CRYONICS

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CRYONICS is the newsletter of the Institute for Advanced Biological Studies, Inc. Published monthly. Free to members of IABS, the Alcor Life Extension Foundation and the Bay Area Cryonics Society. Individual subscriptions $15.00 per year. Group rates available on request. Please adress all editorial correspondence to IABS, Inc., 4030 North Palm #304, Fullerton, CA 92635, or phone (714) 990-6551.

EDITORIAL MATTERS

The persons who are interviewed for CRYONICS and the authors who submit works to it take responsibility for their own opinions and statements. Neither IABS nor the editors of CRYONICS necessarily endorse or agree with the opinions presented in these articles or interviews. The co-editors frequently do not endorse each other's opinions. Our purpose is to publish a variety of material dealing with the many different issues of cryonics, to present differing opinions on specific issues, and to encourage both individual thought and open discussion on the concerns of today's cryonicists. We want to be controversial, to stir up discussion. And we want to print your responses to the ideas in this newsletter. If you have opinions on or objections to articles or ideas in CRYONICS, please submit a well thought-out letter or article to us for publication. If you send us a letter at any time, please indicate whether or not you intend for us to publish it.

To Alcor members: Because of problems in the way in which your copies of CRYONICS were being distributed, you may not have received all of the issues to which you are entitled. You should have received one issue for each month beginning with March, 1981. If you are missing issues, please let us know, at the IABS address. We will send you replacements.

To all other subscribers: Back issues are available from March (#8) to the present for $1.00 each or any three for $2.00. Issues 1-7 are no longer available, since they were published several years ago and have little of current interest. Some of the ideas in those issues, along with a basic introduction to cryonics, were included in our booklet, Cryonics: Threshold to the Future, which is still available for $1.00.

Stephen Bridge
and Michael Darwin (Federowicz)
Co-Editors.

CONSTRUCTION AT CRYOVITA

Upwards of a thousand dollars worth of lumber was delivered to Jerry Leaf's Cryovita Laboratories in Los Angeles in preparation for construction to be undertaken in September and October. Construction plans call for subdivision of the current large single room into an operating room, animal research lab, vivarium (animal care area), and electron microscope room. Completion of this construction will allow for more flexibility and greater ease in carrying out both suspension and animal research.

LOSS OF PRESSURE

Some months ago we reported that a pressure chamber acquired by Cryovita Labs from the Medical College of Georgia for use in vitrification studies was damaged during shipment. It was returned to the manufacturer, Autoclave Engineers in Erie, Pennsylvania, for evalua-

tion, testing, and possible repair. Well, the report from Erie is in and it is more bad news. The tab for evaluating the chamber was $1,200 and the estimated repair bill is in the vicinity of $13,000! Jerry Leaf is in the process of negotiating with the trucking company and its insurance carriers. At this point, there is simply no way to tell when, if ever, the chamber will be restored and ready for research.

A NEW WEAPON AGAINST CANCER

One of the primary reasons most cancer patients succumb, even with early detection and treatment, is that the cancer spreads or metastasizes to sites distant from its origin. Conventional anti-cancer therapy has centered on the administration of highly toxic chemicals which, while they do kill cancer cells, also severely weaken the body's immune system making it even more vulnerable to the spread of malignancy. Additionally, most anti-cancer drugs are capable of CAUSING malignancies themselves.

Now, a group of oncologists at Wayne State University report on the use of prostacyclin (PGI_2) as a powerful antimetastatic agent. It seems that in order for a free floating cancer cell to take root and grow into another full-fledged tumor, it must initiate the formation of a tiny blood clot to anchor it in place. Preliminary studies with conventional anticoagulents such as Coumadin and heparin have been encouraging, but are not nearly as effective as desired.

Prostacyclin is a good inhibitor of platelet aggregation, which is an essential step in the clot-anchoring process a tumor cell uses. Mice were given I.V. injections of PGI_2 before I.V. administration of virulent tumor cells. The treated group experienced a 70% lower incidence of malignancies than the untreated controls. Researchers have also combined prostacyclin with Theophylline in order to achieve a 93% reduction in metastases. Thus, it appears that if the tumor cell can be prevented from initiating thrombus formation after attaching itself to the wall of a vessel, it may simply perish harmlessly. (Honn, K.V. et al, SCIENCE, 212:1270, 1981.)

NEW DRUG FOR SENILE DEMENTIA

Piracetam, a new compound which experimentally has major central nervous system effects without any analgesic, sedative, or tranquilizing properties, has reportedly enhanced cognitive function in elderly patients with slight mental impairment. A wide range of other drugs, from acetylcholine boosters like Deanol to vasodilators like Hydergine, have been tried with disappointing results. Piracetam, much like these other drugs, is reportedly very helpful in only very mild cases of cognitive impairment. Studies with severely impaired patients have not been encouraging. Still, it <u>is</u> another weapon in our armament against senility.

(Resiberg, B. et al, AM J PSYCHIATRY, 138: 593, 1981.) □

A CRYONICS WEEKEND

a report by Michael Darwin

Cryonicists from all over California and the United States gathered September 11-14 at South Lake Tahoe for the annual meetings of Trans Time and the Bay Area Cryonics Society. This year the meetings took on added importance because they were part of a cryonics seminar weekend. Fred and Linda Chamberlain hosted the meetings and organized many delightful sightseeing events, such as a caravan around the lake and an evening dinner and cruise on the MS Dixie. The entire weekend was apparently a delight for all 48 attendees.

