

# Is **More** Life Always **Better**?

## *The New Biology of Aging and the Meaning of Life*

by DAVID GEMS

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The social consequences of extending the human life span might be quite bad; perhaps the worst outcome is that power could be concentrated into ever fewer hands, as those who wield it gave way more slowly to death and disease. But the worry that more life would damage individuals' quality of life is not persuasive. Depending on what the science of aging makes possible, and on how people plan their lives, longer life might even facilitate a richer and deeper life.

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*He had passed that great meridian, the age of forty, when for every man the process of spiritual evolution stops, and he goes on thenceforward working out to the end a character that has become fixed and unalterable.”—G. Baker, in *Tiberius Caesar**

**T**he American biologist Andrzej Bartke recently showed that a combination of genetic alteration and nutritional restriction can increase the lifespan of a laboratory mouse by around 70 percent.<sup>1</sup> While control mice withered and died, the test animals were still zestfully scurrying about, fleet of foot with glossy fur and unclouded eyes, and apparently as full of *joie de vivre* as any young rodent. Discoveries of this sort are now far from rare. I recently found that alteration of a gene called *daf-2* can increase the maximum life span of male nematode worms from 31 to 199 days—a 6.4-fold increase.<sup>2</sup> If a

nematode life were translated into human terms, this would represent a lifespan of around 700 years.

Common sense tells us that aging is universal, inevitable, and associated with gradual physical decline. But in this case, common sense is wrong. Some animal species, such as tiny betentacled hydra, do not appear to age at all.<sup>3</sup> There exist, for example, individual colonies of corals that are over 20,000 years old.<sup>4</sup> What is more, within the last decade biologists have found that the rate of aging is remarkably easy to alter in laboratory animals such as nematodes, fruit flies, and mice. It is no longer far-fetched to think that one day it will be possible to retard the aging process in humans and extend the human life span.

Do we really want this research to succeed? Some bioethicists have professed horror at the thought of dramatic life extension. Many recoil at the notion of extending the lives of people undergoing irreversible physical decline, like the senile and decrepit Struldbruggs in *Gulliver's Travels*. Yet recent research shows it may be possible not just to extend life, but to extend youth. What if each of us could live a longer life,

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in peak physical and mental health, then suddenly shrivel away at the end, like Dracula when he is exposed to the sunlight? Would bioethicists still be so dour? Perhaps so, yet it would no longer be quite so clear why. There may be reasons to worry, but I want to suggest that aging research raises philosophical questions about the shape and purpose of life that bioethics has thus far failed to address.

### The New Biology of Aging

A revolution has occurred in the biology of aging, transforming a sleepy backwater of research into a rapidly advancing discipline.<sup>5</sup> Up until about fifteen years ago, research into the causes of aging was a somewhat disreputable activity occurring at the fringes of biology. Although the researchers working on aging were few, the number of theories they managed to generate were many—by one estimate, over 300.<sup>6</sup> Not many of these theories have proved useful. The Russian immunologist Elie Metchnikoff believed that aging resulted from toxins released by bacteria in the intestinal tract. He suggested that a yoghurt diet would extend human life span to 200 years. Another early theory had it that aging in men resulted from a reduction in the level of secretions from the testicles. This led to a craze in the 1920s for surgically implanting the testicles of goats or monkeys into the scrotum of the recipient. These crank theories have often found an audience among aging souls all too eager to grasp at the hope of cheating death.<sup>7</sup>

What changed everything was the development of a theory of the evolution of aging with real explanatory power and conceptual beauty. The essence of it was originally seen back

in the 1940s by the British geneticist J.B.S. Haldane, working at University College London, who was interested in diseases caused by defective (mutant) genes. One such disease, Huntington's, puzzled Haldane. Huntington's disease attacks the nervous system, causing uncontrollable flaying spasms (chorea), insanity, and death. It is unusual in two respects: first, it does not strike until later in life—the mean age of onset is about thirty-five. Second, the Huntington's mutation is dominant, not recessive. This means that even people with only one copy of the mutation will get the disease.

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Generally, one would expect that dominant mutations causing fatal diseases would quickly disappear from the population. But as Haldane saw, the awful thing about Huntington's is that by the time the disease strikes, most people have already had children, to whom they have passed the Huntington's gene about half of the time. Thus dominant, lethal mutations can be maintained in a population at a high frequency, so long as their effects are delayed until after reproduction. Haldane's insight solved the evolutionary puzzle of Huntington's.

