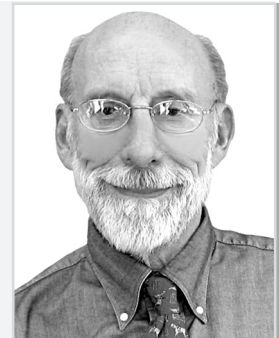




Victor Basiuk
PhD (Intern. rel.), Consultant on Science,
Technology, and National Security Policy, USA
9688 Farmside Place, Vienna,
Virginia, 22182, USA
vbasiuk@verizon.net

UDC 330.341.42:331.5



Huber Warner
Professor of Biochemistry (emeritus),
University of Minnesota, USA
1475 Gortner Ave, Saint Paul, MN 55108, USA
warne033@centurylink.net

WILL A BREAKTHROUGH IN SCIENCE MODIFY WORLD HISTORY?*

Abstract. The article discusses the impact – personal, national, and global – of a forthcoming breakthrough in biogerontology, extension of health span (extension of human longevity without age-related illnesses, like cancer, cardiovascular diseases, diabetes, Alzheimer's, etc.). This breakthrough has been achieved on mice, but to translate it to humans will take additional research requiring about \$10 billions for 5 to 10 years. This is a relatively small amount of money, when compared with the trillions of dollars extension of health span will save in coming years for the United States alone.

Extension of health span will be very important for Ukraine: 1. Ukraine is losing its population, which will be stopped by extension of health span. 2. Because healthcare will be a great deal less expensive, large amounts of money will be released from the health-care sector. This money will be available to invigorate the economy and for other worthwhile purposes.

Keywords: human health span; human longevity; changes in world power; demography; geopolitics.

JEL Classification: F01, H51, H56, H60, J11

Віктор Басюк

PhD (міжнар. політика), консультант із питань науки, технологій та національної безпеки, США

Хубер Варнер

професор біохімії (у відставці), Міннесотський університет, США

ЗНАЧУЩЕ ДОСЯГНЕННЯ В НАУЦІ ЗМІНИТЬ СВІТОВУ ІСТОРІЮ?

Анотація. У статті розглядається вплив – особистий, національний та глобальний – на майбутній прорив у біogerontології, який полягає у розширенні діапазону здоров'я, тобто збільшенні тривалості життя людини без хвороб, пов'язаних із віковими змінами (рак, серцево-судинні захворювання, діабет, хвороба Альцгеймера та ін.). Цей прорив був досягнутий на мишах, але щоб провести його на людях знадобляться додаткові дослідження, що вимагають близько \$10 млрд. упродовж 5–10 років. Це відносно невеликі кошти порівняно із трильйонами доларів, які завдяки розширенню діапазону охорони здоров'я можна буде зберегти в найближчі роки для одних тільки Сполучених Штатів.

Упровадження нових досягнень у галузі біogerontології, на думку авторів, буде дуже важливо для України з двох головних причин: 1. За останніми прогнозами, чисельність населення України до 2050 року скоротиться приблизно до 33 млн. осіб. Розширення діапазону здоров'я здатне зупинити цей процес, тому що люди зможуть жити майже на 20 років довше й при цьому вести яскравий, здоровий спосіб життя. 2. Оскільки витрати на медичні послуги зменшаться, із сектору охорони здоров'я будуть вивільнені значні кошти, які можна спрямувати на поживлення економіки та інші гідні цілі.

Ключові слова: діапазон здоров'я людини, тривалість життя, зміни світової влади, демографія, геополітика.

Віктор Басюк

PhD (междунар. політика), консультант по вопросам науки, технологий и национальной безопасности, США

Хубер Варнер

профессор биохимии (в отставке), Миннесотский университет, США

КРУПНОЕ ДОСТИЖЕНИЕ В НАУКЕ ИЗМЕНИТ МИРОВОЮ ИСТОРИЮ?

Аннотация. В статье рассматривается влияние – персональное, национальное и глобальное – на предстоящий прорыв в биogerontологии, который состоит в расширении диапазона здоровья, т.е. продлении жизни человека без возрастных заболеваний (рак, сердечно-сосудистые болезни, диабет, болезнь Альцгеймера и др.). Прорывные результаты экспериментов в этом направлении были достигнуты на мышах, но чтобы добиться аналогичного положительного эффекта на людях, понадобятся дополнительные исследования, требующие около \$10 млрд. в течение 5–10 лет. Это относительно небольшая сумма по сравнению с триллионами долларов, которые благодаря расширению диапазона здоровья можно будет сохранить в ближайшие годы для одних только Соединенных Штатов.

