

THE EXTENSION OF LIFE  
Challenges and Opportunities of Living Longer Lives  
*Conference Report*

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Oxford Martin School, University of Oxford



*With the sponsorship of Acciona, Telefonica & Desert Technologies*



## Executive Summary

The Altius 2015 Conference, held at the Oxford Martin School of the University of Oxford, brought together preeminent young thinkers with senior experts from different fields to explore the most pressing issues for the future of society that stem from the extension of life.

The conference was split into two parts. The first focused on introducing key parameters of the scientific and humanistic approaches to life extension and the second on the impact of greater longevity on certain fields, specifically Political & Economic Governance, Energy, and Architecture & Engineering. Several global trends introduced in the first panel came under scrutiny throughout the discussions. These included the pace at which scientific research contributes to increases in longevity as well as the implications of a greater longevity given general population ageing and different demographic contexts: stagnant populations in developed countries, primarily in Europe and certain parts of the Americas and Asia; and growing populations in developing countries, mostly in Africa and Latin America. Combined, these changes in longevity and demography pose serious challenges to our governments, businesses, and societies in the coming decades that require deep, interdisciplinary analysis. This conference attempted to grasp the complexity of these developments and suggest possible avenues to make the most of the opportunities they offer as well as mitigate any pitfalls.

*Rapporteur: Pamina Smith*

***With the support of The Oxford Martin School, Nielsen & Liberalnej Edukacji Foundation***



# Welcome Remarks

## Ian Goldin, Director, Oxford Martin School

Goldin's welcoming remarks opened the conference with a degree of optimism, highlighting how the old Indian Institute which now houses the futuristic Oxford Martin School was founded only slightly over a century ago for the education of 'Aryans' (a label which included both Indians and Englishmen, based on the theory of the Aryan invasion). This anecdote aimed to demonstrate how the pace of change in society cannot be underestimated, especially regarding the effects of biological and technological research occurring today. As for changes in demography, Goldin posited that the collapse in productivity of Western countries could be a result of demographic adjustments since these impact both competitiveness and inequality.



# First Part: Introducing Key Parameters

1

## Panel: The Future of the Life Sciences

Chair: Oliver Wernet, University Hospital of Zurich, Switzerland

The first panel examined the ways in which scientific research contributes to our understanding of how to extend life in three manners: by exploring (1) demographic research demonstrating current trends and their implications; (2) biological and technological research contributing to increases in longevity either through combating neurodegenerative disorders or more generally the process of ageing itself; (3) scientific research showing how non-biological and non-technological factors can also affect longevity.

**Speaker: Stuart Basten, Associate Professor of Social Policy, University of Oxford**

Basten covered the demographic research on current trends regarding longevity and their implications in different demographic contexts—stagnant populations of Western countries and growing populations in developing countries. According to Basten, the demographic changes taking place over the next forty years will be dramatic and their challenges will take two principal forms: (1) delivering transfers on a sufficiently large-scale to elderly members of the population, thus also impacting the sustainability of healthcare systems, and (2) tackling broader economic issues related to sluggish growth rates, which cause a higher tax burden on the younger end of populations.

Regarding emerging markets, despite their growing populations, Basten claimed that they will comprise some of the oldest countries in the world by 2050. Basten argued that emerging markets retain some advantages over developed markets due to the following factors: (1) higher levels of private savings; (2) lower coverage, replacement rates, and proportions of GDP expenditure dedicated to social services; (3) mostly universal healthcare systems (caveat: weak on managing chronic health problems); and (4) greater scope for learning from other states. However, the lack of jobs and redistribution remain a challenge, as the resultant high levels of informal employment become a barrier in terms of tax receipts for social services.

Finally, Basten recommended utilizing the 'prospective old age dependency ratio' instead of the conventional 'old age dependency ratio', for the former estimates how many years a person has to live in dependency rather than assuming that dependency occurs after the age of 65. Unlike the old age dependency ratio, the prospective measurement shows a much shallower change in dependency ratios across time, therefore calling into question the idea of an imminent demographic time bomb.

**Speaker: Paul Fairchild, Co-Director, Oxford Stem Cell Institute**

Fairchild launched the discussion on how biological and technological research contributes to increases in life expectancy either through combating specifically neurodegenerative disorders or more generally the process of ageing itself. He reviewed the growing challenges to quality of life posed by chronic and degenerative diseases and how pluripotent stem cells are a possible means to conquering them, referencing the studies conducted by his laboratory.

