because of this we have received (albeit infrequently) mail from antivivisectionist groups.

Additionally, cryonics itself presents something of a target. While we have had few problems in the past, it is always possible that someone in the community may target us for harm. And, despite the fact that we are in a very low crime area, numerous small businesses in our vicinity have been the victim of smash-and-grab burglaries of high-priced office equipment. For these reasons we've been shopping around for sometime for a good central station monitored alarm system. In late March we received an offer we couldn't turn down. For a little over $300.00 we had a fairly sophisticated alarm system installed with monthly monitoring costing only $15.00—guaranteed for 3 years! We checked references on the company who made us this offer and found them to be regarded as reliable. In the four months we have had service with them we too have found them to be reliable (prompt responses both times we goofed and set the system off by mistake).

So, suspension patients (as well as our ability to suspend patients) are now protected by a good intrusion alarm system. The patients themselves are directly monitored with respect to temperature and liquid nitrogen level by another system which is tied into a 24-hour answering service capable of paging two technicians trained to handle emergencies. As far as we know, this represents the best security available to suspension patients anywhere.

GENES FROM AN EXTINCT ANIMAL CLONED

Many of our readers will already be aware of the possibility of recovering intact organisms via cloning from preserved cell samples. Proposals for cloning Egyptian mummies and Siberian mammoths are not new. What is new and quite amazing is that a group of researchers at the University of California at Berkeley led by Allan Wilson and Russell Higuchi have succeeded in cloning about 25,000 genes from the extinct African quagga (SCIENCE NEWS 125, 356 (1984)). The quagga (a zebra-like animal) became extinct through over-hunting a little over a hundred years ago. The only remnants of the animals are preserved hides in various museums. One of these hides which had been preserved by salt drying was recently obtained from a German museum and muscle tissue was removed from it and subjected to enzymatic degradation to release any surviving DNA fragments. The purified DNA was then incorporated into plasmids and inserted into bacteria so that multiple copies could be made for

further analysis and study.

The primary purpose of this work is to attempt to answer evolutionary questions about extinct species. To this end Wilson and his collaborators evaluated quagga mitochondrial DNA fragments for commonality with those of the Zebra and the horse. What the investigators found was that the quagga and the mountain zebra probably shared a common ancestor about 3 million years ago.

These same investigators have also recovered DNA fragments from a variety of preserved hides including from an American bison skin that had been in a museum for over a hundred years! Wilson has also apparently succeeded in cloning DNA fragments from frozen mammoth tissue. While most of the DNA recovered from the mammoth tissue has been (not surprizingly) found to be bacterial in origin, some fragments have been shown to specifically bind, and thus be closely related to, the DNA of elephants.

While being able to reproduce isolated fragments of DNA is a long way from being able to reproduce the entire genome of an extinct animal, it does raise interesting possibilities. In the future, when our abilities to meaningfully read out, engineer, and sort individual genes will be much better developed, it may well be possible to reconstitute an extinct animal from a scrap of preserved skin. Considering the sheer number of copies of the animal's entire genome represented by even a small piece of hide, it should be possible to disassemble each cell in the sample and search out intact copies of a particular gene. In this way, even if there are only a few intact copies of any given gene in any given cell, it should be possible to puzzle out the whole genome and thus the whole organism can be reconstructed.

All of this raises the possibility of recovering a wide range of organisms from relatively modest and unlikely sources. Many insect species which have been extinct for millions of years are represented by a few individuals well preserved in amber. Such specimens apparently contain much intact DNA, and even some chromosomal architecture appears to be intact.

In the long run there can be little doubt that achievements of this kind will do much to buttress our position and to erode the old, inflexible notions of life and death being a black-or-white, all-or-none phenomenon.

ARE OUR BRAINS HARDWIRED?

One of the givens of neurophysiology is that brain cells are laid down only once and that the gross connections between them (i.e., synapses) are made either during fetal development or at latest during the first months of life. This belief is based largely on the response of the brain to injury: dead brain cells are usually not replaced. This view is also supported by the absence of any significant number of dividing brain cells or of other simpler types of supportive brain cells (such as glial cells or astrocytes) remodeling themselves into neurons. Recent work with simple invertebrates such as Aplysia (see "Neuronal Connections in Aplysia" in Science Updates elsewhere in this issue) also seem to support the contention that adult brains are "hardwired" early in development and do not undergo "plastic" changes later in life.

So, it comes as quite a surprize that at least one class of fairly sophisticated animals, namely songbirds, extensively remodel large sections of their brains at least once each year! Fernando Nottebohm and his colleagues at Rockefeller University have recently documented (SCIENCE 244, 1325 (1984)) a tremendous turnover of neurons in a part of the bird's forebrain called the nucleus hyperstriatum ventralis, par caudalis, or HVc for short.

The HVc is the part of the canary brain which is responsible for song production. When the male birds (only males sing) begin to learn to sing at about one month of age the HVc has only one-eighth the volume it will have when song is fully developed in adulthood. Thus, as song is learned it is apparently coded into the hardwiring of the animal's brain.

Evidence that song is encoded in this fashion in the birds' brains comes from the incredible observation that when the birds stop singing in the summer (they sing the most in the spring) the HVc begins to undergo tremendous plastic change. By fall the HVc has decreased to one-half its former size, or about the size which would normally be seen in a 3-month-old canary. Over the following months Nottebohm documented a tremendous regrowth of neurons. As spring approaches and testosterone levels (which control proliferation of the HVc and singing behavior) are at their highest, 1.5% of the neurons per day are being replaced! At that rate of growth the number of neurons in the HVc would double in about 49 days! The HVc exhibits this cyclical pattern of die-back and regeneration throughout the reproductive life of the animals.

Nottebohm believes that the reasons for this growth/die-back cycle is that the amount of information processed by neural systems is constrained by the complexity of their circuitry. Nottebohm suggests: "It might be useful to replace components, even at the risk of doing away with existing memories. Used circuits may have lost their ability to acquire new information." Certainly with canaries this seems to be the case because each spring when the HVc is reborn, the birds sing a new song. It is interesting to note that female canaries also undergo a similar, although not as extensive, remodeling of their HVc's. Apparently the females need to revamp their brains in order to be able to learn and remember the songs being sung by the male canaries.

Of more significance is Nottebohm's finding that the HVc is not the only area of the forebrain which experiences replacement of neurons. Other locations in the forebrain also experience an unexpected turnover of neurons, although it is not as dramatic as that which occurs in the HVc under the influence of testosterone. Overall it is estimated that canaries make as many as 20,000 new neurons each day, including in the cerebellum, midbrain and medulla! Other birds such as parakeets and ringdoves also experience a significant turnover in neurons.

It thus appears that at least some kinds of memories (at least in birds) are actually encoded in the brain as a result of the gross interconnections between nerve cells. To what extent routine learning or so-called "day-to-day" experiences are encoded in this fashion remains unknown. Of course, it is also unknown whether mammals experience a similar turnover in brain cells and whether any kind of mammalian learning is accompanied by actual remodeling of gross neuronal connections in the brain. Nevertheless, Nottebohm's work with birds is suggestive. Memory is probably an evolutionarily old mechanism and what's good for the geese just might be good for man too! Perhaps similar mechanisms are at work in mammals, and even if they are not this early work with birds may suggest ways to induce such plastic change in adult human brains in order to overcome injury, disease, or maybe even the inflexibility of old age. As Nottebohm said himself, "There is a marked change in plasma levels of sex hormones during development and especially at puberty. It is widely acknowleged that early brain damage is followed by better prognosis than late brain damage." It may be," Nottebohm goes on to say, "that if neurologists induced a "prepubertal hormone milieu" in persons with brain injury they may be able to stimulate the growth of new neurons and thus enhance recovery. Perhaps the early peaking of creativity observed in humans is related to growth and remodeling of neural connections around puberty--the age at which most scientists and mathematicians make their most significant contributions.

FULL TIME ALCOR PRESIDENT

Sometime ago ALCOR President Mike Federowicz was contacted by Saul Kent regarding a proposal to start a tissue preservation business which would provide full-time employment for Mike and consequently make him more available for cryonics activities. As soon became apparent when this option was more carefully investigated, such a business would require more time spent away from cryonics, not less. As a consequence, Mike rejected this offer around March of this year. However, Saul was not one to give in easily on his objective of freeing Mike up for cryonics activities. Consequently in late April Saul offered another proposal--to employ Mike full-time on cryonics. With some negotiation, and some trepidation (the offer seemed too good to be true) Mike accepted the offer early in June and began working full-time on cryonics on July 1.