Внедрение новых достижений в области биogerontологии, по мнению авторов, будет очень важно для Украины по двум основным причинам: 1. Украина теряет свое население. По последним прогнозам, численность населения страны до 2050 года сократится примерно до 33 млн. чел. Расширение диапазона здоровья способно остановить этот процесс, т.к. люди смогут жить почти на 20 лет дольше и при этом вести яркий, здоровый образ жизни. 2. Поскольку затраты на медицинские услуги сократятся, из сектора здравоохранения будут высвобождены значительные денежные средства, которые можно направить на оживление экономики и другие достойные цели.

Ключевые слова: диапазон здоровья человека, продолжительность жизни, изменения мировой власти, демография, геополитика.

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Introduction

The United States and a number of industrial nations have been struggling with the issues of the deficit and the national debt for some time. The single most important factor in increasing deficits and calling for borrowing is the rising cost of healthcare. The cost of healthcare is rising because of the aging population and the continual improvements in medicine that are increasingly expensive. In the United States, the cost for the Federal government will run into trillions of dollars per year, which it may not be able to afford.

There is, however, a solution in sight, which at present is well outside of the realm of conventional wisdom. And yet, as we look at the recent history, many policy schemes that once seemed mere utopian dreams are now accepted as parts of the policy fabric. This potential solution, which may be the single most important means to cut the cost of healthcare, is to increase human longevity for a number of years, while freeing it of age-related diseases such as cancer, cardiovascular illnesses, diabetes, and Alzheimer's disease, thus extending human health span (the time of life free of diseases). While extension of health span is a compelling factor in upholding America's and some other nations' fiscal viability, its impact is far-reaching. It affects the distribution of world power and the international system. It could revitalize some economies and would affect immigration policies of certain countries. We shall address these and other issues on the following pages of this article.

The Burden of Healthcare on International Power

In the United States, the principal source of government healthcare funding is Medicare and its huge cost in coming years has become an object of a national debate, which started around 2008. The 2013 Report of the Trustees of Medicare and Social Security, which provided cost projections for the next 75 years, sheds some light on the magnitude of the problem.

According to the Medicare Report, the cost of Medicare will grow from \$565 billion (3.6 percent of GDP) to \$33.7 trillion (7.2 percent of GDP) per year by 2087. These projections were made on the assumption that the cost-saving legislation of 2010 will be fully implemented, which is not likely. If they are not implemented, then projected Medicare costs will rise to a staggering \$45.9 trillion (9.8 percent of GDP) per year.ⁱ

The burden of Medicare is especially troubling in the context of the changing distribution of world power. China's GDP is growing at the rate of 7.5 to 9 percent annually and India's at about 6-7 percent. The United States' growth, in contrast, is 2.5 to 3 percent and that of the European Union is 1 to 1.5 percent. The recent financial and economic crisis has been more damaging to the United States than to China. The United States is very heavily in debt (\$17.6 trillion in 2014), while China's foreign exchange reserves have been reported to be \$3.7 trillion. In 2010, China's GDP exceeded that of Japan, becoming the second largest in the world after the United States. By 2019, China's GDP will likely surpass that of the United States.ⁱⁱ Moreover, the United States has suffered a serious setback in soft power.ⁱⁱⁱ The American model of free-market capitalism spread across the globe as the ideal in the past 30 years is now being questioned. On the other hand, China's quick recovery from the worldwide financial meltdown seems to have shown the strength of its brand of state-led capitalism.

The extremely high cost of Medicare – and healthcare in general – will impose severe constraints on the U.S. budget. Such areas in the budget as armed forces, science and technology, foreign aid, public diplomacy, and education are not protected by entitlement legislation; they are discretionary. Therefore, they are likely to suffer more than others under budgetary constraints. America's viability as a superpower could be seriously jeopardized, given that these areas are critical to strengthening U.S. influence abroad diplomatically, economically, and militarily.

