



## *The Beginning of the End of Aging?*

With his massive, bushy beard, long hair, and boldly-patterned shirts, Dr. Aubrey de Grey of Cambridge University looks one part mad scientist, one part hippie, and three parts Gandalf. And even a casual conversation quickly makes it clear that his groundbreaking work in the biology of aging is not just an academic pursuit. “Aging really is barbaric,” he told the *New York Times*. “It shouldn’t be allowed. I don’t need an ethical argument. I don’t need any argument. It’s visceral. To let people die is bad.”

Late in the 1990s, this obscure computer scientist suddenly became obsessed with the enormity of misery and death caused by the aging process. But instead of raging impotently against age-related biological decay, he set out to *do something about it*. de Grey went back to school, earned his PhD in biology, and began introducing revolutionary changes to the way his colleagues thought about aging – and about what can be done about it. In less than a decade, he has galvanized his colleagues into taking a new look at the emerging research, forcing many to accept the premise that human aging can not only be slowed – but *reversed*. In this article, we’ll talk about concrete proposals for medical interventions which some of the most prestigious scientists in the field of aging suggest could *undo* the ravages of the years; the controversy that has emerged around them, as pessimists scoff and ‘bioconservatives’ demand that we not intervene in “nature’s plan;” and what you can do to push forward the day when decay, disease, and death can be divorced from the passage of time.

### **The Gray Holocaust**

Dr. de Grey knows the numbers. As many as **thirty million lives are stolen each and every year by the biological aging process** – after spending decades beforehand

helplessly suffering the slow degeneration of their physical and mental health. And he understands that while medical research continues to make piecemeal progress against the swelling tide of specific, *age-associated diseases* such as cancer and heart disease, all such attempts are doomed to come up against the law of diminishing returns, governed by the logic of *aging itself*.

Suppose that scientists were to develop, tomorrow, a pill that could *eradicate* cancer and ischemic heart disease – the two biggest killers in the industrialized world. Most peoples’ intuition is that this would lead to a huge jump in lifespan. But instead, this enormous biomedical breakthrough would only increase the life expectancy of the average 50-year-old by six to eight years.<sup>1</sup>

Now suppose that medicine takes another quantum leap forward, and *all* forms of circulatory diseases, along with dia-

*Thirty million lives are stolen each and every year by the biological aging process.*

betes, are suddenly a thing of the past. Even this remarkable advance could only increase the figure by about 15 years, to 85 years in women and 80 in men.<sup>1</sup> And why? Because escaping these *specific* diseases still leaves a person trapped in a worn-out, decaying old body – a vessel that becomes more vulnerable to the next insult of accident or disease with every setting sun.

Dr. de Grey earned his doctorate with a seminal work<sup>2</sup> that overthrew previous thought on the role of mitochondria (the cellular “power plants”) in aging. But he eventually realized that even a solution to the problem of age-associated mitochondrial mutations would not lead to a final solution to the ongoing, seemingly-inevitable theft of health, dignity, and life by the aging process.

### **The Expert Panel**

So in October of 2000, Dr. de Grey took advantage of his growing reputation in the aging research community to convene a panel of big-name aging researchers at the Children’s Hospital of Oakland Research Institute, and charged them with an ambitious mandate. They were to identify a “**Strategy for Engineered Negligible Senescence**” (**SENS**): a panel of interventions which would not only *slow down*, but actually *undo*, the accumulated molecular damage that underlies the age-associated decay of our bodies, restoring us to the health, vigor, and resilience in the face of everything from influenza to atherosclerosis typical of a young adult.

The goal is not just ambitious, of course: it’s *audacious* – even *outrageous*. And some of the interventions sound like

they come straight out of science fantasy. Yet amazingly, at the end of the conference, the answer came back yes.

In the resulting report, issued through the *Annals of the New York Academy of Sciences*<sup>3</sup> de Grey's blue-ribbon team outlined the seven types of damage that scientists have demonstrated to accumulate in our cells and tissues with age (see **Table 1**). More importantly, the assembled researchers found that, for each and every one of them, an existing or clearly foreseeable technology could be applied to undo the damage of the ages. The resulting panel of treatments could be tested in mice within as little as a decade, and in humans not long thereafter – and if implemented, the researchers agreed that they would deliver the astonishing goal of actually reversing human aging.