But instead of stopping there, Haldane went on to make a further brilliant observation. If natural selection

is unable to purge the Huntington's mutation from the general population, what about mutations that do not strike until even later? Could it be that aging itself is the result of mutations that strike very late in life, at an age beyond the reach of natural selection? If this were true, then what we now think of as the process of aging is a form of late-onset, invariably fatal genetic disease caused by genetic mutations that natural selection has been unable to purge from the population. This idea is at the heart of the evolutionary theory of aging. Its essence can be distilled into a single phrase:

the force of natural selection decreases with increasing age after the onset of reproduction.

An elaboration of the evolutionary theory of aging, proposed by George C. Williams, suggests that aging may result from mutations that in early life enhance fitness, but that have harmful effects later in life—the trade-off theory.<sup>8</sup> Because of the relative unimportance of events later in life to reproductive success, a small early advantage may outweigh a later catastrophe. These two theories have been tested experi-

mentally, and the balance of evidence favors the trade-off theory over the simple mutation accumulation theory.

While the evolutionary theory of aging explains why aging occurs, it is not able to explain *how* it occurs—what exactly happens when we age, and what controls how fast it happens. To try to answer this, many biologists who study the genetics of aging work with animals with very short life spans in order to save time. Like a number of others in the field, I work with a tiny nematode worm called *Caenorhabditis elegans*—*C. elegans* for short. These little creatures age and die after a mere two to three weeks. The whole of the *C. elegans*

genome has been sequenced, and a high proportion of *C. elegans* genes have equivalents in humans. Thus, if the genes controlling aging in *C. elegans* are found, they could potentially be used to identify genes controlling human aging.

In classical genetics, the art is to identify genes that control the formation of any particular facet of biology by looking for instances where a single gene has malfunctioned (mutated), producing a defective animal. The geneticist then works back to infer the normal function of the gene. For example, to understand how genes specify the fur color of mice, one might study albinos. Similarly, to understand how genes are related to aging, one would look for mutants where the normal aging process was interrupted, resulting in an increase in lifespan. Surprisingly, nobody thought to take the classical genetic approach to aging until the 1980s. But in 1989, Thomas Johnson at the University of Colorado made a remarkable discovery. He showed that a mutation in a single gene, which he named *age-1*, increased average life span in *C. elegans* by 65 percent.<sup>9</sup> Since that time, geneticists have discovered many life span genes, not only in worms, but also, more recently, in fruitflies<sup>10</sup> and mice.<sup>11</sup>

Evolutionary theory shows us that it is wrong to think of aging as an inevitable consequence of the inherent limits to the durability of biological systems. Rather, the reasons for the occurrence of aging are starkly banal: it is merely a by-product of the process of evolution. It is about as important in terms of adaptation and evolutionary fitness as nipples on men. Life span potential and the rate of aging are genetically controlled traits, like height, sex, or eye color. The secrets of aging and how to block it lie in the genes. The new genetics of aging is starting to reveal these secrets.

### Why Biologists Are Caged

The genetics of aging is widely regarded as one of the most

promising and exciting areas of work in biology, yet biologists are strangely reluctant to advocate the extension of human life, or sometimes even to admit that life extension may be a consequence of their work. Consider the following justifications for aging research grant applications in the United Kingdom:

“Unless we can identify ways through which healthspan can be increased as we age, the strain on healthcare costs owing to the volume of age-related pathologies will be enormous.”

“The results of the study will guide our future ideas about the nature of the ageing process. This knowledge provides an important baseline from which more applied studies to design ageing interventions can be launched.”

“We believe that our findings will eventually have an impact on human health and quality of life.”

“Healthspan,” “human health,” “quality of life”—but not longevity. Some researchers of aging even explicitly deny that their work is aimed at extending life. Publicity material from the recent U.K. Biotechnology and Biological Sciences Research Council (BBSRC) Experimental Research on Ageing initiative reads as follows:

Experimental Research on Ageing (ERA) is a new programme being launched to fund a broad range of science projects on the biology of normal ageing. The aim of ERA is to understand the basic biology of healthy ageing. It is hoped that such information could eventually lead to new treatments that could reduce age related decline and thus increase ‘healthspan’ and improve quality of life for the elderly. ERA is not aimed at lengthening lifespan.”

