

CRYONICS

MAR / APR 2004 A PUBLICATION OF THE ALCOR LIFE EXTENSION FOUNDATION Volume 25:2

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The promise of human cryopreservation
at Alcor Life Extension Foundation

ISSN 1054-4305
\$7.50

“What is cryopreservation?”

Cryopreservation (cryonics) is the ultra-low-temperature preservation (biostasis or cryostasis) of patients who cannot be maintained in a normal, living state by present-day medical practice. The goal is to move these patients into the future (with as little further damage as possible), to a time when cell and tissue repair technology far beyond today’s capabilities are readily available, and where a more comprehensive evaluation of these patients’ chances can be made, where restoration to full function and health may be a realistic possibility. In principle, this is no different from bringing a seriously ill person out of the jungle and to a modern hospital. Applied to cryotransport, the concept is that the only way “out of the jungle” is to travel forward in time. The “modern hospitals” we need can be reached only by traveling decades into the future.

As human knowledge and medical technology continue to expand, people who today are considered hopeless will be easily restored to health. Throughout history, this has been the hallmark of medical progress. Rapidly evolving control of biological and molecular structures promises to soon permit the synthesis of medical devices far smaller than living cells. Through molecular repair, these devices should be able to eliminate virtually all of today’s diseases and allow us to intervene in the aging process, ultimately “curing” and eliminating it. These technologies will also allow us to attempt the repair and recovery of patients waiting in cryostasis. The challenge for us today is to devise techniques that will give these patients the best chances for survival.

“How do I find out more?”

The best source of detailed introductory information about cryotransport is *Alcor Life Extension Foundation: An Introduction* (published December 2001). At 100 pages long, *ALEFI* presents an engaging examination of the social, practical, and scientific arguments that support the continuing refinement of today’s cryotransport techniques in pursuit of a perfected “suspended animation” technology.

ALEFI features chapters on the possibilities in nanomedicine; society’s views of dying throughout the ages; the history of cryonics; the mutability of death; the mechanics of rescue operations, cryonic suspension, and vitrification; the science of molecular engineering; religious and ethical issues surrounding cryonic suspension; key psychological issues faced in the decisionmaking process regarding cryosuspension and advice on how to resolve them; frequently asked questions and answers; and how to join Alcor. Price: \$10.00. Visit our web site at www.alcor.org or contact our front office at 480-905-1906, ext. 113, to order.



For those considering Alcor Membership. . .

Cryonics is published four times a year by Alcor Life Extension Foundation. The magazine is an important benefit of membership and is mailed to all members. Read about the latest findings from cryonics experts, keep up with happenings at Alcor Central, and learn about special events and conferences in cryonics and related fields.

Alcor’s toll-free number for membership inquiries or donations is: 1-877-GO-ALCOR. For other services, call 1-480-905-1906. For inquiries and member services, contact Membership Administrator Jennifer Chapman at jennifer@alcor.org.

Don’t miss a single issue of *Cryonics*—BECOME A MEMBER TODAY!



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Alcor: The Origin of Our Name

In September of 1970 Fred and Linda Chamberlain (the founders of Alcor) were asked to come up with a name for a rescue team for the now-defunct Cryonics Society of California (CSC). In view of our logical destiny (the stars), they searched through star catalogs and books on astronomy, hoping to find a star that could serve as a cryonics acronym. *Alcor*, 80 Ursae Majoris, was just what they had been looking for. It not only had some acronymic “fit” for cryonics but was also symbolic for its historical 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 5th magnitude, barely within the threshold of human vision. Additionally, it is quite close to Mizar from an angular standpoint, and dimmer. Only with excellent vision 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, few people could see the need for a rescue team or even 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*. The Chamberlains could have forced a five-word string, but these three seemed sufficient. *Allopathy* (as opposed to *Homeopathy*) is a medical perspective wherein *any treatment that improves the prognosis is valid*. *Cryogenic* preservation is the most powerful method known to halt the rapid, entropic disorganization of people following clinical death. *Rescue* differentiates a cryonics approach from

(yet to be developed) proven suspended animation. The acronymic 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 would not support or even tolerate a rescue team concept. Less than one year after the 1970 dinner meeting, the Chamberlains severed all ties with CSC and incorporated the “Rocky Mountain Cryonics Society” in the State of Washington. The articles and bylaws of this organization specifically provided for “Alcor Members,” who were to be the core of rescue team activity. Difficulties in securing nonprofit status in Washington then led to reincorporation in California, this time under the name “Alcor Society for Solid State Hypothermia.” In the late 1970s, 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 and perhaps to attain it... to *see* Alcor for what it really is: a vehicle with which to attempt that fantastic voyage!

—Reprinted from *Cryonics*, August 1984.



Cryonics

is a bi-monthly publication of the
Alcor Life Extension Foundation

Editor
The Alcor Staff

Volume 25:2

Mar/Apr 2004

ISSN 1054-4305

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Visit us on the Web at www.alcor.org

How to Join Alcor

Your research is finally complete. You browsed our web site (www.alcor.org), presented your questions to our Membership Administrator (jennifer@alcor.org), and toured our facility. Now you are ready to establish your membership with Alcor Foundation. Congratulations and welcome!

Upon receipt of your completed application for membership and application fee, Alcor will send you various membership documents (samples available upon request). After reviewing these documents, you will need to execute them in the presence of two signing witnesses. Perhaps a representative of your local bank can notarize the single document that also requires this official witness. After returning all of your documents to Alcor for approval, you can expect to receive one original copy of each for your personal records.

Most people use life insurance to fund their suspension, although cash prepayment is also acceptable. If you do not already have an insurance policy, Alcor recommends that you apply for

one at your earliest convenience, as the underwriting process can last several weeks. Jennifer Chapman, Alcor Membership Administrator, can provide you with a list of insurance agents who have previously written policies for this purpose. These agents can assist you with satisfying Alcor's various funding requirements, such as naming Alcor as the owner and irrevocable beneficiary of your policy and ensuring that your benefit amount is sufficient.

With your membership documents completed and your funding approved by Alcor, you will be issued emergency identification tags engraved with your personal Suspension Number. This is your confirmation that Alcor will provide you with suspension services, should our emergency technicians ever receive a call on your behalf. Certainly, Alcor hopes that you will not need our services anytime soon, but as a member of Alcor you can feel confident that our organization will care for you and your future. Please call 480-905-1906 ext. 113 today to request your application.

TO ALL ALCOR MEMBERS AND THOSE IN THE SIGN-UP PROCESS

Please! Please! Please!

When you move, or change phone numbers (work number as well), change e-mail addresses, or undergo any medical procedure where general anesthesia is used, please inform us as far ahead of time as you can.

Too many times we have tried to contact our members and found out the contact information we have is no longer valid.

Other times we find out well after the fact that a member has undergone a medical procedure with life threatening potential.

*Help us to serve you better!
Keep in touch!*

CryoPreservation Case Report:

Patient A-2059

by Todd Huffman and Tanya Jones

Patient A-2059 first contacted Alcor about the sign-up process in early December of last year. His wife was encouraging him to arrange for his cryopreservation, as he had a terminal form of stomach cancer that was proving increasingly difficult to treat. In 1999, he had a total gastrectomy, and his cancer went into remission until 2003. By the time they contacted us, the cancer was inoperable, and his health was deteriorating rapidly. Shortly after completing his arrangements, the patient came to Scottsdale for a visit. He toured the lab in a wheelchair, as his strength was significantly reduced from his battle with the cancer. His wife pushed, and they both asked a few questions before leaving to examine nearby hotels.

They moved to Scottsdale from the southern California region approximately one month before the terminal event. While in Scottsdale, the patient was introduced to a hospice that regularly works with Alcor and seen by a local physician. In this early period, the patient and his wife traveled between Arizona and Southern California several times to visit with friends and family.

During the planning stages of this case, Alcor's relationship with the local hospice was tested and refined in several key areas. Clarifications were needed on both sides with regard to what information is provided to a potential patient and what those patients will typically expect when interacting with hospice personnel. Among the specific issues discussed were: what medical procedures Alcor would like to see implemented by the hospice and which of those the hospice is actually able to provide; what Alcor could do to make the hospice workers more comfortable with our procedures; clarification of financial responsibilities and medical arrangements on the part of Alcor or the patient; and a general agreement that hospice personnel will be included in case planning sooner. While this planning will help Alcor's members in future suspensions, they were not particularly useful to A-2059, as he ultimately did not spend his final days in their care.

The patient was seen periodically by the hospice staff and physicians, but never quite settled enough to be admitted for 24-hour care. In early March after consulting with their doctor, he and his wife decided to make one last return home to provide comfort and closure prior to admission. Balancing the requirements for cryonic suspension and personal comfort is often a difficult issue for members as their health declines, since it is natural for people to want to be at home, surrounded by family and friends at that time; but such measures are complicated when a patient chooses to optimize the cryopreservation circumstances by relocating. Compounding the issue are the difficulties in ac-

curately predicting the state of someone's health, an imprecise art for even the most astute of physicians. This final trip to LA proved to cause problems for this patient.

After making the long drive from Phoenix to the Los Angeles area, our patient suffered cardiac arrest in his sleep during the night of his return. The exact time of death is not known, but post-case analysis indicates 8 in the morning (all times are in Arizona time) is a reasonable estimate. At approximately 10:00 AM, the patient was discovered by his wife, who promptly called both 911 and Alcor.

By 10:40 the police and ambulance services had been to the home. The patient's wife informed them of her husband's cancer and his desire to be cryopreserved; and they determined resuscitation measures were contraindicated. Shortly thereafter, Tanya was informed by the LAPD the death would be ruled a natural one, bearing no additional risk of autopsy. The patient's physician was extremely helpful and agreed to sign the death certificate immediately upon presentation, with time of death listed at 09:11 PST. Because the patient's physician and family were well informed on Alcor's procedures, many unnecessary and damaging delays were avoided.

In accordance with instructions from Alcor, the patient's wife placed ice around the head of the patient. A temperature reading was taken prior to the administration of the ice, but when the patient's wife failed to get the probe under the tongue, an axillary temperature was taken and found to be 31.6 degrees C.

While communication with the LAPD and the patient's physician was taking place, the team leaders of the Southern California Transport Team were contacted and dispatched to the patient's home. Preparedness was high, given the existence of another pending case in the area. The team arrived at approximately 12:48 and immediately obtained intravenous jugular access on the patient to allow for the administration of stabilization medications. The first set of medications was introduced into the patient, and then he was transferred into the ice bath for surface cooling and a round of chest compressions. The next set of medications was delivered; and by 14:00, the patient was transferred into the van.

The decision was made to bring the patient directly to Phoenix. In past cases there have been positive results in driving directly to Alcor, rather than exposing the patient to the complications and delays associated with remote washout. Performing a field washout in the LA area has been known to delay transport significantly (on the order of double digit numbers of hours), so driving straight through was considered to be an attractive option.

Timelines and Overview

| Time | Significant Times | Time since pronouncement | |
|----------------|---------------------------------|--------------------------|-------|
| 3/3/2004 ~8:00 | Estimated cardiac arrest | -2:11 | h:min |
| 10:11 | Pronouncement | 0 | h:min |
| 12:50 | Medications Started | 2:39 | h:min |
| 13:54 | Medications Complete | 3:43 | h:min |
| 13:00 | Surface Cooling Started | 2:49 | h:min |
| 13:05 | Cardiopulmonary Support Started | 2:54 | h:min |
| ~14:00 | Transport Started | 3:49 | h:min |
| 21:19 | Transport Complete | 11:08 | h:min |
| | | | |
| 23:19 | Blood washout started | 13:08 | h:min |
| 23:40 | Washout complete | 13:29 | h:min |
| 23:40 | Cryoprotection started | 13:29 | h:min |
| 3/4/2004 08:40 | Cryoprotection complete | 22:29 | h:min |

| Cryoprotection Data | | |
|----------------------------------|-------|-------|
| Target concentration | 49.4 | brix |
| Final concentration, R Jugular | 49.6 | brix |
| Final concentration, L Jugular | 50.1 | brix |
| Perfused at target concentration | ~3:45 | h:min |



| Temperature History | | |
|----------------------------|---------|-------|
| Initial temperature, °C | 31.6 | °C |
| Time until first 10° drop | unknown | |
| Time until first 100° drop | 26:52 | h:min |
| Time until -196° | ~110:00 | h:min |

| Significant times | | | and differences | | |
|------------------------------------|-------|-------|--------------------------------|------|-------|
| Arrest until notification of Alcor | ~2:00 | h:min | | | |
| | | | Notification until acquisition | 2:50 | h:min |
| Arrest until patient acquisition | 4:50 | h:min | | | |
| | | | Acquisition until transport | 1:00 | h:min |
| Arrest until transport | 5:50 | h:min | | | |
| | | | Transport until arrival | 7:19 | h:min |
| Arrest until arrival | 13:09 | h:min | | | |
| | | | Arrival until start of surgery | 0:31 | h:min |
| Arrest until burr holes started | 13:40 | h:min | | | |
| | | | Burr holes until ramp | 2:20 | h:min |
| Arrest until ramp started | 16:00 | h:min | | | |

Surgical Timeline

| | |
|-------|--|
| 21:19 | Remote team arrives at Alcor |
| 21:23 | Patient transferred from van to surgical table |
| 21:25 | Patient prepared for surgery |
| 21:49 | Bur holes in place |
| 22:05 | Surgeon prepares makes initial neck incisions |
| 22:22 | Left carotid isolated |
| 22:27 | Incisions made on right side |
| 22:35 | Right carotid isolated |
| 22:41 | Right artery cannulated |
| 22:43 | Left artery cannulated |
| 22:52 | Neuro separation begun |
| 23:09 | Separation complete |

Bypassing field washout is an option only feasible for areas reasonably close to Alcor, where it may be faster to transport than to establish remote surgical facilities.