The weekend started on Friday at 7:00 pm with a reception and brunch at the Chamberlains' home. After some conversation that ran into the wee hours, everyone was up bright and early Saturday morning for the Informal Technical Session organized by Hugh Hixon. Hugh did such a fine job of organizing that the word "informal" just doesn't apply. Hugh's technical session was as well run as any AAAS or Cryobiology meeting, and the quality of the papers presented was outstanding.

Saul Kent, long time cryonicist and immortalist, opened the technical session with a paper on the relationship of cryonics to aging research. Saul presented a detailed report on his efforts in South Florida, which so far have resulted in a newsletter, ANTI-AGING NEWS, which has a circulation of 1,100 and an Immortalist mailing list of over 10,000 names. Saul believes that, since more people are interested in aging research than in cryonics,it pays to establish oneself in this area and then use the mailing lists and facilities accumulated in this fashion to solicit people for involvement in cryonics as well. It was an interesting paper with many thought provoking ideas, and there was vigorous discussion from the audience.

Judie Walton, Ph.D, a research gerontologist from the University of California, working at Lawrence Livermore Labs, presented a paper, "Why We Age." Judie presented extensive physiologic and electron microscopic evidence of cell depopulation in aging and proposed several mechanisms to explain them. Judie has concentrated on electron microscopy from dozens of tissues in the rat and human as a means of documenting the incredible morhological and ultrastructural changes which occur with aging. We hope to publish a detailed report from Judie in the future.

Corey Noble, Ph.D., Director of Research for IABS (Corey Noble is a pseudonym), presented an impressive overview of his recent work. Dr. Noble discussed recent progress towards vitrifying organs as well as on an interventive gerontological project being conducted on a long-lived strain of mice at the Life Extension Foundation headquarters in Hollywood, Florida. Perhaps the most interesting thing Dr. Noble discussed was a large amount of previously unreported data on the cryobiology of the cat brain which was generated by Dr. Isamu Suda of Kobe University in Japan (retired). Dr. Suda, at Dr. Noble's request, provided a large amount of written and photographic material documenting his unpublished work on brain freezing. Dr. Suda has demonstrated that even brains stored for 7 years at -20°C retain the ability to generate some electrical activity after rewarming and deglycerolizing. Dr. Suda also reported on damage to

the neuropil (the net of nerve fibers in the CNS gray matter) from apparent cracking, as well as inadequate cryoprotection from PVP. The latter information is not a great surprise, since Robert Williams of the Red Cross Blood Research Lab has demonstrated that PVP "protects" simply by preventing the damaged cells from disintegrating following freezing. Suda's data was fascinating, and we understand that he still intends to publish his findings at a later date. Perhaps most important in Suda's findings is the observation that even some brains cooled to -80°C were capable of occasional electrical activity, although not the continous discharges observed in brains that were only cooled to -20°C.

Following Dr. Noble's talk, we adjourned for lunch to local establishments and no doubt raised more than one adjacent eyebrow with earnest discussions of frozen brains and perfused bodies.

After lunch, Jerry Leaf picked up with an excellent paper on cold agglutination and its implications for cryonicists. Agglutination is the abnormal clumping of red blood cells into irregular masses and is known to occur in some individuals when their body temperature is reduced by as little as 10°C. Jerry discussed the relatively high temperatures at which this phenomenon is observed and pointed out possible predisposing factors, such as lung cancer, old age, and antibiotic therapy with penicillin or Keflin.

Obviously, if the agglutination is allowed to take place, it will result in a blockage of the capillary bed, preventing complete perfusion. We have observed this phenomenon in at least one suspension patient to date. While the agglutination is reversible only by rewarming, Jerry suggested that it may be mitigated to some extent by appropriate pretreatment with methylprednisolone and/or Dextran 40. He also said that, when practical, patients should be tested for cold agglutination before their deaths. In cases where this is found to be a problem, upon the death of the patient the perfusion team members should avoid direct contact of ice packs with the patient's skin and should not allow the patient's temperature to fall below 15°C prior to perfusion. A full report on this work will be published in CRYONICS.

Paul Segall, Ph.D., Director of Researchfor Trans Time, presented some interesting work on the "Total Body Washout of Hamsters." Numerous technical problems have greatly slowed Paul down, but he is making progress and should have much more definite results to present at the next annual meeting.

Next, Michael Darwin presented a paper on "The Glycerolization of the Rabbit." He reported on the impact of glycerol perfusion on the fine structure of the eye, as well as the effects of nonvascular water on glycerol equilibration. This work will eventually be published in CRYONICS.

