The Economic and Humanitarian Imperatives of Hastening the Medical Control of Aging

Aubrey de Grey

As of today, most commentators view global population—both its level and its growth trajectory—as a problem, and I agree. In October 2011, the total number of people alive passed the 7 billion mark, and there is little doubt that progressive alterations to our environment, both in terms of global warming and pollution, are occurring at a more rapid rate than it would be if there were fewer of us. We see this in the never-ending stream of increasingly dramatic images on the world's front pages.

But there are silver linings. First, and almost unnoticed, we recently passed the peak in the rate of growth of the population. When measured as a percentage relative to prior levels, this peak occurred a few decades ago, and now it has also peaked when measured in absolute terms: United Nations statistics show that global population took about 12 years and four months to grow from 6 billion to 7 billion, compared to under 12 years to go from 5 billion to 6 billion.[1]

Perhaps even more significant cause for optimism, however, is found in other realms. Ultimately, as critics of Thomas Robert Malthus have

Aubrey de Grey *is a biomedical gerontologist based in Cambridge, UK and Mountain View, California, USA, and is the Chief Science Officer of SENS Research Foundation. Dr. de Grey is Editor-in-Chief of Rejuvenation Research, the world's highest-impact peer-reviewed journal focused on intervention in aging. He is Fellow of both the Gerontological Society of America and the American Aging Association, and sits on several editorial and scientific advisory boards. He received his BA and PhD from the University of Cambridge.*

observed ever since he made his famous predictions of global misery, the human carrying capacity of our planet is a moving target, perpetually rising as a result of technological advances. The issue, therefore, is whether this capacity can rise as rapidly as population does. But unlike population, carrying capacity does not rise smoothly. Instead, it occurs mostly in spurts that result from specific advances—and these developments have particularly dramatic consequences. Thus far, most of these advances have been in the field of agriculture. Today, an acre of land can now feed far more people than in years past. Another important area has been the identification of less-polluting alternatives to the first-generation materials that have traditionally been included in certain technologies, such as the ozone-degrading chemicals in refrigeration.

The human carrying capacity of our planet is a moving target, perpetually rising as a result of technological advances.

But possibly the single most important source of human damage to the environment, the use of fossil fuels, has yet to be significantly addressed by technology. How, then, might anthropogenic climate change be tackled in the medium and long term? In this essay, I address two technological developments that will be crucial to this challenge: fusion power and medical rejuvenation. I dispute one particular notion of popular concern, namely the possible exacerbation of climate change by the development of truly effective medicines against aging and their perceived consequences in terms of overpopulation.

FUSION FOR ENERGY

The tragic events of March 2011, in the aftermath of the large earthquake off Japan's east coast, called into question the reliability of nuclear energy. In particular, no one anticipated that Japan's highly-rated nuclear energy infrastructure would be so spectacularly unable to contain the damage to the Fukushima plant caused by the resulting tsunami. The worldwide reaction was remarkable, with both the government and private sectors shifting away from nuclear power as a long-term strategy.

On the face of it, this shift sounds like a bad thing for the environment, forcing humanity into even more use of fossil fuels. However, while that may indeed be the result in the short term, a parallel consequence is likely to be a redoubled effort to develop alternative sources of energy. It remains to be seen whether any of the renewable options—wind, wave,

solar, or geothermal—will rise to this challenge. The collapse of the United States' highest-profile solar energy company, Solyndra, cast a long shadow over the renewables realm.

But the story is not the same for the one source of energy that, while not strictly renewable, is still effectively inexhaustible: nuclear fusion. ITER, the primary international effort to develop fusion, remains at an early stage of development (it may be further slowed by financial difficulties arising from the Fukushima disaster), but a number of other initiatives that have garnered less limelight in recent years are regaining momentum: the UK's Joint European Torus (JET, which, like ITER, uses the concept of magnetic confinement fusion), and Lawrence Livermore's National Ignition Facility (NIF, which uses inertial confinement fusion, a technology that relies on extremely high temperatures rather than very strong magnetic fields), are two such examples. Perhaps most interestingly of all, the Canadian company General Fusion's hybrid technology, known as magnetized target fusion, hopes to achieve practical energy delivery at far lower development cost than other approaches, and has obtained funding from Amazon founder Jeff Bezos. Other ventures have attracted similar funding from separate private sources, and even the U.S. government is now getting in on the act. Fusion research has overpromised and under-delivered for many years, but recent developments indicate that at some point it will work, and its medium-term prospects are looking better now than ever. When it does work, the reduction in humanity's environmental footprint will be huge and rapid, especially in view of the on-going rise of the high-performance electric car.

Fusion research has overpromised and under-delivered for many years, but recent developments indicate that at some point it will work, and its medium-term prospects are looking better now than ever.