Principal projects for this two-year period are the production of new literature and the development of a new promotional approach for ALCOR in particular and cryonics in general. Of course, some hoped-for side benefits of a full-time cryonicist working for ALCOR are more research being conducted and better service to the membership. Already, a couple of long overdue administrative projects are being or have been tackled, and research work, which appeared unlikely to be completed in the forseeable future, will probably be wrapped up by the end of the year.

THE QUESTION COLUMN

Where did the name ALCOR come from and what does it mean? ★
-- Doug Platt, Hollywood, Florida

Fred and Linda Chamberlain reply:

In September of 1970, we were asked to come up with a name for a rescue team for the Cryonics Society of California (CSC). In view of our logical destiny (the stars), we searched through star catalogs and other books on the subject, hoping to find a star with a name that could serve as a cryonics acronym. "Alcor", 80 Ursae Majoris, was just what we had been looking for. It not only had some acronymal "fit" for cryonics but was symbolic for its historic use as a test for eyesight and was located in a very well known constellation.

Alcor, a companion star of Mizar in the "Big Dipper's" handle, is approximately fifth magnitude, barely within the threshold of human vision. Additionally, it is quite close to Mizar from an angular standpoint, and dimmer. Only with excellent eyesight can one tell there are two stars rather than just one. For thousands of years, people in the Middle East have used Alcor as a critical test of visual sensitivity and focus. If you could see Alcor, you had excellent vision indeed. In the early days of cryonics itself, few people could see the need for a rescue team, or even the need for cryonics itself. Symbolically, then, Alcor would be a "test" of vision as regards life extension.

As an acronym, ALCOR is a close if not perfect fit with "Allopathic Cryogenic Rescue." We could have forced a five word string, but these three seemed sufficient. Allopathy (as opposed to Homeopathy) is a medical perspective wherein "any treatment which improves the prognosis is valid". Cryogenic preservation is the most powerful method known in halting the rapid, entropic disorganization of living matter following clinical death. Rescue differentiates a cryonics approach from (yet to be developed) proven suspended animation. The acronymal interpretation of ALCOR is therefore "use of a cryogenic procedure, though unproven, to preserve structure and potential

viability, since failing to do so allows further disorganization to occur and reduces the probability (prognosis) of reversal and reanimation at any future time".

Some of these thoughts were presented at a CSC dinner meeting in the autumn of 1970. A number of people who have subsequently become members of the ALCOR Life Extension Foundation were present at that gathering. Over the months that followed, it became increasingly evident that the leadership of CSC did not truely desire and would not support or even tolerate a rescue team concept. Less than one year after the 1970 dinner meeting, we severed all ties with CSC and incorporated the "Rocky Mountain Cryonics Society" in the State of Washington. The articles and by-laws of this organization specifically provided for "Alcor Members," who were to be the rescue team core of activity. Difficulties in securing non-profit status in Washington then led to reincorporation in California, this time under the name "Alcor Society for Solid State Hypothermia." In the late seventies, to further broaden the organization's objectives, the present name (ALCOR Life Extension Foundation) was adopted.

Despite many transitions, the symbolism of the name remains. How long will it take for more people to see that "Ashes to ashes and dust to dust" is a meaningless destiny... to see that it is possible to reach for a distant tomorrow... perhaps to attain it... to see ALCOR for what it really is... a vehicle with which to attempt that fascinating voyage!

AUGUST-SEPTEMBER 1984 MEETING CALENDAR

ALCOR meetings are usually held on the first Sunday of the month. Guests are welcome. Unless otherwise noted, meetings start at 1:00 PM.

ALCOR
ALCOR LIFE EXTENSION FOUNDATION
4030 NORTH PALM #304
FULLERTON, CALIFORNIA 92635
(714) 738-5569

The AUGUST meeting will be at the home of:

(SUN, 5 AUG 1984) Marce Johnson
8081 Yorktown Ave.
Huntington Beach, CA
Tel: (714) 962-7898

DIRECTIONS: Take Interstate 405 (San Diego Freeway) to Beach Blvd. (Hwy 39) in Huntington Beach. Go south on Beach Blvd. approximately 4-5 miles to Yorktown Ave. Turn left (east) on Yorktown. 8081 is less than one block east, on the left (north) side of the street.

The SEPTEMBER meeting will be at the home of:

(SUN, 2 SEPT, 1984) Mike Darwin and Al Lopp
350 W. Imperial Hwy., #13
Brea, CA
Tel: (714) 990-6551

DIRECTIONS: Take the Orange Fwy. (Hwy 57) to Imperial Highway (Hwy 90) and go west through Brea on Imperial Highway. 350 is about one mile from the freeway and in the second block beyond Brea Blvd., on the south side. If the gates are closed, park on the street back to the east.

THE GENETIC EVOLUTION
by Thomas Donaldson

Many years ago, Charles Darwin (not THE Darwin, but a descendant) wrote a book which he called THE NEXT MILLION YEARS, about how and how much human beings will evolve in the next million years. He decided that human beings wouldn't change very much at all in that span of time. He wrote his book, of course, many years before even a glimmer of our actually redesigning our own genetics had come to mind. Our genes were FIXED; it was a time of debates about whether genetics or environment most determined intelligence and other things (there are many backward people today who still debate these things).

Most immortalists feel (quite rightly) that Darwin was disasterously wrong. Even futuristically oriented people can see that control of our design offers many vistas for change. It's certainly true, as MIKE Darwin (no relation!) pointed out, that these technologies are likely to cause a prolonged period of experimentation, and that in itself ought to be interesting. We're now living before most of that experimentation has commenced, and we're likely to revive to a world in which it has become history.

As cryonicists, we expect to revive to a time at which biological changes to human beings, ourselves, will frequently happen. All the excitement and experiments will have faded into history; whatever the changes people will adopt, they will be unremarked commonplaces of the time. I thought it would be interesting to present some thoughts about what's likely to happen. Even though the experiments will be dramatic at the time, I personally think their total effect will be limited. The most prominently visible effect of biological control after 200 years will be an evolution (not a revolution) to a different kind of human being.

One central fear many people have about bioengineering is that of dictatorial changes in human beings. Darwin's book THE NEXT MILLION YEARS is interesting and worth reading even though it is wrong. Darwin had a POINT, exactly about this central fear. His basic argument (as to why human beings wouldn't change significantly) is really an argument against any form of CENTRALLY DIRECTED or EXTERNALLY PLANNED change. You see, when he wrote, the ONLY way anyone could imagine big changes in humanity would be by controlled eugenic breeding. Darwin was arguing that such controlled breeding would be impossible for political reasons, not biological ones.

The one possibility he didn't envision at all was what is now most likely, that people will individually sieze upon some design change as highly desirable and adopt it individually. If the change is so desirable that virtually everyone adopts it, we will have just had a change in the human race without any central direction.

Darwin's reasoning about human political behavior has a lot of merit. He's talking about the problem of the Mad Scientist. One of the nightmares of genetic control is precisely that some small group might suddenly acquire the power to modify EVERYONE ELSE, and then do so irreversibly. Darwin was arguing

that it's very unlikely that could happen. The reasons are simply that:

1) Most scientific discoveries don't happen out of the blue, and a small group couldn't discover how to achieve such an advantage without everyone else being so close to the same discovery that it couldn't effectively be used to guarantee supremacy.

2) Even supposing that such a discovery were made, the likely result would be that the small group, in unquestioned control of the Earth, would immediately fall into civil war among themselves, about how to distribute the benefits of their control.

In particular, eugenic breeding of OTHERS is all very well, but eugenic breeding of OURSELVES is out of the question! Even if some people became domesticated animals, for them to breed themselves would be the last thing farmers would want.

This is really a point which has nothing whatever to do with the nature of the technology used to acquire sudden predominant power, biological, physical, or otherwise. The danger that Mad Scientists could take over has always existed, and has always had the same kind of low probability.

However, there is still a lot more we can say about genetic control specifically. OK, we won't have any Mad Scientists. But just what does control over our own design mean for us? There is one general principle which bears upon this question:

LIFE STYLES AND OPTIMAL ADAPTION

It is a commonplace that control over our own design won't exempt us from physical law. However, this point deserves further explication. If we change our design, we'll be producing a piece of engineering. Any engineering design involves compromises; it is simply not possible to achieve everything we want with the materials available, because of limitations imposed by physics itself. If we want to design ourselves, the major values we use to make these compromises consist of the KIND OF LIFESTYLE we want to live. We'll want to design ourselves to fit that lifestyle.

