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ERUDITIO

*“A multidisciplinary forum focused
on the social consequences and policy
implications of all forms of knowledge on
a global basis”*

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Editorial

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Conference on New Paradigm in Human Development

Al-Farabi Kazakh National University, Almaty, Kazakhstan

November 5-7, 2014



World Academy of Art
& Science



Al-Farabi Kazakh National
University



World University
Consortium

Over the past 15 months the World Academy of Art & Science has conducted a series of international conferences in Europe, Central Asia, North Africa, North and South America on core elements of a New Human-centered Development Paradigm in association with more than a dozen partner organizations from around the world. World Academy of Art & Science, World University Consortium and Al-Farabi Kazakh National University are pleased to announce that the next conference in this series will be conducted in Almaty, Kazakhstan on November 5-7, 2014 in association with other partnering institutions.

The current socio-economic-political paradigm is unsustainable. It is destroying natural, human and social capitals. A change of course is essential. Faulting current approaches has so far proven insufficient to bring about a significant change in thinking and action. Neither has the potential upside of alternative futures been sufficiently documented or projected. The call for a fundamental paradigm change is now accepted by many leading thinkers and institutions, but the precise nature of the change required and the process by which it can be brought about are yet to be defined. A comprehensive strategy is needed to substantiate that practical and effective solutions are possible to successfully address global challenges, backed by quantified research and reliable measures of the desired outcomes.

The conference will address four major sets of interconnected issues

- **Economy:** Employment, Finance, Inequalities, Poverty, & Economic Welfare
- **Ecology and Energy:** Resource Management, Climate Stability & Sustainability
- **Governance:** Human Rights, Democracy, Rule of Law, International Security & Social Stability
- **Human Capital:** Future of Education, Skills Development, Healthcare & Social Progress

The format will involve presentations, panel discussions and working group sessions that cross disciplinary boundaries to explore the interdependencies and linkages between these issues in an effort to develop deeper conceptual understanding and more effective practical strategies.

We are pleased to invite you to participate in the conference and actively contribute to the formulation of new perspectives. For more information, please contact us at almaty.conference@worldacademy.org

[Click here](#) to download the Concept Note

[Click here](#) to view the Draft Agenda

Editorial

Ullica Segerstrale's essay, [“Futuristic Scenarios and Human Nature,”](#) takes up the challenging issue of how human nature may be impacted and possibly even transcended by future scenarios of technological development. She provides us with a very good insight into the problem of the interdependence and interdetermination of social process and technological innovation. This is a challenging vista, one that may generate an optimistic future for human nature and one that is perhaps more dismal among the great challenges of the dynamics of artificial intelligence. As she notes, some machines may indeed have the capacity to self-replicate and improve. The possibility of a dramatic and sudden transition might confront humanity with a “singularity.” What is the role of a human future in the universe of singularity? This is a vital question and the author has done us a service in raising such questions in such a clear and elegant manner.

Ruben Nelson is an original and powerful thinker. His short essay, [“Civilizational paradigm change: The Modern/Industrial Case,”](#) focusing on civilizational paradigm change in the context of the Modern/Industrial civilization is a brilliant outlook at the factors that shape our thought and paradigms of thought. His essay looks at paradigm change from several perspectives, all of which throw light on the forms of civilization and the challenges of transformation. This is another important essay and an indication of the far-reaching intellectual power of the Fellows of the Academy.

John Scales Avery has written a brief but elegant essay on the urgent need for renewable energy. [“The Urgent Need for Renewable Energy”](#) brings in important scientific insights in a form that is readable to non-scientists and public policy intellectuals. The issue of renewable energy, the challenge of climate change, the dominant role that energy interests play in seeking to constrain the evolution of alternative energy sources are a major challenge according to Avery's article, which puts the core issues on the table in a concise and communicable manner. This is an important contribution.

Michael Marien has provided us with a useful summary of the most recent reports touching on the question of how climate change poses serious national security challenges in his [“Book Reviews”](#). Recent reports, for example, look at the challenge climate change poses for economic and national security interests. It is interesting to note that the findings of the Military Advisory Board declared that climate change poses a serious threat to American national security. The Military Advisory Board provided an update expressing its dismay that discussions about climate change have receded from informed public discourse and debate. The military experts again stressed the seriousness that climate change poses for human security systems on a global basis. The military's report is very useful because of its comprehensive checklist of climate change issues, as well as its specific recommendations for action. The author's summary of literature here is a very useful update for those Fellows who are deeply concerned about the challenges posed by climate change.

Robert Hoffman has provided us a short [review essay](#) of a book by Mary Christina Wood. Her book, *Nature's Trust: Environmental Law for a New Environmental Age*, details the failures of the agencies regulating the protection of the environment and is a call for urgent radical reform.

Winston P. Nagan

Chair of the Board, World Academy of Art & Science

Chair, Program Committee

Editor-in-Chief, *Eruditio*

Futuristic Scenarios and Human Nature

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Abstract

This article discusses current developments in information technology and artificial intelligence and their projected implications for humankind. It examines the arguments and projections of some contemporary technological pessimists and optimists in the light of historical insights about technological development and asks what kind of situation we are in at present. Should we believe, with extreme technological optimists, that we will soon reach a point, the Singularity, where it will be possible to “upload” a person in a computer, making him/her in this way immortal? Is it true that technology has a life-like nature and “wants” to evolve? The extreme arguments, however, are based on an outdated view of technology as information. They also involve an unrealistic view of human nature: humans cannot be reduced to information. We are in need of new models. Moreover, as we learn from a Silicon Valley insider, the Internet was never intended to be used to make some people rich through gathering and aggregating data about others. A new digital humanism would help diminish the fast growing global inequality and restore respect for the creative individual.

Is technology an autonomous force that drives social change, or is the use of technology dependent on human choices? Do we have a scenario of technological determinism or technological voluntarism (or what some call constructivism)? And what are the consequences of choosing one or the other to explain the direction of society? The framing of what is going on and the use of language are not neutral but important tools in a cultural struggle with vast consequences. (Think for instance about the word ‘sharing’). Moreover, these perspectives are not obviously connected to either an optimistic or pessimistic outlook on technology, but can be combined with both.

In the following sections, I will briefly discuss these issues in relation to the current situation in digital technology, taking a look at some recent opinions by prominent individuals in the field. We will see different predictions and suggested solutions. The views will vary from cyber-hype to cautious optimism and realistic warnings to outright scares. The solutions are typically connected to an assessment of where we are right now in regard to technological development, and here the diagnosis depends on one’s historical perspective as well as belief in the future of digital power.

1. Changing Views of the History of Technology

Over the last few decades, the traditional “heroic view” of individual inventors has increasingly given way to a view that is more systems and process oriented. This is largely due

to a more complex historical analysis of the way in which technological progress actually took place. A closer look at the detailed background history of many inventions shows that they in fact came about through the accumulation of many small increments over time. Also, much more attention is being paid to such things as the availability and willingness of financial entrepreneurs to support an invention, the availability of suitable supportive technology, and the social need or desire for a particular invention – which may not at all have been obvious at the time.¹

“A closer look at the detailed background history of many inventions shows that they in fact came about through the accumulation of many small increments over time.”