REGENERATIVE MEDICINE

The prospect of fusion power makes for wonderful news, but can we be sure that the climate change benefit of nuclear fusion and renewable energy technologies will suffice, or might it be nullified by other factors? With regenerative medicine making headlines every week, we are increasingly aware of its applicability to the ill-health of old age. Stem cell therapies for aged hearts and brains, artificial livers and bladders, and more exotic

(including genetic) manipulations are converging on a genuinely foreseeable panel of interventions that jointly promise to restore and maintain truly comprehensive physical and mental performance at levels typical of early adulthood. While everyone is content at the prospect of never getting sick, when one raises the idea of bringing aging under real medical control the reaction is quite different. Indeed, the advent of truly effective anti-aging medicine is widely seen as a threat to the levelling-off of global population: as a prominent researcher and advocate in that field, I encounter this concern more often among the general public than any other.

But this conclusion is incorrect. To see why, we must remember that population growth is, of course, dependent on birth rates as well as death rates. And birth rates are conventionally calculated in what, for this purpose, is a singularly misleading way, namely as the average number of children that a woman has in her lifetime. The problem with this calculation is that it ignores changes in the average maternal age at which births occur. If that age does not change over time, we can indeed use the total number of children per woman as a basis for prediction—but it does change. There has been a steady increase in recent decades, both in the United States and worldwide, in the age at which a woman has her first child. Most importantly, there has been a particularly sharp rise in the proportion of women who have their first child when aged 35 or older. This strongly implies—though explicit data, in the form of a survey, would be immensely valuable here—that an increasing number of women are having children only because they are about to lose the chance to have one at all.

The advent of truly effective anti-aging medicine is widely seen as a threat to the levelling-off of global population.

The implication in the context of future medical advances is clear: if (as is highly likely) comprehensive rejuvenation extends to that of female reproductive function, with the result that women can safely give birth at dramatically older ages (and without the stigma currently associated with late childbirth), then there is virtually certain to be a precipitate fall in the birth rate in successive calendar years. The impact on the predicted trajectory of global population has yet to be quantified—SENS Research Foundation is currently funding such a study—but when we recall that the current global birth rate is more than twice the death rate, it is not hard to see that even a modest postponement will have a very substantial effect.

What does this all mean for our priorities today? Each of the topics on

which I have touched above are highly speculative at many levels: timing, magnitude, and degree of impact, as well as the risk that defeating aging might create overpopulation-related problems. In fact, it is conceivable that neither fusion nor any renewable source will reduce fossil fuel use this century, and that fertility rates and maternal age at birth will fail to respond to increasing life expectancy, with population growth exacerbated by the relaxation of China's notorious one-child policy. As such, your instinct may be to "err on the side of caution"—to stick to what we know, and to resist the march toward truly effective medicine against age-related ill-health, thereby alleviating such risks. This may be especially your inclination if you take into account the potential for such technologies to be available to wealthy nations many years before the rest of the world. I do not believe this is likely, however, because this risk will be recognized and acted upon in advance, with much more energy than has typically occurred with, for example, AIDS medicines. Such action would be driven by the immense economic benefits that come with preventing sickness as people age.

Hesitation and delay today would … condemn countless millions to unnecessarily early and unnecessarily painful deaths, for reasons that may turn out to be mere figments of our inadequate imaginations.

Erring on the side of caution would be a tragic error, however. The precautionary principle, of which such a decision would be an example, relates to the risk of constraining our future choices by taking steps into the unknown. But in this case there is no such constraint in prospect: rather, we would be *broadening* our choices. While technological and societal realities impinge on the decision, and though we cannot be sure that the option will be desirable in the end, we must give humanity of the future the opportunity to avoid the ill-health of old age, by developing these medicines as quickly as we can. We have a duty to our descendants to do so. Hesitation and delay today would delay the availability of genuinely effective anti-aging medicine, and would condemn countless millions to unnecessarily early and unnecessarily painful deaths, for reasons that may turn out to be mere figments of our inadequate imaginations.

We are faced today with a massive dilemma concerning the expansion of nuclear power—Fukushima has replaced Three Mile Island and Chernobyl in our psyche, just as they were being forgotten—but fusion promises to allay that concern. And when it comes to anti-aging research, society's ambivalence is overwhelmingly based not on historical facts or

technological uncertainties, but on knee-jerk fear of the unknown, unalloyed by rational analysis. Therefore, if you are inclined to believe that eliminating aging will lead to catastrophic overpopulation, I put it to you that the greater danger is the astronomical guilt that today's humanity will incur if we delay. ***f***

ENDNOTES

1 Theodore L. Steck, "Human Population Explosion," The Encyclopedia of Earth, February 26, 2014, <http://www.eoearth.org/view/article/153596/>.