The paperwork was being processed in parallel with the field team. As expected, the doctor declared the death a natural one and signed the paperwork promptly, and our local mortician was brought on to assist in the processing of the transit permits.

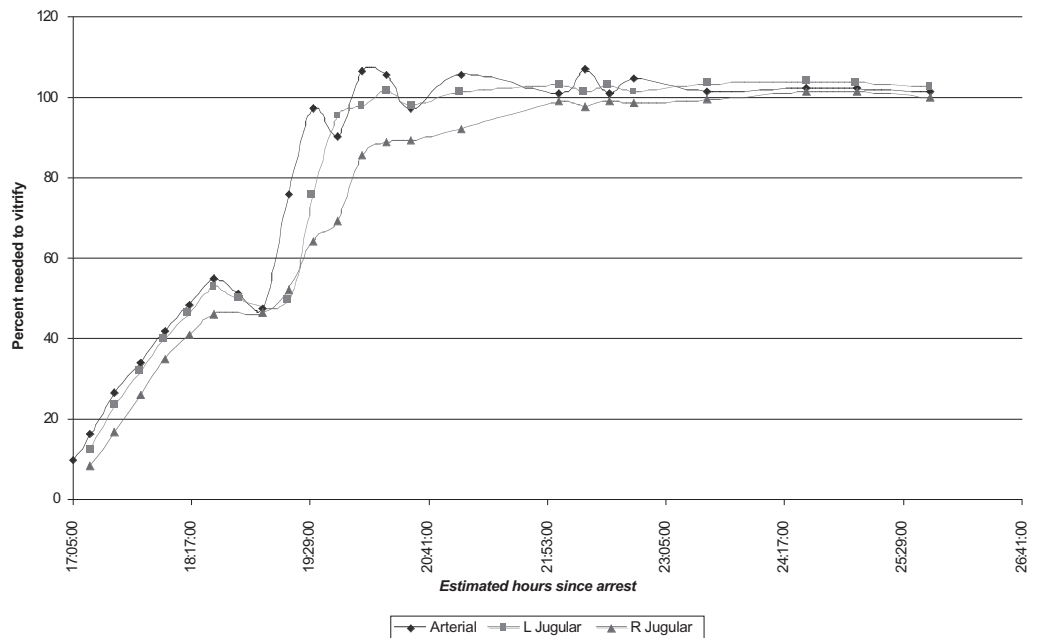
On the procedural side, the temperature recording equipment fell into the ice bath and got wet during transport, which caused it to malfunction and lose temperature data. The equipment is in a water resistant case, but is not immune to total submersion. Other than this one problem, the transport went smoothly given the circumstances.

Arrival at Alcor

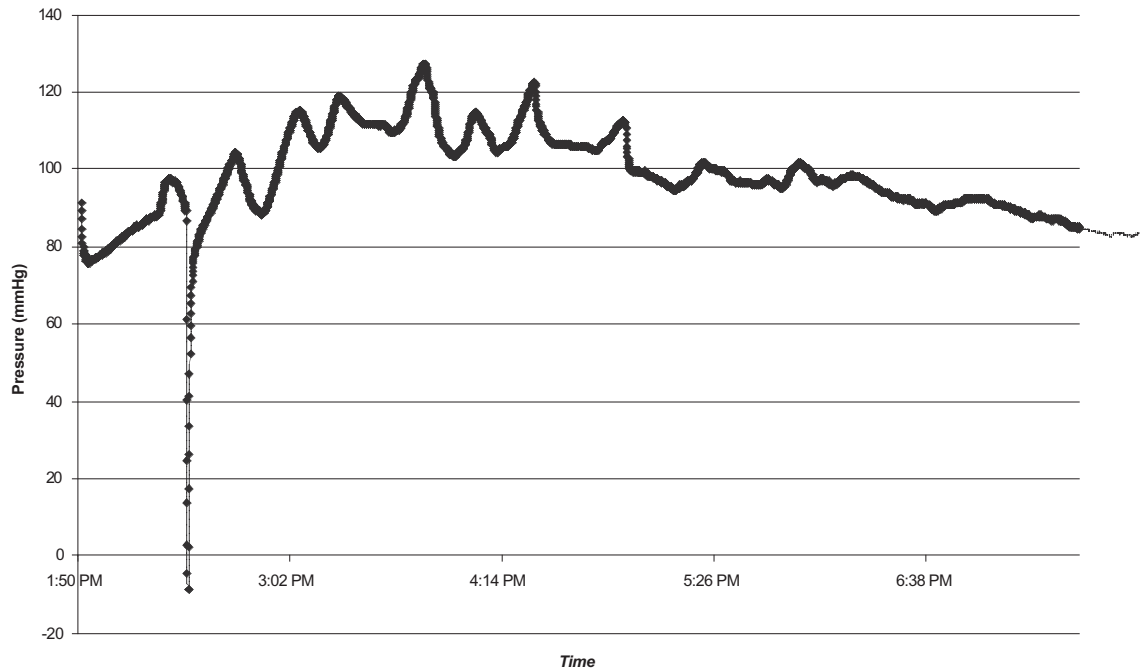
The team arrived at Alcor at 21:19, and the patient had cooled to a nasopharyngeal temperature of 6 degrees C. The patient was on the table and being prepped for bur holes at 21:29. Alcor has since improved its speed in getting patients from the ambulance and into the operating room substantially over the last several cases, often difficult because of the number of people and pieces of equipment that must be synchronized. Further work needs to be done to streamline the process, especially in coordinating the patient’s estimated time of arrival with the operating room staff.

Operating room procedures started with the transfer of the patient from the portable ice bath to a bed of bagged ice atop the surgical table. Surgical sites on the head and neck were prepared with betadine, the head shaved and cleaned, and bur holes opened. The surgeon isolated the carotid arteries, inserted perfusion

A-2059 Cryoprotection



A-2059 Perfusion Pressure



nula, and secured them to the site. The left artery was abnormally small, and the cannula had to be switched to a smaller size.

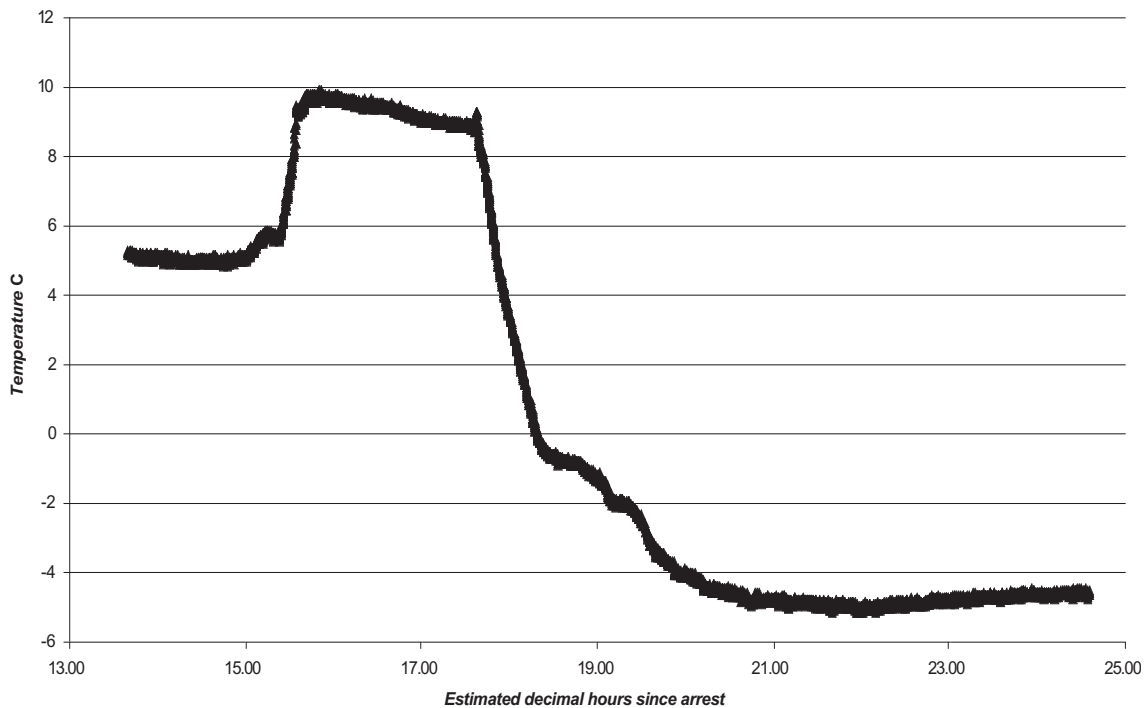
Once the vessels were secured the surgeon performed the neuro separation and placed the patient in the cephalon enclosure. Once the perfusion was initiated, a temperature sensor and crack-phone elements were inserted between the dura and the skull to facilitate later monitoring.

The perfusion revealed several sub-optimal conditions, most

likely due to the delay between cardiac arrest and the administration of Alcor's medication protocol. Indications of damage included the observation of several small clots, higher than average vascular resistance, and asymmetrical brain shrinkage.

Clots were first observed being flushed from the left vertebral artery, and later from the right vertebral artery. The clots were small, approximately the size of pin heads. Clots form if a patient does not receive the 'clot busters' and anticoagulants in

A-2059 Perfusion Temperature



Perfusion Timeline

| | |
|-------|--|
| 23:12 | Patient placed inside cephalon enclosure |
| 23:19 | Cannula connected to circuit and washout begun |
| 23:23 | Several small clots observed from left vertebral artery |
| 23:24 | Several small clots observed from right vertebral artery |
| 23:31 | Thermal probes and sample sites secured in veins |
| 23:34 | Vertebral arteries clamped |
| 23:46 | Thermal probe and crack-phone elements placed between dura and skull (right inserted 3", left inserted 5") |
| 23:55 | Washout complete, circuit closed, and ramp started |
| | Washout length: 9 minutes |
| 23:58 | Nasopharyngeal temperature 10 degrees C |
| 4:00 | Target concentration reached in left jugular effluent |
| 6:30 | Target concentration reached in right jugular effluent |
| 8:40 | Perfusion ended |

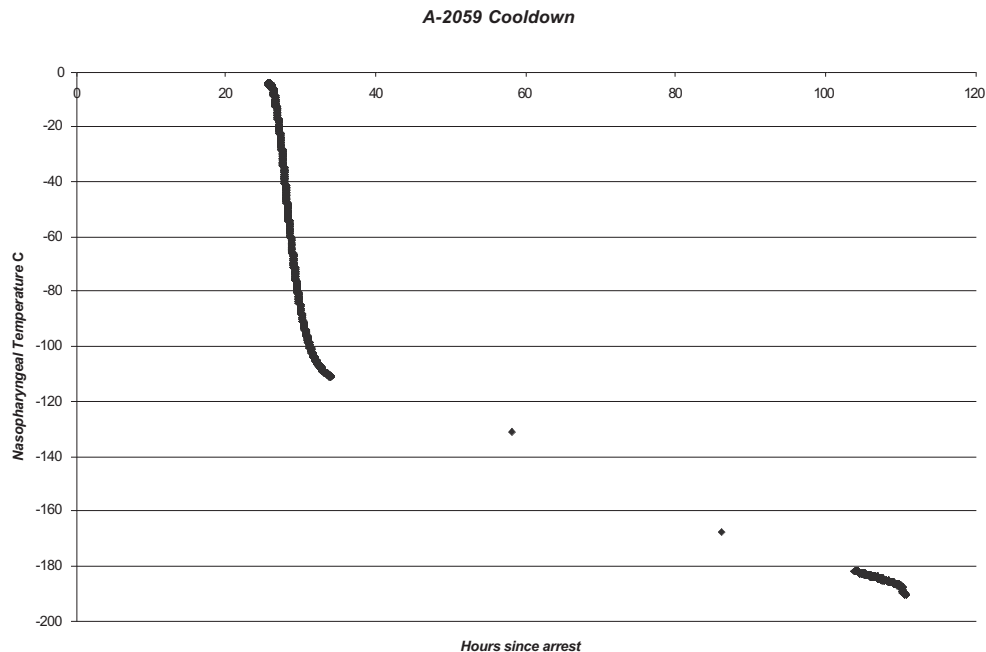
canAlcor’s medication protocol in a timely manner. Even when clot busters are administered later the blockages in flow reduce their effectiveness.