There was often a considerable difference between the original intent of the invention and the way in which it was finally used (a good example is the phonograph of Thomas Edison, which was first developed to record the dying wishes of important men; instead, it was used for music recording and mass entertainment). In fact, customer interest was often a driving force for the development of a new technology, and constant feedback from customers led to continuous corrections of mistakes and improvement of performance of a new technology. These kinds of observations make technology seem more like a product of a social process than something invented by single geniuses.²

2. The Current Situation – Uncontrolled Buildup of Control

Where are we now? Are we at the beginning of an era of unprecedented technological innovation and development? Or are we rather at the tail end of an era that started some 70 years ago? Let's see what some techno-gurus and innovators think. But first, a snapshot of recent developments in artificial intelligence and information technology.

Research in AI is developing rapidly, as indicated by such recent products as self-driving cars and personal assistants like Siri and Google Now. A computer recently won a game of Jeopardy! (Remember when the computer Deep Blue beat the world chess champion Garry Kasparov in 1997?). According to Stephen Hawking, we are now developing the kind of artificial intelligence that is familiar from science fiction movies. Enormous investments are made in information technology and these are bigger than ever before; it can be likened to an arms race. New AI startups are created all the time and receive the financing needed for innovation. Google and other major companies are acquiring artificial intelligence and robotics companies. We could soon have smart robots roaming our streets.³

Another source reports: “Over the past year, Google has bought seven robotics companies... It has bought firms that specialize in natural language processing, gesture recognition, and more recently in machine learning.... If Silicon Valley's best minds succeed, their software will not only be listening, it will be understanding and anticipating.”⁴

Indeed, AI is everywhere in some form. Every time you plug into the internet, someone is there to spy on you and track your behavior. It is almost impossible to avoid being tracked. New face recognition software can now identify you to the authorities whenever you are close to one of the many information gathering devices – including a police constable, who

doesn't even need your name if he has your face identity. And devices are everywhere. New wearable computers of various kinds are being developed. The most intrusive seeming futuristic spyware would be "smart dust" flowing around you, taking pictures of you or measuring your bodily proportions. A picture of your key chain lying on a table in a coffee shop may provide sufficient information to copy your keys, suggests Lanier.⁵

But is all this spying and control actually legal? IIT lawyer and author Lori Andrews has been looking into this. She finds that in the US, at least, there is no law actually forbidding this spying (Which may or may not indicate that the law lags behind technological development and would need to catch up quickly). She has been addressing the issue of smart phones – in fact portable mini-computers, which are providing information about our conversations and movements in real time. In a cleverly titled piece, she asks, "Is your cell phone listening in on you?" Yes, it is – and if it has the hidden program Carrier IQ, it can also read your text messages and emails as you write them. That is one of the many programs installed without your permission; other spy programs you may just unwittingly download together with some legitimate smartphone application. The problem is the existing Wiretap Act. Your consent is not required if your wireless carrier decides that marketing companies are allowed to collect and transmit your personal information.⁶

3. Optimists and Pessimists among the Tech Insiders

Technological optimists see fantastic possibilities of realizing long-held dreams. They believe that it is possible to increase human intelligence and sensory powers so as to create super-humans of some sort. They believe in an extended human life span. There are those who welcome increasingly "cyber-like" humans. The so-called Transhumanists are the most extreme. Technological pessimists point to unforeseen technological problems and dangerous social consequences. Their views may in fact not be particularly pessimistic, just realistic checks on the situation...

But an important question has to do with how we assess the current situation in the history of humankind. Where are we now? Are we in a historically unique period of unprecedented growth and innovation, and open-ended promise (this is clearly the basic assumption of the tech leaders and investors)? Or are we rather at the end of an earlier historical period, picking the last of the "low hanging fruit" of earlier important innovations? This may sound counter-intuitive on the face of it, but it is the recent view of at least one technological pessimist, the economist Robert Gordon, to whom I will now turn.

At the 2013 annual Innovation Forum organized by the *Economist* at UC Berkeley, Gordon provocatively suggested that "long-term economic growth may grind to a halt", especially in economies with advanced technology. Looking backward in history he concluded: "Two and a half centuries of rising per-capita incomes could well turn out to be a unique episode in human history".⁷

Another technological pessimist is the author of *The Big Stagnation*, Tyler Cowen.⁸ He uses the idea of "low hanging fruit" quite effectively, arguing that after the Second World War and the "Sputnik effect" (which triggered a campaign for massive education and innovation in science and technology in the US), there have actually been very few significant innovations. The potential from existing innovations after Sputnik (e.g., the computer,

telecommunications) has already been extracted, which is why economic growth is slow. Although Cowen recognizes the Internet, he argues that much of the activity on the net is free and, if anything, the internet rather displaces jobs than create new ones, and he does not count innovations in fields like health-care and finance as having created significant benefits for people in general.

Moreover, he points to a number of very special circumstances that favored the growth of America – earlier types of “low hanging fruit”, such as available land, an inflow of immigrant workers, available education, and scientific and technological progress. So what is driving the Great Stagnation? He says he can formulate it in one sentence: “Recent and current innovation is more geared to private goods than to public goods. That simple observation ties together the three major macroeconomic trends of our time: growing income inequality, stagnant median income, and...the financial crisis.”⁹

Technological optimists have a different view of the situation. For example, the authors of *The Second Machine Age*, one, the director of MIT’s Center for Digital Business, and the other, a research scientist at that center, argue that digital technologies are dramatically changing our world and economy: as more and more goods and services are produced, they will become increasingly cheaper. At the same time they admit that computers will increasingly take over human labor, which will cause rising inequality. But the solution is to be found in a new kind of collective intelligence, consisting of networked brains as well as strongly connected intelligent machines.¹⁰

Chris Anderson, the editor of *Wired* magazine with his bestselling book *Makers: The New Industrial Revolution*, introduces his readers to the new way in which digital technology is now impacting the production of goods as well, and transforming mass production into small scale or even home manufacturing.¹¹ Digital manufacturing will involve among other things 3D printing which is improving all the time. It will also involve different types of financing (e.g. Kickstarter, which is an online platform for funding seed capital for launching a new business). With the new digital technology for production it will be possible for people to follow the “do it yourself” strategy. The “Makers” has already become a movement. Anderson keeps the door open for impact on other fields too, such as health and education.