Jerry Leaf then presented another paper, "Extracorporeal Membrane Oxygenator Transport of Suspension Patients." Jerry's talk was illustrated with photographs of the transport gurney which is nearing completion. This transport cart consists of an air-driven extracorporeal pump, a membrane oxygenator, and a heat exchanger. Attempting to maintain an elderly or badly compromised patient on an HLR under the best of circumstances only provides 1/4 to 1/3 of the required cardiac output. With Jerry's new system, it will be possible to quickly (within 45 minutes) attach the patient to a heart-lung machine and completely take over circulation. Providing this

total circulation support, as well as having direct access to high blood flow for heat exchange should result in a profound improvement in donor viability. With the ECMO system, it should be possible to cool a suspension donor to 15°C with an hour, as compared to the nearly 8 hours that would be required with a conventional HLR. Jerry pointed out that, because it will take 30 to 45 minutes for the surgical work to couple the patient to the ECMO unit, the patient will need to be maintained on an HLR during this interval. This is more in line with what CPR is capable of sustaining.

One of the most interesting papers was one of the shortest. Hugh Hixon reported on oxygen contamination in liquid nitrogen dewars which have been operated continuously over extended periods of time. Hugh has found that one such container, an LR-40 operated by IABS for 3 years and subject to a good deal of traffic, contained 2% oxygen by volume. This could be a serious long-range problem for both cryonicists and cryobiologists. Even at -200°C, oxygen is active enough to oxydize both organic material and inorganic material such as carbon steel. Hugh discussed several approaches to dealing with this problem such as the use of scavengers like sodium and potassium and more direct approaches such as draining the tanks and starting out fresh every few years.

The paper by John Day, "Economics of Surrounding a Vacuum-Insulated Dewar with Additional Foam Insulation," is presented in its entirety elsewhere in this issue. John's paper is a fine example of the scientific progress which can come from freezing whole bodies.

Reg Thatcher of the Institute for Cryobiological Extension completed the technical session by describing his work on a remote cardiac monitor alarm which could be worn by a high risk patient who lives alone. When cardiac arrest occurs, the unit would signal a receiver attached to an automatic dialer. Within moments, the dialer would have contacted a 24-hour emergency answering service which would in turn notify the cryonics rescue crew. Reg presented a prototype of the unit which performed to standards and discussed terms by which the unit would be leased to prospective high-risk suspension patients. Anyone interested in more information on this device should contact Reg Thatcher c/o The Institute for Cryobiological Extension, 13152 S. Blodgett, Downey, CA 90242.

Following the technical session everyone adjourned to the Chamberlains' for eating and good times. This feast lasted well into the wee hours of the morning, with some people talking in small groups and others forming a circle which locked arms and gently swayed while spirits flowed (both those ethereal and those from the Napa Valley). It is impossible to even touch on the things that were discussed at this evening gathering. The only thing that can be said is that everyone came away from it feeling closer and more thoughtful about WHY we are in cryonics. As Art Quaife remarked several times during the course of the evening, "Ah, the Good Life." That sums it up rather nicely.

Sunday opened with the business meetings of Trans Time and BACS. Saul Kent opened the sessions with a blockbuster of a proposal from Steve Ruddel, a wealthy Forida cryonicist. Ruddel's proposal is printed elsewhere in this issue. Essentially, Ruddel is proposing something of a hybrid self-insurance program with himself as under-

writer. There were several objections raised to this approach, such as: Could it be put on a sound actuarial basis? What about the administrative costs and, more to the point, who would administrate the trust? How reliable is Mr. Ruddel and what do we do if something happens to him? What we do if 10 cryonicists were killed at once in some kind of disaster? Although these are serious objections, everyone present was agreed that the proposal should be looked into further.

Other topics discussed in the meetings included the future of Trans Time's rented facility, the prospects for purchase of a new facility, and the fate of two suspension patients of BACS who have no current funding. (See the September, 1981 issue of CRYONICS.) On the matter of a permanent facility for TT, Fred Chamberlain made an insightful suggestion for an appropriate investment partnership between the nonprofit groups and several real estate investor/cryonicists who were present at the meeting. A commitee was formed to investigate the feasability of this idea and to gather information on costs and logistics.

Following the business meetings we once again adjourned to the Chamberlains' seemingly inexhaustable hospitality. This time the guests provided most of the eats, and a smaller but no less enthusiastic crowd gathered to rehash the day's events and swap tales. Some very important discussions were carried on into Monday morning, and we hope to eventually have complete reports on several of the pressing matters which were debated.

By comparison with the frantic activity of the preceeding three days, Monday was quiet and reflective. The day began about 9:00 am with the Chamberlains' slide show on the history of cryonics. All present were amazed not only at how much the equipment had improved, but at how much the participants had aged. Well, at least some progress is being made. After the slide show, we packed into a couple of vehicles and took off for a leisurely tour around Tahoe. We wound around the mountain roads to the tune of the Grand Canyon Overture which the Chamberlains had cleverly managed to synchronize with passing events and scenes. They even had a bicyclist appear at just the right moment...or so it seemed! Our first stop was Echo Lake, with participants climbing to the top of Echo Summit, a granite peak several hundred feet above the lake. The climbing provided some breathless moments for just about everyone, except the Chamberlains, who took it all in stride. The view from the top was fantastic and the weather was perfect. We stopped for lunch at River Ranch, a delightful outdoor restaurant built right at at crook in the rushing water. It was then more of Tahoe and on to the MS Dixie for a delicious steak and an impressive tour of the lake from the wetter side.