The vascular resistance of a patient can be inferred by looking at the pump speeds and pressures needed to achieve adequate flow rates. A normal pressure used in suspensions is around 110 mmHg, and in this case it was necessary to raise the pressures to above 120 mmHg on several occasions. The vascular resistance of a patient varies because of a large number of variables, ranging from atherosclerotic plaques to ischemic oxidation of vessels. The initial temperature at which the cryoprotectants are introduced is 10 degrees C, which is why the patient’s temperature can be seen to have increased several degrees. Based on results from the sources discussed it is believed the patients left hemi-

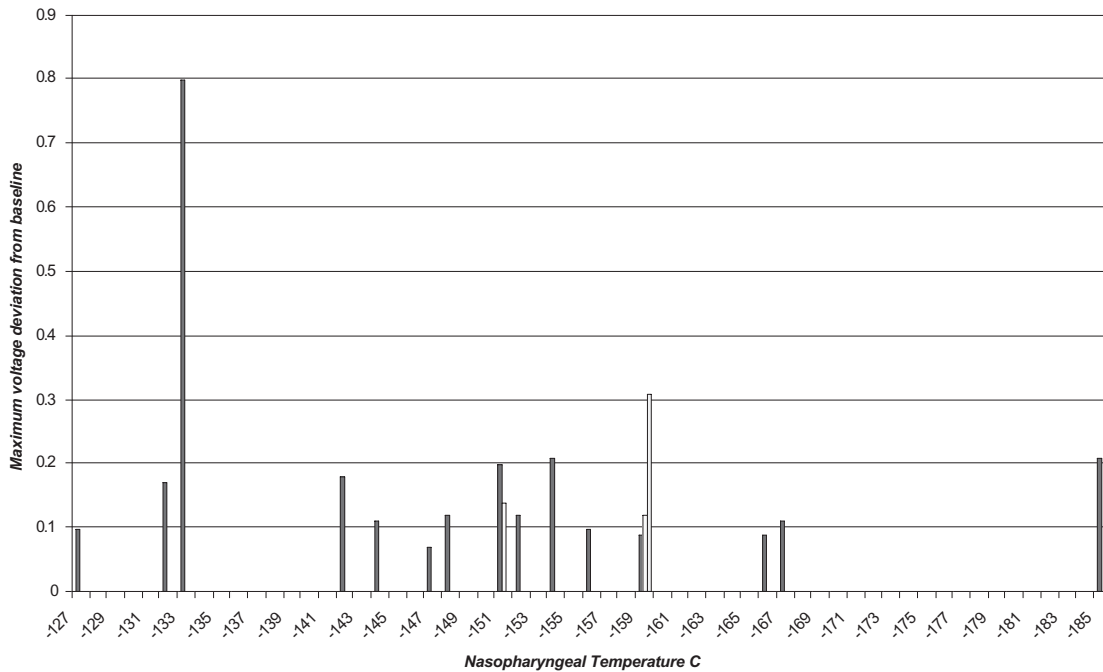
sphere perfused better than the right. This belief is supported by the qualitative observation of temporary edema on the patient’s right hemisphere, which later shrunk to expected levels

The patient entered cooldown at 09:25 on March 4, 2004. Cooldown was carried out using the standard protocol, which was a plunge to -110 degrees C, then a hold for a period of time, followed by a 1 degree/hour temperature descent to -196 degrees C. This procedure was performed by R. Michael Perry, who directed the entire cooldown process.

Another significant loss of recorded data occurred during this cooldown. A power supply failure caused temperature records to be lost between saves. An electric device was plugged into the uninterruptible power supply supporting the cooldown equipment and overloaded the system, causing a breaker to be thrown.



*Time of arrest estimated



Since the procedure was being monitored, this failure affected the computer only temporarily, and did not affect the patient’s condition. However, safeguards have been put into place to prevent further power disruption. Patient temperature data is recorded using two methods, and the missing points reflect the computer failure during the cooldown. Mathematical analysis of the remaining data suggests the cooldown equipment followed the desired curves, a belief which is supported by Mike Perry’s manual temperature recordings.

Eighteen acoustic fracturing events were recorded, which is on the high side of the normal range for a case of this type. The first event occurred at -127 degrees C and the final event occurred at -185 degrees C. In the graph above, the Y axis indicates the maximum voltage the acoustic event caused the crack-phone element voltage to deviate from baseline; and the X axis indicates the temperature at which the events were observed.

Once the patient arrived at the boiling temperature of liquid nitrogen, he was transferred to long-term storage in one of our Bigfoot dewar. Transfers all occurred without incident, and the patient now rests in liquid nitrogen with fellow cryonicists.

“Indications of damage included the observation of several small clots, higher than average vascular resistance, and asymmetrical brain shrinkage.”



Surgical team prepares patient for cryoprotective perfusion.

SPECULATIONS: Post-Cryopreservation Mentation

By Russell Sinclair Grove

Introduction.

What are the thought processes of an immortal? With the advent of arguably feasible cryonic suspension, that question is becoming increasingly more practical and less academic. The issue, of course, is the mental health of the potentially revived patient in the future. That future, if it is ever to exist, likely will provide indefinite life spans to the general human population.

It is important to acknowledge that an *indefinite life span* does not equate to an *eternal life span*. Nothing lasts forever. Even the universe itself must eventually die. Entropy cannot be reversed. What cryonic suspension attempts to achieve is the realization of a very long life span, supported by nanotechnological and other devices and processes and measured in thousands, or tens of thousands, or greater numbers, of years. For all practical purposes, that very long life span must be deemed to constitute immortality. Anything else lies in the realm of the supernatural.

Individuals born into the post-revitalization environment will never view the prospect of death (which doubtless will continue to exist as a function of accident or voluntary selection or, as noted above, the inevitable end of everything) in the same way as the population of our current world. The future population necessarily will be comprised of three classes:

- (1) Those born into the (relatively) deathless environment;
- (2) Those who were in life at the time of the critical technological advance that made indefinite life spans generally available and who transitioned into the deathless environment, more or less seamlessly; and
- (3) Those who were in cryonic suspension at the time of such advance and who were revived into the deathless environment.

In the deathless environment of such a future, those in the third class — the revivees (as hereinafter referenced) — are likely to be a tiny segment of the overall population. Current anecdotal experience with cryonic suspension indicates that only a very small proportion of the general population has any interest in personally pursuing the opportunity for cryopreservation. This may be based on a number of reasons, including a discomfort with any detailed consideration of actual personal death or a dissatisfaction with the prospect of eventual relief from any worldly concerns. Whatever the reasons, the total population in cryonic suspension at any point in the future probably will be minimal,

given current trends. These trends, of course, may dramatically reverse upon the first highly-publicized successful revitalization from a frozen or vitrified state of an experimental animal subject.

As is readily apparent, of the three classes of the hypothetical future population postulated above, only the third class — the revivees — *will have had to experience personal death in order to achieve (through revitalization) an indefinite life span*. This factor arguably may fundamentally alter the world view of the third class vis-a-vis that of the other two classes.

In what way is the world view of the revivees likely to differ from that of the general population?

First, the revivees may place a greater subjective and objective value upon life, particularly if routine restoration of life is available in that future environment (which might foster, for instance, a culture of risk-taking and extreme activities atypical of an existence wherein such events hazard irreversible death).

Secondly, the revivees may face greater challenges in the utilization of the indefinite life span, as functions of its simple alienness and of its complexities of choice.

Finally, the revivees may experience lingering (albeit hopefully low-intensity) anxiety because of the expectations of the Judo-Christian work ethic prevailing in the environment from which the revivees originated.

All of these considerations likely will place stress upon the mental state — including the emotional health — of the revivees, at least during the initial years of revitalized life. With the passage of time, of course, may come familiarization, reconciliation and intellectual acceptance. Of concern is the immediate post-revitalization period, when the revivees' mental and emotional equilibria may be most disturbed. Analysis is indicated because of the possibility that current philosophical understanding and acceptance by potential revivees may lessen future impact and, therefore, difficulties of adjustment. The first two classes of the future population described above, of course, either will have known only a deathless existence or will have had adequate time to adapt to that prospect. Only the revivees will be thrust into an alien and disorienting environment, and present contemplation of the ramifications of an indefinite life span may lessen the trauma of adaptation.

An apt analogy may be found in the evolution of the Civil Rights Movement in the United States. Martin Luther King, Jr. and his associates struggled for many years, often at great personal risk, to win the rights now enjoyed by all. The remaining members of that original activist group appreciate, at a very fundamental level, the magnitude of the victory won in those years past. The current youth in that community, however, do not view

those hard-won achievements as matters for acclaim and celebration. Rather, the rights so gained are now viewed as part of the normal fabric of society, not worthy of special consideration. While familiarity may not have bred contempt, it certainly has engendered indifference. The revivees may find themselves generally perceived in much the same manner as the old Civil Rights warriors are sometimes regarded by members of the modern generation – irrelevant and perhaps a bit tiresome.

The Civil Rights analogy contains an element of caution for the revivee. To function most efficiently in the future world, the revivee should strive to resolve the intellectual issues internally, within the secret places of the heart and mind, rather than by confrontation with or proselytizing of those of the population who never knew death. The key concern of the revivee, at a practical level, must be survival, and that implies adaptation. The philosophical reconciliation of the revivee's state of mind should be a personal, not public, challenge. The revivee should feel no obligation, real or perceived, to convert everyone or anyone to an appreciation of the true magnitude of the accomplishment of overcoming death as an inevitability of life.

So far as is known, no scientific or rigorous method of analysis to date has been applied to the potential issue of the revivee mindset. Arguably, the issue is not even subject to such analysis because of its essential philosophical nature as applied to a situation for which no experiential data exist. Therefore, anecdotal information and reasoning by analogy may be instructive in pursuing a consideration of the factors bearing upon the anticipated state of mind of presumed revivees.

There are several available sources from which illumination may be drawn. While the problems of extended or indefinite human life (as distinguished from supernatural eternal life) have not been seriously considered within either philosophy or the social sciences (so far as is known), religious tradition, folklore and literature do offer some treatments. Rational analysis also may offer insight.

Religion.

While the beliefs and traditions of the Abrahamic religions based on the sacred texts of the Middle East (that is, Judaism, Christianity and Islam) do not contemplate indefinite human life span as an element of worldly existence subsequent to the Fall of Man, there is an acceptance of greatly extended human life spans and indefinite life spans for beings other than human.

Examples of the first category include the patriarchs of the Old Testament. While exaggeration and translational inaccuracy doubtless play some role, from the content of the text apparently life spans of many hundreds of years were not considered unusual in ancient times. (There have been suggestions in the literature that the Old Testament tradition of such prolonged life spans – for instance, that of Methuselah, Lamech and Noah – may echo an actual distant recollection and misunderstanding of a neolithic resurrection cult, independent of the more orthodox acceptance of eternal physical life prior to the Fall.) The

later evocations of a life span limited to “three score and ten” years (such as Psalms 90: 9 - 10) seem more a lamentation than a proscription.

Examples of the second category include the presumed visitations of, *inter alia*, angelic messengers and agents. Particularly in the Old Testament (somewhat less so in the New Testament and the Qur'an), interactions of these supernatural immortal beings with humankind were not considered unusual. Indeed, in the Ethiopic *Book of Enoch*, there are indications of other classes of beings — the “Watchers” and their offspring, the Nephilim — arguably neither supernatural nor human but possibly possessed of indefinite or greatly extended life span.

The *Book of Enoch* is not a portion of the Bible proper, as it came to be constituted in the early centuries *anno domini*, but nevertheless is closely associated with it as Apocrypha and as established by the Qumran scrolls — and Enoch himself is a biblical figure. In the Bible itself, the “sons of Anak” (Numbers 13:33) are an echo of this tradition, which is supported by independent sources, most notably Sumerian and Babylonian tradition, such as the *Epic of Gilgamesh*. All of these sources appear to reflect memories of catastrophic physical events in pre-diluvial times, currently estimated at roughly 7640 BCE on the basis of predicated conventional geological evidence. Interestingly, lands in the far north, between 50°N and 60°N, as interpreted from data in the *Book of Enoch*, are implicated in these traditions.

The principle focus of the sacred texts associated with these religions, of course, is the relationship between humankind and God, including the anticipation of a supernatural eternal life (for good or ill, depending upon the qualities of the individual), rather than any extended consideration of the implications of an extended worldly existence. Nevertheless, for current purposes, several generalizations may be offered.

First, within the apparent cultural context and the belief systems of the original scribes of the texts, extended human life spans were considered neither unusual nor problematic, and indefinite life spans for nonhuman beings were accepted without comment.

Secondly, flowing from the first generalization, an extended human life span, even one of indefinite length, should not be abhorrent to the core belief systems of the three religions — what is important are the dualities of how the earthly life is lived, and of the assumed eternal life beyond it, not the length of the earthly life itself. In fact, in the Enochian traditions, the life spans of the Watchers and the Nephilim are not the subject of comment. Rather, the *conduct* of these entities (essentially the initiation and perpetuation of actions perceived as sinful and abhorrent) is the focus of attention.

A more insidious intrusion of superstition into the consideration of indefinite life spans comes in the form of the accusation of “playing God” as a reference to the undertakings of modern technology and science. Unfortunately, there is at least a veneer of credibility on this accusation when the indefensible applications of “progress” are recalled, such as the eugenic horrors of World War II and the flawed results of some biological engineer

ing efforts. Fundamentalist sects are quick to adopt this approach when combating any development that threatens their monopoly on the sale of “eternal life.” Cryonic suspension offers at least the prospect of doing this, in both dogmatic and commercial terms, and hence may expect unrelenting hostility from these marginal belief systems. Legitimate mainstream religions, however, should welcome cryonic suspension as a viable medical fortification against death, the constant enemy of the life they espouse. As noted above, an indefinite life span gained through cryonic suspension — until a more advanced age cures all current ills and infirmities — is not the equivalent of eternal life. Now and forever, the latter should remain the proper concern of religion.

In summary, the religious beliefs originating in the Middle East offer little assistance with assessing the mental and emotional problems that may be encountered by revivees, because extended human life spans were not considered unusual and no consideration was given to the artificial generation of such life spans. Some denominations have developed great respect for the preservation of life, and hence should embrace any efforts to extend it. Of relevance to the state of mind of any revivee faithful to any of the traditional Abrahamic religions, however, is the lack of any inherent condemnation in them of an extended or indefinite human life span. If latter iterations of any of these religions may have developed such condemnations, they may be considered to be degenerate perversions of the original belief systems and thus anathema themselves. For those more of a spiritual (as contrasted with a religious or superstitious) inclination, the issue is less one of dogma than of rational comprehension.

Folklore.