A Powerful Remedy to Reduce the Cost of Healthcare: Extension of Health Span

There are several ways to reduce the cost of healthcare; improving the healthcare system and cutting the cost of drugs are only some of them. There is another more dramatic and potentially much more effective policy that has not yet been dis-

cussed in the U.S. healthcare cost debate. It comes from the realm of science, namely biogerontology. Extension of health span – by increasing human longevity for a number of years without age-related diseases such as diabetes, cardiovascular illnesses, cancer, Alzheimer's disease, and others – is likely to produce a reduction of the cost of healthcare much greater than all the other means of healthcare cost reduction combined. It would save society trillions of dollars in the coming years and add millions of healthy, vigorous individuals to the workforce, thus potentially invigorating the economy.

Human longevity in the United States increased by 30 years in the past century and is now about 79 years. This was achieved by better nutrition, sanitation, discovery of antibiotic drugs, and progress in conventional medicine, which ameliorated or virtually eliminated a number of diseases. But people are still aging, and the costs of supporting an aging population will grow.

In recent years, biogerontologists have made major progress in elucidating the molecular basis of aging, and they have been able to increase the longevity of worms, fruit flies, and mice by 30-100 percent using a variety of strategies. Whether similar biological strategies will work in humans has not been clinically proven. However, the scientific infrastructure for extending longevity and for corresponding delay in the onset of age-related diseases has been built and clinically demonstrated on mice. Leading U.S. biogerontologists – such as Leonard Guarente (MIT), David A. Sinclair (Harvard), Cynthia Kenyon (University of California, San Francisco), Thomas E. Johnson (University of Colorado), and others – believe that if adequate funding for research were available, within five to ten years the *human* health span could be extended by up to 20 years.^{iv} Human appearance will likely not age. However, when the period of extension of health span expires, the aging process will resume, and so will the risk of diseases.

To Extend the Human Health Span? How?

There are at least three leading methodologies for extension of health span. One is caloric restriction (CR), which has been known to work in mice. CR requires a cut in the consumption of food by 30-40 percent, which activates the defensive mechanism of the body to protect DNA and thus extends health span by about 30 percent. However, this near-starvation diet would not be acceptable to most humans and therefore can hardly be considered as a viable method of extension of health span.

Another method developed by Guarente and Sinclair uses sirtuin genes to activate the defensive mechanism of the body to protect DNA. Sirtuin activation, in effect, mimics CR without requiring dieting. This method has been explored in mice and appears to be promising for humans.^v

A related approach, developed by Cynthia Kenyon and known as hormonal control of aging, reduces the action of insulin and a related hormone, insulin-like growth factor (IGF-1). This activates a gene called FOXO, which in turn stimulates a number of responses that protect cells, including the strengthening of the immune system and an increase in antioxidants, thus extending health span.^{vi}

In 2010, Zeltan D. Sharp and Randy Strong, researchers at the University of Texas at San Antonio, elucidated the potential of rapamycin – a metabolite produced by a bacterium in the soil – for postponement of aging and age-related diseases. It works on mice, and in some cancer patients it may result in tumor regression.^{vii}

In short, biogerontology is now capable of extending health span in mice. What needs to be done is to expand this capability to humans. To minimize the risk of failure and resultant delays, a viable project for extending human health span should pursue research of more than one of the most promising methodologies.

However, at present, biogerontology research in the United States is starved for money. Estimates of the cost of research needed to significantly extend health span in humans are about \$10 billion for five to ten years. Even though the U.S. National Institute on Aging (NIA) has funding of \$1.19 billion (for fiscal year 2014), most of it is for research on age-related diseases, with a tenth of it at most spent on extension of health span.

Thus, what is needed is a Manhattan-like Project for Extension of Health Span (MPEHS),^{viii} focused on life span free of age-related diseases. It would save money in research dealing with individual diseases and would go a long way towards reducing the trillions of dollars the United States will be spending on Medicare in the coming years.

Addiction to Individual Diseases

Preoccupation of the NIA with individual diseases – at the expense of a more fundamental and comprehensive approach, whereby a single drug would protect against a number of age-related diseases – reflects the traditional, deeply ingrained mentality of the United States' and world scientific community. It finds its way into the government and the budgetary process. The National Institute of Health (NIH) has at least nine institutes dealing with individual diseases or groups of diseases. Of these, the National Cancer Institute alone has a budget of \$5.12 billion (fiscal year 2014) – more than four times that of the National Institute on Aging.