As if all this wasn't enough, the Chamberlains have promised to do it again next year! □

A NEW APPROACH TO THE FINANCING OF CRYONIC SUSPENSION By Saul Kent

Every cryonics organization to date has suffered from lack of money. It remains our number one problem.

One reason for the poor financial state of the cryonics movement is that we have never had access to the largest available source of cryonics funds—the money we pay to insure that we will be frozen. Over the past 15 years, we've paid hundreds of thousands of dollars to life insurance companies; during that same period, the insurance companies have paid back only $25,000 in the form of death benefits.

If the money we spend for life insurance could go directly into the cryonics movement rather than into the pockets of the insurance companies, we'd be in far better shape financially than ever before.

The major obstacle to such "self-insurance" within the cryonics movement has been the unavailability of sufficient funds to cover the costs of cryonic suspension. Thus far, no one has been willing or able to put up the large sums of money needed to pay for freezing and storage costs should any of us die. Hence, the necessity for life insurance.

This is no longer the case. Steve Ruddel of Hollywood, Florida is now willing to serve as the financial backer for future suspensions according to the following terms:

1. Ruddel will place $100,000 into a special Cryonics Fund in the form of an escrow account at a major bank. The sole purpose of the Cryonics Fund will be to pay for the full costs of cryonic suspension.

2. Ruddel will guarantee that the Cryonics Fund will have a minimum of $100,000 in it at all times. He will agree to put in additional money as soon as the fund goes below $100,000.

3. Individuals who wish to be protected under this plan will make regular payments to one of the cryonics societies. The amount paid will vary according to their age and health.

4. The cryonics societies will send 50% of the money they collect to the Cryonics Fund; they will keep the remaining 50% for their own use.

5. When a suspension member dies, the cryonics society will withdraw the money needed for freezing and will receive an additional sum of money for its own activities. The society will then withdraw funds to pay for storage on a yearly basis. The amount withdrawn will conform to the provisions of a contract between the cryonics society and the Cryonics Fund.

The Cryonics Fund offers the following advantages:

1. All the money we spend on our own cryonic suspension will go directly into the cryonics movement to promote its future growth.

2. The cryonics societies will gain a much-needed source of revenue.

3. As soon as we die, the money to freeze us will be available immediately. Sometimes, insurance companies don't pay off right away. Occasionally, they try to avoid paying off at all.

4. Prospective members will not have to be told that the "cost" of cryonic suspension is $50,000 or $75,000—only that they have to pay a yearly, quarterly, or monthly fee.

5. Prospective members will likely be impressed that the cryonics movment has the assets to guarantee that they will be frozen. They will be able to verify the assets of the Cryonics Fund by calling the bank that maintains it.

6. The value of each suspension member will be so high that it might become cost effective to do large-scale national advertising to find new members.

7. The Cryonics Fund will increase interaction and cooperation among participating cryonics societies. For example, each group might contribute to a national advertising campaign that would present a single, unified image of cryonics that would benefit the entire movement.

The Cryonics Fund will only work if a large percentage of current suspension members sign up for the plan, and if it is promoted effectively by the participating cryonics societies.

I'm in favor of the Cryonics Fund because I think it's the only way we can raise the money we need to make cryonics big and healthy enough for long-term success. □

THE SALVATION OF CRYONICS

by Thomas Donaldson

I read the article by Corey Noble in the September issue of CRYONICS with great interest. Vitrification certainly shows much promise as a means of improving our own suspension; for this reason cryonicists should strongly support work in that direction, or indeed in any direction aimed at improving our suspension methods. However as a practicing Roman Catholic I feel that Noble's analysis of our problems with the world at large completely fails to discuss the really important steps which we absolutely MUST take in order for cryonics to have any success WHATEVER.

Many cryonicists know that 40 years ago cryonics entered into a long period of terrible disaster and decline. Begining with the writing of Ettinger's book in 1964, cryonics began with an unmitigated disaster when Ettinger did NOT immediately recieve simultaneous Nobel prizes for both peace and medicine. This was a terrible tragedy from which we have only recently recovered. It was not even long after that when cryonics sustained another severe blow. Marilyn Monroe, the movie star, died without having been suspended. Cryonicists all over the world were plunged in woe and turmoil. Disaster followed upon disaster. All world heads of state have consistently IGNORED cryonics. The United Nations NEGLECTS cryonics. And, even now there is no major opera star , nor any important concert pianist, who has made suspension arrangements. All of these disasters, sustained over a period of many years, should convince any reasonable cryonicist that all cryonicists are doomed unless we take strong measures to rectify the situation.

I have formulated a detailed ACTION PLAN by which, starting in 1981, cryonicists can begin to bring cryonics back from the dead and usher in a new period of success for our movement. My plan involves a complete understanding of what is required to make cryonics succeed and how we can achieve these modest aims.

The essential problem with cryonics is that to the vast majority of practicing Roman Catholics, cryonics HAS NO CREDIBILITY. What is more, we can confidently expect that so long as we continue as we have in the past, cryonics NEVER WILL HAVE ANY CREDIBILITY. Why this should be so is a long story; suffice it to say that (whether they are well-informed or not) to most Roman Catholics the theological background of cryonics is totally lacking. What I propose that we as cryonicists do to remedy this problem is to remove the basis of their objections by changing the basis of cryonics itself. The way towards this goal is clear: the formation of a Lay Order and the eventual achievement of PRIESTLY CONSECRATION of every suspension.