The last remark is particularly startling, given that lengthening lifespan is exactly what will happen if ERA-

funded research is successful. BBSRC-funded work has involved treatments that dramatically increase lifespan in nematodes, fruitflies, rodents, and yeast. Yet it is easy to understand how we have arrived at this peculiar attitude of denial. Treating the aging process would have two major consequences. First, it would dramatically reduce the incidence of many of the principal killer diseases of the developed world, such as cardiovascular disease, cancer, diabetes, Alzheimer’s disease, and Parkinson’s disease. This is because what really puts us at risk of these ailments is getting old. It has been said of cancer: “advancing age is the most potent of all carcinogens.”<sup>12</sup> This being so, why invest all the effort into investigating these diseases piecemeal, if there is a chance that by finding a treatment for aging one could get the lot in one swoop?<sup>13</sup> As an argument to convince a grant assessment committee to support a proposed programme of research into aging, this is pretty unbeatable.

But lurking in the shadow of this first consequence of treating aging is the second: enhanced longevity. And here some brows start to furrow. Understandably, biogerontologists prefer to be associated with medical research rather than with a field whose history involved goat testicles and yoghurt diets. Yet it is probably also true that biologists, like many others, are unsettled by the possible consequences of increased longevity.

### Worrying about Living Longer

Surely the possibility of longer life is something wonderful. Yet not only bioethicists are sighing and grinding their teeth: within popular debate about the possibility of life extension there are a number of recurrent worries. Uppermost is the possibility of huge overpopulation. This could indeed be a consequence—but not necessarily. In much of the developed world birth rates continue a long decline, and in some countries the death rate now exceeds the birth

rate, and only immigration prevents population decline. To maintain a steady population each woman must bear, on average, 2.1 children; yet in many developing countries, the birth rate is less than this—in Italy, for example, the actual number of children per woman was recently estimated at only 1.2.<sup>14</sup> Such trends could, in the long term, bring about a global decline in population—a happy prospect. Whether or not aging therapies will ever be effective enough to engender overpopulation, this would not provide sufficient grounds to curtail their development and so lose the benefits in terms of reduced disease. After all, advances in medicine along with improved nutrition and hygiene have greatly reduced infant mortality during the last century. This has led to dramatic increases in population, but no one has called reducing infant mortality undesirable.

Another concern is that, in our desperation to avoid death, we end up endlessly prolonging the morbid phase of our lives. Recent popular articles on the subject of the new biology of aging have ruminated over the myth of Tithonus of Troy, whose good looks inspired the love of Eos, goddess of the dawn. Eos convinced Zeus to grant Tithonus the gift of eternal life, but the king of the gods slyly did not also give him eternal youth. With time, Tithonus grew ever more decrepit, yet could not die, until there was barely more of him than his croaking voice. This, of course, mortified Eos, and in the end, as an act of mercy, she transformed him into a grasshopper. Most of us would agree that it makes little sense to postpone death once our quality of life has diminished beyond a certain point. As has been observed, “Most older people fear disability and the dependency and loss of dignity it brings more than they fear death.”<sup>15</sup>

One may also ask whether life extension *per se* constitutes a medical treatment in the usual sense, or something quite different. A distinction is often drawn between medical treatments, which restore us from illness

back to health, and enhancement technologies, which go beyond treatments to make us more than well. Examples of enhancement technologies include cosmetic surgery (face lifts, breast augmentation, and so on), the use of antidepressants such as Prozac to alter personality (so-called cosmetic psychopharmacology<sup>16</sup>), and the use of drugs or hormones to enhance athletic performance. Enhancement technologies raise all sorts of tricky ethical problems, relating to authenticity and identity, for example.<sup>17</sup> Life extension bears more than a passing resemblance to an enhancement technology, as long as the current average life span is considered healthy—to extend a life beyond the current average span would be to go beyond what health requires. Similarly, as with many enhancement technologies, its value is strongly culturally determined and it could lead to alterations in identity. Guilt by association with the disreputable forms of enhancement is likely to reinforce the desire of biogerontologists to distance themselves from life extension.

Another important issue that has been considered previously is distributive justice: greatly increased longevity for the rich alone would be hard to stomach for those without access to such treatments. More seriously, this might also result in a further concentration of wealth and a widening of inequality. It has also been suggested that access to life extension technology might be considered a fundamental human right, like that of access to education. But as biogerontologist Leonard Hayflick has asked, should such a technology be made available to all—even murderers?<sup>18</sup> Should we rejuvenate Charles Manson? Hayflick also touches on a more worrying issue, that of preventing the aging of tyrants.