According to Fairchild, chronic and degenerative diseases are filling the void of infectious illnesses due to the ageing nature of the population, especially in the Western world. In the US alone, 125 million Americans (45% of the population) currently suffer from one chronic or degenerative disease and treating them consumes 75% of the healthcare budget. With his research, Fairchild aims to provide novel treatment regimes that mitigate suffering and dependency to guarantee productivity for an ageing population.

Rejuvenating tissues is one such possible remedy and scientists today study organisms that are masters of tissue regeneration, such as the planarian flatworm. The flatworm contains a large number of pluripotent stem cells, which have the capacity to generate each type of cell necessary to comprise the body of an adult worm. One can find this variety of cells in humans, though only in an embryonic state. However, researchers have developed a method whereby adult human cells can be reprogrammed to enter an embryonic stem cell-like state and thus become induced pluripotent stem cells (IPS cells). Fairchild noted that one can undertake this procedure on the elderly, develop the IPS cells into therapeutic cell types, and transplant them back into the patient to help cure a range of diseases. Although this method has proven promising for treating age-related macular degeneration, to thoroughly address other age-related diseases, Fairchild contended that generating entire organs will become necessary. He relates how blastocyst complementation could be a possible solution in this respect and that ethical approval has been granted in Japan for experiments using this methodology. However, a participant noted that progress has temporarily halted on this research in Japan due to the enormous expense involved.

**Speaker: Alex Yi, Senior Investigator in Translational Medicine, Novartis Institutes for Biomedical Research**

Yi related insights regarding drug development given his extensive experience in the sector. As a member of the Novartis Institutes for Biomedical Research (NIBR), Yi helps reinvent early drug discovery through conducting fast and rigorous proof of concept studies used in phase II of drug development. These studies aim to demonstrate the therapeutic rationale for the drug rather than proving its safety (phase I) or efficacy (phase III). For NIBR, the best drug development projects are those that have the highest unmet need and highest scientific background supporting them. As the process of developing drugs is time consuming and very expensive—taking occasionally more than 10 years and costing more than 2 billion dollars—Yi contended that currently emerging digital tools harnessing big data will greatly expedite the process of early drug discovery and thereby reduce burdens on the healthcare and social care systems.

**Speaker: Aubrey de Grey, Chief Science Officer, SENS Research Foundation**

De Grey discussed the approach of the SENS Research Foundation towards combating ageing. He defines ageing as the life-long accumulation of damage to the body that occurs as an intrinsic side effect of the body's normal operation (or metabolism). According to De Grey, the body can tolerate some damage, but too much can cause disease and disability. The SENS Research Foundation, instead of

focusing on curing the consequences of ageing—in the manner of geriatrics or gerontology—rather aims to prevent ageing from surfacing in the first place through the ‘maintenance’ approach, one that periodically repairs damage incurred throughout life. De Grey contended that this strategy promotes healthy longevity by striving to encourage longer lives free of the dependency caused by infectious, genetic, or chronic diseases. Given the progress of the SENS Foundation’s research on therapies since 2008, De Grey expected that a child born today will attain a life expectancy in at least the four-digit range. As to the ultimate end goal of the Foundation, De Grey envisioned developing a pill or even a therapeutic method similar to that of stem cell or gene therapy to counter ageing, whereby viruses are injected into the bloodstream. Finally, De Grey concluded by detailing his vision of a society where one cannot tell the difference between grandmothers and their grandchildren.

**Speaker: Peter Bourne, Senior Research Fellow, Green Templeton College, University of Oxford, Former Assistant Secretary General at the United Nations**

Bourne reviewed how scientific research has also shown that non-biological and non-technological factors can affect longevity as well, variables that governments need to understand in order to better address their positive and negative consequences. Bourne first related the findings of a 25-year study of 18,000 British civil servants conducted by University College London (UCL) that examined death rates according to the grade of civil servants in the system. It revealed that those who die early were not those in higher grades with more responsibility and presumably operating in high stress environments, but rather the lowest in the hierarchy, as these had the least control over their lives. A second study showed how those with strong social networks also usually live longer, a factor that researchers found usually benefitted the affluent. Finally, Bourne cited the results of a third study to demonstrate the powerful effects of psychology on longevity. In a small study of 173 participants, researchers discovered that the recipients of Academy Awards, who therefore reached the pinnacle of their acting careers upon winning, were likely to live four years longer than those who only received a nomination; for comparison, finding a cure for heart disease would likely have the same degree of impact on lifespan. Bourne also highlighted how economic factors can affect longevity as well, referring to the twenty-year difference in life expectancy from one end of Washington D.C. to another and how certain areas of Mumbai enjoy a better average life expectancy than parts of Glasgow.