Here, then, is my action program, for the attainment of these goals. Many cryonicists will feel that they are hard to attain, but that is not the right attitude to take. Anything is possible to determined people; we must not let the pessimism of some towards cryonics deflect us from the essentially important goals.

1981 - 1985

Initial studies are begun towards the formation of a Lay Order of Cryonicists. Vestments and rituals are selected, and a choir of cryonicists begins weekly practicing of suitable Gregorian Chants. The necessary incense, wine, and wafers are purchased and held for later use.

1985 - 1990

The Roman Catholic Church grants BACS a charter as a bonafide Lay Order. Leading cryonicists, after prolonged studies in seminaries about the country, are finally ordained as priests. Articles in the THOMIST are published, explaining how cryonics is the culmination of the thought of St Thomas Aquinas. The first Consecrated Suspensions are held, and Trans Time keeps a large vat of Holy Water ready for instant use for the Suspension of any Member.

1990 - 1995

At least one archbishop announces in favor of cryonics. By this time most suspensions are Consecrated by our own cryonics priests. Cryonical Theology becomes a subject for study in more forward - looking (ie. radical) seminaries. The Pope contemplates issuance of an Encyclical; meanwhile, the Lay Order of Cryonicists of St Jude is founded and sets up missions throughout Latin America. The demand for liquid nitrogen by the peasnts of Northeastern Brazil is written up in Time and Newsweek.

1995 - 2000

The Pope issues his Encyclical ("Humanae Aeternitatis") in favor of cryonics and agrees to be suspended by Trans Time in St Peter's Cathedral, Rome. The suspension occurs and attracts an audience of more than 1 million pilgrims, who file past kissing the Pope's capsule.

2000 - 2005

Cryonics becomes a recognized part of the Roman Catholic Church.

This is an eminently achieveable program and I feel all cryonicists should see the necessity of such measures as I describe. When in the year 2005 the Church takes cryonics as its own, as it must surely do if these policies are implemented, it will have been because of the farsighted actions of cryonicists TODAY, who by their thought and planning have made it all possible. □

FINAL CHANCE TO PURCHASE CURRENT OFFERING OF TRANS TIME STOCK

Trans Time currently has a one year permit to issue its common stock at $30.00 per share, which expires on October 27, 1981. The permit allows us to issue stock to our current shareholders, plus full members of non-profit cryonics societies for whom Trans Time assumes contractual responsibility for their cryonic suspension. Almost all of you who qualify have already received our Offering Notice in November 1980, and later updated financial information such as our Annual Report 1980. If you are interested in purchasing stock and need further information, please contact pronto:

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SCIENCE REPORTS

by Thomas Donaldson, Ph.D.

NALOXONE HELPS BRAIN DAMAGE DUE TO ISCHEMIA

Naloxone was first known, and still is chiefly known, for its effect antagonizing opiate drugs. However as scientists have continued to study the brain, they have discovered that the brain contains its own natural internally produced opiates, the endorphins, which if artificially provided will cause similar effects. Present theories about the endorphins suggest that their chief role is to control our perception of pain; however endorphins may also play a role in adaptation to heat, occurrence of seizures, in shock, and other physiological reactions too. Most important of all from the viewpoint of cryonicists is the possibility that the natural brain opiates, and the receptors for them, may play an important although yet undefined role in the occurrence and nature of brain damage due to ischemia.

Two recent articles in LANCET have highlighted this possibility, and one of these articles has suggested that this role may allow us to cure or treat damage previously thought completely irreversible. In LANCET 18 July two South African doctors, MA Gillman and FJ Lichtigfeld, present some interesting theoretical and empirical suggestions regarding the natural opiates in brain damage. In the first place, when an animal's spinal cord is damaged, it will go into shock. This shock involves a decreased production of catecholamines (a class of brain transmitters, among which are norepinephrine and dopamine). A similar decrease in production of catecholamines happens during brain damage. Since naloxone will help reverse the c shock which occurs after spinal injury, we might try naloxone for brain injury too. Gillman and Lichtigfeld point out also that the endorphins may play a role in consciousness itself, and any condition in which coma occurs may happen, in part, because of an increased production of endorphins and a fall in the production of catecholamines).

In LANCET 8 August (p.272) David S. Baskin and Yoshio Hosobuchi of the University of California San Francisco report their experiences with three brain damage patients to which they gave naloxone. In two female patients each of whom suffered an episode of local brain ischemia, naloxone would completely reverse the paralysis of one side which this episode had produced. In a third patient, for whom ischemia had proceeded to actual death of tissue, naloxone had much less effect, but still seems to have been helpful. Baskin and Hosobuchi also report some of their experiments with gerbils (which have an anatomy which makes them particularly suited for experiments on brain damage). After cutting off blood supply to one half of the brain, survival and recovery of those gerbils who received naloxone was considerably better than that for those gerbils who did not. The natural brain opiates apparently injure the brain by their overproduction; Baskin and Hosobuchi report studies of the chemistry of the receptor molecules in brain tissue after ischemia which show them to be unchanged, so that the damage to the brain must happen because of too much endorphins rather than any change in the response of the brain to these endorphins.