Two other insiders have an alternative approach. They recognize today’s huge global challenges involving such things as population, food, water, energy, education, and health-care and want to tackle these problems head on on huge market opportunities! These are the authors of the book *Abundance: The Future is Better than you Think*, Peter Diamandis and Steven Kotler.¹² This book, published in 2012, can be seen as a response to Cowen’s pessimism. Peter Diamandis has degrees in molecular genetics and aerospace engineering from MIT and a medical doctorate from Harvard and is the founder of more than a dozen tech companies. He is also in charge of the XPrize Foundation, which provides support to young social entrepreneurs’ innovative ideas and awards them. Kotler is a journalist and book author. Together they suggest that we take the initiative away from slow-moving governments and encourage small innovative teams instead to solve the big challenges facing humankind.¹³

An even more impressive voice is that of the billionaire Naveen Jain, founder of the World Innovation Institute, who similarly concentrates on finding solutions to difficult global problems with great impact on the quality of life. Health, energy, environment, and education

are some of his core areas. For Jain the true measure of progress is not economic productivity but rather improvement of the quality of life. In other words, he is advocating a type of social entrepreneurship, which he is supporting through his institute. Just like the authors of *Abundance*, he believes the solution lies in creative new applications of information technology, and that major innovations are just around the corner. He is an innovator himself, a developer of Windows and other Microsoft products.¹⁴

4. The Promise and Scare of Artificial Intelligence and the Singularity

The possibility of highly intelligent machines has existed a long time in science fiction and in movies. The tension is typically between machine power and human power and the question is the extent to which machine power will come to dominate humans.

Using technology to enhance or modify our human nature is already a reality.

For technological optimists, the benefits of AI are obviously enormous. In fact, it seems that they take a future involving highly intelligent machines for granted. This is clear from the attitudes and jargon among some leaders in Silicon Valley.

A couple of articles from May 2014 describing the culture of Silicon Valley bring this point home; the titles already tell the story: “Silicon Valley: an army of geeks and ‘coders’ shaping our future”, and “In the future, the robots may control you, and Silicon Valley will control them.” We learn about lots of young people working 80 hour weeks without taking weekends off and a startup company “incubator” called Hacker DoJo where anyone can come and work for free on his own project and meanwhile be in close proximity to others with whom they may later form a team. The language of the Valley, interestingly, is full of expressions like “changing the world” and “disruption”, deriving from a certain counter-cultural rhetoric from the sixties and seventies. The place is also said to sustain a spirit that regards failing as acceptable and part of the process, as long as one learns from it.¹⁵

The people in the Valley naturally conceive of an unfolding future of AI with an open horizon towards superhuman intelligence. What is more, to the extent the machines become self-replicating or self-improving – which is also expected to happen – they could effectuate a sudden transition, the situation that techno-wizard Ray Kurzweil famously calls “singularity”.¹⁶

For Kurzweil, this is an event that is bound to happen, and soon, because following Moore’s Law, the power of information technology rapidly and inevitably increases in sophistication, doubling every 18 months. When this happens, the expectation is for human intelligence to merge with machine intelligence, making it possible to “upload” a person’s digitalized personality for preservation and access in the future, achieving a sort of immortality in this regard. There is a tremendous attraction to this kind of thing, it seems, for some of the leaders in information technology, and also for other techno-enthusiasts. (Experiments at a milder scale are already underway, for instance the possibility of exchanging emails with a deceased person, based on this person’s typical answering pattern).

Is it true that *The Singularity is Near*, as Kurzweil’s famous book with the same name suggests? Well, it is coming nearer at least in the form of the 2014 blockbuster movie

Transcendence, depicting such a state. This will now spread one of the weirdest ideas of the Silicon Valley to the general public. Here is a short description of what is involved by a fellow tech guru who has followed Kurzweil closely:

“The Singularity, recall, is the idea that not only is technology improving, but the speed of improvement is increasing as well... We ordinary humans are supposedly staying the same ... while our technology is an autonomous, self-transforming supercreature, and its self-improvement is accelerating. That means it will one day pass us in a great whoosh. In the blink of an eye we will become obsolete. We might then be instantly dead, because the new artificial superintelligence will need our molecules for a much higher purpose. Or maybe we will be kept as pets.”¹⁷

We are also informed that Kurzweil “awaits a Virtual Reality heaven that all our brains will be sucked up into as the Singularity occurs, which will be ‘soon’. There we will experience ‘any’ scenario, any joy.” Here we encounter a clearly religion-like atmosphere, which presumably also permeates the Singularity University, which Kurzweil helped found, located next to Google.

Some time ago another technophile, Bill Joy, after first being enthusiastic, reflected on (an early version of) Kurzweil’s optimistic interpretation of the future development of technology. He came to a negative conclusion. “The future doesn’t need us,” was his alarming realization, and the title of a famous long article of his. Joy could not see how humanity could avoid the possibilities for destruction on a mass scale.¹⁸

The real scare of AI was expressed most recently by a group of scientists including Stephen Hawking. The fear is that AI technology will end up not only surpassing humans in inventions, but producing things that humans cannot understand, while outsmarting them in various ways. “Success in creating AI would be the biggest event in human history,” Stephen Hawking recently wrote in an op-ed in *The Independent*. “Unfortunately, it may also be the last”. He continued: “Whereas the short-term impact of AI depends on who controls it, the long-term impact depends on whether it can be controlled at all.”¹⁹

Equally extreme is the idea of a life-like direction to technological progress, argued by the founder and first editor of *Wired* magazine, Kevin Kelly, in the book *What Technology Wants*.²⁰ The main thesis of the book is that technology “wants” to evolve. It is a process similar to evolution, which at the same time follows Moore’s Law. This “want” of technology is supposedly so great that humans become just bothersome obstacles to what technology wants. Therefore, it is natural for technology to “want” to transcend humans; we are just its temporary vehicles.

This relative contempt for human beings in favor of technology – or is it concern for humans, it is hard to tell! – can be taken even further. We humans are not only not good enough intellectually, but also morally, according to a book called *Unfit for the Future: The Need for Moral Enhancement*.²¹ The authors suggest that we do something to radically enhance human nature – we are not up to the responsibilities that come with the future of technology and the new challenges we will face. We are too morally weak and our traditional methods of transmitting morality are too inefficient. Therefore, in order to guarantee our

survival as a civilization we should provide ourselves with more adequate moral capabilities. This is being argued by the Director and Research Fellow of the Program on Ethics and the New Biosciences at Oxford University.

5. What happened to Human Nature?

But what happened to human nature in these last projections? It seems that great liberties are being taken with assumptions of who we are. The first two extreme arguments appear to see humans as bundles of information.

The Singularity scenario appears to involve a would-be religious view of information as the essence of what it means to be human. Information was, incidentally, a metaphor also used by molecular biologists – all those scientists (such as Jim Watson, first Director of the Human Genome Project) who early on wanted to persuade us about the importance of the human genome project and how it would reveal to us our “blueprint” or “the very essence of being human”.²²

“The biggest problem with these futuristic scenarios may be the unrealistic way in which they conceptualize human nature. Humans cannot be reduced to information.”

The second case uses the same conception of technology as information, this time actively evolving by itself. But the information model is not of a living organism adapting to its (changing) environment, it is only of its DNA. The claim is entirely dependent on the validity of the information model of the gene. This is particularly ironical today, since it has been recently realized that all those earlier assumptions about DNA as an information code were too simple. They ignored DNA’s ongoing requirements for appropriate stereochemical and environmental conditions for it to function at all. DNA is alive, it is not just a code, and it is far more complex than previously assumed. Also, it turns out to be hard to find simply identifiable “genes for” most human traits.