### The Political Value of Aging

This is why I fear research into aging. If treatments had been available in the twentieth century that

halved the rate of aging and doubled lifespan—as some mutations do in *C. elegans*—Mao Tse Tung might still be alive. He would be the equivalent of fifty years of age, and might not be expected to die a natural death until 2059. Worse still, Joseph Stalin would be “sixty-three” and would live until 2027. Do we really want anti-aging therapies in the hands of Robert Mugabe, Fidel Castro, or Kim Jong Il?

Historically, a great benefit of aging has been deliverance from tyranny. It is biology’s analog of the most successful feature of parliamentary democracy: an effective means to dispose of bad leadership. Even under tyranny one can at least wait, and hope to outlive one’s oppressor. For this reason alone, anti-aging treatments represent a very serious threat to humanity in the long term. The happy events of 1989 should not delude us as to the inevitability of ultimate, unending global democracy. Consider the possibility of a global dictatorship with a non-aging president. Remember the words of O’Brien to Winston Smith in Orwell’s *1984*: “If you want a picture of the future, imagine a boot stamping on a human face—forever.” This “forever” is what biogerontological research has the potential to achieve.

Doing away with Stalin is the most benign example of a more general benefit for society of aging: the redistribution of power. Less important, but still worrisome, is the possibility of extending the lifespan of business tycoons. One may easily envisage problems arising from energetic, supercentenarian tycoons, in the mould of the media magnate Rupert Murdoch, relentlessly and rapaciously expanding their business empires, and concentrating power in their hands. But perhaps with effective legislation to prevent such accumulations of power and wealth, akin to those that guard against monopolies, such threats may be disarmed.

A quite different nest of worries relates to the value of life extension itself—that is, its effect on quality of

life in the one who experiences it. Would life inevitably become boring—even to the point that it would not be worth living? This is the meat of this discussion. There are two factors that will affect how much we ought to want life extension and that have not previously been considered. One is the progressive psychological changes that occur during normal aging, the other the character of the life plan or life narrative in whose context much of what we do has meaning.

### **Pessimism and the Repeatability of Experience**

One problem with living a lot longer is that one might end up having experienced all there is to experience and arrive at a state of terminal boredom. An example of an unhappy Methuselah is Elena, the 337-year-old opera singer in Karel Capek's play *The Makropulos Secret*.<sup>19</sup> She describes her condition as “not so much boredom as frozen, soulless emptiness, such that the short-lived people around her seem little more than shadows.” The play ends with all the *dramatis personae* gloomily rejecting life extension and burning a paper bearing the recipe for Elena's anti-aging elixir.

Why does Capek think life extension is so terrible? In part, it reflects a pessimism that was fashionable among intellectuals during the early twentieth century (the play was published in 1922). Modern audiences might not be so sympathetic with the play's ending.

Central to such pessimism is the notion of the absurdity of human endeavour. Here is Moritz Schlick, describing Arthur Schopenhauer's views:

Man sets himself goals, and while he is heading towards them he is buoyed up by hope, indeed, but gnawed at the same time by the pain of unsatisfied desire. Once the goal is reached, however, after the first flush of triumph has passed away, there follows inevitably a mood of desolation. A void remains, which can seemingly find an end only through the painful emergence of new longings, the setting of new goals. So the game begins anew, and existence seems doomed to be a restless swinging to and fro between

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pain and boredom, which ends at last in the nothingness of death.<sup>20</sup>

What is immortality to Sisyphus but the cruelest element of his punishment? Yet really this is an unrealistically gloomy assessment of the character of goals and desires and their place among the things that make life engaging. I often think, in this context, of my parents. I am pretty certain that however much their lives were extended (with reasonable health), my father would continue to enjoy going sailing, and my mother writing plays and gardening. While it certainly is true that some desires have the Schopenhauerean quality of disappearing upon their attainment, many do not. More importantly,

many are highly repeatable—though the capacity of desires to be revived and rekindled varies with the type of experience concerned. Some take a long time before their repetition does not involve a diminution of quality. And some can never be repeated—particularly where the experience involves a discovery; to be rediscovered, a thing must first be forgotten, and some things are hard to forget. Nicholas Saunders has spoken of parachute jumping as an example of an unrepeatable experience: no jump can ever be quite as vivid as the first.<sup>21</sup>

Some people seem especially able to enjoy endless repetition of the same experience, a quality that one may value or despise. Leon Kass, imagining a possible 25 percent increase in lifespan, has asked: “Would the Don Juans of our world feel better for having seduced 1,250 women rather than 1,000?”<sup>22</sup> I can accept that on his deathbed, the extra 250 women might not seem that important to Don Juan. But if he was only at number 1,000 and was offered an extra 250, one can only imagine his joy.