Furthermore, Bourne contended that governments could increase the longevity of their citizens’ lives through simply addressing inequality. He maintained that the narrower the gap in inequality, the higher the national life expectancy, and therefore concludes that the redistribution of wealth is the best way to most dramatically improve longevity. Bourne also argued that governments have to change public attitudes regarding how ageing is conceptualized by passing laws to contain discrimination against the elderly as well as offering educational programs to help citizens understand the realities of life for the elderly and to help the elderly themselves (e.g. lifelong learning). In addition, Bourne advocated for governments to encourage coordination between social care and health care systems, while bearing in mind the limits to which the government can take care of people’s lives.

## Keynote – ‘Ars Longa, Vita Brevis’

**Speaker: Philip Rylands, Director, Peggy Guggenheim Museum, Venice**

**Chair: Sally Davies, Financial Times**

This keynote discussed the theme of ageing from an artistic perspective, which entailed examining how the general style of artists evolves as they enter old age; in other words, it evaluated the extent to which artists have an old age style or ‘alte stil’ and whether or not all old age styles resemble each other in certain aspects.

Davies framed the keynote by presenting two broad schools of thought regarding ageing: the Aristotelian and Philip Larkin-esque conceptualization that views age as a gradual erosion of faculties and bodily degradation—overall a rather more downcast outlook—and the platonic or stoic conception of old age, which sees it as a positive development since it liberates the human in a transcendent manner from the fleshly concerns of youth. In the context of artists, these options could entail a worsening of technique or a wiser, improved style, respectively. Davies concluded by positing that the idea that life is short, but art as a technique takes a long time to acquire – *ars longa, vita brevis* – can be undermined in two ways thanks to life extension: (1) naturally, life is gradually becoming less and less short and (2) artistic techniques no longer have to take a lifetime to acquire, given the pace of creation possible with digital technology.

Assuming that *ars longa, vita brevis* holds true, Rylands reviewed how artists adapted their art to the boundaries of their own lives. Rylands does not consider there to be an *alte stil* that transcends each individual artist, contrary to the theory originating in 17th century Germany contending that artists paint differently in youth, middle age, and old age: in youth, artists copy masters; in middle age, they achieve their own identity; and in senility, artists are a mannered and less vibrant version of themselves. Consequently, in the 20th and 21st centuries, some art theorists posited that this old age style transcends the individual. Art historian Kenneth Clark suggested that the *alte stil* generally consisted of differences in both technique and content, the latter of which was usually marked by pessimism, religiosity, and meditations on morals and universal truths.

Rylands then proceeded to detail examples that buttressed his thesis. He demonstrated how in various instances, a gradual erosion of faculties and bodily degradation heavily affected the nature of art, as in the case of Poussin who suffered from syphilis and therefore had a shaking hand and weakening sight, disabling him from painting with precise detail. But unlike the depiction offered by Davies, this change of technique did not necessarily have a negative impact on quality and many appreciated his new, almost pointillist approach. Similarly, De Kooning, plagued with Alzheimer’s, evolved his style from a dark abstract expressionism to something more cerebral, with many critics lauding his later works as the best of his career. Regarding content, Botticelli’s late paintings are noticeably characterized by religious expressionism and mannered figures compared to the pastoral grace exhibited in the *Primavera*, among others; however, it is unclear whether this change has anything to do with age as much as the heated religious crises disturbing Italian city-states at the time. In addition, Rylands noted that Turner’s *alte stil* was rather golden than dark and that while Rothko’s style was quite black in his old age, the same could be said of the work produced in his middle age, consistently marked by tragedy and timelessness. Therefore, one cannot state that old age allowed artists to develop a wiser style rather than perhaps simply a different one.

## 2

### Panel: Art & Humanities

Co-Chair: Carlos Blanco, Universidad Pontificia de Comillas and Javier Solana, University of Oxford

The second panel continued this exploration of the implications of greater life expectancy and ageing in general from a humanist perspective. It sought to discuss whether we should revise bioethical codes in view of these scientific breakthroughs and the extent to which living longer lives will entail living *better* lives.

**Speaker: George Leeson, Co-Director, Oxford Institute of Population Ageing**

Leeson, similarly to Basten of Panel I, discussed how demographic research reveals current trends in developed countries, particularly the UK, and mainly demonstrated that everyone is now living to extremes of old age. According to Leeson, the prevailing assumption that the mortality of people over 60 years of age would be constant in the future has been disproven due to scientific advances in combating infant mortality rates. As shown by the Office of National Statistics, a third of babies born in the UK in 2012 will survive to celebrate their 100th birthday: though Leeson acknowledged that a considerable drop in 65-74 mortality rates can be attributed to a successful government-led anti-smoking campaign, rather than scientific breakthroughs. Although the survival curve has been pushed up and to the right, it remains unclear whether the maximum age can move further to the right as well. Leeson, however, remained confident that this trend of living to extremes of old age will continue in the future and proclaims that the 21st century will be the age of centenarians and supercentenarians (110+). Agreeing with Aubrey de Grey's assertions that ageing is a curable disease, Leeson optimistically noted that we are on the way to ensuring that as many people as possible can live for as long as possible.