The biggest problem with these futuristic scenarios may be the unrealistic way in which they conceptualize human nature. Humans cannot be reduced to information; we have bodies and emotions, and are from birth absolutely dependent on nonverbal interaction. Also, even the most extreme information capabilities will not take care of the many inbuilt biases that affect the decision-making of our evolved human minds. We will continue jumping to conclusions, confuse correlation with causality, select cases that support our views, believe in self-fulfilling prophecies, sustain a good image of ourselves through various self-serving biases, etc. (Of course since we know this better now, we should also be better at counter-acting it).

In fact, evolutionists have already for some time been concerned about the discrepancy between the speed of technological development and the biological adaptability of humans – exactly because we are not machines!

What about the third extreme suggestion, that of enhancing human morality? The authors’ perception of the necessity for this measure is postulated on their assumptions that humans do

not have an innate moral sense, and are therefore dependent on education and culture. But this is an assumption that is being increasingly challenged by scientists such as ethologist Frans de Waal, in books such as *Primates and Philosophers* and *The Age of Empathy*.^{23,24} Frans de Waal is on the forefront of those who point to an evolutionary programming in humans for empathy, altruism and cooperation, in direct opposition to those who present human morality as basically hypocritical and grounded in our self-interest (for instance Robert Wright in his book *The Moral Animal*).²⁵

This kind of argument about innate morality (and empathy) taps into a fundamental philosophical difference between two camps. There are those who see human nature as “saved” from the brutality of the natural world by the existence of culture, and others who regard humans as part of the natural world, but with the special addition of a cultural dimension. The famous proponent of the first view was Thomas Henry Huxley, whose contrast between nature and culture (education) was later reiterated by Richard Dawkins. Unfortunately, Dawkins’ popular biology book *The Selfish Gene* (1976) was often seen to further ingrain the idea of natural human selfishness.

A counter-scenario to deterministic arguments emphasizes human choice and the need for and capability of humans to take charge. As responsible humans we should be able to rely on traditional human morality, culture and social norms, instead of referring to technology as a social force somehow external to us. And this is where I wish to bring in Jaron Lanier.

6. Toward a Humanistic Technology

Time has come to bring in one more technology wizard, computer scientist Jaron Lanier, a long time insider of Silicon Valley, best known for having created virtual reality. Lanier believes in technology (obviously). But he is thinking deeply about the actual potential of internet-based technology and culture and asking himself if what we have in place now is the best way to go, and if not, what can be done.

Positive results: the Internet has shown that people are not passive consumers (as some worried during the time of television) but instead want to express themselves. Especially in the developing world, the Internet and mobile phones have had a dramatic effect, empowering people to connect and coordinate with each other.

But, according to Lanier, deterioration began with the rise of so-called “Web 2.0” designs around the turn of the century. These designs valued the information content of the web over individuals. The expressions of real people were aggregated into dehumanized data instead. There are many more things wrong with this. Only the “aggregator” (like Google, for instance) gets rich, while the actual producers of content get poor. Newspapers are dying. “The Internet has become anti-intellectual because Web 2.0 collectivism has killed the individual voice,” he complains.²⁶

His book *You Are Not a Gadget* takes up this issue with a number of books that glorify “the crowd” or the collective. The popular idea that the collective is smarter than the individual is wrong, he argues. Crowd processes are good for some things, such as setting a market price, or for political elections, but they typically fail in cases that involve creativity and imagination. (An earlier author who examined such aspects of the Internet was Cass Sunstein

in his classical book *Infotopia*. He went through the various potential uses of information technology and worried among other things that the Internet might promote such undesirable phenomena as “group think” on a mass scale).²⁷

Yet another criticism has been that “open culture” sites such as Wikipedia undervalue achievements by human individuals and overvalue the collectivist spirit and anonymity of a crowd community. Lanier’s argument here is that important inventions are not mass phenomena but connected to individuals who struggle and persist, and test and modify their products. The current emphasis is on quantity when it should be on quality!

But this is not a logical consequence, Lanier protests. The internet does not *have* to be used this way. New radical technologies do not *have* to deny the uniqueness of the individual. Collectivism is not inherent in the Internet or the Web. The actual challenge will be, and should be, to develop a new digital humanism that can accommodate creative and innovative individuals.

Lanier was recently interviewed on television about his most recent book, *Who Owns the Future?* The information networks have taken an unexpected turn towards reducing human participation in the economy, he explained. This was not the intent! Lanier himself was part of this when it started: “We wanted to make the system more open and self-regulating,” he said. Instead, big companies with strong computers started aggregating information about humans, trying to learn about them.* However, computers can only generate a statistical picture of the world. They don’t know and cannot see physical limits. Lanier gave the example of automated machine translation. Back in the 1950s there was a belief that a formula could be created for computers to translate one language into another. Total automation would be achieved. This turned out to be impossible. In fact, computers that do language translation today actually rely on human translators. Computers scan the Internet for examples of language usage and based on this create a statistical picture of translation from one language to another. This automated translation can stay close to reality as long as there are professional human translators whose work the machine can keep aggregating. However, automation lowers the price of translation, and human translators cannot make a living. Today, translators do translations as a side job. Should they quit in larger numbers, there will be no reference base and machine translation will collapse completely! Lanier used this case as an example of what is going on in other fields too, such as finance, insurance, and other areas where Big Data is involved. According to him, the process of automation has a limit. If people are laid off, the economy will have no workers. His solution is to subdivide the information tasks so that humans will play a role in this. He believes that a new middle class can be created this way. He also believes that there should be a system of micro-payments: every time someone uses data about you, you get paid by them.

Lanier invented virtual reality, but at the same time he is a musician, and has a strong feeling for the creativity of the individual. He also strongly emphasizes the need for people to be paid for their creations. The aggregation of data about people is stealing from them, just as “mash-ups” of pieces of music are not giving royalties to the individual musician. The big mistake that was made with the idea of open source and sharing was that not everybody has the same computer power. Lanier says:

* See Interview with Charlie Rose, PBS, March 19, 2014 <http://www.bing.com/videos/watch/video/ukraine-jaron-lanier-yancey-strickler/17w9xmljt>

“The old ideas about information being free in the information age ended up screwing over everybody except the owners of the very biggest computers. The biggest computers turned into spying and behavior modification operations, which concentrated wealth and power.

Sharing information freely, without traditional rewards like royalties or paychecks, was supposed to create opportunities for brave, creative individuals. Instead, I have watched each successive generation of young journalists, artists, musicians, photographers, and writers face harsher and harsher odds. The perverse effect of opening up information has been that the status of a young person’s parents matters more and more, since it’s so hard to make one’s way.”