Within folklore and myth may be found more fruitful material. The Norse myth cycles, particularly, offer a useful dichotomy directly relevant to the transition of a revivee from a death-oriented existence to one directed towards immortality. Humankind, in Norse myth, was deemed to inhabit a middle sphere of the universe, termed *Midgard*, which was one of nine worlds. The gods themselves, who were not immortal but doomed to a cyclical existence (analogous to the “Big Bang” universe collapsing in upon itself and triggering a subsequent cycle of creation), dwelt in the upper sphere of the universe, termed *Asgard*. Between the two — between men and gods — resided another race, similar to humans but of indefinite life span. These beings, generally aligned with men and the “good” gods in the ongoing struggle with the “bad” gods, inhabited *Alfheim* (hence the designation *elves*, for that race was termed the “light elves”) between *Midgard* and *Asgard*. The giants, the dwarves, the dark elves and others lived in other parts of the nine worlds. Light elves and men could and did cooperate and share the same goals and values, but they were of different kind and of different mind — hence their separation.

Within this conceptualization lies a nugget of essential truth for the revivee. For the revivee, the realization of contentment, even of happiness, and the elimination of anxiety, and perhaps

of an inchoate sense of guilt, lies with an understanding and acceptance of the *difference* between what the revivee becomes upon revitalization and what the revivee previously constituted in the life before cryonic suspension.

Before, the revivee was burdened with the doom (or the gift, depending upon one’s perspective) of an early death — a death at the end of a life measured in finite units of time, beyond which in this world existed no opportunity for growth, or experience, or accomplishment. The revivee, before suspension, was faced with an inevitability which forced, as a condition of mental functionality and survival, an acceptance of a limited duration of physical existence. With this acceptance came a multitude of assumptions and acknowledgments concerning the restricted parameters of the revivee’s life before suspension.

Upon revitalization, the revivee will be faced with an entirely new kind of existence, a life for which the old assumptions and acknowledgments have been abrogated, a life no longer enumerated by a scant number of finite units of time but rather spanning an appreciable portion of the remaining duration of the universe. In short, the difference in the revivee before cryotransport and after revitalization is the difference between a man and an elf — and a revivee that does not recognize, and accept, and assimilate that difference cannot effectively function in the new reality attendant upon virtual immortality.

The Norse concept of a duality between humankind and a parallel immortal race is reflected in numerous other northern myth cycles, most notably those of Iceland, Denmark, Sweden and in the Celtic lands. In Irish folklore, the *Sidhe* (“shee”) strongly resemble the Norse light elves. In all these traditions, the concept of a similar but different race is present, with a fundamental difference being the virtually immortal nature of the other (nonhuman) race. Significantly, in many of these traditions the “gods” are yet again distinct from both humans and the immortal race.

If there is any validity to the Middle East implication of northern lands in the Enochian stories, and if in fact the Enochian stories reflect actual if distorted memories of ante-diluvial events, then the northern myth cycles themselves may incorporate similar ancient memories of a separate immortal race. If this is so, then the “immortals” appear to have long ago died out or become assimilated into humankind. There is, perhaps, a moral here for the potential revivee. Possibly a more probable interpretation is that the Enochian stories, the northern myth cycles and other folkloric sources recall an actual neolithic culture with a strong resurrection belief, now translated into an “immortal” race.

Literature.

In literature, the northern myth cycles have received substantial attention. Perhaps the best known and most carefully developed of these are the works of J. R. R. Tolkien. Tolkien devoted considerable attention to the elven race, which fit the Norse (and Icelandic and Celtic) concept of a separate immortal breed of sentient being detached from most of the concerns of

humankind. In Tolkien's cosmology, the elves are characterized by a concern for the earthly environment, and by a nobility of spirit, far superior to that of humankind, as well as by commitment, ferocity of purpose and an exceptionally long-term view of worldly events, with the expected implications for elven strategy in dealing with such events. (In Tolkien's voluminous notes are extensive details concerning his conceptualization of the elven race. Much of this material has been assembled and published by his son Christopher in the numerous volumes comprising *The History of Middle Earth*. Of particular significance are *Athrabeth Finrod ah Andreth* and *Laws and Customs Among the Eldar*, in the tenth volume, because both treatises address directly the implications of indefinite life spans.)

In these attributes of the elves of Middle Earth, which seem to echo a wisdom and maturity of perspective gained from long experience, are valid lessons for the prospective revivee. (Interestingly, in Tolkien's view, a major burden of the elves is the "weight of memory" that accumulates through long years of life.) A functional world view of the revitalized individual likely will resemble closely that of Tolkien's elves.

Similarly, an altogether different kind of immortal also has received substantial attention in literature — the vampire, a creature neither dead nor alive but possessed of an extended period of existence sustained by the life forces (manifested as blood) of living humans. The concept of the vampire is greatly influenced by supernatural (that is, religious) overtones, and by the angst generated by the vampiric requirements for continued existence. Vampires, therefore, are not particularly useful role models for the prospective revivee, and offer little enlightenment for successfully coping with the mental and emotional challenges inherent in an indefinite life span for an otherwise normal human being. It is worth noting, however, that the "modernized" vampires (and associated entities) of Ann Rice's many books have come to terms with the Information Age in a manner reminiscent of Poul Anderson's immortals, discussed below.

In more recent literature, and specifically within the genre of science fiction, the problems of the immortal life style have been examined in detail. While *The First Immortal* by James L. Halperin considers the specifics and logistics of cryotransport, a series of novels by Poul Anderson have dealt more extensively — and from varying perspectives — with the more philosophical aspects of the indefinite life span and its attendant ramifications. *The Boat of a Million Years* (a title based on ancient Egyptian myth cycles) postulates a tiny population of natural immortals, and follows the challenges faced by these individuals over the many millennia of their lives. (A similar motif was utilized in *The Highlander* motion pictures and television series.) The most significant problem, as developed by Anderson, is reconciliation of the immortals to the horrifically limited life spans of the surrounding normal humans. His immortals handle this by a combination of detachment and subterfuge — deliberate emotional aloofness from the short-lived humans, and careful concealment of their fundamental difference from humankind (that is, their immortality). While the prospective revivee faces a very

different environment — where everyone lives indefinitely — there are still valid lessons here. For one, emotional attachment to material, and therefore ephemeral, things is problematic. For another, sometimes cloaking your difference from all those around you is the most prudent course of action.

In a series of four novels (*Harvest the Stars*, *The Stars Are Also Fire*, *Harvest the Fire* and *The Fleet of Stars*), Anderson examined the consequences of the postulated technological advance of "downloading" human identity into mechanical constructs. This, of course, is one of the avenues along which the future revitalization of subjects of cryonic suspension may develop. The story line also introduces the problems of *duplication of identity* by creating multiple downloads of the same personality and memory set, and of *assimilation of nonorganic existence* by investing human consciousness and personality into mechanical hosts of convenience. With its attention to interstellar colonization and the divergence of cultures subject to vast lags in light-speed communication, the series of four books addresses problems likely beyond those that initially will confront the successfully revitalized revivee. The emerging lessons, however, include the importance of adaptation to radically changed environments and the crucial role that human determination and indomitability play in immortal survival.

Stories involving immortals, either of humankind or another race, have been very popular in science fiction, science fantasy, pure fantasy and even mainstream fiction. The above examples are but a small specimen of the material available, but impart a flavor of the issues confronted in the imaginations of the various writers.

Rational Analysis.

When the larger issues of guilt and adjustment and adaptation and cosmic meaning have been successfully reconciled in the mind of the revivee and some peace and psychological and philosophical accommodation with virtual immortality have been achieved, there still remains a troublesome practical question: What to do with all the time available?

This is more than a trivial consideration, because it may mask a true danger to the revivee — a tendency towards boredom, which may engender thoughts of suicide. Without purpose, a life that stretches on endlessly may lose its imperative, its urgency, its very point.

For the revivee who has not made arrangements for the future availability of financial resources, there will be the matter of finding a way to produce income for living expenses. Over the years, of course, such a revivee should be able to amass capital through gainful employment and gradually "retire" from the necessity of a working life. However, any job or profession, no matter how alluring, ultimately loses its appeal, and so eventually all revivees will be faced with the issue of the engaging, if not productive, use of the time available. Even the most sybaritic at some point must tire of endless leisure.

Travel is the obvious means of expending time in an inter

esting manner. The earth itself offers only finite possibilities. By the time revitalization becomes a reality, at least limited opportunities for travel (and perhaps residence and employment) should exist elsewhere within our own solar system. Anything beyond that will require the development of superluminary transportation systems, and thus may be a speculative prospect.

Complicating the issue of finding engaging uses for time is the possibility that machine-organic interface in the future may facilitate the internal availability to the human mind of encyclopedic stores of knowledge. Thus, the goal of learning how to do or achieve a particular thing (such as fluency in Mandarin or competence with woodworking) may not present a meaningful challenge in a future world where all information may be inherently installed within the brain itself by the simple addition of a memory chip or its equivalent.

What this suggests is that any selected challenge should not be a goal of knowledge *accumulation* but rather of knowledge *application*, such as striving to become the most renowned Mandarin poet in history or the most creative, artful woodworker in the world. Thus, a great value may reside in certain characteristics of personal identity, many of which fortunately may be cultivated – creativity, curiosity, inventiveness, cleverness, acceptance of challenge, organized thought processes, even humility and wisdom. These intellectual and emotional capabilities, and others like them, will enable the revivee to constantly reinvent the future world to always present a novel and engaging aspect and thus force it to offer enduring value for the revivee's continued life and existence.

Conclusion.

The above considerations harken back to a fundamental truth the prospective revivee should accommodate – that happiness likely will depend less on what is encountered within the future than on what is carried forward into it. In large measure, that future environment of the mind – comprising the thought processes of the immortal – may be generated and influenced *now*. To do so requires the active effort of the candidate for cryonic suspension, the potential revivee, to create and cultivate an internalized state of mind, a personal philosophy, a mental and emotional discipline, that accepts and embraces an indefinite life span with all its consequences and ramifications. In other words, arguably one of the most important things a candidate for cryonic suspension can do now to facilitate a successful future revitalization is *to carefully and comprehensively analyze and reconcile the implications of an indefinite life span*.

— Russell Sinclair Grove
November 2003

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EMERGING CRYOPRESERVATION Procedures

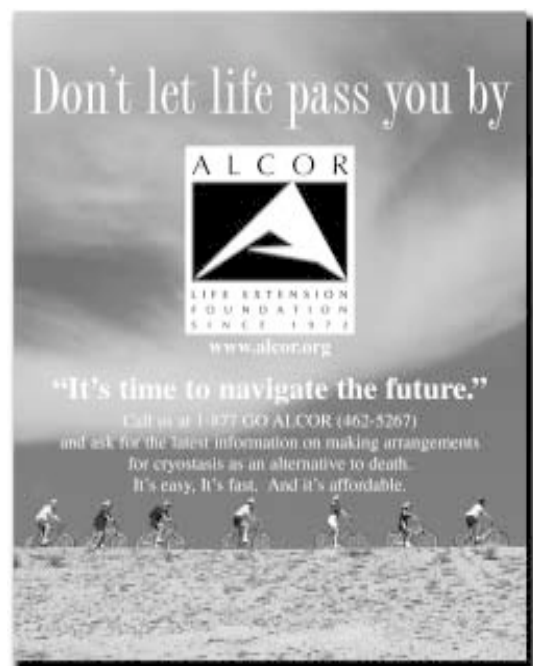
There has been a great deal of discussion lately about which cryopreservation procedures Alcor should offer. For instance, we currently have neurovitrification, whole body with glycerol, and the combination procedure that includes the neurovitrification and whole body glycerolization together. All these procedures require storage in liquid nitrogen.

Recent developments in the lab will make several other options available to our members. Before we begin offering these options, we will need to inform our membership of the details. Some of the options we are considering are:

- a) Whole body vitrification (which would make our combination procedure obsolete);
- b) Customized intermediate temperature storage for neuro and whole body patients;
- c) Less expensive intermediate temperature storage involving the selection of a common temperature.

The complexities in cryonics are growing as new developments significantly raise the price of each procedure - while providing a commensurately higher quality of care. However, we want our members to make an informed decision about which procedure is best for him or her.

In an upcoming issue of *Cryonics* magazine, we will take an in-depth look at these emerging technologies. By the time additional options are available, we want our members to be fully prepared to make the necessary funding or paperwork changes concerning his or her own arrangements, if a different procedure is desired.



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CEO Report

by Joseph A. Waynick

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My first four months at Alcor have been nothing less than a blur. We have been performing a case every three to four weeks since January. That is four cases in four months. In one instance, we actually had two cases overlap. Fortunately, we have yet to face performing two simultaneous cryopreservations at once, but it is only a matter of time before that happens.

Of course, everyone knows that the big news in the first quarter for Alcor was the defeat of HB2637. It was the first attempt by an Arizona elected official to impose regulatory oversight upon Alcor. I say the “first” because we have every reason to believe that we will come under scrutiny again next year.

Before I go much further let me state without reservation that I believe oversight by a medical or scientific board is not only appropriate, it is actually desirable. There are several exciting technologies under development by well-financed and reputable research organizations in the fields of nanotechnology, stem cell research, anti-aging, cell regeneration, and organ preservation, that I believe will ultimately lead to the medical advances we need to establish the validity of cryonics. With each medical breakthrough, the process of death is pushed further back along the life-cycle continuum and our theories gain more support among the scientific community daily.

For these reasons, it is vitally important that Alcor prepare for and embrace appropriate legislative oversight and work with state officials to construct language that will solidify our legal right to pursue the science of cryonics free from legislative “limbo.”