Therefore if we ACQUIRE any new capabilities, we're likely to have to lose some other capabilities. Rather than just talk about supermen (or superwomen), therefore, one key to understanding how we might redesign ourselves might be to think about capabilities we would LOSE. It is exactly because we lose these capabilities that we'll acquire many others.

To be specific, I shall consider the chimpanzee. No one seriously wants to be turned into a chimpanzee. Usually without thinking about it, people will say that the chimpanzee is a "lower" form of life and we human beings are "higher". This is a fallacy. If we seriously wanted to adopt the LIFESTYLE of the chimpanzee, we would choose the brain and body design most optimal for that lifestyle: i.e., we'd turn ourselves into chimpanzees. After all, we're very poor at finding food under rocks and living in the jungle. The chimpanzees might EVEN NOW feel we human beings are rather poor, inadequate caricatures of the ONE BEST DESIGN.

Turning this around, of course, it suggests that after we redesign ourselves we'll probably seem LESS effective and MORE FRAIL in today's environment than we do now. Here are some specific ways:

1) Environmental control will be much better. It therefore no longer becomes necessary to have such well-developed metabolic abilities to

adapt to changes in temperature and humidity. Control over diseases will be improved. We will therefore have less need for our well-developed immune system. Control over our chemical environment (the many poisons and carcinogens in our everyday life) will be much greater, therefore our livers will not have such well-developed abilities to detoxify these substances.

2) We may acquire a need for new chemical substances in our food which we formerly made in our own bodies. The best analogy comes from the evolution of the primates, which need Vitamin C in their food because their normal diet of fruits and vegetables contains so much Vitamin C they have no need to make it. I can't presently say just what substances these may be, but a change from making to eating an essential chemical involves more than just dropping the machinery to make it from our metabolism. For argument's sake, let's suppose that the substance is insulin. Life would not simply be a matter of everyone being a diabetic. We would have a special digestive (or other) metabolism which allowed us to conveniently eat insulin without degrading it. We might have methods for storing it, and other processes which would take it out of storage when needed. Rats can make Vitamin C in their bodies; primates are not just metabolically defective rats, they are just as adapted to eating Vitamin C as rats are to making it.

One fascinating possibility is that we would acquire a need for special chemicals which are currently far too expensive to become constituents of our bodies. We might consider, say, enzymes using platinum- or gold-catalyzed biochemical reactions with fewer free radicals than our present constituents. An energy-rich society could afford to have platinum as an essential element.

3) Our mental abilities and psychology are likely to change in ways which would, if present in someone of today, result in quite disasterous performance on all standard tests of "intelligence". Even if we could devise suitable tests, mental capabilities would differ.

This requires a bit of discussion. First the idea of an intelligence test assumes that the testee takes the "proper" attitude to the test, sincerely attempts to answer the questions asked, and in short, attempts to FOLLOW DIRECTIONS. We presently live in a society in which almost all people spend almost all their lives FOLLOWING DIRECTIONS. We call such a condition employment. Everyone who does this is essentially doing something which will, someday, be done by machines. Once that happens, we'll want to have a cast of mind best suited to GIVING DIRECTIONS and DECIDING ON DIRECTIONS rather than following them.

Naturally, in a society which depends on people following directions, tests for advancement will have this ability as a very large, implicit component of the abilities they are testing. In 1984, a society consisting only of Chiefs, with no Indians, would turn quickly into a disaster area. Nor could we easily judge the "intelligence" of someone from future time. If they require material reward more than our praise as authority figures to induce them to do the problems set, they could easily find greater material rewards elsewhere, simply abandoning our tests for some other activity.

4) Finally, to a quite unknown degree our present measures of ability,

> IN THEMSELVES, depend on skills and conventions learned and needed in contemporary society. Analogies, for instance, may depend on learning a sense of what differences and similarities are "important" AT THIS HISTORICAL TIME, which will certainly change with time. Arithmetic and number reasoning may change as the basic idea of "number" changes. Even today we may be living in a time when the ability for fast mental calculation becomes less necessary because of hand calculators. People living in a society with very large databases "on line" would need a much greater ability to absorb information quickly and much less ability to remember it for prolonged periods. Even if we WISHED to find food under rocks, our abilities to do so would not equal those of a chimpanzee.

Why should we want to LOSE abilities which we now have? This is exactly where the matter of optimal design for a lifestyle comes into play. It simply won't be possible, for reasons of physics rather than biology, for us to carry around with us in our bodies every conceivable ability. "Bionic Man" or "Superman", for instance, is simply impossible on physical grounds. The pupils of his eyes are not wide enough to give the visual resolution claimed for his telescopic vision; there are no materials strong enough to support the weight of objects which he lifts; etc., etc., etc. No amount of genetic discovery can solve these problems!

The point is that if we live in an environment where we seldom use an ability, carrying it around with us all the time becomes a waste of energy and matter. We could use this energy and matter more effectively for those abilities which we really do need constantly. We could spend so much of the circuitry of our brain upon means to GIVE directions and DECIDE on directions just BECAUSE we had omitted the ability to follow them.

What abilities might we acquire as replacements for the metabolic abilities we'll abandon? Perhaps the ability (figuratively) to learn tensor calculus in a day (and forget it five months later). Another suggestion would be the mental ability to attend to many different things in our environment at the same time (to do many things at once). I'm talking about a situation in which our environment is much better controlled than now; it could easily become useful to increase our ability to attend to the controlling and regulating of that environment. Anyone seeing an airplane cockpit will know immediately what I mean. We would imagine a person able to attend to 10 or 100 times that amount of ongoing information, about as consciously as we attend to our own breathing.

There is a second implication to the principle that our redesigning can't do the physically impossible. Just what kind of lifestyle do we really want, anyway? I've described the consequences of greater environmental control and automation precisely because no one seriously wants LESS environmental control or MORE repetitive work at someone else's direction. These are VALUES. It isn't really enough simply to say that some lifestyle could be arranged; what people WANT becomes very important. They can only get it, of course, if it is possible for physical reasons. It's only possible for everyone to become a Chief after machines have taken over all the work done by employees.

Here are some things which should become possible:

> 1) Immortality, in the sense of never aging, and furthermore in the widespread practice of cryonics. Yes, folks, aren't you surprized that this is on the list!
>
> I've said this before. However, I will note that immortality only becomes possible if we start living a lifestyle in which we face no serious risks to becoming old enough for old age to matter.

Deathrates due to "natural causes" other than to old age were very high until quite recently. One study of the English nobility found an average age at death of 40. We live right now in an unusual, unstable situation, not at all the "natural" state in which we evolved. Immortality only became POSSIBLE because death rates due to causes other than aging have fallen so low. People have wanted immortality since Gilgamesh, but it has only recently become physically possible.

2) No more need to sleep. The underlying physical changes are first, the development of artificial lighting to a high standard, and secondly, the availability of a high energy level to support the increased activity which people who did not sleep would engage upon.

In animals, both sleep and hibernation began as strategies to conserve body resources during times when activity was otherwise useless. An animal which hunts at night, for instance, would sleep in daytime. Neither of these conditions exists any longer, and we can see even now how people are interested in strategies for getting by with less sleep. However, sleep has become necessary to other processes such as learning; people who never slept COULD NOT simply be the same as ordinary people with particularly good stimulants. Their brains would have a different organization, so that the absorption of knowledge happening to us when we sleep could happen to them while awake. This could mean a quite different state of conciousness to any of those we presently consciously know.

Finally, I come to some quite fundamental questions of our own values. A significant number of people reading this essay have probably felt impatient with me for failing to discuss some quite dramatic changes in the human form and lifestyle. Why not turn ourselves into great brains, or link ourselves with a common (or a private!) data bank, or become patterns of information in a gigantic world computer, or alter our mechanical design into something which doesn't resemble human beings at all?

Some or all these possibilities are likely to be tried. As creatures in themselves, they would probably be viable. What I feel extremely skeptical of is whether they would comply with ALL the values which almost all people hold, as expressed in what they want. In particular, I feel that many of these dramatic changes would be rejected by those who claim to want them IF they actually became possible. Furthermore, some of these changes confuse an END (to have instant access to vast information) with a MEANS (hooking ourselves physically into a data bank). Anyone who owns a computer and a modem has quite good access to vast information IF THEY KNOW WHAT TO ASK FOR (which is a crucial problem).