*“As the French economist Thomas Piketty has shown in his massively documented and bestselling *Capital in the 21st Century*, more and more wealth is being concentrated in the hands of the few. According to him, this tendency is inbuilt in capitalism.”*

So, who owns the future, or rather, who should own it?

“If we keep on doing things as we are, the answer is clear: The future will be narrowly owned by the people who run the biggest, best connected computers, which will usually be found in giant, remote cloud computing farms.

The answer I am promoting instead is that the future should be owned broadly by everyone who contributes data to the cloud, as robots and other machines animated by cloud software start to drive our vehicles, care for us when we’re sick, mine our natural resources, create the physical objects we use, and so on, as the 21st century progresses.

Right now, most people are only gaining *informal* benefits from advances in technology, like free internet services, while those who own the biggest computers are concentrating *formal* benefits to an unsustainable degree.”

In other words, Lanier is here addressing a central problem that others have also commented on and found explanations for: the increase in inequality that is taking place. He approaches it from the point of view of having the technological power to make money. He uses the term “Siren Servers” (for e.g. Google) to indicate the temptations they present to individuals to submit to an ever increasing connectivity and data collection on themselves. He might add that it has been shown that digital media, especially cell phones, can easily become addictive – just as in the case of addiction, a reward center in the brain is being stimulated.

The rising inequality is a serious and fundamental social problem, even without the technological development that hugely magnifies its impact. As the French economist Thomas Piketty has shown in his massively documented and bestselling *Capital in the 21st Century*, more and more wealth is being concentrated in the hands of the few. According to him, this

tendency is inbuilt in capitalism.²⁸ He suggests that we are in fact on the way to a 'patrimonial society' where inherited wealth (rather than talent and merit) will increasingly come to dominate the economy which can result in political upheaval. That is, if the government does not do something. In other words, beyond all the tech talk and AI hype, in the 21st century we are back to the very basic problems of political economy.

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Civilizational Paradigm Change: The Modern/Industrial Case*

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Abstract

*The intent of this paper is to put a fundamental, if not yet urgent, question on the table for further exploration and discussion. We proceed by defining our use of three key concepts: **Paradigm, Culture and Form of Civilization**. Then the concept of paradigm is applied to the concept of a form of civilization. The question is asked, “**Is it plausible to think that we are in a truly rare time during which our dominant form of civilization (Modern/Industrial) is disintegrating and a truly new form of civilization is beginning to emerge?**” The significance of a positive answer is briefly considered for serious conversations about our actions intended to nudge us towards a transition to a new society are briefly considered.*

1. Introduction

I have long been convinced of the vital importance of the mental maps, images and metaphors through which we experience, make sense of and plan our lives as persons, groups, cultures and whole forms of civilization. The prime reason our sense-making matters is that, contrary to any form of realism, we are animals that construe our world and we live within and as a part of a reality that is itself construable. A second reason is that human persons only occur within cultures. This is important because all cultures not only construe reality in some ways and not others, but do in ways that are largely unseen by those who constitute the culture at a given time and place. It follows that all cultures are both a human construct and a cosmic bet that their grip on reality is sound and reliable enough for their grandchildren to cope with the emerging conditions of their time and place.

Sadly, we know that the widespread and deeply-held human assumption about the reliability of one's culture's grip on reality is not always warranted. In 2014, a small but growing minority are increasingly worried about the human future.^{1,2}

It follows, especially in turbulent times such as our own, that it is wise for every culture to make special efforts to become consciously aware of the cognitive content, emotional freight and logic of the metaphors, images and mental maps by which it imagines, shapes and experiences its world and itself. Great danger lurks when we insist on continuing to construe life in unconsciously inherited ways. As Will Rogers put it, “*You can't trust your eyes when your imagination is out of focus.*”

* Some of the material in this paper draws on an earlier paper: Ruben Nelson: “Adelaide's Lament: Exploring Our Inability to Make Reliable Sense of Our Situation.” A Keynote address delivered to the 2012 Summer Conference, “Saving the Future,” Silver Bay, New York, July 31, 2012. Available at <http://eruditio.worldacademy.org/author/ruben-nelson>

The contribution I seek to make to the conversation about our journey to a new society has four parts. First, I shall offer my understanding of a *paradigm*. Second, I shall offer my understanding of a *form of civilization* and argue that this concept is now needed if we are to make reliable sense of the dynamics of the 21st Century, let alone human history. Third, I shall ask if there is any reasonable chance that ours is a time of *civilizational paradigm change*. Fourth, I shall offer my understanding of the core characteristics of our *Modern/Industrial form of civilization*. Such an understanding is needed if there is any reasonable chance that the dominant way we have come to construe life over the past 1,000 years is in long-term disintegration and decline. In such a situation, we must give up the illusion that a better version of the world we know will serve us well in a truly new future. We need to be able to assure ourselves that those things we take to exemplify a new civilizational paradigm, to be a sign that we are moving towards a new society, are not just freshly painted versions of yesterday.

2. Paradigm

The OED offers both ‘pattern’ and ‘exemplar’ in its definition of ‘paradigm.’³ This implies that both features – a pattern and an example of the pattern – are required for a complete understanding of a paradigm.

For example, being told by one’s mother that one must finish cutting the lawn before one can eat supper, may be seen, at least by the mother, as paradigmatic of the general and desirable pattern that one should finish what one starts before taking on another task.

As so many have noticed over the years, particularly Margaret Masterman, the concept of ‘paradigm’ is inherently fuzzy.⁴ Therefore, I shall note five things in order to be clear about how I use this term.

First, since they are not the same thing, it is necessary to distinguish patterns of the imagination from patterns of thought and both of these from patterns of action. All are patterns. Therefore, a paradigm – a pattern and an exemplar – can exist at each of these levels. But such paradigms would exist at quite different levels of generality. Typically, human imagination is seen as being at a higher, or more general, level of mind than human thought. This view is reflected and reinforced by the litany that “*as we see the world, so we will think it and think it through. As we think the world, so we will act within it. As we act in the world, so we set ourselves up for future success or failure.*”

The litany makes it clear that there is a hierarchy of what may be characterized as degrees of change or transformation. From the least to the most transformative the hierarchy runs like this:

- New actions that reflect and reinforce familiar patterns of thought and imagination.
- New actions combined with new patterns of thought that reflect and reinforce familiar patterns of the imagination.
- New actions combined both with new patterns of thought and new patterns of the imagination.

These levels of generality must be taken in account. It may be helpful if we learn to see, think and act routinely in these terms:

- PC_A stands for paradigm change solely at the level of human action.
- PC_T stands for paradigm change solely at the level of human thought.
- PC_I stands for paradigm change solely at the level of human imagination.
- PC_{TA} stands for paradigm change at both the levels of thought and action.
- PC_{IT} stands for paradigm change at both the levels of imagination and thought.
- PC_{ITA} stands for paradigm change at all three levels – imagination, thought and action.