**Speaker: Sean Cleary, Founder, Future World Foundation**

Cleary addressed the socioeconomic effects of the extension of life on humanity in general and also on political and economic governance. He described how the sharp increases in ageing in most societies (the Middle East and Africa remain exceptions) and breakthrough disruptive technologies together not only contribute to life extension, but also engender many challenges to current governance models, such as the following: (1) the increase in migration towards European countries tests the EU neighborhood policy, among other geopolitical agreements; (2) the questioning of representative democracy, as millennials increasingly believe that social media will have more of an impact than the political system itself, causes a decline of political party membership and voting; (3) the accelerating urbanization especially in Asia and Africa results in a third of the global population likely becoming slum dwellers; (4) the higher returns to capital over the past 30 years than labor as well as falling interest rates enables more inequality; and finally (5) the constant technological innovation prompts a radical adaptation of primary and secondary education to help societies compete effectively in the world. All of these challenges, Cleary emphasized, are interrelated.

Clearly additionally asked to what extent we should govern technology in these spaces – given that it follows a dynamic and not linear process—as well as how we can determine which technologies to support. He also questioned whether humanity will ever have the ability to benefit from the improved lifestyle that combating ageing allegedly brings, as the highly connected global economy lacks a sense of global community. He concluded by stating that ageing forms one part of a complex adaptive system in which humanity has to find its way.

**Speaker: Robert Ranisch, University of Tübingen, 'Bioethics' Research Training Group**

Ranisch broadly discussed how transhumanism approaches the prospect of life extension and argued that intergenerational responsibility is necessary to living better lives. He defined transhumanism as a social and intellectual political movement that affirms the theoretical improvement and enhancement of human conditions in terms of behavior, physical traits, and healthspan. Ranisch reviewed the history of the movement, recalling how its founders did not have life extension on the agenda and were more interested in enhancing the quality (rather than quantity) of life as well as improving society using technology. According to Ranisch, the current transhumanist parties in the UK, US, and Germany espouse values that reach across the traditional left-right divide; in the US, the party primarily focuses on life extension and immortality. Ranisch suggested that life extension might contribute to overpopulation and, in that scenario, posited introducing a system to contain this effect, perhaps through a parental license, as some transhumanists have suggested.

In addition, Ranisch questioned the morality of investing in immortality. If research resulted in an extension of life span, but not health span, would this development enhance the quality of life, he asks? Finally, Ranisch suggested contemplating matters of intergenerational justice to determine any obligations to coexisting and non-coexisting younger generations. He therefore wonders whether it might be morally better to spend money on improving social systems and climate change in this context.

**Speaker: Marcin Kilanowski, Nicolaus Copernicus University**

Kilanowski reviewed the bioethics of life extension through examining its consequences on individual and societal outcomes. He opened by declaring that the society must determine whether it should have the ability to decide what is good or bad about human nature, as genetic engineering increasingly facilitates this ability. He asked: what is the similarity between genetic engineering, cloning and torture? All of them allow for experimentation and prognosticating about the results, turning a blind eye to possible pain (physical or mental) which they incline. The pain does not matter – what matters is getting the desired outcome – even if there is no certainty that the outcome will be reached. By genetic engineering we can gain something, but we can also lose: the integrity of our life, society and body. We already lose when we postpone by medical means the moment of the natural death of ill people with no chances for a better life, when longer life does not go hand in hand with happiness, or health.

Although scientists reassure that the positive effects outweigh their corresponding negative consequences, the society could witness another resurgence of the eugenics movement, Kilanowski warns. Scientists' predictions are based on the assumption that the whole process can work in our favor and can lead to more freedom, equality, brotherhood, a healthier society, and a longer life for everyone. But expanding freedom does not have to lead to equality, brotherhood, peace, stability, or prosperity. We can hide under the umbrella of nice ideas, like freedom or equality but in fact we will make some people even more privileged than others. The process of enhancement can lead to more inequality, to unbalanced distribution of wealth and power, and to lack of peace and instability. And it

will, Kilanowski predicts, because in the 21st century still only some have washing machines or food, not to mention medical care; for instance, in Africa, medicine for malaria is rarely available.