Here are some comments on such ideas, which are very common in science fiction and elsewhere.

1) Why not turn ourselves into machines?

First, the distinction between biological and machine will become thoroughly blurred; the suggestion is that somehow we would become machines or computers in a sense in which we aren't now! I note that in many discussions, transferring our personalities to machines is thought desirable because (guess what?) COMPUTERS DON'T AGE. By the time we're seriously able to transfer ourselves into "computers", this problem will have been solved for biology too. Furthermore, anyone who seriously considers living things compared to computers will notice that the living things are actually LESS fragile, LESS subject

to breakdown, and more adapted to their lifestyle than any computer or machine yet built. Our frustration with living things, compared to machines, comes precisely from this fact: they are adapted to serve THEIR OWN purposes, rather than ours, and so are not nearly as malleable as machines are. The comparison between living things and machines is actually a comparison between the IDEAL machine and the ACTUAL creature.

A second reason given is that computers can think much faster than we. Possibly we'll want to change ourselves so that we can think faster; alternatively, we'll use computers to do the fast thinking for us when we need that. The idea that biological entities, merely because they were biochemical rather than metal, simply could NOT transmit nerve impulses as fast as electricity has lost a lot of plausibility since physicists discovered the organic conductors. However, there is a very likely REASON why nerve impulses don't travel as fast as electrical impulses. This is, that we think in order to affect the external world. It doesn't help to have thoughts if they don't matter; we therefore have no need to think faster than our arms and legs can move. This is a PHYSICAL limitation in our design, which genetic changes can't get around.

2) Why not turn ourselves into giant brains?

This may be another confusion of means and ends. We have a large brain in order to reach conclusions and decide upon actions. A human being equipped with a large computer is at least as effective as a single large brain, and MAY be more effective. Why? Because the calculations which the large brain makes inside its head can be done by the human on his/her computer, while if the human finds the computer a burden at some time or circumstance, the human can leave the computer behind. The human can also replace the computer by another one HIGHLY SPECIALIZED to achieve a highly specialized calculation, while the large brain must either get a similar computer (which defeats the whole idea) or attempt to carry out this specialized calculation with a brain which is not optimal for it.

I believe that the whole course of the last 10 years in microcomputers shows that sheer power is not always (or even OFTEN) the most efficient way to obtain a goal.

3) Why not become patterns of information in one single large world computer?

Now really. Aside from the fact that this is presently impossible, this sounds very much like the people who want to replace private cars by a vast system of public transport. I don't believe that people would accept this if it were available, any more than they want to give up their private autos, and for much the same reasons. They have control over their private autos (and their private bodies). They would not have control over the shared public "body". Our personalities and memories ARE patterns of information, but we want them under private control. Do you want your private parts controlled by a Congressional committee?

4) Why not alter our mechanical design?

By mechanical design, I'm referring not just to metabolism but to questions like the number of arms and legs we have. For this one lifestyle is everything. There is one situation which may actually

bring about such a major change, and that is space travel and space habitats. Optimal mechanical design for weightlessness just isn't the same thing as for living in gravity. Perhaps we would want four arms, no legs, and a shoulder-like structure where our pelvis now is. However, it's also true that we could easily compensate for the disadvantages of our present form by the right tools and equipment.

My own feeling is that compensation of this kind would win out. Metabolic adaptions to weightlessness, on the other hand, would certainly take place. The kind of bone loss and possible metabolic imbalances which now happen wouldn't.

Summing all of this up, we get people who would actually LOOK very much like people do now. We might look a little more frail. However, alterations in our metabolism would be profound. If thrown out naked into today's world, we would become severely ill because of chemical deficiencies in our diet, the sudden extremes of temperature, the diseases, to none of which would we have resistance. We would also have very low measured IQ's, but if someone watched us closely we wouldn't look or act like mental defectives at all (that is, except for the consequences of insulin deficiency and an advanced case of Immune Deficiency Syndrome).

But of course, throwing a man of this future time out into today's world isn't really a representitive test any more than asking us to compete, naked, with a chimpanzee. The essential idea distinguishing people from other animals consists of detachable parts, which are tools. Tools, precisely because they're not a permanent part of us, make it possible for us to adapt to a far wider range of environments than we could adapt to if we had to carry the equipment around with us all the time. Compared to redesigning ourselves, tools are far more efficient.

In combination with our tools, clothing, and equipment, we'll turn out very well. First, all the metabolic deficiencies could be compensated by special add-on organs, perhaps modified tapeworms or other creatures which would burrow into us and provide the organs which we lack. These could easily give us the ability to digest grass and to make virtually any needed chemical. We would expect, in fact, equipment which would allow us to create our own food from air and rock. If we expected to be dropped into the ocean, we'd acquire gills, either as a special suit or as organs which would attach themselves to our body. If in space, we'd have similar arrangements, perhaps our own strontium-90 power source incorporated into an organ, and immunity to radiation. Biological control would mean that we could metamorphose ourselves, going into a chrysalis form and coming out again completely reorganized, if necessary.

VALUES AND THE GENETIC WARS

Just because we have technology doesn't mean we can get everything we want. Some wants are contradictory within themselves, so that we'll never reach them because they are intrinsically impossible (attempting to live longer without curing aging is one such; peace is another). Other values can only be held because the physical world prevents us from attaining them; once we acquire the technology, we'll discover, slow or fast, that such values aren't viable. It is likely that humanity will see severe conflicts around these problems, either covertly as a government attempts to enforce a decree against widespread opposition or overtly in civil war.

Here is a simple example, distant enough for the principles to become clear: male children. In India, male children are highly favored and female children unwanted. Furthermore, at least in India, means to control or change

the sex of the newborn don't exist. People can want boy babies, but that won't affect the sex ratio. If, however, the Indians can control the sex of their children, immediate problems will arise. There will start to be too many boy babies. People will notice this fact, but they still won't want to give up the advantages of having boy children and no girls. Some people will therefore try to force OTHERS to have the girl children while they go on as before. In India, it is the family of the woman who provides brideprice, which belongs to the groom not just as a social custom but as a matter of RIGHT AND JUSTICE; the argument will not be only about the availabilty of women but about money and property and tradition. There will be attempts to restrict the availabiltiy of sex control to the "right" people. These attempts will produce smuggling, evasion, and crime. Directly or indirectly, the value of a girl child will become equal to that of a boy, but simple free-market economics is unlikely to be applied, until, perhaps, years after a prolonged period of covert gang war like Prohibition in the US.

Here is another, much closer to home: Peace and Altruism. The idea that people should be unagressive, nurturing, and attend to community good is very common. We've already seen how this Christian idea has produced totalitarian dictatorships and concentration camps. Its power is probably not yet exhausted; only in the next rerun, the attempt will be to produce people who are genetically conditioned to be nonaggressive and unselfish. The claim will be put that people OUGHT to be this way, only not MY children, but YOURS. Isn't it the Christian (or socialist) way to be? It seems to me that this set of values combined with genetic control has a great potential for meddling, riots, rebellions, mutinies, and civil war, which potential will almost certainly be realized. In fact, the experiment will probably not get far before it explodes into civil war.

I believe that intelligence is another such value, at least in 1984, and if means to increase intelligence come too soon they will cause equal social conflict. It would be the problem of too many chiefs, only again some classes would attempt to deny the means of intelligence increase to others. It would make the lower orders discontented with their lot, after all. On the other hand, technology doesn't happen in isolation; a strong drive to discover means to increase our "intelligence" won't happen until we NEED it, which means not until we need all those Chiefs and far fewer Indians.

The individual experiments people might make will cause less historical impact but at least as much personal tragedy. I'm not talking about experiments which fail because of technical deficiency, but experiments which fail because those involved did not think out their own values. Some people will clone themselves or their relatives, and discover that because all are identical they have become a cell in a single large body. Some will attempt to flee this body as refugees, and it will try to get them back or kill them (because if it dissolves into its component individuals it is gone). Widespread sex changes are likely to give those who do them a costly lesson that nothing is solved by changing one's sex.

One group will dramatically redesign themselves into creatures which don't look human at all, and discover how much this cuts them off from everyone else. Another group will try a kind of telepathy and discover that they've produced a group mind much more totalitarian than any other, aware of their every thought and trying to control them despite their will.

Finally, I believe that two issues which awaken much attention today WON'T mean very much at all. That is, first, changes in methods of reproduction, and second, immortality. When biological changes in humanity are raised, most ordinary people become obsessed by sexual permutations and combinations. Cloning, ectopregnancy, in-vitro fertilization, genetic surgery upon the

unborn...many permutations. They live in a society obsessed not just with sex but with reproduction, entirely predictable when the death rate is so high. When immortality becomes a serious reality, reproduction just won't be very important.