Table 1: The SENS Interventions.<sup>3,4</sup>

Damage Driving Aging	Intervention
Cell Nucleus DNA Mutations	WILT: Deletion of Telomerase (to Prevent Cancer) and Re-Seeding of Stem Cells <sup>5</sup>
Cellular Senescence	Selective Removal or Restitution
Mitochondrial DNA Mutations	Moving mtDNA Instructions to the Nucleus
Fluorescent Aging Pigments	New Enzymes to Fortify the Lysosome
Extracellular Crosslinks	AGE-Breaker Drugs
Extracellular Aggregates	Fortified Immune Cells and Lysosomes
Cell Loss	Stem Cells; SCNT (Therapeutic "Cloning")

Dr. de Grey has thrown down the gauntlet to his peers: *prove us wrong*. So far, maddeningly, his colleagues have refused to take him up on the challenge: his opponents either dodge the argument, or fail to provide any real analysis of the feasibility of SENS. So to take things to the next level, de Grey went beyond his original eight-member expert roundtable, bringing together *hundreds* of academic researchers into biogerontology (the biology of the aging process) for a global conference on the SENS platform.

### The World Congress

Dr. de Grey realized that part of the reason for his colleagues' ongoing dodging of the challenge presented by the SENS program was based on a combination of ignorance with gut feeling, leading to a vague, irrational feeling of unexamined pessimism. The key would be to get his fellow biogerontologists together with researchers

working on those obscure shortcuts on the road to SENS, and *show them* that the roadblocks they anticipate exist primarily in their own imaginations.

So when Dr. de Grey was inaugurated onto the Board of Directors of the International Association of Biomedical Gerontology (IABG), he saw the chance to *force* his colleagues to confront the progress being made on the key scientific advances needed for implementing SENS: the upcoming Tenth IABG Congress (IABG 10).

By taking the mammoth task of organizing the Conference almost entirely onto his own shoulders, Dr. de Grey was able to ensure that the scientific presentations at IABG would focus on the bold theme of the imminent feasibility of genuine anti-aging medicine – and, specifically, on research contributing to SENS. Moreover, he changed the standard format of the conference, inviting not only the academic biogerontologists that make up the IABG membership, but also biotech wizards and a few of the “gifted amateurs” passionately pursuing life extension as a very personal experiment.

The result was reminiscent of the penetration of AIDS advocacy groups into academic conferences on HIV in the mid-1980s: the usual academic's ivory-tower view of aging as a merely *academic* problem could not survive IABG 10's heady fusion of cutting-edge biogerontological research presented in an environment fertile with the entrepreneurial spirit of biotech capitalists and the existential urgency of men and women acutely aware of the ticking of their own biological clocks.

Those participants heard of progress on every front – and thanks to the volunteer efforts of Kevin Perrot of the Immortality Institute,<sup>6</sup> you can hear nearly all of the speakers' presentations online;<sup>7</sup> the abstracts are also on the Web,<sup>8</sup> and the full papers appeared in the *Annals of the New York Academy of Sciences* this summer. Researchers at IABG 10 reported studies on genes that can reverse the process of senescence (cellular “aging”) – at least, in the test-tube.<sup>9-13</sup> Cellular studies were described in which some of the genes currently held in the precarious housing of the

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mitochondria have been moved into the much more protected “bomb shelter” of the cell's nucleus<sup>14,15,16</sup> – an intervention which, if implemented across the mitochondrial