Kilanowski furthermore questions the degree to which it is right to privilege the attainment of freedom (regarding one's own genes and life) over solidarity and equity. There is a danger that enhancing some will not only lead to greater inequality but also to further lack of solidarity. He contends that it is immoral to spend millions on extending life, when so many die of illnesses due to insufficient funds to get regular drugs on time.

Kilanowski points out that the problem lies not in the conditions but in our perception. We want to change other people – also our offspring – so that the relationships can be easier, and the phenotype closer to the desirable one. But there is a big chance that we will not accept the changes later on either. We want to change ourselves – to live longer lives – but there is a big chance that we will still be dissatisfied with the outcome, because the problem lies not within the qualities and conditions but within us and our perception.

Kilanowski concludes by asserting that the society should accept imperfections and ageing, as extending life will not necessarily guarantee a more painless existence. He adds that changing the environment or ourselves was always the case, but there is a question of limits. We do not know where to stop. We did stop with torture and developed universal human rights. But did we really or do we sometimes accept what we do not like under a different name, he asks.

## Second Part: The Extension of Life and its Impact on Certain Fields

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### Panel III: The Impact for the Future of Political and Economic Governance

Co-Chairs: Alexandre Perez, Principia Investments and Former Investment Executive at KKR & Stan Veuger, American Enterprise Institute

The third panel aimed to analyse the impact of the extension of life on political and economic governance. In his introduction, Perez discussed how technology can facilitate the ageing process (e.g. through self-driving vehicles), but also can substitute workers through the replacement of cognitive tasks by machines. This latter effect will likely cause a global workforce crisis due to both a fall in demand and skill mismatches. Could population ageing and life extension—provided they elongate meaningful life, not sickness—help furnish a solution to the problem provided by technology, Perez asks? Technology has also contributed to the rise in mobility of job seekers, who also increasingly seek validation for work rather than a high salary figure, and therefore are more likely to opt for self-employment. These two conflicting trends demonstrate the ability of technological progress to engender both challenges and opportunities, a tension that framed the remarks of the three panel speakers.

**Speaker: José Cordeiro, Director of the Millennium Project and Founding Faculty, Singularity University (NASA, Silicon Valley)**

Cordeiro offered a provocative presentation on the opportunities offered by the future developments of technology, overall extending the discussion from Panel I. He described this generation as the first “human immortal” generation who will witness the “death of (biological) death”. The idea of the singularity—popularized by Ray Kurzweil, founder of Singularity University—entails that man will become immortal between 2029 to 2045 and Cordeiro described how there are four technologies converging to lead towards this end: nanotechnology (atoms), cognotechnology (neurons), biotechnology (cells), and infotechnology (bits). He also emphasized how reaching the singularity entails the beginning of the post-human age, when artificial intelligence surpasses the intellectual ability of humans; as a result, humans will fuse with technologies to become ‘enhanced’ in order to survive.

According to Cordeiro, the dawn of preventative medicine (as opposed to curative medicine) consists of another trend moving humanity towards immortality. He believes that humans will have the ability to know what they will die of, so that they can find the adequate preventative medicine according to their genes. But with sufficient advances in synthetic biology, humans could change and improve their genome through technological improvements as well. Going even further, Cordeiro suggests that we will soon be able to design children and therefore claims that in the future traditional reproduction will occur only for entertainment.

In general, Cordeiro depicted the next few decades as characterized by exponential growth rather than linear evolution, citing examples of reconstructing the DNA of Neanderthal men, curing ageing in 20 to 30 years with the help of the company Calico, and creating artificial brains in 20 years, among others. Participant Stephen Minger, however, questioned the timeframes Cordeiro posited for eliminating neurodegenerative diseases and contended that data indicating a likely cure for either Parkinson's or Alzheimer's in 20 years' time is rather speculative. In addition, Minger asserted that scientists should be realistic about the pace of scientific research; policymakers need timelines that are as reasonable as possible in order to properly plan for any effects.

**Speaker: James Russo, Senior Vice President, Global Consumer Insights, Nielsen**

Russo generally discussed the disruptive global trends affecting consumption patterns that would be key for policymakers to understand when creating governance structures to account for them. He contends that most people are working longer than previous generations and changing professions, as a traditional career now usually occupies only half of the average person's lifespan. Multigenerational households are also becoming the norm in the developed world. In addition, Russo claims that society operates increasingly at the convergence of the physical and digital, with growing numbers of people using social media and enjoying connectivity. On this note, he indicated that the highest increase in adoption of social media and new technologies generally comes from the elderly.