Furthermore, when the death rate falls with immortality, it should cause a change in relations between men and women. "Nurturing" is an emotional adaption to a need to reproduce, in both men and women, and childbearing was a major female role. It takes little prescience to see that this will change. Sexual feelings and emotions will change; changes in the biology of sex won't play a large part at all.

As for immortality itself, I don't see any important potential for social conflict, even though (as every cryonicist knows deeply from personal experience) the potential for INERTIA is vast.

SCIENCE UPDATES by Thomas Donaldson

A CLUE ABOUT SPINAL CORD REPAIR?

In these columns we've followed work on repair of spinal cord damage and damage to the central nervous system. Some of the most significant recent work of this kind has involved the observation that embryonic tissues, if transplanted to a damaged adult brain will tend to grow over and repair the damage. Major papers describing these results include A. Bjorklund et al (NATURE (262, 787 (1967)) and R.L. Lund and S.D. Hauschka (SCIENCE (193, 582 (1976)).
One researcher in this field, G.D. Das at Purdue University, has recently presented some of his results on the attempt to extend these ideas to repair of spinal cord injury (JOURNAL OF NEUROLOGICAL SCIENCES, 62, 191-210 (1983)). As a prototype experiment for clinical application, his result was a failure, but after closer reading it still contains some interesting clues towards solution of the problem.

Das transplanted several different kinds of embryonic rat neural tissue into the spinal cords of adult rats. Some recipient rats had intact spinal cords when transplanted. Others had either partially or completely cut spinal cords. Das reports that his best results, in terms of survival of the graft and its integration with the host, were achieved when nerve cells from the neocortex of the fetal rat were applied to spinal cords which had been partially (rather than completely) cut. In particular, transplants of embryonic spinal cord invariably failed.

Nevertheless, the experiments in which transplanted tissue "took" were very suggestive. The axons of the cut spinal cord grew into the transplant and connected with it. One problem with the repair of spinal cords has always been the formation of scar tissue from the glial cells; the successful transplants seem to have prevented the formation of scar tissue along their interface with the host spinal cord, even though they had no effect on the formation of glial scar tissue as such. Since the spinal cord axons did grow and interface with the transplant, it follows that after injury spinal cord nerves do not lose the ability to grow and interface. The fact that embryonic tissue could aid this process suggests that it may produce some chemical which aids growth and healing of nervous tissue. This suggests that a great deal more could be learned about how to repair spinal tissues by continuing these transplant experiments.

Gopal Das, the researcher responsible for this work, has also studied freezing of embryonic neural tissue for use in transplants (CRYONICS, October 1983). Despite the strong moral opposition to curing brain damage by transplants of fetal tissue, the body of this work, together with the work of Bjorklund and others suggests to me that cure of brain damage and perhaps even spinal damage by this means is imminent.

NEURONAL CONNECTIONS IN APLYSIA

Some time ago I wrote an article in CRYONICS about survival of memory. One of the points made was that current evidence suggests that the wiring diagrams of our brains were genetically determined. Subsequent learning would not change the wiring diagram. At that time, the fundamental evidence that our wiring diagrams were fixed came from observations on simple systems. All such systems kept their neuronal connections unchanged through learning. Explicit maps of the nervous systems of several invertebrates already existed. How such wiring diagrams were determined was still unknown.

In particular, existence of a fixed wiring system suggests that neurons "know" which other neurons they must connect to, even if they aren't actually connected to them. This ought to mean a lot for future repair.

Readers may have heard of the important work of Kandel (E.R. Kandel et al, SCIENCE, 218, 433-443 (1982)) and others on the neural anatomy and memory of Aplysia (the sea hare) and other invertebrate animals. Because such animals are so simple we'll probably first understand how memory works in them and only later come to find out how it works in mammals.

Quite recently a paper in JOURNAL OF NEUROSCIENCE (3(12), 2614-2620 (1983)) presents some decisive evidence that neurons, at least neurons of the sea hare, actually carry with them information stating which other neurons they should link up to. Joseph Camardo and others report in this paper how they grew Aplysia neurons in cell culture. They found that these neurons would form synaptic connections only with specific other neurons, which turn out to be exactly those neuron types to which they connect in the intact animal.

Specifically, the synapses involved link up the neuron L10 with a class of cells called the upper left quadrant cells. These neurons are all parts of the named map of Aplysia's nervous system. The L10 neuron will not form connections with right upper quadrant cells.

Different neurons employ different chemicals to transmit impulses from one to another. Dopamine, GABA and acetylcholine among others are all used by one type of neuron or another. One very interesting comment which Camardo et al make here is that both the left upper quadrant cells and the right upper quadrant cells use exactly the same neurotransmitter, acetylcholine. This means that whatever it is that guides these neurons to link up in culture, it cannot simply be the type of neurotransmitter they use.

If we wish to repair a damaged brain, we'll need information about what connections the neurons should have even if these connections are broken. This paper is particularly interesting because it suggests that the actual connectivity remains encoded in our individual neurons, information about how we should be wired up could be found from the neurons themselves. It's even more interesting here that Camardo, et al took their neurons from juvenile, but grown and functioning animals. The connectivity information therefore remains even after the real physical connections are laid down.

As yet we don't know how this work extends to mammals. Nevertheless, the fact that invertebrates have a clearly defined system of nerve cell connections makes it much more likely that the same is true in man. After all, what reason is there to believe that human brain organization proceeds by a fundamentally

different process than that observed in invertebrates?

SO THEY'VE FINALLY STARTED!

Several cryonicists have brought up the idea that in the future our control over biological phenomena will let us achieve many engineering feats currently inaccessible. These would particularly involve very fine control over the molecular structure of matter.

Even a slight reading of biochemistry will reveal the concept of enzymes. What an enzyme is, is a tiny molecular machine. Enzymes can promote or inhibit a reaction depending upon whether or not another chemical is linked to them in another site; they act as catalysts because they can grasp one molecule and then (purely by their design as small machines) grasp another and pair them together.

This idea of how enzymes work, and the discovery of enzymes themselves, ranks as the most important idea in biochemistry, even more than recombinant DNA. Recombinant DNA is after all only one new method for controlling and creating enzymes.

For a long time anyone who knew about these ideas could predict that someday people would use them technologically. The point is that once we have conceived of tiny molecular machines it isn't a big step (IF we think like engineers) to conceive of custom design. Once we conceive of custom design, we don't have to limit ourselves to "natural" reactions on "natural" substances. We can think about designing molecular machines to achieve all kinds of special purposes.

A recent series in SCIENCE (223, 154 (1984)) reveals that some chemists have finally begun to think seriously about designing special enzymes to achieve special chemical purposes. Hurrah!

Klibanov, at MIT, is one chemist who has studied this problem. He has proposed using one biological enzyme, glucose oxidase, to produce hydroquinone, a commercially useful chemical in photography. This would constitute an unnatural use of a natural enzyme. The reactions involved, although chemically similar, are not the same one the enzyme catalyzes in nature. Another enzyme which might have commercial use, even taken "as is" from nature, is galactose oxidase. This enzyme might help make glyceraldehyde from glycerol.

To use natural enzymes for unnatural reactions is only a first step. The next step, of course, is to chemically modify natural enzymes into new forms capable of carrying out useful reactions. Chemists have started to do this too. Gray and Margalit of Cal Tech and Pecht at the Weizmann Institute in Israel have combined sperm whale myoglobin, the oxygen-binding chemical in whale muscle, with a catalyst which uses the metal ruthenium. The myoglobin binds oxygen and the ruthenium catalyst uses this oxygen to carry out oxidation reactions. The article gives examples of several other substances chemists have produced to carry out catalysis in an "enzyme-like" fashion, even though they are not natural enzymes. The substances all have in common that they combine an "inorganic" catalyst or chemical with a protein molecule, and the protein molecule enhances the performance of the catalyst.

What does this work mean? Well, as a bystander my impulse is to say that it took them a damned long time to start thinking along these lines. Indeed, I personally would be far more interested to learn why they took so long to start thinking along these lines than I would to know that they had finally begun. But more specifically, enzymes are only the lowest constituents of a living system. We have to imagine that our machines will someday consist not of bulk matter, but of complex systems of chemicals, at least comparable in complexity to those of a living cell. Living cells, of course, consist not merely of individual enzymes but of a vast variety of enzymes and other structural

materials such as DNA, and the proteins and lipids which make up cell membranes, all integrated into a functioning system.