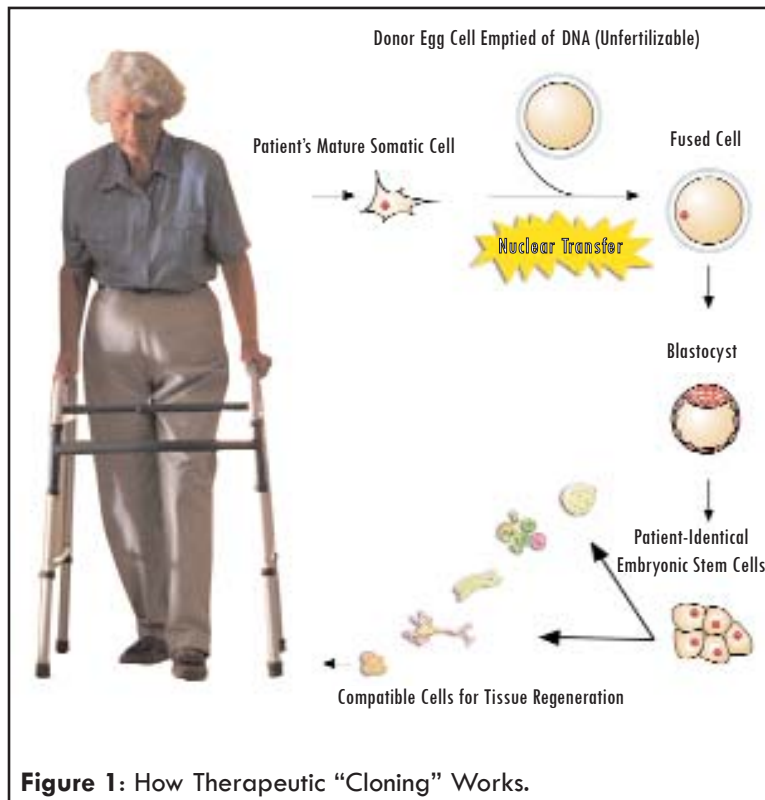
genome in a living person, is expected to sever the major link between free radical production and the aging process.<sup>2,17</sup> Early results were reviewed from clinical trials using first-generation drugs that not only slow down the accumulation of **Advanced Glycation Endproducts (AGE** – proteins whose structure has been warped, and whose function has been impaired, by chemical reaction with blood sugar), but *break* them after they're formed;<sup>18</sup> the drugs are crude, limited, and prone to side effects, but could initiate a new class of ever-better agents to rejuvenate crosslinked tissues. Research on **mIGF-1**, a special form of the active signaling molecule released by growth hormone, has shown that it can allow old mice to regenerate their muscles in response to injury by mobilizing stem cells<sup>19</sup> – without the apparent “pro-aging” effects of growth hormone or “regular” IGF-1. And scientists from the Delaware Biotechnology Institute revealed that they can now correct genetic defects in isolated cells by activating the cell's own DNA repair pathways and directing them to specific mutated sites.<sup>20</sup>

The power of the interdisciplinary approach was epitomized at IABG 10 by the presentation of Dr. John Archer of Cambridge, a scientist who has spent years researching the use of specialized microorganisms to clean up hazardous environmental sites. Dr. Archer has now identified enzymes from soil bacteria which can digest the insoluble, aggregated gunk that clogs our cells as we age,<sup>21</sup> – cellular “toxic waste,” whose accumulation leads to age-related diseases such as age-related macular degeneration, atherosclerosis, and Alzheimer's disease and apparently contributes to aging *itself*.<sup>22</sup> The next step is to develop ways of delivering these enzymes into our lysosomes (cellular “hazardous waste recycling centers”), where they can finally clean up these uniquely biological toxic waste dumps while we're still alive to benefit from the process.

If this sounds a like a wild, unproven notion, you should know that this very strategy is *already* used to treat **lysosomal storage disorders** – genetic disorders caused by the body's inability to produce the body's *normal* complement of lysosomal enzymes. And **crude, early versions of the therapy have been shown to partially reverse atherosclerosis<sup>23</sup> and neurodegenerative disease<sup>24</sup>** in experimental animals.

### Therapeutic Cloning

Perhaps the most controversial aspect of the SENS program is its proposed use of **embryonic stem cells** – and the likelihood that the best way to use stem cells will be through the technique of **somatic cell nuclear transfer (SCNT)**, or “therapeutic cloning.” The use of the term “cloning” to



**Figure 1:** How Therapeutic “Cloning” Works.

SCNT medicine has already been used to cure many of the devastating conditions for which treatments must still be found.

describe this emerging medical technique is unfortunate, because the technique doesn't involve what making “clones” of people at all.

In SCNT, a donor provides an unfertilized egg to scientists, who empty out the original cell nucleus. They then replace that nucleus with a nucleus taken from the person who needs stem cells – using, for instance, a cell from the inside of his or her cheek. The scientists then use chemicals or a zap of electricity to fuse the egg with the patient's nucleus, kick-starting the creation of stem cells. These new, youthful cells replace old, damaged, or destroyed cells and tissues in the patient's own body (see **Figure 1**).