**Speaker: Simon Grenfell, Co-Head Global Markets Commodities, Natixis Investment Banking & Member of the Government Council, Order of Malta**

Grenfell reviewed the impact of the extension of life on capital markets and its implications for political and economic governance based on his experience in the financial sector over the past twenty years. He first detailed how increasing risk aversion can be detrimental for the wider economy given that major countries might default due to pension liabilities. Due to this risk, he states that pension and sovereign wealth funds are growing in number, investors have increasingly used the longevity market, economic investments are generating lower yields, and the number of investors interested in aligning investment with a social dimension (e.g. age care homes, hospitals) are also growing.

He also highlighted the degree to which the private sector can influence public policy outcomes related to ageing using the example of age care facility ownership and emphasized that markets should be designed with the right incentives. In one example, he remarked that if his bank pursued a "one-degree increase in temperature" within the bandwidth allowed by the regulator, a 10% increase in the mortality rate of an age care home would occur. But Grenfell stated that the biggest challenge in terms of ageing is inequality: who gets to be immortal? He contends that only billionaires will have this luxury, not the average working class person and agrees that there will be a higher return to capital than labor in both productive and non-productive growth.

Finally, Grenfell touched on increasing problems of migration and food supply. As emerging markets will become the centers of the world population by 2050, this trend will inevitably result in drawing more people from these regions to the west. On the latter subject of food security, given current projections for 2050, India will only be able to produce 59% of its own food use, and China, 30%. Grenfell emphasized that private and public sector authorities need to set the correct market signal to sufficiently address this food imbalance.

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## Panel IV: Energy

Chair: Augustus Rylands, Desert Technologies

The fourth panel focused on the impact that a global growing population of individuals living longer lives will have on natural resources and energy. In his introduction, Rylands stated that as energy consumption increases with population growth, the main challenge consists of how to satisfy this new demand in a sustainable manner—which technologies will be necessary? As this panel took on a format that was more fluid and interactive rather than structured around presentations, the summary of the remarks will reflect this style.

**Speakers: Lady Barbara Thomas Judge CBE, Chairman Emeritus, United Kingdom Atomic Energy Authority; Ben Moxham, Director for Europe, Enviva; Julian Brown, Chairman of Renewable UK; Luis Quiroga, Hg Capital**

Lady Judge opened the discussion by arguing that the solution to any challenges related to energy, including demographic ones, require a bouquet of options—oil, gas, renewables, nuclear, and coal—of which nuclear energy is an important part. She contended that nuclear energy addresses the three most important questions that governments have to ask themselves regarding energy with baseload generation: energy security (it is a large-scale infrastructure project that can be controlled in a manner to guarantee enough energy for homes), energy independence (governments can build nuclear powerplants within own country), and climate change (nuclear does not emit carbon). To address some critiques of nuclear energy, Lady Judge also offered her perspective of the Fukushima disaster. She emphasized that no death could be attributed to radiation, as the earthquake was instead the main factor. Secondly, she contended that other factors included the weak regulatory structure, the outdated technology of the powerplant as well as the Japanese consensual culture.

Moxham reminded the panel that generally speaking, people consume more energy the longer they live. In the UK, the elderly are disproportionately represented in the fuel poverty target group, due in part to their sensitivity to extremes of temperature. Regarding Lady Judge's energy bouquet, Moxham addressed more particularly the role of renewables and their ability to bring technological as well as price improvements to the energy sector. However, he emphasized that these developments will be incremental in nature since energy is not a very dynamic industry, with renewables taking over 20 years to be developed. As for solar energy, Moxham stated that its price depends to a large degree on the price of storage. Moxham additionally suggested withdrawing subsidies for oil, gas, and coal in order to generate better incentives for the energy marketplace, but acknowledges the extreme political difficulties involved. Quiroga agreed that fuel subsidies could perpetuate bad behavior. However, Brown argued that subsidies for the fuel poor as well as renewable energy technology are essential. Regarding the question of storage, Brown contends that the Tesla Powerwall is a complementary, not disruptive technology. Quiroga added that due to an increase in peer-reviewed papers on storage technologies, the sector is closer than ever before to a major breakthrough in this area.

All panelists agreed that increasing energy efficiency is crucially also an issue of behavior change. Governments should be able to control the use of air conditioning, overheating, and insulation through a combination of fiscal policy, regulation, and public education, especially in OECD markets. Overall, most conceded that given recent developments, energy efficiency will continue to improve.