Such a system of course will be capable of things which bulk crystallized steel couldn't possibly achieve. Room temperature superconduction, self-repairing paints, clothing, and materials, as well as clothing which adapts to temperature and gives us oxygen if we fall into water, conductors of heat which continually renew themselves at high temperatures rather than slowly vaporize and become brittle, flat viewscreens the size of a wall which present vivid, detailed 3-dimensional images lifesize, devices to store electrical or other energy at very high density with very low weight, computer memories orders of magnitude cheaper and denser than present ones: these are all the relatively trivial applications such a technology might have.

Naturally the ability to construct complex materials made up of thousands of integrated machines on a microminature level means that the kinds of surgical and medical instruments we can make will also improve. Currently for instance, surgery involves quite gross cutting. We might imagine special surgical machines which would act like hybrids of bandages, surgical instruments and drugs all rolled into one: applied to a wound they would invade it, heal it and then withdraw.

Look, folks, this isn't a new idea to cryonicists. I'm talking precisely about the anabolocytes written up by Mike Darwin years ago, and the repair machines (which would separate out every individual brain cell, repair it, and then link all the cells together again) which I wrote up in "This So-Called Death" in THE IMMORTALIST. But of course repair of freezing injury is only a special subset of the repair of injury and disease in general.

Furthermore, the technology of construction would improve. Welds are clumsy: we can see how the materials out of which our houses and tools are built would have this complex internal structure, and would need other devices to link them together, like intelligent glues.

Artificial enzymes, of course, imply the possibility of changing the biochemistry of our own bodies. Of all possibilities, this is perhaps the most complex, since no amount of biochemistry will make us exempt from natural selection and the need to optimize our design. This means that we can't really expect to change our design without changing the ecological conditions under which we live. These include our level of wealth, our deathrates due to illness and accident, our birthrate, the nature of our work (whether it needs intelligence or whether intelligence might actually disadvantage someone).

As an example only, I note that ruthenium doesn't currently appear to be a biochemically essential element. Perhaps enzymes using ruthenium can perform useful functions in our own bodies "better" than our present enzymes. We did not evolve in a milieu in which we had enough free energy to use ruthenium. Now that our wealth is much greater, it may turn out to become more efficient for us to use enzymes and biochemistry of different designs, depending on rarer elements (such as ruthenium). Control over our own biology and design of enzymes lets us proceed to use these biochemicals, and perhaps improve radically on nature's designs.

Changing our biochemistry, of course, involves much more than just exchanging one gene for another as the "genetic engineers" envision. Even to redesign one enzyme (SUCCESSFULLY!!) requires orders of magnitude greater understanding.

This reported work on enzymes is really only a halting first step in this direction. I personally think that its ultimate effects will far exceeds those of recombinant DNA. This short article has sketched some of these ultimate effects. It is probably salutary to understand that most chemists would feel I was reading far too much into the work of Klibanov and others.

SHOULD WE SHIP PATIENTS BEFORE OR AFTER PERFUSING WITH GLYCEROL?

As cryonicists we all know that freezing itself causes damage, even despite cryoprotectants. A recent paper in Cryobiology (21, 6-12 (1984)) by W.N. Wicomb, N.A. Halaz and G.M. Collins has just presented evidence that maintaining kidneys without cryoprotective agent (and therefore perhaps other organs such as brains?) at below zero temperatures in the supercooled state (in the absence of freezing) may also cause damage. This damage which occurs even when there is no ice formed is referred to as chilling injury. Even more interesting, perfusing these kidneys with a mixture of the cryoprotectants propylene glycol and glycerol was almost completely effective in protecting against chilling injury.

Wicomb, et al. studied rabbit kidneys and treated them in six different ways: storage at Ø degrees C, supercooled storage at -4 degrees C, storage at -4 degrees C followed by seeding with ice and initiation of freezing, and then the same three sets of conditions with the addition of cryoprotective agents. Of course they perfused kidneys in all six groups with a supportive solution for hypothermic storage before the tests.

Basically those kidneys which they had supercooled without cryoprotectants did not survive as well as kidneys merely taken down to Ø degrees C. They evaluated kidneys for function both by attaching the kidneys to a test animal and measuring their ability to remove creatinine (a waste product) from its blood, and by measuring the ratio of potassium to sodium in tissue slices.

They speak of their experiment as bearing on the feasibility of supercooling. I found their work very interesting for reasons I will describe below, but I also feel that their work has little to say about preservation in the vitreous state (an extreme example of "supercooling"), especially since cryoprotectants seem to prevent the effect.

The most interesting practical suggestion I see coming from this work is what it may suggest about transport of cryonic suspension patients. Providing prolonged exposure to cryoprotective agents at high subzero temperatures can be shown not to be toxic itself, we may wish to perfuse patients with cryoprotectives and ship them before actual freezing. During shipment, particularly in winter months, we may be faced with less than perfect control over temperatures. Perfusing patients with cryoprotectant under such difficult circumstances may help to mitigate this problem and prevent freezing or chilling injury at high subzero temperatures such as might be encountered sitting on a loading dock at an airport in the winter.

TRANSITIONS

by Mike Darwin

On warm summer evenings like this one when the days activities have left me full of restlessness and rushing thought I ride out into the cooling California dusk on my ten-speed. Often I navigate up and down tree-shaded suburban corridors past quarter-million dollar homes and watch the flow of other people's lives. Some nights, like this one, now drawing to a close, are special. Dusk falls with a rosy glow that fills the West and the moon hangs in a clear, azure blue California sky, framed by towering palms.

As the dusty heat of day is absorbed by falling darkness I am drawn off the

corridors of life to the dusty lane that leads to the cemetery. It is safe there, the entrance drive is chained; no cars with blinding lights and roaring engines can break the silence. There is just the blacktop, the scattered stones and a lone man gliding silently on a bicycle.

This cemetery is in many ways unusual. It is nearly full now, many of the stones date to the early 1900's. There is little space left which is not filled with row upon row of markers set flush with the earth in Forest Lawn fashion. The mausoleum, with its quaint screen doors that shut with a long spring, brings back memories of childhood; of screen doors forever slapping shut on quiet midwestern summer nights much like this one. The ashes in the columbarium just inside the doors are in big brass books and gilded Greek urns which speak of a vanished era.

The cemetery is unusual in other ways as well. It is a place where the mortal shells of some of us—cryonicists—have met with flame and turned to ash. I have taken some of their worn and broken bodies there myself. Always in the morning though, on cloudy, misty, winter days. As I ride along my mind wanders back to the last time I had business in the cemetery.

The man who runs the place is not much given to philosophy, which I suppose is to our benefit. Cemeteries like this one are hard to come by—for cryonicists. The manager is cheerful as he leads us back to the retorts. These glowing ovens are the salvation of cemeteries like this one--cemeteries too full—with endowments too small. The manager remarks that he doesn't want to know what's in the cardboard coffin. He laughs and says he doesn't care to look. "What's inside is your business" he says with a smile. "Just have the paperwork in order!"

While waiting for the flame to do its work the two of us from ALCOR wander over grass still wet with morning dew. In the distance the steady, muffled jet-like roar of the retort speaks of flesh speeding into dust. What makes a man a man? Is it brain, or body? Is it both? As we walk over wet grass and look at stones which struggle to speak an entire life in a name, a date, and a word or two I wonder. I think of changes going on inside the retort. Of hands that sewed, and touched with love, of hands that moved in endless motion; making change, washing faces, pushing lawn mowers. Of arms that held loved ones and moved once sleek young bodies through summer-warm water. What makes us what we are? Where are those people whose hands and bodies were turning into ash as I walked quietly among the stones and markers?

I know that despite the flames their minds are safe. And with them, as in a seed, lay all the plans for hands and arms and running legs. Plans encoded there for youth and strength, not withered limbs and worn hearts that served until they broke. And minds. What of the minds? Minds with memories of hands filled with a lifetime of sweet sensation. Minds full of thoughts and tastes and quiet moments. Great satisfaction comes from that thought. From knowing they are still there. From seeing past the glowing pile of embers raked out of gray ovens.