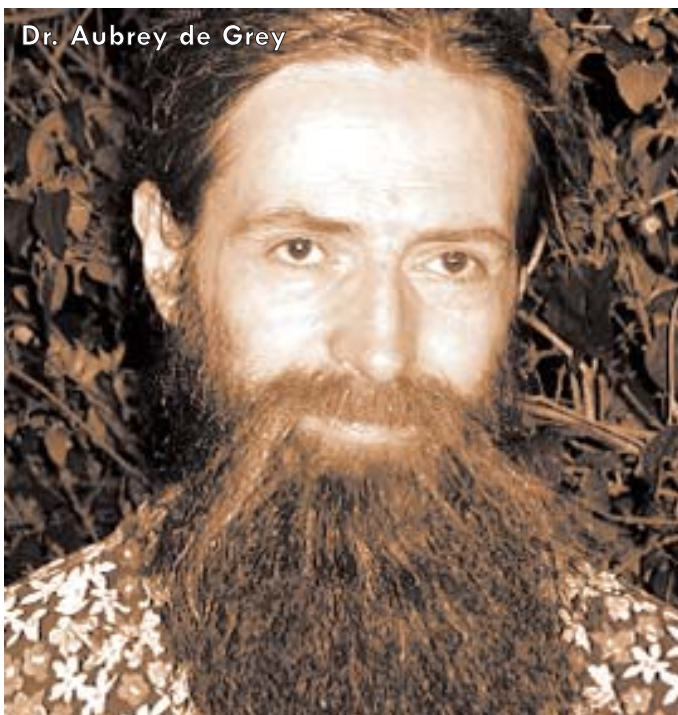
There is a clear distinction to be drawn between SCNT – *therapeutic* “cloning” – and *reproductive* cloning, which is the use of similar techniques to clone a baby. No egg is fertilized by a sperm; no new, unique DNA identity is created; no embryo is implanted in an uterus; no pregnancy results. SCNT technology creates cell life, not human life: renewed cells, not new people. In fact, the balls of cells used in SCNT are still at such an early stage that, even if placed into a womb, they can still go on to become either one, or two, or even more *different* people (which is how identical twins are formed). Fundamentally, you are being cured with *your own cells*, restored to the potential they had in their first moments of existence.

The therapeutic potential of SCNT is far greater than that using adult stem cells or stem cells derived from embryos

left over from *in vitro* fertilization (IVF). Unlike adult stem cells, cells derived from SCNT are “pluripotent:” they harbor the power to become *any* kind of cell in the body – specialized neurons for patients with Parkinson’s disease, or heart muscle cells for victims of massive heart attacks, for instance. And while IVF embryonic stem cells also hold this flexibility, these “master cells” have a potential weakness: the risk of immunological rejection. Embryonic stem cells derived from IVF contain the DNA of the fertilized egg of the *donor couple*, not the recipient, so the immune systems of patients receiving these cells may attack them as immunologically “alien.” But SCNT cells are an exact genetic match to those in your own body, and are treated as ‘self’ by your immune system.<sup>25</sup> Freedom from the specter of rejection, graft-versus-host disease, and a lifetime spent on toxic immunosuppressive drugs is another clear therapeutic advantage of SCNT cells.

In preliminary, preclinical research, the new regenerative powers of cells derived from SCNT have already shown their promise. In animal models, **SCNT medicine has already been used to cure many of the devastating conditions for which treatments must still be found**, such as **Parkinson’s disease**<sup>26</sup> and **heart attack damage**.<sup>27</sup> And because the results were obtained faster, required fewer cells, and led to fewer side-effects, than had been observed in previous studies using adult (bone marrow) stem cells or embryonic stem cells from IVF, these studies suggest that SCNT therapy is clinically superior to what can be achieved with adult stem cells.

The researchers who performed the Parkinson’s study believe that their technique could also be used to treat



Dr. Aubrey de Grey

SCNT research has been criminalized in Canada. Similar legislation is pending in the United States.