## **Keynote II – ‘The Future of the Life Sciences’**

**Speaker: Stephen Minger, former Chief Scientist for Cellular Sciences, General Electric Healthcare Life Sciences; Current Director of SLM Blue Skies Innovations Ltd.**

**Chair: Thomas Dermine, McKisney**

Minger related several insights that he acquired throughout his career as well as his opinion on the latest developments and possible upcoming breakthroughs in scientific research. He began by detailing how he developed the first human embryonic stem cell lines in the UK at King’s College London with the sponsorship of General Electric (GE). Minger recalled his initial astonishment that GE wanted to become an enterprise invested in human stem cell therapy, but was grateful for the enormous amount of funding granted by the company to support groundbreaking projects—a sum significantly heftier than what public bodies were able to provide at the time. Regarding the latest developments in scientific research, Minger discussed the following innovations: the revolution in cancer therapy of the last five years in which drugs can train the immune system to eradicate the disease; the emergent possibility of eliminating the need for transplants due to 3D printing and how tissue printing will likely become possible within our lifetimes; the explosion in microbiome research, fecal diagnostics and neuron rehabilitation leading to potential cures for diabetes and autoimmune disorders; and finally the potential of artificial intelligence data mining (c.f. Google’s Deep Mind and IBM’s Watson) to transform the healthcare system through its ability to analyze the records of millions of patients.

## **Fireside Chat: ‘A Futurist Perspective on the Politics of Living Longer Lives’, David Wood, Executive Director, Transpolitica & Chair, London Futurists.**

Wood discussed the impact of the scientific extension of life on various fields, but especially political and economic governance. He opened by describing the profession of futurists as practicing foresight—looking out at the set of possible long-term future scenarios and analyzing the threats as well as potential opportunities that could arise therein. Wood asserted that futurists face numerous difficulties in discussing the future because of two main factors: 1) the acceleration of technology—things are developing at an increasingly difficult pace to keep up with; and 2) the difficulty of tracking converging trends. He characterized current scientific research as contributing not only towards extra longevity, but also towards improving all phases of life more generally, while still warning of some sinister outcomes such as government surveillance.

Wood then delineated the four main normative reactions to technological progress that he has encountered throughout his career. The first is techno-skeptical, which entails believing that progress will eventually run out of steam and hardly affect fundamental aspects of intelligence. The second, techno-conservative, asserts that society should slow down the pace of technological progress. Wood contended that both of these scenarios are very unlikely to be realized in practice. The techno-libertarian view recognizes that there is greater inequality, but insists that the divide rests between the ‘haves’ and ‘have lots’ since storage costs are declining. On the other hand, the fourth reaction of techno-progressivism encourages redistribution and recognizes that one must encourage free enterprise as well as better regulation and new social systems. This viewpoint entails using technology to attain a sustainable evolving well-being (e.g. rejuvenation biotech will lead to super health), tech-savvy proactive risk management (e.g. new social contract alongside automation for the workers that will become unemployed), and regeneration (e.g. redesign education for a radically different future). Wood believed that governments should intervene to invest in longevity and thereby ensure that people work smarter, seek out the wisdom of the elderly, and attain a voice in developing their future.

The last panel explored the impacts of greater life expectancy on architecture and engineering and how these disciplines might help society better cope with the ageing process. McMinn framed the panel discussion around the following question: how can the tools of architecture and engineering help us improve the quality of the life we lead—dependent on the freedom from ravage of disease as well as meaningful engagement in life, according to Atul Gawande—and lower the costs on social systems as we age?

**Speakers: Betsy Fields, Project Lead, IDEO & Luis Cilimingras, Managing Director, IDEO.**

Fields and Cilimingras discussed how organizations can adapt to a society with increasing life expectancy through design, and how their firm IDEO helps its clients make this adjustment. IDEO champions the following five principles regarding ageing: 1) promote agelessness: empower people to stay active and engaged regardless of age; 2) lead with purpose after the ‘age of retirement’: the elderly can help protect the younger generation; 3) foster intergenerational relationships, e.g. the first elder care orphanage in Iraq; 4) support the journey: to avoid a period of decline, support the elderly spiritually and intellectually through educational programs; 5) acknowledge the destination: design death better, e.g. by ensuring painless departure or helping encase memories for those left behind. To further these goals, IDEO recently formed the ‘Powerful Now’ coalition to help determine how to redefine ageing through design and ensure positive ageing for all.

Cilimingras additionally related how IDEO designed a healthcare system from scratch for a Latin American country that will improve the quality of life for citizens and lower costs on the health and social care systems. Cilimingras took away five principles from the experience that he thought would be transferable to other countries: 1) level the playing field: the only way for citizens to start having a relationship with doctors is breaking the ‘aura of superiority’ and have both parties speaking the same language; 2) save time to take time: reduce massively the time of engagement, so patients will not need to take an entire day off from work, for example; 3) treat the entire family: sometimes family members can affect the extent to which a patient recovers, e.g. the diet of a male diabetes patient is solely determined by his wife; 4) show and tell: in order to ensure a patient recovers, doctors need to ensure he/she has a basic mental model of what has caused the problem and what is going to solve it; 5) technology: need to reboot health care with an IT system that is fit for purpose.