In 2006, a group of prominent researchers in biogerontology headed by S. Jay Olshansky (University of Illinois, Chicago) attempted to change the way of thinking in the scientific community with regard to aging and diseases and thus modify the system of allocation of funding. They published an article in *The Scientist* which pointed out that by extending longevity free of age-related diseases, a number of illnesses – not just one – could be deferred, thus saving a great deal of money presently allocated to individual diseases.^{ix} The researchers met with U.S. senators dealing with the NIH budget, but their efforts failed to produce results. The present NIH system continues to place emphasis on curing individual diseases.^x This is precisely why a Manhattan Project for Extension of Health Span, functioning outside of the NIH community and free of its mentality, is essential.

The total savings to society from extension of health span would be huge, but they would be only a temporary reprieve. The reason for this is that after the 20 years of extension of health span, the risk of diseases will begin to increase again. However, in terms of costs, the temporary nature of this reprieve could be greatly reduced by compression of morbidity.

Compression of Morbidity

What is compression of morbidity? As a human begins to age, he or she starts to accumulate age-related pathologies, which cause actual or potential disability. The process begins at about the age of 55 and worsens until the time of death, which usually occurs in the late seventies. The aggregate of such disabilities (morbidity) can be compressed to the years close to the end of life. If morbidity is compressed, the cost of healthcare will significantly decrease. Instead of persisting throughout a couple of decades, the incidence of age-related diseases will fall mainly into the few years before death.^{xi} Indeed, with the help of compression of morbidity, extension of health span will come fairly close to eliminating those costs of healthcare that arise from age-related diseases, and thus virtually lose its attribute as merely a temporary reprieve.

There are two causes of clinically identified compression of morbidity. The first consists of the efforts and willpower of individuals. If human beings exercise, eat healthy food, do not become obese, do not smoke, use preventive medicine, and have healthy lifestyles, they push morbidity towards the end of their lives.^{xii} The second is genetic characteristics. Apparently, centenarians have morbidity-compressing genes, which make them lead healthy lives until a few years before their death, at which time their health rapidly declines.^{xiii}

The problem with the first cause is that it is difficult to make it widespread. However, if the morbidity-compressing genes in centenarians could be identified and translated into drug treatments, then compression of morbidity might be available for the population as a whole, thus further cutting the cost of healthcare. Thirty of such genes have already been identified and, as a group, they can have strong influence, but individually they are not strong enough to be translated into drugs. Thus, what is needed is to identify one or two genes powerful enough, so that they could be used in drug development.^{xiv} It would therefore be appropriate for MPEHS to undertake a concerted effort to discover such morbidity-compressing genes.

Extension of Health Span and Fiscal Viability of the United States

The reduction of the cost of healthcare could be critical for the fiscal health of America in next few decades, especially with regard to the national debt. According to 2013 projections by the Congressional Budget Office (CBO), the national debt could rise to about 190 percent of GDP or \$100.9 trillion by 2038. The importance of these numbers is clear in a historical perspective: the highest debt-to-GDP level for the United States was shortly after World War II; in 1946, it reached 106 percent.^{xv}

The growth of spending on healthcare programs would be the single most important factor in the rise of the national debt. According to 2013 projections by the CBO, if current laws remain in place, spending on the major Federal healthcare programs will grow from 4.6 percent of GDP in 2013 to 8 percent in 2038, or \$4.2 trillion per year.^{xvi} A MPEHS could materially help resolve the situation by eliminating the need to treat age-related diseases for an extended period of time.

The United States is the leading nation in longevity research, and it could undertake a MPEHS unilaterally. The lower cost of healthcare would alleviate constraints on the U.S. budget and would make it possible for the U.S. government to avoid curtailment of the essential social services, including Social Security; perhaps it might even be possible to increase them.

An International Program for Extension of Health Span?