**Multiple Sclerosis** and other demyelinating disorders, **Huntington’s disease**, **ALS (Lou Gehrig’s Disease)**, and **other motor neuron diseases**.<sup>26</sup> Scientists have also cured the animal equivalent of the “bubble baby” syndrome (SCID) in fully-developed, adult organisms born with the disease through the use of SCNT.<sup>28</sup> In related research, embryonic stem cells harvested from leftover embryos in fertility clinics have been used to cure animal models of **juvenile diabetes**,<sup>29</sup> **spinal cord injuries**,<sup>30</sup> **Multiple Sclerosis (MS)**,<sup>31</sup> **stroke**,<sup>32</sup> **cerebral palsy**,<sup>32</sup> and other diseases.

Several presenters at IABG 10 unveiled work which, while less dramatic than these cures of animal models of disease, will be important to our ability to fully master this emerging new regenerative medicine. And as several researchers emphasized, SCNT and embryonic stem cell therapy will be crucial to our ability to conquer aging itself.

<sup>33,34,35,36</sup>

But access to the new regenerative medicine requires the overcoming of an enormous roadblock which has nothing to do with science and everything to do with politics. In the panic which has surrounded wild claims of *reproductive* cloning by crackpot religious cults, and the artificial balling together of embryonic stem cell research – and SCNT in particular – with the abortion debate, severe restrictions have already been placed on *all* embryonic stem cell research in the United States by the Bush administration. In Canada, embryonic stem cell research is legal – but **under Bill C6, SCNT research has been criminalized in Canada**: scientists pursuing SCNT research face fines of up to \$500 000 and imprisonment for up to 10 years. **Similar legislation is pending in the United States**, sponsored by Sam Brownback in the Senate (S 245) and Representatives Dave Weldon and Bart Stupak in the House (HR 234).

These bills would *imprison* scientists for working on cures for the most terrible diseases we know. In fact, if a doctor uses SCNT to cure a patient, **these bills would put both the healer and the healed in jail** – even if they went overseas, outside the jurisdiction of the imposing government, to receive the treatment! The bills slam the door shut on treatments for victims of Alzheimer’s disease, MS, spinal cord injuries ... and in the end, *all of us*, as we fall prey to the degenerative process of aging. If these breakthroughs are to be brought into the lives of suffering patients, these bills must be stopped.

#### **Methuselah Mouse, Methuselah (Wo)Man**

IABG 10 also showcased advances in other fields essential to the SENS agenda of not just *fighting* aging, but *beating it back* – actually *reversing* the age-related decay of our

bodies. The research synthesized in the SENS roundtable clearly shows that with the right combination of committed scientists, dedicated research funding, and the political will to put them together, the human condition can be transformed. In a post-SENS future, our cells and tissues can be renewed and our lives extended in good health – perhaps indefinitely.

But at the moment, research can't even get started, because of a perverse interface of research needs, public perceptions, and political realities. Before we can put an end to aging in humans, we will have to successfully test any would-be age-reversing therapy a mouse, just as we would with any other medical treatment. That will require big investments in cash and brain power – which normally means government funding. But because reversing aging is widely believed to be impossible, politicians don't dare to “waste” taxpayer dollars on such a “delusional” project.

But that leaves us stuck in a catch-22, because the best way to smash through that disbelief is exactly for scientists to create that rejuvenated mouse. So until scientists succeed in undoing the aging process, the very skepticism that blocks funding for the research needed to accomplish that goal will remain in place. Facing this vicious circle, researchers, don't even bother to write up grant applications seeking the funds they need to do the work. So public skepticism leads

or induces a sweeping anti-aging effect that dramatically extends lifespan and preserves

to no funding leads to no research ... leads to public skepticism!

In 2002, Dr. de Grey was approached by entrepreneur David Gobel about a bold, “outside-of-the-box” – or in this case, “outside-of-the-coffin” – strategy to break out of this deadlock: the **Methuselah Mouse prize**. Simply put, the idea is to give aging researchers an extra motivation to test serious anti-aging interventions in animals. A large cash prize – set up through tax-deductible donations to the Methuselah Foundation, a registered charity – will be awarded to scientists who can show that their intervention has led to new records for the longevity of a mouse. One prize exists for *slowing* aging; another, for *reversing* it, by extending the lifespan of an animal that is *already* old.

By its very structure, a prize mobilizes several *different* groups of researchers to work on the problem, and likely using *different kinds* of interventions, without requiring any up-front money to be raised for an effort that might succeed or fail. It rewards success, and success only. In the end, the best mouse wins.