### **Aging and Rigidity of Identity**

Consider the fact that, on the whole, people become more set in their ways as they get older. One cannot, it is said, teach an old dog new tricks. One informal study has suggested that as we grow older, windows of receptivity for the acquisition of new tastes close progressively—for one particular fashion (tongue-piercing) by age twenty-three, for popular music by thirty-five, and for an alien food type (sushi for Kansans, say) by thirty-nine.<sup>24</sup> Admittedly, these findings were not published in a peer-reviewed scientific journal—in fact, in general, studies of age-related changes in personality are notoriously difficult to reproduce.<sup>25</sup> Yet for primary



language acquisition, for example, a tight window of receptivity certainly exists.

If a prerequisite for enjoying a greatly extended life is the capacity to change and develop oneself, find new interests, and develop new ambitions and desires, then the loss of flexibility with age limits the value of life extension. In this sense Elena Makropulos's condition could really be horrific: extended life accompanied by progressive straitjacketing of the mind and ossification of the self, resulting in the condition of a mental Tithonus.

This raises an important empirical question about the relationship between biological and cognitive aging. Why do people so often become more conservative as they get older? Is it a property of mind—of the same sort as the acquisition of knowledge? Or is it the consequence of age changes in brain neurophysiology?

I suggest a hypothesis about the character of aging itself. Consider the honeybee. Among worker bees are many castes performing different roles in the maintenance of the hive. At the end of pupation, the newly emerged worker bee takes on the role of nurse bee, feeding the growing larvae and tending to the queen. After a while, she transfers to hive-cleaning duties. Then, typically at the age of around three weeks, she undergoes a major physiological change—her hormone levels alter and there are transformations in the structure of her brain—and she leaves the nest to start work as a forager, seeking out flowers, collecting nectar and pollen, bringing it back to the hive, and communicating its whereabouts to other foragers. From the time that she becomes a forager, her life expectancy is around three weeks. Toward the end of her life, she may take on a fourth role, that of soldier and defender of the hive.

Biologists refer to this phenomenon of serial adult identities as social development, or age polyethism, and it is a marked feature of eusocial animals—those that live in colonies where there is a single reproductive queen.<sup>26</sup> These include bees, ants, and termites, and one mammal: the naked mole rat, colonies of which live in big underground nests in parts of East Africa. An interesting possibility is that something akin to age polyethism occurs in human beings. In fact, humans' high degree of social structure and interdependence is reminiscent of eusocial species.<sup>27</sup> We even

*The extension of lifespan might not simply be more of the same, but rather, it could create a larger foundation upon which a life of greater scope, possibility, and achievement may be constructed.*

have non-reproductive adult females: post-menopausal women. Are we soul brothers of the naked mole rat?

Admittedly, such parallels are a little far-fetched, but let us stay with this idea for a while. The presence of age polyethism in humans would imply a concerted program of biological changes in our brains, occurring during the course of adulthood.<sup>28</sup> From my own experience, I am amazed by how much my character has changed over the years. Once in 1978, at the age of seventeen, I went to a small club in Torquay to see a punk band called The Damned. The venue was chock-a-block with sweat-soaked, drunken teenagers, and the music was so loud that my ears rang for weeks afterwards. I believe that I suffered slight but permanent damage to my hearing when the singer, Dave

Vanian, slid his microphone over the low ceiling to create a head-splitting feedback. But what is significant is that I thought it all perfectly wonderful. Now, at age forty-two, I am often tormented by pop music (often not even especially loud) in public places. I suspect that this change reflects profound age-related psychological changes affecting not only my musical tastes (this morning I listened to Mozart's *Waisenhaus Mass*), but also my aesthetic and moral sensibilities. In my teens I once tried to add synthetic estrogens to the water supply of a caravan where an old, one-eyed school warden lived, in attempt to get him to grow breasts. I would not dream of doing such a thing now.