During the past four months we worked hard to cooperate with elected officials from the Arizona House of Representatives to bring forward a bill that provided comprehensive consumer disclosure and protections. Alcor fully supported those objectives and continues to do so. We also continue to cooperate with the Department of Occupational Safety and Health Administration (OSHA), the Scottsdale Fire Department, Arizona Funeral Board, Environmental Protection Agency (EPA), and Department of Environmental Quality (DEQ). These agencies are charged with protecting the public welfare and enforcing the laws that keep our workplace and the environment healthy and safe.

Unfortunately, compromise language could not be developed in the very short amount of time available to the stakeholders. The drafting of the bill was complicated by the lack of early consultation with Alcor and by the haste with which it was being pushed through the House. Admittedly, Alcor was late getting involved with the legislative process; a failing I promise will not be repeated. However, once we learned of the initiative, we had to overcome an assortment of challenges to have our voice heard at the capital. Due to our late start and inexperience in political matters, not to mention the less than straightforward manner in which the legislation was being positioned, we were unable to stop the bill from passing the House. Still, several representatives steadfastly supported Alcor right up to the House floor vote. Most notably, Representative Linda Lopez argued persuasively in favor of Alcor as she rose in opposition to the damaging legislation.

Assurances were given to the legislature that the content of the bill would not harm Alcor or threaten our ability to legally operate as we have for over 30 years. Yet despite these assurances, the bill Alcor agreed to support in the House Health Committee and the modified bill which was shown to us just prior to the House floor vote was not the same as the bill that was sent to the Senate for approval.

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Despite the fact that a reasonably acceptable bill was passed by the Health Committee with Alcors' support, the bill was further modified without our input or even the ability to alert house staffers to the severe consequences to Alcor of those changes until just an hour or two before the house floor debate. HB2637 passed the house with so many egregious errors that both supporters and opponents alike were astounded.

Throughout the legislative process, Alcor was told that the purpose for proposing regulation was to protect public safety, provide consumer disclosure, and ensure the dignity of our patients is maintained. Alcor fully supports all of those objectives. In addition, Alcor, the Health Committee, and the entire legislature was told from the House floor that the bill was not intended to harm our organization. Yet the legislation that left the House would have done exactly that; ended the existence of an organization that has operated legally in the state of Arizona for the past 10 years and in California for the previous 20 years.

Having learned a very difficult lesson in the House, Alcor changed tactics in the Senate. We immediately embarked upon a much more intense "cryonics education" campaign with the state Senators to ensure that they had accurate, factual information regarding Alcor's operation, including any public controversies that were in progress. After it was announced that the bill would be assigned to the Commerce Committee in the Senate, Barry Aarons and I personally met with each committee member to discuss the merits of the bill, the House "process" that resulted in the gross errors in the bill they were being asked to consider, and why they should support Alcor's position. We were pleased when we found a very open and receptive group of Senators with whom to negotiate.

Most importantly, we engaged the committee chair, Senator Barbara Leff, early in the Senate process. Barry, Tanya Jones and I attended a Republican fundraising dinner to meet Senator Leff and discuss the pending legislation at the event. Senator Leff intently listened to our concerns and those of all other stakeholders as well. She held fair and balanced meetings each week so that there was plenty of time to discuss and deliberate the issues prior to a committee hearing.

Our finest moment came when Alcor representatives drafted an alternative bill that addressed all of the publicly disclosed objections of the stakeholders and successfully submitted it to the committee as a striker bill to HB2637. The tide turned and we were no longer on the defensive. Suddenly, hidden agendas were forcefully revealed in the very next stakeholder meeting as the opposition scrambled to counter our initiative. Hastily drafted alternate bills were presented to the chair only to be rejected because of their inherent flaws. Barry masterfully argued for our position as only a man with his long years in state politics could. Our striker stood firm because it was fair, well thought-out, and drafted with the utmost care to address the stated goals of the legislation.

Rather than see an amended bill supported by Alcor pass the Senate and return to the House for confirmation, the sponsor withdrew HB2637 from the session. Alcor had prevailed in defeating a dangerous piece of legislation that threatened our very survival.

The grassroots support from our membership and supporters was a key component of our victory. Special recognition needs to go to the Life Extension Foundation and Immortality Institute. They contacted thousands of their supporters to help generate the strong email, phone, and fax campaign that was urgently requested when the bill came up for a House vote. Thank you!

Once again, and for the record, Alcor fully supports appropriate state regulation, as any good corporate citizen would be. However, state regulation should not have the consequence of driving legitimate organizations conducting lawful operations out of business and/or out of the state no matter how "unintended" that consequence may be. The bill as originally proposed would have shut Alcor down, if passed. Unless that was the intent of the legislation, then there was no reason to object to alternative language that would have served the purposes of all constituents concerned, including Alcor. Yet, it was only through the vocal opposition of our members and supporters around the country that brought national attention to the inherent flaws of the original bill.

Alcor cannot, and will not, support legislation that threatens its legitimate right to exist and operate lawfully. We will however, work with any lawmaker who feels oversight is necessary and construct legislation that achieves the above stated goals. Meanwhile, Alcor will voluntarily work with any appropriate state board who wishes to review our operation so long as they agree to respect and protect the confidentiality of our members and patients.

We believe in cooperating with local, state, and federal government agencies and we welcome any opportunity to demonstrate our commitment to the public good.

Alcor Membership Status

Alcor has 662 Suspension Members (including 106 Life Members) and 64 patients in suspension. These numbers are broken down by country below.

| Country | Suspension Members | | | Country | Suspension Members | | |
|-----------|--------------------|------------|-------------|---------------|--------------------|------------|-------------|
| | Members | Applicants | Subscribers | | Members | Applicants | Subscribers |
| Argentina | 0 | 0 | 1 | Netherlands | 1 | 0 | 1 |
| Australia | 8 | 1 | 3 | Russia | 0 | 0 | 3 |
| Austria | 0 | 0 | 0 | South Africa | 0 | 0 | 1 |
| Canada | 19 | 6 | 12 | South Korea | 0 | 0 | 0 |
| China | 0 | 0 | 0 | Spain | 0 | 5 | 0 |
| France | 0 | 0 | 1 | Sri Lanka | 0 | 0 | 1 |
| Germany | 4 | 2 | 2 | Sweden | 0 | 0 | 1 |
| Ireland | 1 | 0 | 0 | Switzerland | 0 | 0 | 2 |
| Italy | 0 | 2 | 3 | Taiwan | 0 | 0 | 1 |
| Japan | 1 | 1 | 2 | U.K. | 13 | 9 | 8 |
| Lebanon | 0 | 0 | 1 | U.S.A. | 613 | 94 | 246 |
| Mexico | 0 | 1 | 1 | | | | |
| Monaco | 2 | 0 | 0 | TOTALS | 662 | 121 | 290 |



Can We Beat Doomsday?

Some Thoughts of J.B.S. Haldane and Bertrand Russell

by R. Michael Perry, Ph.D.

As cryonicists we often may find ourselves feeling like time travelers trapped in a pre-immortal past. Our timeship, as it were, has broken down and cryonics is our best prospect for making it back to our proper time, when aging and now-terminal diseases should be things of the past. Our vision of the future thus incorporates a powerful imperative to do something specific here and now, that is, make arrangements for cryopreservation in the event of death. It also carries the implication that progress of the right sort must continue so that technology to restore us to good health will eventually be developed and applied. Though many have questioned the likelihood of such an outcome, the rapid pace of development in such areas as nanotechnology and molecular genetics lends confidence to our predictions. No known violations of physics would be involved in carrying through our program so that its success can be viewed, with cautious optimism, as just a matter of time—provided, of course, that the postmortem preservation of individuals is good enough meanwhile and is maintained long enough.

Paradoxically, though, it seems we now face a challenge because some of our ideas are finally being taken seriously, after decades of indifference and dismissal as sci-fi fantasy by the public at large. We hope for a world where we, as more-than-humans, may thrive indefinitely in states of harmony, clarity of thinking, creativity, and sheer joy of living that have not been possible before. Others, lately awakened to the possibility that nano- and other technology might make more of a difference than they thought, see it otherwise. The prospect of human enhancement, including eliminating aging, they view as “dehumanizing” and something to be discouraged or even, if necessary, suppressed by force. They propose to enact their controls, in the first instance, through peaceful legislative channels, which at least offer a constructive, non-clandestine avenue for opposition to their program of constraint. Then there are others of not unrelated, luddite mentality who find immediate violence more appealing, and are not afraid to die trying to stop what they consider an unacceptable threat.

In a sense both the would-be peaceful controllers and the all-out terrorists have a point. Something they value *is* threatened, something which, if it is to be retained, requires keeping humanity at its present level in some basic ways, or in more extreme cases, regressing it to an earlier level. Such stagnation or regression is, of course, unacceptable to many, including but not limited to immortalists. The progressives do not agree on all issues but do see, in the prospect of the constructive changes that seem in the offing, positives that well outweigh the negatives. Especially this is true of immortalists, and so we ask if good will prevail and the changes occur, or will the luddites win or something worse happen—a war, say, that destroys all of humanity and much or even all of the rest of earthly life.

There is, of course, no sure and easy answer—only time can tell if we can escape Doomsday—but the question has long been pondered, and answers were attempted well before cryonics got its start in the 1960s. Here I will consider one such attempt dating from the 1920s, a basically optimistic projection of future history under scientific guidance, and a more pessimistic rebuttal. Some eight decades have passed since these pieces were written, but their relevance, I think, has not ended, plus we gain a sobering perspective by comparing the predictions with what has actually happened in the intervening years.

The optimistic projection is presented in J. B. S. Haldane’s 1923 essay, *Daedalus, or Science and the Future*.¹ Daedalus was a mythical ancient Greek hero who achieved powered flight with a set of wings he had ingeniously fashioned from feathers and wax. The modern, scientific Daedaluses were also making unprecedented advances through their understanding and ingenuity, toppling the old gods in the process. (Haldane, a prominent British scientific and social philosopher, was also an atheist and felt that religion was an impediment to progress and an all-around detriment.)

In his essay, Haldane conjures a document from approximately the early twenty-first century, that is to say our own time, which summarizes scientific advances over the preced

J.B.S. Haldane



ing hundred years. Two main advances are reported, both relatively modest technologically but having great social consequences: greatly increased food production due to an agricultural innovation, and, more significant still, the use of ectogenesis or reproduction outside the womb. Human ectogenesis is first achieved in the laboratory in 1951. In due course a large fraction of children are produced that way, and it opens an easy path to both population control and eugenesis or improvement of inheritable characteristics. “The small proportion of men and women who are selected as ancestors for the next generation are so undoubtedly superior to the average that the advance in each generation in any single respect, from the increased output of first-class music to the decreased convictions for theft, is very startling.” Indeed, so great are the advantages that this program can be said to have fore-

stalled Domsday and saved civilization, though for stated reasons that are sure to raise hackles now as must have occurred then. “Had it not been for ectogenesis there can be little doubt that civilisation would later have collapsed within a measurable time owing to the greater fertility of the less desirable members of the population in almost all countries.”

As might have been expected, a rebuttal was not long in coming. *Icarus or The Future of Science*,² a 1924 riposte by Haldane’s eminent philosophical colleague and countryman Bertrand Russell, sounds a pessimistic note in keeping with its title. (Daedalus made a set of wings for his son, Icarus, warning him not to fly too close to the hot sun. The headstrong youth did so anyway, melting the wax binding, and he fell to his death. Are we more like the prudent Daedalus or the rash Icarus in our pursuit of advancement through science?) Is continued scientific advancement a good thing? Russell is far from certain, because, he tells us, people are not primarily interested in advancement per se, but in besting rivals. This explains the existence of nations, which are locked in competition and rivalries that periodically flare into violent conflict, and why these nations are unable to organize into a viable world state.

When it comes to the touchy issues of population control and eugenesis, Russell is quick to point out the possible downsides. As long as nations are unable to unite, individual states must carry out their separate versions of the proposed programs. So the primary aim, we can reasonably assume, will not be overall human betterment but national aggrandizement with its many ugly attendants, including racism. As for the actual effects, there are many reasons to doubt that the goals forecast by Haldane will be achieved. Population control will not necessarily happen, for example, because a state may want “to employ more

“There is still no world government but only individual nations whose energies are all too often wasted in petty squabbling and rivalries that periodically erupt in violent conflict.”

prolific races as mercenaries.” As for producing “superior” individuals, we have to ask by what standards. The answer, of course, is that it will depend on who is in charge. “So, if eugenics reached the point where it could increase desired types, it would not be the types desired by present-day eugenisists that would be increased, but rather the type desired by the average official. Prime Ministers, Bishops, and others whom the State considers desirable might become the fathers of half the next generation.” The issue is also raised of how desirable traits would be recognized in the first place; people with exceptional but specialized talents might well go undetected.