The competitive structure has another advantage: it's exciting. It sparks the imagination. And when people see that serious research labs around the world are actually in a race to retard or reverse aging, they will begin first to hope, and then to believe, that it can



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be done. And this belief leads, ultimately, to the demand that government funding be liberated to achieve the same ends in humans. When that informed optimism becomes the view of most people in the developed countries, then the vicious circle of pessimism will be broken, and the War on Aging will have truly begun.

### What You Can Do Now

Dr. de Grey has given his informed guess that, with sufficient intellectual and financial capital, we could have the first age-reversing therapies in place in as little as



Stem Cells Differentiating into Neurons (Red) and Supporting Glia (Green). Image courtesy of the University of Wisconsin, Madison

thirty years. But thirty years can be a long time to wait, even if you're thirty – let alone if you're sixty. What can you do, *today*, to help insure that you're around to benefit from the coming conquest of aging and death? In increasing order of importance:

#### 1. Clean Livin', and a Few Promising Supplements

If you're reading *Advances*, you're probably already doing what you can to guard your health: eating plenty of fruits and vegetables; avoiding starchy carbs and saturated and *trans*-fats; getting some exercise; maintaining a healthy weight; wearing your seatbelt; and taking some basic nutritional supplements – such as essential vitamins and minerals – to avoid frank deficiencies which might lead to *early* cancer or heart disease.

There is no proof that supplements can actually do more than this, and actually impact aging. But there is *some* promising evidence for a few supplements. If you're willing to take a small gamble, the consumption of a few capsules of **R(+)-lipoic acid**,<sup>37-40</sup> **Benfotiamine**<sup>41-44</sup> and **Pyridoxamine**<sup>45-47</sup> seems worth while: clinical trials have proven them safe when used as directed, and they all interdict what are believed to be basic mechanisms of aging *in the living body* – as opposed to most “anti-aging” supplements, whose molecular effects have only been demonstrated in test tubes.

But it would be foolish, at this stage in our knowledge, to rely on these steps *alone* to save you from aging. The fact remains that **no dietary supplement has yet been shown to actually stave off biological aging.**

#### 2. Calorie Restriction

So far, calorie restriction (CR) is the only *proven* way to slow down the aging process in mammals.<sup>48,49</sup> CR is a remarkably simple intervention: reduce an organism's intake of Calories to an amount less than what its body “thinks” it needs, without compromising the intake of essential nutrients, and somehow you activate a primordial survival reflex in which the body's defenses against aging are revved up, keeping it young and healthy beyond its merely “natural” evolutionary “warranty period.” **CR induces a sweeping anti-aging effect that dramatically extends lifespan and preserves health.**

The effects of CR have been documented in a vast range of species, from roundworms and yeasts to fish, lab rats, dogs, and cattle. And increasingly powerful evidence suggests that this anti-aging lifestyle will also work in primates – including *human* primates.<sup>50-52</sup> If you are driven to start slowing down fundamental aging *now*, rather than waiting impatiently for the more effective – but perhaps far-off – anti-aging medicine of tomorrow, then you must seriously consider taking up CR. If you decide to take the plunge, then resources are available to help you get started – notably, the books of Dr. Roy Walford of UCLA<sup>53,54</sup> and the nonprofit **Calorie Restriction Society**:

< <http://www.calorierestriction.org> >.

#### 3. Demand the Decriminalization of Lifesaving Research

The ongoing threat of a ban on research into regenerative medicine using somatic cell nuclear transfer (“therapeutic cloning”) in both the US and Canada is paralyzing our best medical scientists and keeping lifesaving medicines out of reach of desperate patients. Research cannot advance when, any day, investigators engaged in basic science devoted to alleviating suffering and curing diseases, old age, and death may at any time be subject to imprisonment for their troubles.

To learn more about SCNT and what you can do to prevent politicians from banning this lifesaving new medicine, visit the website of the **Coalition for the Advancement of Medical Research** < <http://www.CAMRadvocacy.org> >, a coalition of nationally-recognized patient groups, biomedical organizations, nonprofit foundations, and individuals suffering with life-threatening conditions, demanding the liberation of these breakthrough cures of tomorrow. Although there is no similar central SCNT advocacy center in Canada, the Stem Cell Network < <http://www.stemcellnetwork.ca> > provides some informa-

tion on the Canadian SCNT scene, and you can find contact information for your MP and the Health Minister at < <http://tinyurl.com/2bpkl> >.