Any cryonicist can of course see that we have a long way to go from ways to improving brain recovery after ischemia by using naloxone to finding ways to make a brain recover at all after one hours total ischemia followed by three days of refrigeration followed by suspension. However naloxone clearly provides an improvement in means of caring for brain damaged patients. We must expect further improvements: "irreversible" is a religious rather than a scientific category.

CENTROPHENOXINE AND CROSSLINKING?

One of the standard measurements of aging consists of the degree of crosslinking of collagen. While the notion that this crosslinking has anything directly to say about aging phenomena no longer has any following, collagen crosslinking remains still a particular example of an age-related change which may parallel other age-related changes in cell DNA or other cell proteins which would be of very much more importance. For instance, Sinex and others have proposed that crosslinking of DNA may play a considerable role in preventing protein synthesis by the aged cells and therefore decreasing their ability to adapt, exactly the change which takes place with aging.

One very gross measure of the amount of crosslinked protein in aged cells consists of measuring the amount of water-solublecompared to total protein in the cells. Some differences exist on how water-soluble protein should be measured, and different measurements give different results. However even with this gross measure of degree of crosslinking, some scientists have found age-related changes. For instance, Naber et al (EXPERIMENTAL GERONTOLOGY 14(1979) 59-63) report finding an age-related decrease in the percent of water-insoluble proteins in human brains, when this percent is measured by one particular technique. In their recent paper, I. Sz-Nagy et al (EXPERIMENTAL GERONTOLOGY 16(3) (1981) 229-240) report results using another technique on the rat brain and liver. Using their technique, Sz-Nagy et al find an age-related decrease in the percent of soluble protein.

Most important of all, they studied the influence of the drug centrophenoxine on this phenomenon. Animals to which they fed 100 mg/kg body weight per day for 4 weeks showed a significant fall in the level of insoluble proteins. This informtion therefore yields some additional support for the use of centrophenoxine or deanol in aging. Other work by the same people has shown that the active substance in both centrophenoxine and deanol, DMAE, is incorporated into the cell membranes and forms an effective scavenger of free radicals.
Although this information is technical, it should interest those immortalists or cryonicists who are known to be taking Centrophenoxine or its US relative, Deaner. The most interesting part of the information, of course, is the suggestion that Deaner and/or Centrophenoxine act upon one of the major changes associated with aging, the degree of protein crosslinkage.

AT LAST A LONGEVITY EXPERIMENT ON VITAMIN E

For a long time the popular press has clamored with the claim that Vitamin E would increase longevity. At the same time knowledgeable immortalists have known that of all the various candidate longevity drugs, Vitamin E may have the least amount of actual experimental support. Support for Vitamin E, in fact, comes from one small abstract by Harman, with statistics, in which it is shown that Vitamin E will increase survival in one strain of mouse by 10%, and will actually decrease the effect of other antioxidants when mixed with them. Unfortunately all of the those who promote Vitamin E for its proposed effects on longevity have not also tended to promote experiments to verify the claim.

Quite recently, however, two English researchers at the University of Leeds have published a paper in which they give complete and detailed experimental data on the effect of Vitamin E upon longevity in two different strains of mice. AD Blackett and DA Hall (GERONTOLOGY 27:133(1981)) report that Vitamin E would indeed increase longevity in at least two different strains of mouse, the C3H/He mouse and the LAF1 mouse; however this increase turns out to be small for both strains, and not entirely supportive of free radical theories of aging.

Blackett and Hall kept 96 mice of each strain and culled both control mice and experimental mice periodically to examine them for diseases, causes of death, and measurement of body weight and the different organ weights. In the earlier period of the experiment, they fed the experimental mice a diet of .25% by weight of Vitamin E, while the others received the normal laboratory chow. In the earlier period of the experiment, their experimental mice definitely survived better than their controls. For instance, their LAF control mice had 3 deaths in the first 20 months and 7 in the first 24 months, while the LAF experimental mice had only 3 deaths in the last 4 months of the same period. When young, control mice did not die of any single particular cause; in the older mice, the Vitamin E supplement decreased the incidence of tumors. The percent of experimental mice developing tumors was 2/3rds that of control mice.

Vitamin E showed no signs of increasing the longevity in the sense of maximum lifespan of the mice, and thus no signs of acting on aging. Survivorship after about 24 months was closely the same in both groups. This information, coupled with the experiments of Kohn in which antioxidants did not increase the longevity of a longlived strain of mouse suggests that Vitamin E is not really an antiaging drug. However these experiments do show a very clear effect of Vitamin E on health and deathrate in the period prior to old age; anyone concerned with means to improve their health might therefore pay close attention. □

Economics of Surrounding a Vacuum Insulated Dewar with Additional Foam Insulation

John Day, Engineering Director
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Trans Time currently owns 5 super-insulated vacuum jacket cryogenic dewars for storage of whole human patients. We may wish to further insulate these dewars with conventional foam (e.g. polyurethane) for at least three reasons:

1. Reduction in expenditure for LN_2.
2. "Belt and suspenders" -- protection against a vacuum failure of a dewar.
3. Protection against mechanical damage from laboratory mishandling, or from an earthquake.