The cost of healthcare is a global, not only U.S. problem. Its principal drivers are the expanding capabilities of medical technology and the aging of populations. Because of differences in policies and local conditions, different nations are affected differently. In the United Kingdom, the cost of healthcare is growing, the population is aging, and fertility is at 1.7 per woman, which is below the replacement level of 2.1. Due to immigration, however, the population is still projected to grow from 63.4 million in 2013 to 71.2 million in 2050. By contrast, the population of Japan is projected to dwindle from 127.3 million in 2013 to 107.2 million by 2050, and Russia's present population of 143 million may shrink to as low as 99 million in the same period. In China, the cost of healthcare is high, and its population is also aging.^{xvii}

Therefore, it would be advisable for the United States to undertake an International Manhattan Project for Extension of Health Span (IMPEHS), jointly with the European Union (EU), Japan, China, and perhaps other nations. An international approach would lower the cost of research for the United States – perhaps down to \$3-5 billion – because other nations would share the cost. All nations would benefit from the lower cost of healthcare, but those with dwindling populations – like Japan, Russia, and Ukraine – would be additionally advantaged because the decrease in their populations will be at least slowed down, more likely stopped or even increased, by the increase of healthy longevity.

The full benefits for the United States of an international approach to extension of health span are easily recognized when such a project is viewed in the context of recent history. The United States' soft power – its image in the world, world leadership (including that in science), public diplomacy, relationship with its allies as well as with less friendly nations – suffered significantly and unnecessarily under the George W. Bush administration. Given that the United States' hard power – the economy and the military – is relatively declining and will decline further in coming years, it would be critical for the United States to attempt to compensate for its relative losses in hard power by gains in soft power. In this category, U.S. world leadership would be perhaps the most important. IMPEHS could be a powerful instrument of soft power for the United States, especially if Washington policymakers effectively capitalize on it and, wherever possible, skillfully translate its soft power potential into hard power. For example, if extension of health span stops decline of Japan's population, revives its economy, and generates a great deal of good will for the United States in Japan, the United States could perhaps take advantage of this good will (soft power) to conclude a favorable trade

treaty (hard power) with Japan, or win other concessions in the area of hard power.

The potential for translating soft power into hard power requires attention because of the relative importance of hard power in foreign affairs. Soft power has been gaining in recent decades and will be gaining in the coming years, but hard power is still the predominant form of power in international relations. This has been dramatically illustrated by Vladimir Putin in his aggression in Ukraine in 2013-14, which caught the West by surprise as being «inappropriate» in the 21st century.

In sum, biogerontology, through its prospective capability to extend human health span, would significantly help the United States cope with the two major challenges the nation is facing in the twenty-first century: the relative decline of U.S. power in world affairs and America's fiscal viability.

Indeed, it is not likely that the United States will be able to do both – to maintain its superpower status and provide the essential services to its population – for very long without resorting to the potential of biogerontology. However, if it effectively combines its revitalized hard power with IMPEHS and other instruments of soft power, this goal could arguably be achieved.

Will Science and the Flow of History Save the West from Potential Adversity?

On the previous pages, we have pointed out that biogerontologists have in recent years made major progress towards the capability of increasing human health span. Extension of health span will most likely result in a massive reduction of the cost of healthcare. A Manhattan-like Project for Extension of Health Span, focused on life span free of age-related diseases, would significantly reduce the trillions of dollars the United States will be spending on Medicare and Medicaid. It is very likely that in the coming years the United States will be able to maintain its superpower status and provide the essential services to its population—perhaps even improve them—with the help of biogerontology and a skillful use of soft power. The cost of healthcare, however, is a global problem. An international approach would not only benefit all nations through lower costs of healthcare, but would also lower the cost of research for the United States because of cost sharing. Moreover, the United States would make significant soft power gains if it were to lead such a program.

Now we would like to raise more general and abstract questions. What will be the regional and global consequences of an International Manhattan Project for Extension of Health Span (IMPEHS)? How does extension of health span affects trends in foreign affairs? How does it fit in history?

Although science has extended human longevity, it has done so at a high cost. We have reached the point where the combination of the extension of human longevity by traditional means and the aging of populations is bringing us to a dead end – it constrains America's resources so much that it will be increasingly less capable of accomplishing other important objectives, including those of national security and foreign policy. But now science offers a different solution – extension of health span – that would release huge resources for other purposes. The upward trend of evolutionary history suggests that extension of human health span will happen anyway, with IMPEHS or without it. IMPEHS is merely intended to accelerate the process and steer it towards specific objectives.

Extension of health span introduces a major discontinuity into trends in foreign affairs. Unlike the most recent major discontinuity – the collapse of the Soviet Union – it will not be sudden but gradual. Trends in demography are a looming force in changing the distribution of world power in the twenty-first century. As mentioned earlier, extension of health span will at least slow down the population decline – if not revert the trend – in those nations where population dwindles, thus enhancing their viability and preventing potential instability.