Nearly a century has passed since the two essays were written; from our present vantage point in the early twenty-first century we can assess

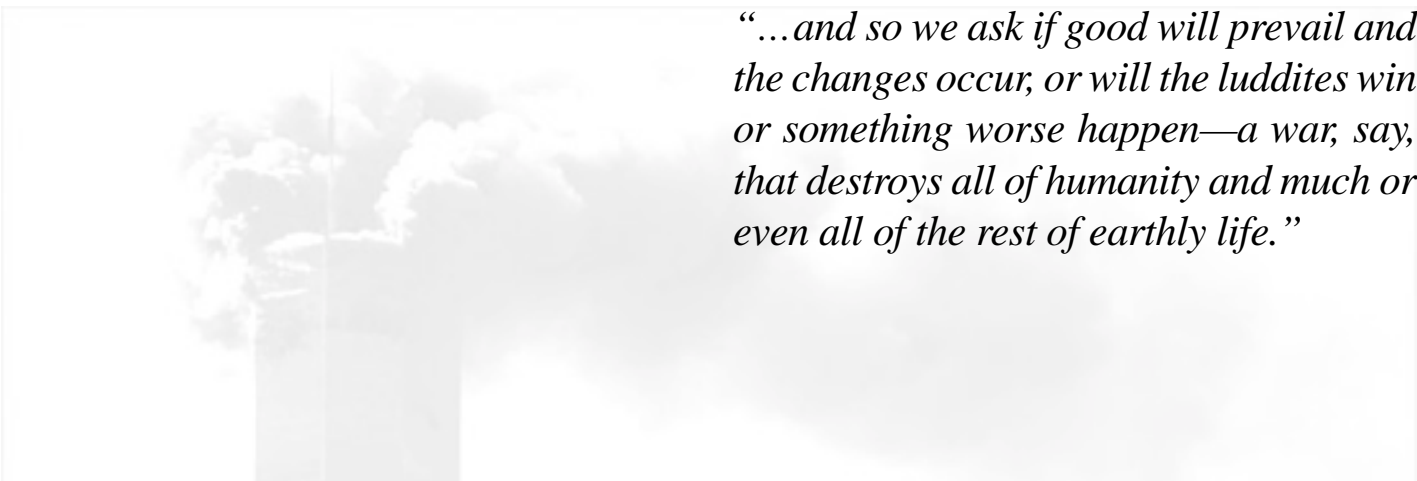
how well the predictions have held up. In both cases we see that, while there are many discrepancies in the details, overall there is an interesting partial success.

In the case of Haldane, we do not have his agricultural innovation (a kind of algae) but food production has improved substantially due to the “Green Revolution” and other advances, and world hunger does not seem to be a particularly worsening problem, despite a substantial population increase. Full ectogenesis, which would involve use of an artificial womb from conception to birth, has not been achieved but we do have reproduction outside the (original) womb through in-vitro fertilization (“test-tube babies”) and surrogate motherhood. This, however, is only used on a small scale and has not replaced the natural reproductive process, nor is a substantial fraction of the population being born through a state-arranged mating of persons with desired characteristics, as Haldane envisioned. At the same time there has not been an overwhelming surge of “less desirable members of the population” through greater fertility. Population growth rates have diminished substantially worldwide, in many instances because of voluntary birth control though some state-imposed controls have had effect too (in China for instance). Birth control itself is more widely available, encouraged, and accepted, and techniques have substantially improved.

Turning to Russell we see far more verification of his basic contention than we’d like. There is still no world government but only individual nations whose energies are all too often wasted in petty squabbling and rivalries that periodically erupt in violent conflict. Worse yet, there are new and terrible weapons Russell and



Bertrand Russell



“...and so we ask if good will prevail and the changes occur, or will the luddites win or something worse happen—a war, say, that destroys all of humanity and much or even all of the rest of earthly life.”

Haldane never envisioned. The two of them wrote of the “collapse of civilization” as the worst calamity they imagined but we can see worse yet—extinction of the human species or even all life on earth, depending on how much ingenuity is shown and action taken with these weapons of mass destruction. WMDs are proliferating, despite concerted efforts to stop their spread, and it seems likely they are both getting more effective and more available all the time. However, the main threat to civilization and possibly life as we know it may not be the hostility of nations but of smaller bands of individuals—terrorists who could also obtain WMDs or develop their own. Such groups are often suicidally bent on achieving their destructive aims and thus not subject to the usual controls that keep governments in line and limit their excesses.

Both Haldane and Russell, we note, assigned a principal role to the state as an instrument for good or ill, with the individual in a decidedly subordinate position. In 2001, however, a terrorist group managed to stage a surprise attack on the United States more devastating than any that ever occurred from a hostile government in wartime. Nineteen suicidal attackers using four fuel-laden, hijacked aircraft as ordnance cost three thousand lives and an estimated \$35 billion in property damage and lost work productivity.³ The attackers, by appearances, did not receive major financial support from any government but only from wealthy, private individuals whose organization is still operating clandestinely and planning more attacks. It was indeed a “wake-up call” and showed, in one particularly terrible way, how individuals acting apart from governments are gaining increasing powers to make a difference at the global level.

There are other, more constructive ways that individuals could make a major difference, ranging from sponsoring research to exercising reproductive or other options not formerly available. In particular, Haldane’s scenario of eugenesis through ectogenesis could be carried out by individuals exercising free choice rather than a government-dictated policy. Such well-intended efforts would not necessarily produce desired results but would require some time to develop, allowing for corrective measures if things were not going right. Other individual efforts could explore the sort of unconventional research possibilities that governments might be reluctant to investigate, including

halting the aging process. Much good might be realized, not excepting our dreams of revival from cryonic suspension and subsequent physical immortalization. Nevertheless some see a threat here perhaps equal to or greater than that of terrorism, inasmuch as the results could have an effect on what it means to be human. If it is assumed that basic changes in the parameters of human life are necessarily bad, then such fears may be well founded, but such an assumption seems both absurd and very tragically mistaken. Indeed, a case could be made that the failure to achieve immortalization will eventually result in our destruction, as a consequence of the inevitable frustrations, confusions, and hatreds of fallible humans trying to cope in other ways with life’s “vale of tears.” We must find ways to keep terrorists and other misguided people at bay, while at the same time supporting and encouraging developments that could liberate us from the mortal coil. For I think there is no long-term future for humanity, collectively speaking, unless the prospect of a long and wonderful future can be extended to the individual.

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3. See, for example, <http://www.africaonline.com/site/Articles/1,3,50913.jsp>.

Another useful source is Dronamraju, Krishna R., ed., *Haldane’s Daedalus Revisited*, Oxford: Oxford University Press, 1995.

Direct Observations of RNA “Proofing.” When Ralph Waldo Emerson said that nature pardons no mistakes, he wasn’t thinking about RNA polymerase (RNAP)—the versatile enzyme that copies genes from DNA onto strands of RNA, which then serve as templates for all of the proteins that make life possible. Emerson’s comment notwithstanding, RNAP makes plenty of mistakes but also proofreads and corrects them before they have a chance to create abnormal proteins. (*Eurekalert* 11/25/03) http://www.eurekalert.org/pub_releases/2003-11/su-nia112503.php [NGN 12/4/03]

Robot Nation? Marshall Brain, the writer and founder of HowStuffWorks, thinks we’ll be losing jobs wholesale to robots in the very near future, long before things like nanotechnology have a chance to change the world: (*TCS: Tech Central Station* 12/3/03) <http://www.techcentralstation.com/120303B.html> [NGN 12/4/03]

Molecular Memory Chips. Stan Williams and his team of 30 at Hewlett-Packard are researching ways to make computer chips at the atomic level, smaller than a bacteria or a virus. If they succeed in their mission, HP could begin deploying a new manufacturing technique within the next three to five years. This technique allows an entire wafer of circuits to be stamped out quickly and cheaply from a master mold. (*San Jose Mercury News* 12/29/03) <http://www.bayarea.com/mld/mercurynews/business/7563605.htm> [NGN 1/2/04]

Nanowire a Superior Disease Detector. A wire thinner than a human hair has proven to be 1,000 times more sensitive at detecting disease, producing results in minutes rather than days. Charles Lieber of Harvard University in Boston, Massachusetts and colleagues developed and tested the silicon nanowire in what they say is the first example of direct electrical detection of DNA using nanotechnology. “This tiny sensor could represent a new future for medical diagnostics,” says Lieber, a professor of chemistry at Harvard and a cofounder of nanotechnology company NanoSys. (*Betterhumans* 12/18/03) <http://www.betterhumans.com/News/news.aspx?articleID=2003-12-18-3> [NGN 1/2/04]

Nanofabrication on a Biological Substrate. Dip-pen nanolithography, a process being developed for ultrasmall feature definition on semiconductor ICs, may blaze new trails in medicine as well, if preliminary work reported at the fall meeting of the Materials Research Society can be turned into practical procedures. Alben Ivanisevic, a bioengineer at Purdue University’s Bindley Bioscience Center (West Lafayette, Ind.),

described a process in which amino acid-based nanostructures were assembled on retinal tissue. The structures might be useful to surgeons trying to correct blindness caused by macular degeneration. (*EETimes* 12/11/03) <http://www.eet.com/at/n/news/OEG20031211S0028> [NGN 1/2/04]

Designer Molecules Against Cancer. Welsh researchers are working on developing ultrasmall nanoparticles to tackle breast and prostate cancers more effectively. It could allow higher doses of more toxic drugs to be used without fear that widespread damage to tissues will be caused. The work is being carried out by the recently established Centre for Polymer Therapeutics established within the Welsh school of Pharmacy at Cardiff under the direction of Professor Ruth Duncan. (*Small Times* 12/23/03) http://www.smalltimes.com/document_display.cfm?section_id=45&document_id=712 [NGN 1/2/04]

Microassembly at Zyvex. Zyvex Corporation Dec. 22 announced the A100 Assembly System, a manipulation and assembly tool which can be used with either a scanning electron or optical microscope to assemble microscale components. “The A100 Assembly System represents a significant product line extension for Zyvex,” said Robert Folaron, Director of Product Development at Zyvex. “Customers will not only benefit from Zyvex’s industry leading nanomanipulation capabilities for assembling complex MEMS structures, but will also benefit from the microassembly techniques we’ve developed through our NIST-ATP program.” (*NanoInvestorNews* 12/25/03) <http://www.nanoinvestornews.com/modules.php?name=News&file=article&sid=2144> [NGN 1/2/04]

Nano Menagerie Heralds Controlled Assembly. Researchers from Sandia National Laboratories have found a simple way to make tiny, complicated shapes from zinc oxide, including arrays of vertically-aligned rods, flat disks, and columns that resemble stacks of coins. The researchers grew the structures, which are similar to those found in biomaterials, by seeding a solution with zinc oxide nanoparticles. They were able to produce different shapes by changing the amount of citrate in the solution at different points during particle growth. (*Technology Review* 12/24/03) http://www.technologyreview.com/articles/rnb_122403.asp [NGN 1/2/04]

Nanotech Spy Eyes Life inside the Cell. In *Prey*, Michael Crichton’s tale of nanotech gone awry, a swarm of light-sensitive nanoparticles swim through a human body, creating the /

ultimate medical imaging system. In the real world, biochemists are hoping to go one step further, deploying viruses as “nanocameras” to get a unique picture of what goes on inside living cells and a greater understanding of how viruses themselves work. A team led by Bogdan Dragnea at Indiana University in Bloomington is exploiting the ability of viruses laden with gold to break into cells, along with the viral shell’s own telltale response to laser light. Together these give an unprecedented picture of the chemical and physical activity in cells. (*New Scientist* 1/31/04) <http://www.newscientist.com/news/news.jsp?id=ns99994615> [NGN 2/8/04]

Nanostructure Possible Key to Regeneration. It may well be the smallest scaffolding in the world, and the easiest to set up. Researchers have devised a tiny self-assembling structure that they hope will help repair damaged spinal cords. (*Nature News Service* 1/23/04) <http://www.nature.com/nsu/040119/040119-13.html> [NGN 2/8/04; MP]

Curved Structures Made with Nanoscale Building Blocks. The natural world is full of curves and three dimensions, but the ability to deliberately and rationally construct such complex structures using nanoscale building blocks has eluded nanotechnologists who are eager to add curved structures to their toolbox. Now a team of Northwestern University chemists report they have discovered ways to construct nanoscale building blocks that assemble into flat or curved structures with a high level of predictability, depending on the architecture and composition of the building blocks. The results are published in the Jan. 16 issue of the journal *Science*. (*ScienceDaily* 1/19/04) <http://www.sciencedaily.com/releases/2004/01/040119082010.htm> [NGN 2/8/04]

Nano not Terrifying. American scientists said recently the application of nanotechnology could affect human health as nanometer scale particles can easily penetrate the human body and may cause diseases. Meanwhile Chinese scientists say this negative aspect of nanotechnology should not be exaggerated...Dr. Jiang Lei, with the Chinese Academy of Sciences, has been engaged in the research of nanotechnology for years. He says the test result is one-sided. “Nano particles do exist and can easily penetrate into the respiratory tract and skin of human beings. But there is also a question of quantity. How many such particles could affect human health? At the present no scientists anywhere are able to answer this.” Dr. Jiang Lei also tells us how to protect ourselves in nano research. “In the course of research, we can try our best to avoid the presence of nano-scale objects in particle form. However in the liquid or solid states they are unable to penetrate human bodies.” (1/14/03) http://news.xinhuanet.com/english/2004-01/14/content_1275787.htm [NGN 2/8/04]

Progress toward 65nm Chips. Semiconductor companies are becoming increasingly confident about making 65 nanometer chips. Some are even stating that the 90 nm to 65 nm transition

will be easier than the 130 nm to 90 nm shift. Many of the technical problems associated with 65 nm chip production have been solved, and Intel has already demonstrated 65 nanometer SRAM chips. Intel will probably create the first prototype 65 nanometer microprocessors sometime in 2004, and hopes to have volume production of 65 nanometer chips by 2005. 65 nanometer chips will be made with 193 nanometer lithography, and will suffer from severe electrical leakage issues. As a result, chipmakers are making a concerted effort to introduce multi-gate transistors at the 65 nanometer node. (*Geek.com* 2/6/04) <http://www.geek.com/news/geeknews/2004Feb/bch20040206023770.htm> [NGN 2/8/04]