#### 4. Sponsor the Mouse!

The day when a mouse – a mammal, like us – in late middle age is regenerated to youthful health and vigour will be the tipping point in the most important battle of the War on Aging. On that day, a youthful lifespan of centuries, free of increasing debility and death, becomes inevitable. By contributing to the **Methuselah Foundation** < <http://www.methuselahfoundation.org> >, you can help generate the research dollars needed to mobilize scientists, and the ongoing publicity to galvanize a pessimistic public, bringing this day closer to realization.

#### The Desire of the Ages

The desire to live is primordial. It is written into the thread of life – woven into the coiled strands of DNA. That which lives, wants to go on living; that which has tasted the vigor of youth can never be satisfied with old age, decay, and death.

Since the dawn of history, human beings have suffered the unique pains of being fully aware of our own mortality. That same consciousness allowed us to craft the tools which have liberated those of us living in industrialized countries from the despair of lives routinely cut short in childbirth, predation, and infectious disease. In the last few generations, those achievements have granted us lifespans long enough that we now suffer from degenerative processes unknown to our forebears: the infirmities of the aging process.

We stand now at a crossroads. Medicine can make only incremental progress in attacking the *diseases* of aging. To save lives, to put an end to the horrors of the warehoused elderly, we must take the next step: the conquest of aging itself. By attacking the molecular damage that underlies the decay of our bodies, biology can be raised triumphant over mere chemistry. A new day will dawn, in which our transient bodies shall be transformed, transubstantiated ... transfigured, into unaging flesh that might last as long as the Universe itself.

It is time to throw off our molecular shackles, and step forward into an eternal summer of youth.

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## Erratum

We strive to make every issue of *Advances* perfect by the time it rolls off the press. However, printer's errors, typos, and simple misstatements do occasionally slip in.

In the Winter, 2003 Osteoporosis Special Edition of *Advances*, in the article page 27, right hand column, we wrote, "The loss of bone ash and bone mineral content caused by the mock-menopause was also prevented by strontium." We documented this finding by citing reference number 49. The correct citation is a cross-reference to reference 37.

This was a technological error, caused by the fact that Microsoft Word's cross-referencing function only updates its output when a document is printed. Because a final print of the original Word document was not performed before passing it on to graphic design and the printers, this cross-reference was not updated.

In the article "Bone-Building Basics," errors were made in discussing optimal protein intake for bone health (page 37, top left-hand paragraph). In converting grams of protein per kilogram of body weight into the more familiar pounds, we mistakenly multiplied by 2.2 instead of dividing. Thus, the article reads, "The optimal intake of protein to support a healthy skeletal system appears to be in the range of 1.0 to 1.5 grams per kilogram of body mass, or 2.2 to 3.3 grams of protein for each pound that you weigh.<sup>68†</sup>" The correct Imperial measurement is instead 0.45 to 0.68 grams per pound. The article then compounds the error by indicating that "This is an intake significantly higher than the RDA for protein, which is set at 0.8 milligrams of protein per kilogram of body mass." The correct figure, of course, is 0.8 grams of protein.

We apologize for any confusion. Our sincere thanks to Dr. Jacob Schor, ND for pointing out the cross-referencing problem, and to Dr. Vince Lurie, ND, of AltaVista Naturopathic Clinic, for alerting us to the conversion errors in the protein discussion.



Advanced Orthomolecular Research (AOR) is dedicated to translating breaking science into research-backed nutraceuticals for support of healthy life extension. But we go forward in the understanding that the only proven anti-aging intervention available today is *calorie restriction* (CR) – and that CR itself is a prescription which few find palatable, and which cannot truly fulfill the dream of radical life extension.

Biological aging is a *disease* – the number one cause of human disability and death. A decisive end to age-related decay and loss of life will require the development of new tools: true anti-aging biomedicines that will not only slow, but reverse, the ravages of aging. **The**

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\*These statements have not been evaluated by the Food and Drug Administration. This product is not intended to diagnose, treat, cure, or prevent any disease.