If extension of health span is successful, current projections of the distribution of power in the world, as measured by demographic trends, will not materialize. The decline of Japan's population from 127 million to 107 million by 2050 will not happen. With extension of health span, Japan's economy is likely to be revived and Japan could emerge, again, as a viable world

power. Russia's population is conservatively projected to dwindle from the present (2013) 142.5 million to 129.9 million (by some estimates, to as low as 99 million) in the next 37 years.^{xviii} Extension of health span would probably help reduce the decline. However, it is not clear if it would solve the problem entirely, since Russia's severe population crisis has multiple causes, including poor health conditions and excessive consumption of alcohol.^{xix} To optimize the benefits of extension of health span for Russia, substantial improvements must be made in these and other areas.

Ukraine's population, instead, would remain at a much better level than the projected 33.6 million for 2050 (from the present 44.6 million). If it solves – or at least alleviates – its multiple political problems (largely stemming from Ukraine's proximity to Russia), then extensive resources released from the healthcare sector which would invigorate the economy as well as other major components of the nation, better demographics, a substantial industrial base, rich natural resources, and a well-educated population could help the country evolve into an influential European nation.

China's population has been aging and its size will be shrinking. By 2050, it is projected at 1.304 billion, 46 million less than in 2013. Extension of health span would stop the population decline, is likely to improve the economy, and possibly prevent the potential instability arising from the huge number of elderly people devoid of an adequate social safety net. On the other hand, India's fertility rate is at 2.8, its population growth has been rising rapidly, and the government's efforts to stem it have not been successful. By 2050, it is projected at 1.657 billion, 353 million larger than China's. Extension of health span would reduce the cost of healthcare and be beneficial for the Indian economy, but it is likely to aggravate India's rampant population growth.

The picture is clearer for the European Union, which will significantly benefit from extension of health span. According to present projections, the EU will lose only 12.1 million in population (to a total of 497.1 million from the present 509.3 million, nearly all of them – 9.6 million – in Germany) by 2050. Extension of health span would be important for the EU because it would help increase its population numbers and revive its economy. Improvements in economic conditions would likely stimulate European integration, possibly nudging the EU towards a superpower status.

Current demographic projections are favorable for the United States. At present, the United States is the only major developed nation that has a fertility rate at or above the replacement level of 2.1 per woman.^{xx} With the help of immigration, its population is expected to grow and reach the size of 423 million by 2050, an increase of 106 million from 2013. With extension of health span, the total number would likely be larger. The vast majority of population will be healthy and potentially much more productive.

Conclusions

By 2050, with extension of human health span the United States and the European Union – the two regions comprising the hub of Western civilization—will have a total population of about one billion of well educated, vigorous, and productive people. Extension of health span enhances vitality and viability of societies not only in the economic sphere, but also in other areas of human endeavor – like music, science, technology, the environment, education, foreign affairs, and literature – all important elements of a civilization. The most talented individuals in each of these fields will live healthy and vibrant lives by up to 20 additional years, thus not only enriching their respective fields but, in their aggregate, enhancing and accelerating the evolution of Western civilization. Accordingly, to speak of the twenty-first century as «an Asian century» – which is fashionable now – may be shortsighted. True, extension of health span will also benefit Asian nations, but the impact will be differential, and it will favor the West.

The reasons for the differential impact vary from country to country, but perhaps the single most important reason is that nearly all Western countries would benefit from the two major advantages of the extension of health span – population expan-

sion and economic growth – while this is not so for Asian countries. Populations of most Asian countries are rapidly growing, and for some of them accelerated growth could be damaging to their society (e.g., India). A significant exception is Japan, but Japan happens to be the most Western major industrialized Asian country, whose economic revival would be in the interest of the West.

What does the favorable impact of extension of health span for the West and, more broadly, for Western civilization, mean for America's role in the world? For thousands of years the world has been evolving towards a higher civilization and in this evolution Western civilization eventually gained ascendancy; it is still on its forefront. By favoring the West, extension of health span opens up new opportunities for America's leadership, especially if the United States effectively capitalizes on promotion of evolution of world civilization as a component of its soft power strategy. In this regard, a close cooperation between the United States and the European Union – the cradle of Western civilization, economically and politically revived by the extension of health span – would be essential.