Reverse-Direction Movement of a Molecular Motor. German scientists mastermind a backwards-moving molecular motor. In a new study, which appears in the Feb. 5 issue of *Nature*, researchers based at Hannover Medical School and the Max Planck Institute for Medical Research in Germany describe the engineering of an artificial backwards-moving myosin from three pre-existing molecular building blocks. (*MaxPlanck Society* 2/4/04) HTML (PDF also available): <http://www.mpg.de/english/illustrationsDocumentation/documentation/pressReleases/2004/pressRelease20040203/index.html> [NGN 2/8/04]

Virtual Modeling One Atom at a Time. It’s hard enough to thread a needle. Imagine trying to manipulate threads and needles miniaturized to one-millionth the normal size. Now, you’re thinking like the emerging group of nanotechnologists whose growing dexterity at fashioning new materials and devices may eventually improve every arena of technology, from aerospace to drug development. While many researchers focus on developing tools for working on nanoscale materials, others are pursuing a virtual pathway toward nanotechnology applications. As ever-more powerful computers have become ever more affordable, computational nanoscientists can readily simulate materials atom by atom. (*ScienceNews* 2/7/04) <http://www.sciencenews.org/20040207/bob8.asp> [NGN 2/8/04]

Improved Vitrification Solutions. An old dream of organ preservationists appears to be a step closer to reality. Long-term, reversible preservation of organs and tissues at low (cryogenic) temperature has to date been prevented by a number of problems involving the protocols used in preparing the specimens prior to cooling. Typically, blood and other fluids are replaced with a cryoprotective agent to protect against otherwise lethal freezing damage when the specimen is cooled. Such a substance may either be toxic to the cells or, alternatively, provide inadequate protection. Significant progress on these twin problems has now been reported in a collaborative effort involving researchers in California and Wales. Dr. Gregory Fahy and colleagues have developed and applied a theory of cryoprotectant toxicity to design improved cryoprotectants that greatly improve the viability of mouse and rabbit cells upon rewarming from cryogenic temperatures. *Cryobiology* **48** (2004) 22-35, available online at <http://>

www.sciencedirect.com/; search under “Cryobiology.” [MP]

Cancer-Fighting Nanotechnology. A company working with UMass Lowell is getting ready for clinical trials on a nanotechnology-based cancer treatment for prostate and breast cancer. “We’re getting a little too big for our incubator. We’re about to pop out of our shell,” said Dr. Samuel Straface, CEO of Triton BioSystems, which collaborated with UMass Lowell to develop the treatment. Representatives from Triton and UMass Lowell, as well as U.S. Rep. Marty Meehan were scheduled to unveil details during a press conference Wednesday at Triton’s Turnpike Road headquarters. (*Miami Herald* 2/18/04) <http://www.miami.com/mld/miamiherald/7982426.htm> [NGN 2/25/04]

DNA Octahedra Offer Possible Building Blocks. A group of scientists at The Scripps Research Institute has designed, constructed, and imaged a single strand of DNA that spontaneously folds into a highly rigid, nanoscale octahedron that is several million times smaller than the length of a standard ruler and about the size of several other common biological structures, such as a small virus or a cellular ribosome. These octahedra are potential building blocks for future projects, from new tools for basic biomedical science to the tiny computers of tomorrow. (*Scripps Research Institute Issue 6* / 2/23/04) http://www.scripps.edu/newsandviews/e_20040223/nano.html [NGN 2/25/04]

Nerve Cells on a Microchip. Researchers at the University of Calgary have found that nerve cells grown on a microchip can learn and memorize information which can be communicated to the brain. “We discovered that when we used the chip to stimulate the neurons, their synaptic strength was enhanced,” said Naweed Syed, a neurobiologist at the University of Calgary’s faculty of medicine. (*sophists.org* 2/20/04) <http://www.sophists.org/article184.html> Also see: <http://cnews.canoe.ca/CNEWS/Science/2004/02/19/353566-cp.html> [NGN 2/25/04]

Glass Beads Reveal Molecular Interactions. Berkeley Lab and UC Berkeley researchers have developed a fast, cheap, and highly sensitive way to detect molecular interactions without using sophisticated equipment. Their technique, which uses thousands of microscopic glass beads coated with a substance that mimics a cell membrane, opens the door for the high throughput evaluation of an ever-growing family of pharmaceuticals that fight diseases by targeting membrane-bound receptors. (*Berkeley Lab Science Beat* 2/17/04) <http://www.lbl.gov/Science-Articles/Archive/sb-PBD-glass-beads.html> [NGN 2/25/04]

Nanopore for Rapid DNA Sequencing. One project that illustrates several aspects of biomolecular engineering is the nanopore analytical instrument being developed by research scientist Mark Akeson with Deamer, Haussler, and their students. The nanopore instrument is built around a membrane containing a tiny hole just a few nanometers in diameter (a nanometer is one-billionth

of a meter). An electrical field drives single molecules such as DNA through the nanopore. As a molecule enters the pore, it produces an electrical signal that provides information about its concentration, identity, and composition. The pore itself is a naturally occurring bacterial toxin made of self-assembling protein molecules. Potential applications of the nanopore device include ultrarapid DNA sequencing. (*nanotechwire* 2/21/04) <http://nanotechwire.com/news.asp?id=727> [NGN 2/25/04]

Tools Made of Nanotubes. Researchers have assembled carbon nanotubes into arrays of loops, lassos, and hooks, according to the 13 February PRL. Physicists hope to use these several-nanometer-diameter tubes to build tiny mechanical and electronic devices, and the unexpected bending shows that they are more versatile than had been assumed. As one example, these bent tubes might lead to more sensitive sensors to detect fluid flow. (*Physical Review Focus* 2/13/04) <http://focus.aps.org/story/v13/st7> [NGN 2/25/04]

Nanotech Promises Optical Computer. Imagine a computer with amazing processing power, a 3D display (literally, not figuratively) instant response, able to run every available OS and application at the same time, virtually no power consumption, zero moving parts and complete security—and whose physical component is about the size of a pack of playing cards. That’s not all. It would also hold every music CD and movie DVD you ever owned, or will own, and still leave space for not only your family album, but your brother’s, sister’s, aunt’s and uncle’s too. And no more expensive upgrades. As better designs and firmware became available, you’d simply send the Optocom back to the maker and its holographic circuitry would be re-programmed with new circuits and firmware. Optocom? It reads like science fiction but it’s short for Optical Computer, and it’s based on firm science fact, says Michael Thomas, inventor of the atomic holographic nanotechnology that will make it possible. And it would only cost about \$1,000. (*P2net* 2/25/04) <http://p2pnet.net/story/842> [NGN 2/25/04]

Virus and Bacteria Deactivation. An environmental engineer at Washington University in St. Louis with his doctoral student has patented a device for trapping and deactivating microbial particles. The work is promising in the war on terrorism for deactivating airborne bioagents and bioweapons such as the smallpox virus, anthrax and ricin, and also in routine indoor air ventilation applications such as in buildings and aircraft cabins...“When the aerosol particles come into the device they are charged and trapped in an electrical field,” Biswas explained. “Any organic material is oxidized, so it completely deactivates the organism.”...Anthrax is nasty stuff. An environmental engineer at WUSTL uses smart catalysts in his device that can detect the airborne presence of anthrax and other bioweapons and disable it. On the walls of the device, Biswas has coated nanoparticles that catalyze the oxidation. These nanoparticles are “smart” objects that are turned “on” and “off” by irradiation. (*Washington*

University in St. Louis 3/3/04) <http://news-info.wustl.edu/news/page/normal/726.html> [NGN 3/8/04]

Toward Self-Assembling Nanochips. IBM brings closer to reality chips that put themselves together. Self-assembly has become a critical implement in the toolbox of nanotechnologists. Scientists and engineers who explore the nano realm posit that the same types of forces that construct a snowflake—the natural attractions and repulsions that prompt molecules to form intricate patterns—can build useful structures—say, medical implants or components in electronic chips. So far much of the work related to self-assembling nanostructures has been nothing more than demonstrations in university laboratories. To go beyond being a scientific curiosity, these nanotech materials and techniques will have to get from benchtop to a \$2-billion semiconductor fabrication facility. (*Scientific American* March Issue 04) <http://www.sciam.com/article.cfm?chanID=sa001&colID=6&articleID=000170D6-C99F-101E-861F83414B7F0000> [NGN 3/8/04]

Progress in Simulated Nanostructures. A novel method of simulating protein behavior to achieve new, desirable nanostructures has been achieved in prototype by two researchers from Sandia National Laboratories. The method treats proteins like little construction crews, sequencing and controlling their molecular behaviors to build structures of interest. “A bird builds a nest differently each time, but you end up with a nest that works,” says Sandia Fellow Gordon Osbourn, who developed the method with his colleague and wife, Sandia physicist Ann Bouchard. “We build simulated nanostructures the same way.” “There are many paths to a useful outcome in our method,” says Bouchard. “Many details in how the assembly happens don’t matter. As long as the conditions are met [for protein interactions], we get a result we care about.” (*NanoApex* 3/6/04) <http://news.nanoapex.com/modules.php?name=News&file=article&sid=4348> [NGN 3/8/04]

Human Performance Enhancement Discussions. Think Nano Has Ethical Problems? Just Wrap Your Brain Around Neuro. What new tools to improve human performance will emerge from the convergence of nanotech, biotech, infotech and cognitive science? This was topic of discussion at the recent NBIC conference in New York, where several hundred scientists, ethicists, government officials and business executives gathered. Like nanotechnology 10 years ago, speculating about potential NBIC applications is easy. Developing novel tools that solve real world problems remains hard. Always keeping this in mind, Mike Roco, conference co-chair and architect of the National Nanotechnology Initiative, performs the difficult task of distinguishing practical applications from mere conjecture, while cultivating an environment that encourages exploratory discussions. One goal was to explore the political and economic issues that might arise as these converging technologies make possible neurotechnology — tools that can influence the brain. (*SmallTimes* 3/5/04) <http://www.smalltimes.com/>

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Better Outpatient Blood Analyzer. Three university scientists are developing a prototype device that they say will allow patients on blood thinning medication to take their own blood-clotting readings at home. The cell phone-sized device would work like the machines that diabetics use to check their blood glucose levels, according to the Drexel University researchers, who recently founded a firm called BioSensus to develop and market the NanoAcoustic Blood Analyzer. “Patients become more confident and in control of their own fate by taking their own readings,” said J. Yasha Kresh, a professor at Drexel’s College of Medicine. The researchers said that their device is different from other blood analyzers on the market because it can be targeted to read the amounts of specific kinds of proteins in the blood that are involved in clotting and bleeding. Other blood-testing machines on the market use a system of capillary-sized tubes to determine blood’s thickness by measuring how quickly it works its way through the tiny mazelike structure. The Drexel scientists say their nearly submicroscopic technology – analyzing particles 1/75th the width of a human hair – would more easily adapt to a wide variety of uses other than blood thickness and to adjust for as-yet undiscovered medicines. (*NEPA* 3/5/04) http://www.zwire.com/site/news.cfm?newsid=11079252&BRD=2212&PAG=461&dept_id=465812&rfi=6 [NGN 3/8/04]

Holograms to Sort, Steer Nanotubes, Cells. Scientists have found a simple way to use light to manipulate one of the most important building blocks of future technologies: carbon nanotubes. Experts said the technique could lead to the mass manufacture of a new generation of novel devices. “It’s like having hands in the microscopic world,” said researcher David Grier, a physicist at New York University, one of the participating institutions. “It’s a new platform for doing things on small materials on a large scale.” (*The Washington Times* 3/3/04) <http://www.washtimes.com/upi-breaking/20040302-031523-8819r.htm> [NGN 3/8/04]

Quantum Dots Capture First Movies of Cells “Talking.” Nanotechnology Aids Researchers in Revealing Mechanisms Vital to Drug Development. Researchers at Max Planck Institute in Germany have used a new nano-sized imaging tool to capture the first-ever movies of cells transmitting the messages that control genes. The breakthrough is expected to help pharmaceutical companies speed and enhance the process of screening candidate cancer drugs. In a study published in the February issue of the respected science journal *Nature Biotechnology*, the researchers reported they used quantum dots developed and manufactured by Hayward-based Quantum Dot Corporation (QDC) to provide prolonged, real-time visualizations in living cells of the signaling mechanisms of the erbB family of receptors, the targets of many cancer drugs. Quantum dots are nano-scale crystals of semiconductor material — up to ten-billionths of a meter

in size — that glow in several different colors, depending on their size, when excited by a light source such as a laser. The dramatic video-clip images mark the first time researchers have been able to see moving images of a cell's basic means of communication with its environment. (*Businesswire* 3/1/04) http://home.businesswire.com/portal/index.jsp?epi-content=GENERIC&newsId=20040301005297&newsLang=en&beanID=202776713&viewID=news_view [NGN 3/8/04]

Nanoscale Elevator. A complex nanoscale machine that can shuttle molecules like a tiny elevator has been designed, built and operated. Developed by Italian and American researchers, the tiny, chemically driven machine consists of a platform with three rings, each of which is attached to the leg of a tripod-like structure. At just 2.5 nanometers high and 3.5 nanometers in diameter, the elevator represents a big advance for the construction of molecular machines, experts say. (*Betterhumans* 3/18/04) <http://www.betterhumans.com/News/news.aspx?articleID=2004-03-18-4> Also see *Chemical & Engineering news*: <http://pubs.acs.org/cen/topstory/8212/8212notw8.html> [NGN 3/22/04]