The possibility of something like age polyethism in human beings raises interesting questions relating to the value of life extension. For example, it suggests that one might distinguish forms of adult maturation or character development that are biologically programmed from those that are simply the result of accumulated experience. Imagine three individuals who had undergone life extension, but in whom the progression of age polyethism was arrested at different stages, equivalent, say, to the ages of seventeen, forty and sixty-five years. In an important respect, each of them would continue to mature, acquire experience, develop new abilities, interests, and perhaps new vices. Yet somehow each would retain characteristics of the stage of arrest. For example, the "seventeen year old" might grow wiser yet retain a stage-typical plasticity of identity—and perhaps continue to enjoy having his ear-drums rattled in a mosh pit at the age of 150.

Perhaps the most desirable outcome would be this: if one understood the neurobiological basis of age polyethism, one could develop the

means to select at will the stage at which one wanted to live. Such a capacity would also affect the length of life that, given the choice, one would select. For surely the process of becoming progressively set in one's ways with increasing age helps to make more bearable the diminution of one's life expectancy with increasing age, since it makes it less likely that one's identity will alter and give rise to new ambitions and desires. It has often been argued that a blessing of the aging process is that it encourages us to weary of life, thereby drawing the sting from death. Yet if it were possible, when experiencing the ennui of a very long life, to revert to the biological mental age of a seventeen-year-old, with the relative plasticity of identity that would result, one could then undergo a renewed adult ontogeny, bringing with it new desires, tastes and ambitions, and a renewed desire to live. In such a future, young and old minds would live side by side—as now—yet either could be chronologically ancient. This would be akin to replacing the cycle of life and death of a perennial flower with the cycle of renewal of a deciduous tree.

But to return to biologists' caginess about life extension: the occurrence of patterned psychological changes with increasing age raises serious questions about the quality of extended lives. Clearly, at least, we may not assume that life extension of the magnitude of that achieved in nematodes and rodents would be, like good health, simply more of the same.

### Life Plans and Expectation of Future

The added value to human existence of increased longevity may be further explored by means of a thought experiment. Suppose that it were possible to eliminate entirely the outward symptoms of senescence without increasing life span. One may imagine the resulting people, who would retain the appear-

ance of being somewhere between twenty and forty years old throughout their adult life. They would then die suddenly, typically in their eighth or ninth decade. Furthermore, death would be painless, not involving illness or disease—a sudden loss of consciousness, preceded optionally for a few days or weeks by some form of painless, unambiguous indicator of impending death to allow time for goodbyes. Such non-aging mortals might fear death, but they would have no cause to fear the process of dying, any more than they should fear falling asleep. Such a life would represent the perfect fulfilment of the current stated aims of biogerontological research programs such as BBSRC ERA.

Such evergreen mortals might elect to undergo a life-extending treatment either because they want a longer life, or because they are afraid of death. Arguably, considered apart from the questions of one's reasons for wanting to live, for the evergreen mortals the actual process of dying is something of a non-event. As for death itself . . . as the Epicurian adage rightly has it: when death is there, we are not, and when we are there, death is not—really, we should not fear it.<sup>29</sup>

So our evergreen individual has rationalized away his fear of death. It would not surprise us to learn that he still chose to extend his life. Several factors might influence how much such an evergreen individual would want such a treatment, and how much of such a treatment he would want.

In *The Human Encounter with Death*, Stanislav Grof and Joan Halifax describe the difficulties that terminally ill cancer patients experience in coming to terms with death.<sup>30</sup> It is generally held that death is more tragic when it occurs in the young, since it is premature, coming before its victims have had the opportunity fully to live out their lives. This is borne out by the particular difficulty experienced by younger cancer patients facing im-

minent death. According to Grof and Halifax, this has less to do with fear of imminent nonexistence, or even the horror of dying, than with the difficulty of accepting that plans for the future will not be fulfilled. A focus of Grof's psychotherapy (which included the use of the psychedelic drug LSD) was to help the patients to radically alter and curtail their conceptions and expectations of their future lives. A measure of the efficacy of such treatments was, according to Grof and Halifax, that patients often required less pain medication.

Arguably, the most transformative element of effective anti-aging treatments would be to bring about an expansion of one's future. Expectation of a future of a given, approximate length provides the foundation for our future plans and expectation of the trajectory of our lives. This sense of future is one of the mainstays of the framework of meaning in which many of our actions make sense. To use the current argot, "Human actions are embedded within the narrative of a human life, and human lives are embedded in larger social narratives."<sup>31</sup> From this it follows that the value of an extension of future will be influenced by the sort of life narrative or life plan a person has.