Jimmy, the little man who runs the retorts and packs away the ashes, brings out a smoking metal box of glowing embers. It was once part of a man. The least important part. Not his soul. Two hours at 1,700 degrees Fahrenheit and that is all that's left; embers glowing cherry red. The modern electric doors of the retort slide soundlessly shut. The glowing LED readout begins to climb again. The temperature which dropped when the ashes were raked out is beginning to recover. There is another man ready to go in—this one with his body and his soul, both of which soon will pass away forever.

Outside, Jimmy spreads the ashes out on a large stone slab to cool. There is a strong, familiar odor. Surprizingly, it is DMSO. Strong and cloying, it alone has survived the raging flames. The ashes cool and soon with gloved hands

Jimmy starts the sorting. Large pieces go in coffee cans where they are pounded with a section of steel pipe and ground into smaller pieces. What remains is shaken through a screen. The fines, which are all that remains of flesh and blood, are scattered on the ground. Indeed, the earth is littered with such ashes. I wonder at the ruins of minds around us. What of the brains which thought and pondered life's meaning? What of the minds that dreaded thinking of this moment they've become forever? Finally the ashes of the bones, reduced to porus pebbles are placed within a plastic box and carted unceremoniously to the office, where Jimmy says that we can call for them.

I am back now in the present. It is eight 'o clock and Jimmy's locking up. One time when we were there to burn a body Jimmy told us why he did this work. "I'm not very smart" he said, "that's why I do this job, it's all I can handle." He is simple and his honesty is direct and disarming. Jimmy is old, eighty-one he says. His face has been reshaped by surgery. No doubt some cancer years ago. The scars are old and faded. As he locks up he asks me if it's dangerous to ride my bike on open roads so late at night. "It is" I say, and comment that that's why the cemetery is so appealing. As he gets into his truck Jimmy says he's thought about a moped for himself. "Why not!" I ask with bright enthusiasm. "Oh, I guess I want to live another year or two," he says. "I know I haven't long to go, but I want the year or two I may have left."

I wave goodbye as he drives off and I ride back past the gate among the legions of the dead. I cannot help but think of them. Hundreds of them, perhaps a thousand or more. The radio playing in my ears cannot drown out the thoughts. I glide past stones with names, a tiny fraction of the information that made a man or woman once a person. The music comes hauntingly into my ears flowing down inside my helmet. Sometimes the songs are sad, sometimes they race with life. That is the essence of the cemetery. There were <u>people</u> here. Men much like me. People who dreamed, children who thought about walking on Mars on nights like this when it glows red on the horizon. Some of the children have barely kissed the earth. The children's section is one of the few that is not full up. There are broken dreams there. Memories of starry nights like this one which have fallen to dust. There is a fresh grave with a new stone. I wonder if the boy buried there longed to see a Martian sunset and dreamed of life, adventure-full stretching before him without limit? What of the memories going to dust around me?

As I glide on in the gathering darkness I am aware of the sweet scents around me. The jasmine is in bloom; the white flowers are pale specks in the rosy light. As I race down curving lanes it comes to me that it is good to be alive. Deep sorrow rushes over me for those who have vanished here and lost their lives.

Are there words to say what they are missing? Is there a price for a summer evening with a full moon and jasmine-scented breeze? I am filled with the urge to shout at them, to shake their dusty bones and rotting flesh and tell them to wake up, to stop missing out on <u>being alive!</u> But it is hopeless for they aren't really here. I wonder how <u>much longer</u> I have before I join them. Will I be frozen when I die? For the love of life and all that's in it will I survive? I wonder and I worry. It mars the glorious realization that it is good to be alive. I don't wonder at all at what it's like to be dead. I know what it's like to be dead. It isn't like anything at all. It is just not being there anymore. It is not feeling the sweet promise of being alive, it is not feeling strong legs move a bicycle swiftly forward, it is not dreaming of standing on Mars and watching its moons race madly across the jet black sky. Most of all, it's losing not just what you've been, the memories and loves and hopes we carry with us, it losing all we could have been. It's not just the loss of a finite past with all the security it carries with it, it's losing all

of that which is yet to be. An infinity of thoughts and dreams and worlds and new ideas wait out there for us--if we live. Those, poor, poor people who've vanished into dust around me will never know the things I'll know, the thoughts I'll think--if I live.

I think about that, about my body which is falling apart. I think about my efforts to stop the inexorable fall towards nothingness. I hope my doctors are wrong with their worried looks. I hope the medications work for me again. I hope that if all else fails that those I love and trust will get me frozen and keep me there. I hope they'll fight for me, as I will fight for them and that somehow they'll realize just how much my past and most of all my tomorrows mean. I hope they'll think about the countless souls whose thoughts and dreams have passed away forever and that they'll fight for me--should all else fail.

I think about the waiting not so much as I think about the future. I feel better now about tomorrow than I have felt in years. I can thank Eric Drexler for that. I can thank him for a fresh new vision of tomorrow where molecular machines exist and scraps of people grow whole and walk the earth again. I thank him for his book* and the optimism it's given me. I used to doubt that those who wait were coming back. I wondered how we'd get them out and make them whole again. Even though I knew the answer I sat and worried. I still worry, but not about the biology so much as before. I think I know the game plan that will be used. I see the shape of things to come.

I hope that in my lifetime molecular machines will be made which will free me from this evening's worries. As I ride along I fantasize about a drop of cloudy liquid on my tongue full of virus-sized machines. Machines small enough to multiply inside my aged and damaged cells. Machines smart enough to bring order to chaos. Machines strong enough to turn age to youth and death to life. If only I can last till then.

If I am forced to wait in liquid nitrogen my sole concern is that the wait be long enough. That I can wait until the era of molecular engineering. I worry only at the patience and the judgment of those who follow. I worry only at the common sense of a world in love with death. I worry about a world with cemeteries. A world where memories fall to ash in furnaces and mouldering earth. I worry at a world where children never get to walk on Mars.

Despite the worry it is good to be alive.

It is good to be alive.

It is even worth waiting for.

"He was working hard at increasing his life span. He did it by cultivating boredom. Dunbar was working so hard at increasing his life span that Yossarian thought he was dead."

"There was only one catch and that was Catch-22, which specified that a concern for one's own safety in the face of dangers that were real and immediate was the process of a rational mind."

--Joseph Heller, Catch-22

"I met a Californian who would
Talk California - a state so blessed
He said in climate, none had ever died there
A natural death."

--Robert Frost

NEW YORK LIFE SIGNS BENEFICIARY AGREEMENT!

By Steve Bridge

In the August, 1983 (#37) issue of CRYONICS, Robert Brakeman proposed a model agreement to test an insurance company's willingness to consider a cryonics company an acceptable beneficiary. The point of this agreement would be to insure that the insurance company would pay the death benefit to the cryonics company without contesting it. Brakeman stated that two unnamed insurance companies had agreed to sign this document. We have not heard whether or not these companies have actually signed the document for anyone yet. However, New York Life Insurance and Annuity Corporation --a sister company to New York Life Insurance Company-- has signed my policy.

I have a $100,000 Universal Life (see following article) policy, with 50% going to Alcor and 50% going to my family. I gave my local insurance agent, Ed Muir, the Brakeman guidelines and asked him to see what the Central Office would agree to. After 4 months without hearing anything, I received a copy back, signed by Franklin Ciaccio, Secretary of NYLIAC. NYLIAC had agreed to all of the provisions -- and had not even asked to negotiate. (If you already own an insurance policy through New York Life Insurance Company, you can expect that its policy on approval of the Brakeman statement would be the same as NYLIAC's.)

This agreement was signed on a policy which had already been approved for me with my brother and sister as joint beneficiaries. Mr. Muir says that there is no reason that one could not apply for the policy with Alcor as the initial beneficiary. The main problem is that it customarily takes the company longer to approve a policy with a non-relative beneficiary. If you have a family which you are also trying to protect in case of your death, it may be important to get the policy into effect right away. You can then do as I did and change beneficiaries. (Before I took out this policy in the first place, I had my brother and sister sign contracts guaranteeing to pay 50% of the proceeds to Alcor if I should die before the change was made.) NYLIAC does not require any waiting period before a beneficiary can be changed, unlike some companies in the past.

While this does not constitute official acceptance of the value of cryonics, it does represent some kind of acceptance of the legitimacy of cryonics, which may be just as important in the long run. The fifth largest insurance company in the country is willing to deal with us on a straightforward basis, with no attempts to make excuses later.