I have argued elsewhere that in a time when change is occurring at all three levels, “thinking outside the box” will not get the job done because one’s new thinking will still reflect and reinforce one’s inherited imagination.⁵ In my view, this hierarchy does not imply that only changes of action, thought and imagination are to be valued. However, it is to say that until our faltering steps towards a new way of living reflect how we see, think and act, with reasonable consistency, the job of becoming a new society will not be complete. At the least, talking glibly about moving towards a new society as if we know what we are doing when only one level of human life is involved is inappropriate and unwise.

“The disintegration of the existing order is a prerequisite for a new order to emerge.”

Second, it should be noted that the dynamics of transformative paradigmatic change can work both from the inside-out and from the outside-in. To take the latter case, there are many stories of a new imagination emerging in ways that shatter the existing patterns of imagination, thought and action. “*She loves me*” and “*His character is not a biological function of his skin colour*,” are but two examples. In such cases, it is almost always inappropriate to ask of the person who has just had such an insight, “*What are you going to do now?*” Most often the person with the insight has no idea. It takes time to wrap one’s mind and heart around new realities and let them sink in to the point that one can begin to think through what new paths one must learn to travel.

Third, any culture that has even a reasonable chance of success has to be reasonably coherent in two ways. One way to measure coherence is the degree to which the key elements at any of the three levels are consistent with one another and mutually reinforcing. A second measure of coherence is the degree to which there is a coherent line of sight from the patterns of imagination, through those of thought, to those of physical action.

Fourth, any journey to a new society, provided the “new” is truly a new paradigm of human civilization, will experience a temporary and profound increase in the degree of incoherence not only in its society, but in all societies that are exemplars of its inherited form of civilization. The disintegration of the existing order is a prerequisite for a new order to emerge. Does this insight help us make sense of the largely unanticipated increase in disordered societies globally? Sadly, cultural disintegration does not entail the emergence of a new order. Sometimes societal death is the end of the road.

3. Forms of Civilization

I have come to distinguish between a culture and its current *form of civilization*. For me, this distinction is critical. By ‘*culture*’ I mean not *arts and culture*, but the totality of a

people's ways of being – their seeing, thinking and acting. However, for me, it is not sufficient to use the category of *culture* to capture the deepest and most profound transformations that are afoot within and among us today. Much as cultural differences are not to be overlooked or taken lightly, they do not capture the deepest dynamics of what is going on among humans in the 21st Century. To get at these deeper dynamics and changes I use the phrase '*form of civilization*.'

By 'form of civilization' I point to the deep and largely unconscious patterns and boundaries of the imagination, thought and practice that characterize a culture that is an exemplar of a particular form of civilization. In this sense a society in any given place and time is a paradigmatic exemplar of some form of civilization. This implies that *at any given time in human history, if we are to make reliable sense of what has gone on, is going on and may well go on, we must understand both the unique character of every culture and the wider, deeper and longer frame of reference each culture exemplifies, namely, its form of civilization.*

"To ignore the larger game of civilizational transformation is to ignore the key changes and dynamics on which our future hangs."

I note that a form of civilization is not bound by geography, but by time. Therefore, it is a mistake to define civilizational differences, at least as I use the term, as a function of geographic differences. Today's differences between East and West are real, but they hang on a time shift, not on different locations on the planet. More specifically, in 2014 there are real and noticeable differences between Eastern cultures and modern Western cultures, but the difference is not at root an East VS West difference. Rather, the difference has been created by the fact that over the last 1,000 years the West has experienced a civilizational paradigm change, while Eastern cultures, now generally committed to this transformation, are not yet far enough into it to understand how they themselves are changing.

I readily acknowledge that mine is a stipulated definition of '*civilization*.' It differs from the vast array of senses commonly given to this term. Since there is today no coherent and common sense of what is meant by '*civilization*' – rather its usage is a dog's breakfast – I feel free to stipulate how I shall use the term. I follow this path, of course, because, at the least it clarifies how I use the term. In addition, my usage allows me to make more sense of the past, present and future and do so more reliably than any other usage.

By distinguishing between a culture and its form of civilization at any given time, we can identify cultural changes that occur within its current civilizational frame of reference and distinguish them from those changes that indicate that a culture is growing out of its inherited civilizational frame and possibly into another. *This distinction is vital because these two types of cultural change have very different dynamics and very different risks for truly tragic outcomes if mishandled. Therefore, very different strategies are required to handle each type of change successfully.* Sadly, this point is not well or widely understood. I am suggesting that we must not focus only on the evolution of different cultures as if this is the most important game in town. Such a focus systematically misses a good deal of the length, breadth, depth and drama of the challenges and opportunities we face in the 21st century. To ignore the larger

game of civilizational transformation is to ignore the key changes and dynamics on which our future hangs.

An example may help.

Consider the statement made in a powerful Keynote address in 2009 in Essen, Germany at a conference on Climate Change as Cultural Change by my friend and colleague, Thomas Homer-Dixon: "*I have come to realize that the solutions to our climate-change crisis will ultimately reside at the level of culture.*"⁶ Most who hear this statement will hear it as Homer-Dixon intended it – as a call to include in our attention not merely the technology of climate change but also the much wider and more powerful level of the shape and evolution of the whole culture. While I wholly agree with this call and his use of 'culture', I would add to his statement, "*and the form of civilization it manifests.*" In my view, the changes he is pointing to and calling for not only entail a transformation of our *culture*, but the evolution of our commonly-shared Modern/Industrial form of civilization into a new *form of civilization*. It may be that our future hangs on understanding and operationalizing this difference. If it does, the distinction matters. Put bluntly, in my view we must sustain success not only as a culture, but as a truly new form of civilization. I note that the aspiration of consciously evolving our Modern/Industrial form of civilization into a new form of civilization is not yet on the agenda of any significant body on this planet.

As I consider our history as a species, I find it useful to distinguish five forms of civilization. I will list them in the order in which they emerged. Only the first four are now exemplified in actual human cultures and societies. First, Small-group Nomadic forms. I note that this was the only form for 95% of our life as a species. Then roughly 10,000 years ago Settled Regional forms of civilization emerged. These were followed in a few places by Settled Empires. Fourth, over the last 1000 years, the Modern/Industrial form has been developed. Fifth, we may now be in a long transition to the next form of civilization. I call it the Consciously Co-Creative form of civilization.

This understanding implies that any given *form of civilization* is not static and forever. If the conditions are right, a new form of civilization can emerge from an existing form. If this were not so, there would still only be one form of civilization on Earth. For good and ill, this is obviously not the case. Consider for example, that the French, among many other Europeans, have lived in the first four forms of civilization, although, of course, they did not know themselves as *French* 20,000 years ago. This evolution suggests that we may well find traces of prior civilizational forms in any culture that is no longer Small group Nomadic. I note that the Hebrew/ Christian tradition also runs through these four forms. The evolution is from "*A wandering Aramean was my father*" to "*We shall have a King like the others,*" through the Roman Catholic church of Settled Empire and on through the Reformation to Modern/Industrial main-line Protestant churches. Americans and Canadians, on the other hand, save for our aboriginal cousins, have lived our whole lives within the Modern/Industrial form of civilization. By 1500 the foundation was well laid and much of the edifice already designed, if not yet embodied. Does this account, in part, for our frequent misreading of and impatience with those who still know and live by earlier forms?