Solar-Powered Molecular Motor Built. The first molecular motor has been created that runs on electricity or light. Developed by Frederick Hawthorne and colleagues from the University of California, Los Angeles, the tiny motor could power machines on a scale smaller than biological motors such as flagella. "Given the existence of biological motors, the interest of chemists in designing molecular motors stems from the challenge not only of making even smaller nanomachines that perform controllable motion, but also of creating systems that can be powered with light or electrical energy, rather than depending on the delivery of ATP," say the researchers. (*Betterhumans* 3/18/04) <http://www.betterhumans.com/News/news.aspx?articleID=2004-03-18-3> [NGN 3/22/04]

Single Molecules Pass Doping Test. Physicists in the US have moved a step closer to controlling the electronic properties of individual molecules in a condensed matter environment. Michael Crommie and colleagues at the University of California at Berkeley and the Lawrence Berkeley National Laboratory have demonstrated a new way to "dope" single carbon-60 molecules with potassium atoms. The team says its method is the molecular equivalent of the n-type doping that is widely used in the semiconductor industry. (*R Yamachika et al. 2004 Scienceexpress* 1095069). (*PhysicsWeb* 3/12/04) <http://physicsweb.org/article/news/8/3/7> [NGN 3/22/04]

Software Tools for Micro Hardware. Zyvex Uses SolidWorks Software to Design Nano-Scale Devices for Building and Testing MEMS, Carbon Nanotubes. Nanotechnology pioneer Zyvex Corporation has standardized on SolidWorks(R) software to design and analyze microscopic tools that build and test mechanical devices and materials measuring a fraction of the diameter of

a human hair. SolidWorks enables Zyvex to visualize, develop, and troubleshoot nanomanipulators, microgrippers, and microassembly devices used to make and test everything from sensors on ink jets to the materials that will seat the next-generation of computer chips. (*BusinessWire* 3/22/04) http://home.businesswire.com/portal/site/google/index.jsp?ndmViewId=news_view&newsId=20040322005145&newsLang=en [NGN 3/22/04]

Electricity Controls Nanocrystal Shape. Wires, tubes and brushes make it possible to build and maintain the machines and devices we use on a daily basis. Now, with help from a surprising source, these same building blocks can easily be created on a scale 10,000 times smaller than the period at the end of this sentence. Researchers at Argonne have figured out the basics of using electrochemistry to control the architecture of nanocrystals—small structures with dimensions in billionths of meters. Their findings, published in the March 3 edition of the *Journal of the American Chemical Society*, provide a practical method of generating large quantities of architecture-controlled nanocrystals, such as superconductors, ferromagnets and noble metals. (*Argonne* 3/17/04) <http://www.anl.gov/OPA/news04/news040317.htm> [NGN 3/22/04]

2003 Researcher of the Year. The industry's court artist chisels 'tetrapod' masterpiece to harness sun. Nanotech's own Michelangelo has an equally polysyllabic name: Alivisatos. Like the Renaissance sculptor, the modern-day chemist is a master of material and shape—except Alivisatos' materials are semiconductor nanocrystals, not marble or plaster, and his shapes are dots, rods and pyramids. It's no surprise that his colleagues describe his nanocrystals as "visually beautiful." But Alivisatos' ability to control the dimensions and shape of nanocrystals as they grow ensures that they are functional as well. One form of his nanocrystals, called quantum dots, already is marketed as biological markers, while his nanorods are being tested in solar cells. (*SmallTimes* 3/04) http://www.smalltimes.com/document_display.cfm?document_id=7562 [NGN 3/22/04]

Nanotech Project to Reconstruct Human Corneas. A new EU funded project is set to transform eye surgery and dramatically cut the number of experiments conducted on animals by reconstructing a human cornea in vitro. The 'Cornea Engineering' project is adopting a unique approach to corneal replacements—using tissue engineering to create a three dimensional human cornea. This is the first time that this feat will have been attempted in Europe, although similar research is being conducted in the US and Canada. (*nanotechwire* 3/18/04) <http://nanotechwire.com/news.asp?nid=784>



Converging Technologies for Improving Human Performance: Nanotechnology, Biotechnology, Information Technology and Cognitive Science

by Mihail C. Roco (Editor), William Sims Bainbridge (Editor)

Dordrecht: Kluwer Academic Publishers, 2003;

available online at http://wtec.org/ConvergingTechnologies/Report/NBIC_report.pdf

Reviewed by Mike Perry

Converging Technologies is the remarkable report of a workshop organized by the U.S. National Science Foundation and the Department of Commerce. The workshop dealt with the difficult art of trying to forecast future development based on current trends in science and technology, with some thought to what the proper role of government should be. It was held at NSF headquarters in Arlington, Virginia, in December 2001, and included authorities from government, academia, and the private sector, all of whom contributed to the report. The report itself is very bold and forward-looking. Among other things it explores possibilities for life extension and other human enhancements with an attitude that, handled as they can and should be, these developments will indeed be beneficial and desirable, while on the other hand, also crucial to the future of the human species. That it was produced by a government (a big one at that), and under an administration not noted for its advocacy of such things as human enhancement, is all the more remarkable, and even suggests this administration may not be so dominated by bioethics nay-sayers as it seems to be.

So what are the possibilities explored in *Converging Technologies*? Pretty much everything you've dreamed of, anything of potential benefit that seems to have serious scientific backing (short of resuscitations of cryopreserved humans—cryonics is one topic not covered). Included are enhancements of human capabilities both physical and mental, greatly extended life-span, direct brain-to-brain communication, uploading the mind to an artificial device to essentially achieve immortality, and even quantum teleportation.

Some will be skeptical of these visionary possibilities, or wish to focus more on what seems achievable within a decade or two at most, and without presuming too great an advance over present technology. They too will not be disappointed in the smorgasbord that is offered: considerable space in fact is devoted to more mundane topics, such as improving the quality of life for the disabled, who, conservatively, would still remain disabled.

A bold new paradigm is offered under which all the advances, great or small, will be achieved, a *convergence* of technologies and sciences grouped under four headings: nano, bio, info, and cogno (the latter relating specifically to the mind)—these form the acronym NBIC which serves as a unifying banner. Some contributors reasonably add a fifth heading, “socio,” to make NBICS, for the accompanying progress that will be needed in social matters—human relations and interactions—to make it all work out as it should. In fact, a major emphasis in the book is on various forms of human interactions ranging from person-to-person communication to the role that government ought to play to realize the greatest benefit. Perhaps more important than any of the single headings, however, is the notion that all are part of a developing pattern, one which will produce sweeping changes and define human destiny, one which can and must be channeled to constructive ends.

With so much on the positive side, some caveats should be mentioned. The report consists of many articles by different authors and, like many a committee's effort, suffers from unevenness and lack of unity, despite efforts at unification (the NBIC/NBICS acronyms for instance). Some of the papers are short and rather vague. Others are longer but also more technical, sometimes delving into mathematics or specialized concepts it is helpful to have Internet access to clarify. This is a government report, and the areas foreseen for government involvement range from national security to funding of basic research and support of education and health care programs. Those of strong libertarian bent (as are many futurists) may find some of this off-putting (or worse), but my overall impression is that the approach here is light-handed. The government will avowedly play a part in guiding and sustaining the effort, but the real backbone of the enterprise will consist of the labor of individuals in fields they have freely chosen. An additional matter is availability: the book can be purchased in hardcopy but is expensive, listing at \$167 for its approximately



500 pages. A good PDF version is free online, however. Many, I think, will find this worthwhile to download and treat as a (searchable) reference rather than reading it straight through. A wonderful opportunity exists for someone to write a book *about* this one, shorter, more unified, and in a popular, informative vein, with possibly some updates relating to progress in the areas covered. But, useful though this would be, it would not displace the original, which should be worth consulting for years to come.

Alcor News

Have you subscribed to the Alcor News electronic newsletter? If not, you should or you will miss out on a great deal of timely information about Alcor happenings. Alcor News is published monthly, usually one week after the board meeting. It is designed for the more technically minded individual.

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Editor's Notes

Publishing this magazine on schedule continues to be a challenge. Going back to a fixed regimen after several years of irregular publication requires a significant amount of retooling of our administrative procedures. We believe we have worked out the "bugs" in our publication schedule and you will see the first evidence of this with the May/June issue when it goes to press mid June and when the July/August issue prints in mid July. We should then be on schedule from that point forward.

We are still committed to publishing six bi-monthly issues per year. We are also committed to continue enhancing the quality of the magazine content. For example, this issue contains a fascinating article called "Speculations: Post-Cryopreservation Mentation" written by our guest author, Russell Sinclair Grove. In addition, we have increased the circulation by 20% so that we can provide more complementary subscriptions to University and public libraries. We have made these two significant changes at no increase in the magazine budget over the four issue schedule and lower circulation of 2003.

Authors Wanted

If you have good writing skills and you have something on your mind, why not volunteer to write an article for *Cryonics* magazine? Freelance volunteers are always welcome. You get a chance to have your work published and you get the opportunity to contribute to the cryonics community. We are particularly interested in articles relating to cultural adoption of cryonics, supporting articles for the technical basis of cryonics, or even speculative fiction addressing things like potential revival scenarios. If you are interested in preparing an article for us, please contact the editorial staff at articles@alcor.org for information on deadlines and submission requirements.

Employment Opportunities

Have you ever thought about joining the team here at Alcor central? We have immediate needs for licensed paramedics and emergency medical technicians to join our nationwide Transport Teams. Your participation would be on a contract basis. You will be given cryonics training that will enable you to participate in our rescue and patient transport cases. Licensed professionals do not have to be members to work with us. We welcome your expertise and interest.

Tim Is Back!

We are very happy to announce that Tim Hublely will begin designing our magazine covers once again. If you were a subscriber in the 90's you might remember all of the stunning futuristic covers he used to create for us. In fact, you can purchase some of his designs directly from him if you wish. Look for his advertisement on page 27 of this issue. Tim's first design for us will be with the May/June issue. We are really looking forward to seeing it.

Letters to the Editor

Letters to the editors are most welcome on all topics, including counterpoint on previously published materials and suggestions as to future content. We especially invite questions about cryopreservation (cryonics) that are original and far-reaching. If you are seeking information about Alcor, please consult our web site, at www.alcor.org. If you have questions about developmental programs within Alcor, you may stir us into talking about them even sooner than we might have otherwise. If your letter is lengthy and involved, we may use it as a separate article and may ask you to expand it. We need your ideas, your personal visions. This is the place to start.

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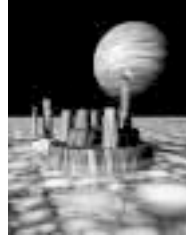
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The Alcor Life Extension Foundation is a nonprofit tax-exempt scientific and educational organization dedicated to advancing the science of cryotransport and promoting it as a rational option. Alcor currently cares for 58 patients in cryostasis, and has more than 600 signed-up Members. Being an Alcor Member means knowing that—should the worst happen—Alcor's Emergency Response Team is ready to respond for you, 24 hours a day, 365 days a year.

Alcor's Emergency Response capability includes equipment and trained technicians in Arizona, northern California, southern California, and south Florida, as well as many additional cryotransport technicians on-call around the United States. Alcor's Arizona facility includes a full-time staff with employees present 24 hours a day.

MEETINGS

ARIZONA

Scottsdale:

Alcor Board of Directors Meetings

Alcor business meetings are generally held on the first Sunday of every month starting at 1:00 pm. Guests are welcome. For more information, contact Alcor at (480) 905-1906.

Scottsdale/Phoenix:

Alcor Social Meetings

Frequent meetings are held in members' homes and at Alcor Central. Call Alcor (480) 905-1906 for up-to-date details about Arizona events, or e-mail paula@alcor.org.

Las Vegas:

To all Las Vegas members: Are you feeling alone and isolated from other cryonics members? There are many Alcor members in the Las Vegas area. If you wish to form a loose group to meet and socialize, contact Katie Karrs at (702) 251-1975. Katie has given several interviews on the subject of cryonics to the Las Vegas media. She is a wonderful person and wishes to get to know as many local Alcor members as possible. Let's get together!

CALIFORNIA

Los Angeles Area:

Alcor Southern California Meetings

For information on *Southern California* meetings, call Russ Cheney at (310) 316-5761 or e-mail him at rbcheney@msn.com.

Although monthly meetings are not regularly held, there are no shortages of Los Angeles Alcor Members you can contact via Russ.

San Francisco Bay Area:

Alcor Northern California Meetings

The remaining Alcor Northern California meetings in 2003 will be held on September 14 and December 14 at 4:00 pm, followed by a potluck dinner and socializing. Guests are welcome to attend. For more information, call Tim Freeman at (408) 774-1298 or e-mail to tim@fungible.com.

The September 14 meeting will be at:
381 North Fernwood Circle
Sunnyvale, CA 94085

WASHINGTON

Seattle Area:

For information on Northwest meetings, call Richard Gillman at (425) 641-5136 or join our e-mail group CryonicsNW at <http://groups.yahoo.com/group/CryonicsNW>

DISTRICT OF COLUMBIA

Life Extension Society, Inc. is a cryonics and life extension group with members from Washington, D.C., Virginia, and Maryland. Meetings are held monthly. Contact Secretary Keith Lynch at kfl@keithlynch.net. For information on LES, see our web site at www.keithlynch.net/les.

MASSACHUSETTS

Boston Area:

A cryonics discussion group meets the second Sunday of each month. For more information, contact Tony Reno by phone at (978)433-5574, or e-mail: tonyreno@concentric.net. Information can also be obtained from David Greenstein at (508) 879-3234, e-mail: davidsgreenstein@juno.com.

UNITED KINGDOM

There is an Alcor chapter in England. Its members are working hard to build solid emergency response, transport, and suspension capability. For information about meetings, contact Andrew Clifford at andrew@banknotes.ws or sue.hopkins1@virgin.net. See our web site at www.alcor-uk.org.



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