If you are still trying to decide what to do about life insurance to pay for your suspension, you might be wise to start by speaking with a New York Life agent. You know this company will be co-operative. Give them a copy of this agreement and the name of

Secretary Ciaccio if you decide to purchase the insurance. If you already own a policy from New York Life, immediately submit a copy of the agreement, with a beneficiary change if you have not already switched the insurance over to Alcor. In either case, have your agent attach a note saying that this is the same sort of company (or the "identical" company, if you are using Alcor) and the same agreement used by NYL agent Ed Muir of Indianapolis for client Stephen W. Bridge. When your agreement is signed and returned to you, immediately send Alcor a copy for your suspension files. Having a signed agreement won't protect you if we can't prove it when you are suspended.

If you are satisfied with your insurance package from another company, you might be able to persuade them to sign this agreement by pointing out that New York Life has signed it. I will be happy to send you a photocopy of my agreement, if that seems to be necessary. If your company refuses to sign, you have several choices: [a] stick with what you have and hope they really will pay, [b] change your beneficiary to a co-operative relative who will promise not to die before you do and who will promise to immediately pay the money to Alcor, [c] change your beneficiary to a trust which will pay the money to Alcor (this is tricky, but do-able), or [d] do as I did --get a policy with a co-operative company and drop your old one. Do it in that order, PLEASE. Do not leave yourself without coverage while you negotiate.

Mike and I feel that this document is of considerable importance to your security. Please do not delay in pursuing it with your own company or with New York Life. We will be happy to announce any success with other companies. The complete text of my document is reproduced below. This is essentially the same as the Brakeman original.

Dear Gentlemen:

My beneficiary designation on policy #----- is as follows:

50% of proceeds to Alcor Life Extension Foundation, Inc.
50% of proceeds to --------(brother) and --------(sister)

In an effort to make sure the proceeds will in fact be distributed this way, I would like to ask the New York Life Insurance and Annuity Corp (NYLIAC) to agree to the following.

A) NYLIAC agrees that a cryonics organization is an acceptable beneficiary of a life insurance policy, with "cryonics organization" hereby defined to mean association or corporation (whether profit-making or non-profit) with the function of freezing a human body upon clinical death, in the hope and expectation that the future progress of medical science will make possible the eventual curing of the fatal ailment, as well as resuscitation and revival.

B) NYLIAC hereby recognizes that such a cryonics organization has an "insurable interest" in the life of a policyholder.

C) NYLIAC consequently waives the right to contest payment of the death benefit of such a policy on the ground of "no insurable interest."

D) NYLIAC similarly waives the right to contest payment of the death-benefit of such a policy on the ground of the "unorthodox" nature of either the beneficiary, the beneficiary/policyholder relationship, or both.

E) NYLIAC furthermore waives the right to contest payment of the death-benefit of such a policy on the ground that either cryonics generally or the beneficiary/policyholder relationship in particular is "not recognized in existing law or practice."

F) NYLIAC agrees that it waives the right to contest payment of the death-benefit of such a policy on the ground that there is no "usual" or "customary" relationship between the policyholder and the beneficiary, e.g., the relationship between relatives.

G) NYLIAC consequently agrees that it intends to pay, and will pay, the death-benefit of such a policy in precisely the way, and with the promptness, which it would employ if the beneficiary were a blood relative of the policyholder rather than a cryonics organization.

H) NYLIAC stipulates that its acceptance of all the foregoing provisions will remain in effect irrespective of the progress, lack of progress, advances, or set-backs (whether physical, legal, or financial in all those four cases) of the cryonics movement generally or of any particular cryonics organization.

I) NYLIAC agrees that if any of the provisions of this agreement should be held invalid by a court of competent jurisdiction, the company will continue to be bound by all the provisions not held invalid.

J) NYLIAC agrees to be bound by all the provisions of this agreement whether a cryonics organization is only the beneficiary of a policy or is both the beneficiary and the owner of such a policy.

K) NYLIAC stipulates that in agreeing to provisions "B", "C", "D", "E", and "F" above, it is basing its adherence on the general sense of the provision, and not merely on the precise words in quotation marks therein, and will therefore not contest payment of the death-benefit of such a policy on any ground substantially the same as those listed in quotation marks.

Sincerely,
Stephen William Bridge

UNIVERSAL LIFE INSURANCE MAY FIT YOUR NEEDS

One of the hardest problems facing a cryonicist is how to provide the funds required for suspension. Whole body rates run as high as $100,000 from Alcor, which seems like an incredible amount of money. Life insurance has generally been proposed as the most flexible and affordable way to do this. Traditionally there have been two kinds of life insurance policies: a) Term Life insurance is purchased for a set period of time. It is less expensive, but it has several critical flaws for cryonicists. It does not build in value over the years and renewal is strictly at the option of the insuring company. Typically the cost goes up with each renewal, to the point that it is nearly impossible to obtain Term insurance past the age of 60. b) Whole Life insurance is a much better policy for cryonics. Once you start a policy it cannot be dropped by the company except for lack of payment. The policy grows in value and is usually figured at a fixed rate of payment. The biggest disadvantage is that it is quite expensive. Until recently I was paying $80.00 per month for $50,000 of Whole Life insurance.

During the past three years, several insurance companies have come up with an intriguing new plan called Universal Life insurance. Universal Life combines the best of Term and Whole Life insurance. It features low cost (I am paying $60.00/month for $100,000 of insurance from New York Life Insurance and Annuity Corporation); but it grows in value, has a steady cost, and is not cancelled by the company. There are some additional advantages not found in other policies. The growth in value of a Whole Life policy is figured through dividends (being defined in insurance circles as "return of excess premiums"). But the growth in Universal Life policies is figured strictly on the rate of interest paid. My policy is currently paying 11%, well above the 4-5% average for dividends. This interest is tax-deferred, i.e. you don't pay taxes on the interest until you withdraw it --probably after you are 65 when your tax liabilities are less. If the economy changes to the point where dividends are greater than interest payments, you have the option of switching the policy to Whole Life.

There are several other options offered with Universal Life policies. You may assign your interest payments to either the death benefit or to cash value, depending on your future needs. If the interest is credited to cash value, the death benefit remains at $100,000 until about age 65, at which point it also begins climbing. Using this option, by age 95 (assuming today's interest rates) both the cash value and the death benefit would be over one million dollars. You may switch back and forth between the options at any time according to your needs. Another attractive option is the opportunity to stop paying on the policy at any time and not have it automatically cancelled. Payments are taken from the built-up cash value as long as funds are available. This may enable you to stop paying for years at a time, perhaps late in your life when the cash value has become very large. Finally, you may split the policy between several beneficiaries, such as Alcor and your family, as I have have done. You may change these amounts at any time.

The one disadvantage some (neuropreservation members, for example) may find in Universal Life is that most companies will require you to purchase at least $100,000 of insurance. This may not be the problem that it seems, however. First, remember that the cost for a $100,000 Universal Life policy is significantly less than for only $50,000 of Whole Life. It is quite likely that $50,000 will someday be the basic cost for neuropreservation and that you would be smart to plan that way well in advance. $100,000 should give you ample cushion. If you are opting for whole body suspension, the $100,000 plus growth in value should protect you very well also. SB.

INSURANCE COMPANIES AND AUTOPSIES

Of course you do not want to have an autopsy performed on your remains if you are going to be suspended. However, you should check your insurance policy to make sure you have not been put in a double bind. Insurance companies do not have the right to demand an autopsy. However, they may in some circumstances be able to refuse payment if an autopsy is not performed. Generally these circumstances are restricted to two: a policy which includes double payment (double indemnity) if the policyholder dies in an accident, and the normal restriction of non-payment if the policyholder commits suicide within a certain time period (usually two years).

The first circumstance is easily taken care of. Do not have an accidental death benefit on your policy. If you have such a clause in your current policy, HAVE IT REMOVED IMMEDIATELY. The suicide restriction, however, has a long legal history and is not about to be removed from your policy. A death which occurs within the specified time and which could have been suicide might cause problems; but Ed Muir of New York Life has explained to me that, in fact, very few insurance autopsies actually occur. Most accidents are obviously such; and autopsies would not establish intent in many suicides (such as falling out of a window). The most common requests for autopsies are for suspected drug overdoses and for gunshot wounds. The main recommendation I can make here is: Don't commit suicide during the restricted period of your policy. Secondly, make sure your friends know that you have no intention of commiting suicide at any time; so that you have a chance of avoiding an autopsy in case something strange does happen. In any case, if you purchase the Universal Life policy discussed above, New York Life only has a one year suicide restriction on it, which offers you some further protection.

*** I want to thank New York Life Agent Ed Muir for all of the help he gave me on these three articles. SB

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