In any case, it is clear to me that the diversity we celebrate is diversity within the Modern/Industrial frame. Those who would challenge this frame are marginalized, not lionized.

In this perspective, what we call “development” can be seen as an attempt to move a given culture from its inherited form of civilization into the Modern/Industrial form. That this fact is not well understood, and even often denied, is a major source of confusion both for folks in “developing” countries and those of us in Modern/Industrial societies.

“Is it even plausible to imagine, think and act as if ours is one of the truly rare times in history during which a civilizational paradigm change is occurring?”

If I had time, I would argue that this perspective can re-frame our well-intended but almost wholly misbegotten ways of creating public policy about human security, social welfare, innovation, multiculturalism, Islam, globalization, the clash of civilizations, development and East/West differences. One policy implication is clear – we should stop promising persons in any existing culture, including our own, that they have the right to maintain their present form of civilization forever. Whatever our intentions, this is a promise we simply *cannot* keep. Given the actual dynamics of human life on this planet, no way of life as either a culture or a form of civilization is non-negotiable and forever. On this point, those who continue to claim otherwise are not only wrong, but wrong-headed.

4. The Question We Must Learn to Ask and Answer

We are now in a position to ask and briefly explore what may well be the most important questions for humanity in the 21st Century: *“Is it even plausible to imagine, think and act as if ours is one of the truly rare times in history during which a civilizational paradigm change is occurring?” “When we talk of a ‘transition to a new society’ must we also learn to see, explore, understand and respond to a transition to a new form of civilization?” “Are those who worry about the long decline of our Modern/Industrial world essentially right in what they assert, even if, by and large, they are still largely blind to the signs of emergence of the next form of civilization?”*^{7,8}

This short piece is not the place to respond to these questions. However, I note three things.

First, this question has been at the centre of my life as a futures-oriented societal researcher, policy wonk and activist for five decades. My own response to the above questions is, “Yes.”

Second, these questions are not yet securely in our minds or on our lips. As far as I know, no significant organization or research centre in any sector is dedicated to raising and exploring the above questions. At best, only half of the view advocated here – that our Modern/Industrial form of civilization has no long-term future – is hesitantly recognized. Even the boldest of political parties or business associations are wholly unwilling to gently suggest more than the view that *while we may have trouble, long-term, sustaining our Modern/Industrial way of living is the only way to frame our situation in the early 21st Century*. Sadly, even the vast bulk of the sustainability conversation has been captured by those who presume

that if we apply enough capital and science-based technological innovation within a Modern/Industrial frame, our future is secure.

Third, the frame of civilizational paradigm change changes almost everything. It makes sense of the fact that our normal patterns of sense-making no longer enable us to make reliable sense of our world. It allows us to face, rather than deny, the facts of the long-term disintegration of the world as we have known it. It also allows us to come to terms with the increasing disorder caused by the intensification of our own efforts to impose order by the means that are consistent with our Modern/Industrial mindset. Most important, it changes the story we are in from one of either outright denial or the embrace of never-ending decay to one of facing a challenge that no other humans have had to consciously embrace – their conscious and active participation as agents in the emergence of a new form of civilization. This understanding provides a firm basis for a call to active service that is the psychological equivalent of a call to arms. Yes, the odds are long. One may be pessimistic about the chances we have. But hope is warranted.

Hope is also conditional. It is justified only if we are willing to pay the price of learning to see our situation and our role within it for what they are and then respond to what we are coming to know. This will take degrees of courage, insight and love that are truly rare. Yet we know that to call us to any other response is a betrayal of all that we hold dear.

5. The Modern/Industrial Form of Civilization

My next task is to sketch my understanding of the core character of our modern/Industrial form of civilization. Having an adequate grasp of who we have been and mostly still are is a necessary, if not sufficient, condition for a successful transition to a truly new society that exemplifies a new paradigm of civilization. The reason, as noted above, is that, openly and consciously, we must come to be able to distinguish between those new things that are truly new and those that merely reinforce our existing habits, if with greater subtlety. Reflexive consciousness is required because as we have learned from every liberation movement *imaginations we do not know we have, have us*.

It is useful to remember that the modern/Industrial form of civilization grew out of pre-Industrial forms of settled civilization, namely Regional Empires and Regional Settlements. Assuming that the modern/Industrial form did not break in every respect with what went before, it is useful to ask, *“Which defining characteristics of the earlier forms of civilization were inherited by the modern/Industrial form and which were developed as truly novel?”*

My response is that one of the two deepest defining characteristics of Modern/Industrial civilization is a continuation from the past. I refer to the deeply-held sense that ultimate reality is timeless and changeless; that truth, if reliably known, is the same for all persons in all places in all times; that the logic of contradiction and contrariety both hold; and that certainty is a mark of true knowledge. It follows that in a classic modern/Industrial culture life will be organized, both inside and out, hierarchically. The practical reason is that for large scale purposes someone must be in charge. The ultimate reason, of course, is that in order to get organized as humans we must assure ourselves that we have reliable access to eternal truth, even if only through a great chain of being, with a god-king as the key link between heaven and earth.

This hierarchical sense can be seen in Ken Boulding's doggerel, *"In every organization from root to crown, ideas flow up and vetoes flow down."* Command and control based on one's role and place in the hierarchy are of the essence. It follows that the whole point of human life is to learn to live on earth in the ways that best reflect and reinforce our knowledge of the unchanging eternal. *As above, so below.* Obedience to the eternal is also built in. As Pope Paul IV, the first Pope to visit the USA, reminded Americans as he flew out of Detroit, even if one disagrees with him, to be Roman Catholic is to understand the requirement that to be faithful to Christ is to obey him as Pope. Given the presupposition of static reality and timeless truth, this claim is reasonable and to be expected. Finally, I note that a sense of hierarchy is not Western or Eastern. It shows up in every culture that exemplifies the Regional Empire, Regional Settled or modern/ Industrial forms of civilization. Thousands of years ago, once the logic of a settled life took hold of our ancestors, truth has always been found higher up the hierarchy – beyond one's pay grade.

"In what our culture produces, whether it is art, philosophy, military strategy or political and economic development, there are no accidents; everything a culture produces is equally a symbol of that culture." – Northrop Frye

But to the last several Popes' consternation, the West did not remain wholly faithful to the Regional Empire form of civilization into which the church was born. We developed a powerful new insight that came to deeply define the modern/Industrial West. While we kept the sense of static reality and the hierarchy that goes with it, over the last 1,000 years the West has cut a new swath in history. We in the West moved slowly and incoherently from our pre-modern/Industrial default sensibility of a deep holistic grasp on reality to the sense we now still largely take for granted, at least for most public and private purposes: *whole systems and entities are made of pieces, that are themselves made of pieces. It is pieces all the way down. Further, the pieces are ultimately more real than the wholes they, when taken together, constitute.*

In sum, the holistic grasp on reality that marks all forms of civilization prior to the Modern/Industrial age was fragmented by the Modern/Industrial into stand-alone pieces. The roots of this journey run very deep. It can be seen in 11th Century architecture. By the thirteenth century time was fragmented enough to demand mechanical clocks; reality was fragmented by Aquinas who authorized us to think about the earth apart from God. I know that Aquinas is not normally thought to be a father of our Modern/Industrial world, but he is. Once on the path of fragmentation, we soon learned to think of physics without philosophy or even the history of physics, fact without value, the secular apart from the sacred, commerce without ethics, nations as sovereign entities, and solipsistic individuals as sufficiently primordial to require a social contract in order to have any relationships with or obligations to each other or to a common societal authority.