On the other hand, drawbacks to adding foam around these dewars include:

4. Inconvenience of access to dewars surrounded by foam.
5. Reduced aesthetics and loss of visibility of dewars to persons, including the media, who visit the facility.

The last four considerations are too subjective to quantify, so this paper will concentrate on quantifying (1).

We will determine the net present value (NPV in $) of an investment in polyurethane foam surrounding a vacuum insulated capsule, as a function of:

F = cost of installed polyurethane foam $\cong$ \$8.00/ft^3

r = radius of vacuum insulated dewar (ft)

s = outer radius of dewar with added foam (ft), so that

$s - r$ = thickness of added foam (ft)

i = yearly desired return on investment in excess of inflation, compounded continuously $\cong$ .10/yr

u = useful lifetime of foam installation $\cong$ 10 yr

R = facility space rental = $3.63 \frac{\$}{yr\text{-}ft^2}$

h = height of vacuum insulated dewar $\cong$ 8 ft for the dewars we consider

Investment

The cost of the installed foam surrounding a capsule is:

$$I = F\pi h(s^2 - r^2)$$

Discounted Cash Flows

Future cash flows from this project at time t, comprised of increased facility rent and decreased LN_2 expense, must be discounted back to the present by the

factor e^{-it}. Since we will assume these cash flows to be constant (after inflation, which is accounted for in i), the discount factor to be applied over the life of the project is:

$$\int_0^u e^{-it} dt = \frac{1-e^{-iu}}{i} \quad (yr)$$

With the desired 10% return after inflation, the above factor is 6.321. (This factor would simply be 10 yr if we ignored interest).

Rent

The discounted expense of the next u years facility rental space for additional foam surrounding a dewar is:

$$R\pi(s^2 - r^2)\left(\frac{1-e^{-iu}}{i}\right)$$

Steady State Heat Flow

We consider a hollow foam cylinder surrounding the vacuum dewar, with interface temperature T_i and outer (ambient) temperature T_o. Let:

N = cost of LN_2 = $.34 \frac{\$}{\text{liter } LN_2}$

K = thermal conductivity of polyurethane foam

= $.021 \frac{BTU}{hr\text{-}ft\text{-}°F}$ = $184 \frac{BTU}{yr\text{-}ft\text{-}°F}$

T_o = 70°F

T_n = -320°F

b = heat energy for LN_2 to rise from -320°F to estimated escape temperature 32°F

= $170 \frac{BTU}{lb\ LN_2} \times 1.784 \frac{lb\ LN_2}{liter\ LN_2}$ = $303 \frac{BTU}{liter\ LN_2}$

The heat flow through a long, thin wall, hollow foam cylinder is given by:

$$H = K\, 2\pi rh \frac{dT}{dr} \quad \left(\frac{BTU}{yr}\right)$$

$$H \frac{dr}{r} = 2\pi hK\, dT$$

Integrating, we find for the surrounding thick wall hollow foam cylinder:

$$H \ln(s/r) = 2\pi hK(T_o - T_i)$$

Thus:

$$(1)\quad T_o - T_i = H\frac{\ln(s/r)}{2\pi hK}$$

This long cylinder approximation can be partially justified by assuming that the ends of the dewar are well insulated. The fudge factor f below overshadows remaining errors of approximation.

Heat Flow Through Walls of Vacuum Insulated Dewar and Polyurethane Foam

We let:

L = liters LN_2/yr consumed by the vacuum insulated dewar

$$f_{udge} = \frac{LN_2 \text{ loss through sides of dewar}}{\text{total } LN_2 \text{ loss}}$$

For the dewars we consider, we will estimate $f \cong .75$. This guesstimated value should be replaced by a calculated or measured value in a more precise treatment.

The heat flow through the sides of a vacuum insulated dewar is given by:

$$H_o = Lfb$$

Since the heat flow is proportional to the temperature difference, after adding foam to surround the vacuum jacket we will have:

$$\frac{H_o}{T_o-T_n} = \frac{H}{T_i-T_n}$$

$$(2)\quad T_i - T_n = H\frac{T_o-T_n}{Lfb}$$

Adding equations (1) and (2), we obtain:

$$T_o - T_n = H\left[\frac{\ln(s/r)}{2\pi hK} + \frac{T_o-T_n}{Lfb}\right]$$

so that:

$$(3)\quad H = \frac{1}{\frac{\ln(s/r)}{2\pi hK(T_o-T_n)} + \frac{1}{Lfb}}$$

The discounted cost of the next u years of liquid nitrogen is:

$$\frac{N}{b}\left(\frac{1-e^{-iu}}{i}\right)\left[\frac{1}{\frac{\ln(s/r)}{2\pi hK(T_o-T_n)} + \frac{1}{Lfb}}\right]$$

Net Present Value of Investment in Polyurethane Foam

Adding up the nitrogen savings, rent cost, and foam investment terms from above, we see that:

$$(4)\quad NPV = \frac{N}{b}\left(\frac{1-e^{-iu}}{i}\right)\left[Lfb - \frac{1}{\frac{\ln(s/r)}{2\pi hK(T_o-T_n)} + \frac{1}{Lfb}}\right] - \pi(s^2 - r^2)\left(R\,\frac{1-e^{-iu}}{i} + Fh\right)$$