Where do life narratives come from, and do they exhibit general features or fall into distinguishable types? Presumably, like other facets of human culture, individual life plans draw on a common cultural stock of life narrative elements that have evolved over the millennia of human cultural history. This being so, one would expect that many such components will have evolved within the constraint of the twenty to fifty years of active adult life typically available to our ancestors.

If the value of life extension depends upon the sorts of life plans people possess, then to evaluate life extension one needs to ask what sort of different life plans there are, and how they affect the value of life ex-

tension. There certainly are differences in the sort of life plans that people possess. Some are relatively static, such that the desired future is essentially a continuation of things as they are: carrying on in the same or similar relationships, doing a similar job, or pursuing similar past-times. In others, the focus is on the achievement of specific goals—getting married, having children and seeing them through university, reaching the top of a promotion ladder, or paddling across the Pacific in a canoe. A key feature of this sort of life plan is that a given goal can be reached (however unlikely its achievement may be). The life has discrete milestones and an end point—at least theoretically. In still other life plans, however, goals may be more open-ended. Consider a medical researcher who wishes to relieve as many people as possible from suffering, or an entrepreneur who wants to make as much money and acquire as much power as possible.

An interesting type of life plan is that which can lead to changes of personal identity, and consequently, to an altered life plan. This in turn can further alter identity, producing another alteration in life plan, and so on. Such cycles of change could end with the appearance of other types of plan. The Western *Little Big Man* depicts this life plan; the hero, played by Dustin Hoffman, is by turns a Cheyenne brave, a Christian evangelist, a quack medicine salesman, a gunfighter rubbing shoulders with Wyatt Earp, a drunken hobo, and a scout working for General Custer's 7th Cavalry, which he sees cut down at the battle of Little Big Horn.

Other life plans may be directed, with self-development as a goal. They are therefore less open-ended, insofar as they aim to remain open-ended. An example here is the life plan of someone whose ambition is to become ever wiser, or creative in new ways. Perhaps Leo Tolstoy lived this way.

To some degree, the different types of life plan are typical of different ages, or stages of life. The *Little*

*Big Man* pattern is characteristic of youth and early adulthood. Between adolescence and the age of perhaps thirty, many people pass through multiple cycles of transformation of life plan and identity, as they “discover who they are” or “find themselves.” To some extent, one may distinguish varying degrees of maturity in life plans, particularly as there develops a better sense of one's own capabilities (or *arête*, as the ancient Greeks would have it). Similarly, static life plans may become increasingly common among older people, for example among those who have fulfilled or abandoned their aspirations.

The type of life plan that one has, or is likely to conceive, may affect the value of a possible extension of future. In the case of static plans, where the possibility exists of wearying of such a life, the value of an extended future may be relatively low. In the case of fixed goal life plans, the value of life extension will depend on whether the plan is realizable. Someone might choose to extend his future indefinitely in the hope of witnessing the Second Coming of Jesus. In the case of open-ended plans, the value of extension may be higher, since the conception of new plans is likely to bring with them the desire for more time to fulfil them.

If life plans involve a framework within which our actions have meaning and are of a traditional length, then life extension might appear superfluous. But this, of course, is no argument against life extension. The possibility of conceiving life plans on a grand scale represents an exciting challenge.

### A Life of Greater Scope

It is impossible to say whether life-extending treatments will ever actually be developed. But simply to state that human life extension is not an aim of biogerontological research ducks the issues. Yet, biologists are bound to be more concerned with obtaining funds to continue their research than with resolving the tricky

ethical problems associated with life extension (and convincing review panels)—especially since the potential medical benefits are so great.

Life extension poses some intriguing problems.<sup>32</sup> For me, the most chilling of these is the prospect of power concentrated relentlessly into the hands of a few undying individuals—and particularly into the hands of tyrants. Concerns about the effect of more life on the quality of life, however, are less compelling. Depending partly on whether one retained the mental plasticity of youth as one aged and on whether one opted for an open-ended life plan, extending a life has the potential to improve it. Thus, extension of lifespan might not simply be more of the same, but rather, it could create a larger foundation upon which a life of greater scope, possibility, and achievement may be constructed.

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