**Speaker: Roger Battersby, Managing Partner, PRP Architects**

Drawing from his extensive career in the design and delivery of housing for Britain’s elderly population, Battersby discussed how architectural tools can be used to help society improve the poverty of later life. He first reviewed the history of government policy towards elderly housing in the UK, starting with the 1960s and 1970s approach of creating institutionalized environments and ending with the 2000s ‘lifetime neighborhoods’ strategy that facilitated more integrated independent living, overall empowering individual citizens. In 2009, the government published the first HAPPI (Housing our Ageing Population: Panel for Innovation) report, which drew from innovative European housing case studies to recommend better quality homes for the baby boomer generation.

Battersby asserted that guaranteeing housing for the elderly involves creating the right incentives for people to move out of independent housing at the right time. To handle the current intergenerational tension between baby boomers and younger citizens, who struggle with affordability, he advocates creating incentives for people to downsize by, for example, lowering pensions. Battersby also recommended downsizing through co-housing, where groups of families decide to live together; a model very popular in Denmark. Another option, suggested by a participant, could be an intergenerational Airbnb, where elderly people partner with students in exchange for completion of daily chores such as grocery shopping.

Finally, Battersby related lessons from his experience developing homes for the elderly in China, which currently faces a housing challenge for this demographic due in part to the one child policy. He remarked that Chinese culture has a stigma associated with state-provided elderly care given the tradition of family support. As the state only provides very institutionalized homes, Battersby recommended that China use instead a combination of the American and European elderly housing models as well to ensure a better lifestyle.



# Closing Remarks

## Manuel Muñiz, President of Altius

Muniz closed the conference by summarizing the main themes that emerged throughout the various panel discussions and speeches. According to Muniz, Panel I as well as the Keynote by Stephen Minger revealed that significant scientific breakthroughs contributing to gains in life expectancy will most likely occur in the next few years given the clear trends outlined by participants. Panel II attempted to explore whether these trends are desirable and how we could address them from an ethical perspective. The last three panels discussed the challenges and opportunities of these trends in various fields. While the debates surfacing throughout the conference did not lead to any specific recommendations for policymakers, it did remain clear that the following challenges need to be addressed: (1) the rapid increase in dependency, which calls into question the welfare state in developed countries and family support in developing countries; (2) the sustainability of pension systems and the extent to which we can expect societies to follow Lady Judge's advice to "work longer, save more, and expect less"; (3) the sustainability of public healthcare systems; and finally, (4) the increased strain on energy supply given the expanding global population.

Muniz then enumerated ten general questions to prod the debates even further:

- 1) What is the actual life expectancy of a child born today? Is it the four-digit expectancy that De Grey suggested or the Leeson 100? We need to better clarify the upward trend predicted by researchers.
- 2) Are we extending life or are we extending old age?
- 3) How will the decrease in cost of drug development affect further scientific advances?
- 4) To what extent does psychology affect ageing?
- 5) Is the normative debate related to philosophy worth having if technologists will continue to further progress in the end?
- 6) Will euthanasia and assisted suicide become more necessary?
- 7) How are gender roles affected by increases in life expectancy, especially given that women can still only bear children at a certain age?
- 8) What are the effects of these trends on inequality, as access to technologies will be distributed unequally?
- 9) How should we best approach the consequences of ageing given its complexity?
- 10) To what extent should governments be involved in creating a governance structure over these trends (e.g. countering inequality, guaranteeing access to technologies) and at what level—national, supranational, global? Will we need a new social compact and, if so, what form should it take?

Reacting to Muniz’s summary and questions, participants offered various comments that fell along two main themes. The first was the degree to which we have, at best, only a small idea of all the effects the scientific developments occurring in the coming years will create. Despite this elusive character, most agreed that public policy and regulatory debates on these trends still need to occur. Participants also noted that the inability to apply collective action at a transnational scale implies that society will likely experience a painful route to the new future equilibrium. The second theme rested on inequality, and how the wealthy will most likely live significantly longer lives than the poor, resulting in perhaps a 9-19 year difference in life expectancy between the two groups. No potential solution surfaced from the discussion; however, the consensus remained that it might be the single most important challenge to emerge from extending life.

Muniz concluded by announcing some possible topics for next year’s conference—ICT, robotics and AI, the nature of power in the world of social media—and revealed that Altius might consider institutionalizing itself even further by offering consulting services to governments. Given the lack of research on creating governance mechanisms to handle the societal implications of futurist trends, the Altius Society is very well placed to emerge as a global leader in this field.

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