This equation leaves the two parameters r and L to describe a particular dewar, plus one parameter s to be optimized. In order to maximize the net present value of our investment in foam, we set:

$$0 = \frac{\partial NPV}{\partial s} = \frac{N}{b}\left(\frac{1-e^{-iu}}{i}\right)\left[\frac{1}{\left(\frac{\ln(s/r)}{2\pi hk(T_o-T_n)} + \frac{1}{Lfb}\right)^2 2\pi hK(T_o-T_n)s}\right] - 2\pi s\left(R\,\frac{1-e^{-iu}}{i} + Fh\right)$$

Thus:

$$s\left[\ln(s/r) + \frac{2\pi hK(T_o-T_n)}{Lfb}\right] = \left[\frac{N}{b}\,\frac{hK(T_o-T_n)}{R + Fh\,\frac{i}{1-e^{-iu}}}\right]^{\frac{1}{2}}$$

Substituting the assumed values of the parameters, we obtain:

$$(5)\quad s\left[\ln(s/r) + \frac{15873}{L}\right] = 6.843$$

We proceed to solve equation (5) for the optimal outer radius s for three of our extant vacuum dewars. After substituting values of r and L, this equation is most rapidly solved by the Newton-Raphson iterative method. In the course of inventing the calculus and describing the System of the World in Philosophiae Naturalis Principia Mathematica, Sir Isaac found time to show a method for solving $f(x) = 0$. We make an initial guess x_1, and iterate:

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$

until the x_n's converge.

Applied to equation (5), this procedure yields:

$$s_{n+1} = \frac{s_n + 6.843}{\ln(s_n/r) + 15873/L + 1}$$

Starting with an initial guess $s_1 = 2r$, this algorithm yields s correct to 5 decimal places (several more than the data justifies) in only two iterations, which are easily carried out on a hand calculator.

Note that after we have solved equation (5) for the optimal s, equation (2) after some manipulation simplifies to:

$$(6)\quad T_i = 904500\left(\frac{s_{opt}}{L}\right) - 320$$

and equation (4) simplifies to:

$$(7)\quad NPV_{opt} = 1.612\,(L - 2319\,s_{opt}) - 273.1\,(s_{opt}^2 - r^2)$$

Andonian

$L = 6575$ liters/yr

$r = 1.042$ ft

Equation (5) becomes:

$$s[\ln(s/1.042) + 2.414] = 6.843$$

The solution is:

$s_{opt} = 2.173$ ft

$s_{opt} - r = 1.131$

$T_i = -21.1°F$

$NPV_{opt} = \$2476 - \$993 = \$1483$

This shows that insulating the Andonian capsule is a worthwhile project, unless there are competing investments with a greater NPV.

Minnesota Valley Engineering #1

$L = 4018$ liters/yr

$r = 1.292$ ft

Equation (5) becomes:

$$s[\ln(s/1.292) + 3.950] = 6.843$$

The solution is:

$s_{opt} = 1.635$

$S_{opt} - r = .343$

$T_i = 48.1°F$

$NPV_{opt} = \$365 - \$274 = \$91$

It is hardly worth the effort to add foam insulation to this capsule for a $91 saving over a ten year period, and this calculation further confirms that it is hard to improve on an MVE unit.

CryoFab

$L = 26718$ liters/yr

$r = 2.750$ ft

Because of the large volume of this dewar, we can take advantage of reduced prices for bulk delivery of LN_2, reducing N from $.34 to $.17 per liter. This reduces the right side of equation (5) by a factor of $(17/34)^2 = .7071$, yielding:

$$s[\ln(s/2.750) + .5941] = 4.839$$

The solution is:

$$s_{opt} = 4.476 \text{ ft}$$

$$S_{opt} - r = 1.726$$

The first term in equation (6) must be divided by .7071. The first constant in equation (7) must be multiplied by .5, and the second constant must be divided by .7071, yielding:

$$T_i = -105.7°F$$

$$NPV_{opt} = \$9705 - \$3406 = \$6299$$

The subpar performance of the CryoFab dewar shows clearly that when we are ready to place it into service, we should add additional foam insulation.

Robert Ettinger (May 1971 Immortalist, and personal communication) states that from his own experience, formulas describing heat flow through thin foam insulation cannot be extrapolated to thick foam insulation. He offers the rule of thumb that returns diminish rapidly at about 1 ft of foam insulation.

Since apparently most of his experiments treated the case where one side of the foam was cooled to cryogenic temperatures, it is not clear how they relate to our proposed foam installation. For the Andonian capsule with calculated foam thickness of 1.131 ft and $T_i = -21.1°F$, addition of 1 ft of foam should be close to optimal. For the CryoFab capsule with calculated foam thickness 1.726 ft and $T_i = -105.7°F$ (which we are unlikely to achieve in our actual foam installation), we should probably also reduce the installed foam thickness to about 1 ft. Cracks in the foam created by the difference in the amount of contraction at T_i versus T_o, and by the method of foam installation itself, will likely reduce its resistance to heat flow well below our calculated value. □

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