Notes and References

ⁱ *The 2013 Annual Report of the Board of Trustees of the Federal Hospital Insurance and Federal Supplementary Medical Insurance Trust Fund* (2013). Washington, D.C. U.S. GPO, and data provided by the Center for Medicare and Medicaid Services. The dollar figures were computed by the authors.

ⁱⁱ According to *The World Almanac and the Book of Facts* (2014). New York: World Almanac Books: 764, 849, in 2013 GDP in the United States was \$15.9 trillion and that of China, \$12.6 trillion. Projected annually at 3 percent for the United States and at 7.5 percent for China, in 2019 it will be \$19 trillion for the United States and \$19.6 trillion for China.

ⁱⁱⁱ The term «soft power» as used here is any actual or potential influence of a nation in foreign affairs other than by coercive use of hard power – military and economic might.

^{iv} Personal communications of Victor Basiuk with these and other researchers in May 2014.

^v Sinclair, D. A., & Guarente, L. (2006). Unlocking the Secrets of Longevity Genes. *Scientific American*, 294, 48-56; Hubbards, B. P., Gomes, A., & Dai, H. (2013). Evidence for Common Mechanism of SIRT1 Regulation by Allosteric Activators. *Science*, 339, 1216-19.

^{vi} Telephone interview of Cynthia Kenyon by Victor Basiuk, 19 June 2012.

^{vii} Sharp, Z. D., & Strong, R. (2010). The role of mTOR signaling in controlling mammalian lifespan: what a fungicide

teaches us about longevity. *The Journal of Gerontology, Series A: Biological Sciences and Medical Sciences*, 65, 580-89.

^{viii} This is not to suggest that a project for extension of health span should duplicate the organization of the Manhattan Project, which produced the first nuclear weapon, but that it should have its principal characteristics – a single focus, intensity of pursuit of its objective, and independence from other scientific institutions.

^{ix} Olshansky, S. J., Perry, D., Miller, R., & Butler, R. N. (2006). In Pursuit of the Longevity Dividend: What Should We Be Doing to Prepare for the Unprecedented Aging of Humanity? *The Scientist*, 20, 28-36.

^x Kronos Longevity Research Institute (2009). *Grey Is the New Gold; State of the Science Two Thousand Nine*. Phoenix, AZ: 5.

^{xi} Fries, J. F. (2002). Compression of Morbidity. *Encyclopedia of Aging*, 257-59.

^{xii} Swartz, A. (2008). James Fries: Healthy Aging Pioneer. *American Journal of Public Health*, 98, 1163-66.

^{xiii} Pearls, T. T. (1997). Centenarians Prove the Compression of Morbidity Hypothesis; But What About the Rest of Us Who Are Genetically Less Fortunate? *Medical Hypotheses*, 49, 405-07; Hitt, R., Yinong, X. U., Silver, M., & Peris, T. (1999). Centenarians: The Older You Get, the Healthier You Have Been. *The Lancet*, 35, 652.

^{xiv} Sebastiani, P., & Perls, T. T. (2012). The Genetics of Extreme Longevity: Lessons From the New England Centenarian Study. *Frontiers of Genetics of Aging*, 3 (November 2012) and telephone interviews of Paola Sebastiani by Victor Basiuk in May 2013.

^{xv} Congressional Budget Office (2013). *The 2013 Long-Term Budget Outlook*. Washington, D.C.: U.S. GPO, 1, 3, 8, 11. The dollar figures have been computed by the authors.

^{xvi} *Ibid.*, 42. The dollar figure has been computed by the authors.

^{xvii} Jackson, R., & Howe, N. (2008). *The Greying of the Great Powers: Demography and Geopolitics in the 21st Century*. Washington, D.C.: Center for Strategic and International Studies; Unless otherwise indicated, the population and projection figures on the following pages are from *The World Almanac* (2014), 733-34.

^{xviii} Jackson, R., & Howe, N. (2008). *The Greying of the Great Powers*, 180.

^{xix} Eberstadt, N. (2009). Drunken Nation: Russia's Depopulation Bomb. *World Affairs*, 171, 51-62.

^{xx} Howe, N., & Jackson, R. (2011). Global Aging and the Crisis of the 2020s. *Current History*, 110, 20-25.

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