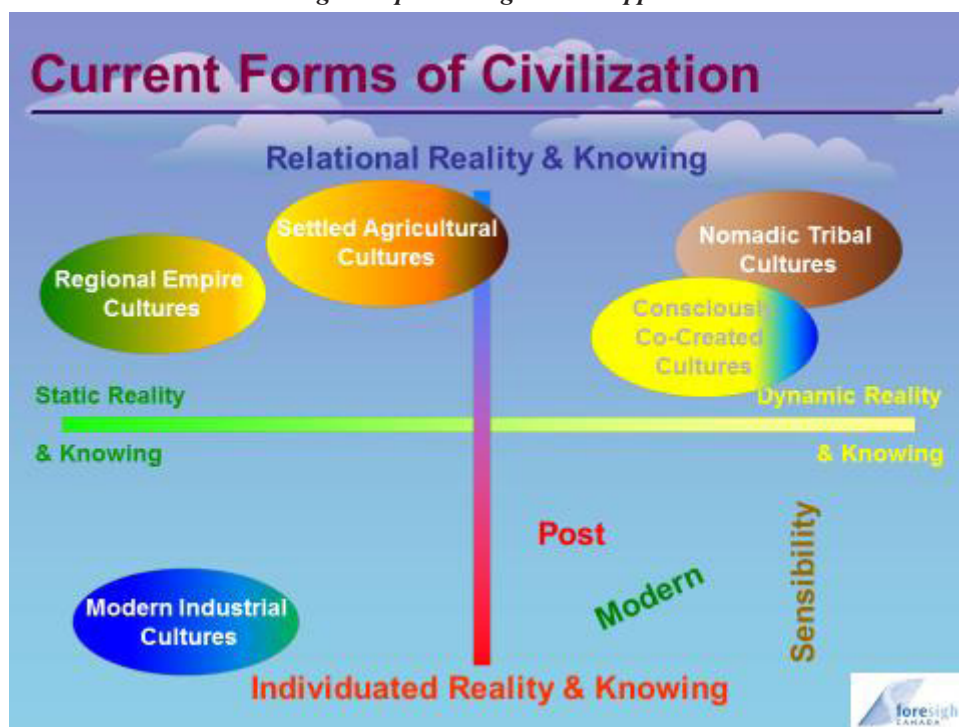
I note in passing that all of these developments, at best, are puzzling, if not offensive, to those with a pre-modern/Industrial sensibility. Most would pay it no heed if we did not have

more money and better weapons as an outcome of our sensibility. We would be well-served to reconsider the rebellion of some parts of Islam against the West in these terms. We would learn things about ourselves and our situation that we need to know.

This evolution from wholeness to fragments can also be seen in Western art, architecture, weaponry and philosophy. As Northrop Frye observed, *"In what our culture produces, whether it is art, philosophy, military strategy or political and economic development, there are no accidents; everything a culture produces is equally a symbol of that culture."*⁹ Again, I would add, *"and its form of civilization."*

If you wish to take the time, I invite you to work with a few others and answer this question, "What are the major features of a culture that assumes and exemplifies a sensibility that is the product of the tension between these two deeply defining ontological/epistemological assumptions about reality: One, that reality is static, not dynamic. Two, that reality is made up of and can be known by individual persons as separate pieces – pieces *which then can be added together to result in some form of wholeness?*". This space can be seen in the bottom left quadrant of Figure 1.

**Figure 1: Forms of Civilization as Determined by
Ontological/Epistemological Presuppositions**



I have facilitated this exercise for over 30 years. It is my experience that a variety of possible cultures, all of which embody and reinforce the Modern/Industrial form of civilization, can be inferred from the tension and interaction between these two fundamental ontological and epistemological assumptions. I note that no well-trained Jesuit would be surprised or

bothered by this assertion. I note further, that the resulting diverse cultures are all isomorphic with our Modern/Industrial form of civilization.

One way to experience the sensibility that has come to define our Modern/Industrial form of civilization is to walk through any art gallery with a decent collection of European art from roughly 1200 to today. You will see the slow transformation that marks our journey as a form of civilization along the left hand side of the above figure, from top to bottom.

I shall offer, then, my understanding of some of the core elements of the mythology that have come to dominate and shape the Modern/Industrial form of civilization, and therefore, all Modern/Industrial cultures. For me this is not a random list. Rather the following features are entailed in the interaction of the two deep assumptions that underlie our way of being in the world. Given variations in time, geography or among cultures these features will not all show up to the same degree or in the same ways. In this sense some Modern/Industrial cultures can be said to be more or less Modern/Industrial than others. But these features are present as defining features of all cultures that can be characterized as developed Modern/Industrial cultures.

- A Modern/Industrial culture will have a reductionist/materialist bias – physical realities will be seen as not merely more obvious, but as more real than subtle realities that touch us gently. In the *Rock, Paper, Scissors* game of such societies, numbers always trump metaphors and anecdotes. On this point, every Chamber of Commerce agrees with Karl Marx.
- In human terms, individual persons are seen as the primary units of reality and each individual is complete in him or herself.
- Nation states are spaces where persons who are culturally similar live together. Each nation state is a sovereign unit unto itself and must not be intruded on by those external to it, not even by the UN's recently declared "*responsibility to protect*."
- Within the culture, life is divided into public and private realms – matters that are shared and common to all (the public realm) are divided from those that are unique to each individual (the private realm).

In the public realm, the same rules must apply to all without discrimination. The price that must be paid for each of us legitimately to have an idiosyncratic private life is that our subjectivity cannot be taken into public space as if it belongs there. In public space, we are functions, not persons. *Don't bring it to the office*. For example, in Canada's largest province you cannot know anything about my private persona for public purposes. If you want to hire me it is illegal to ask me what schools I attended. The reason is that I may have gone to St. Michael's and then you might think I am Roman Catholic – a private matter that by law you may not know for public purposes.

- Public, *common to us all*, space is itself divided into self-contained sectors in some way or other. One type of division is the now common Triple Bottom Line with its economic, environmental and social sub-sectors.
- Institutions in every public sector are organized hierarchically. Those few that have merged recently that are not organized this way are seen to be paradigm breakers.

- Economic matters trump all others. Their primary function is to increase material wealth. They do this primarily by increasing the scope and efficiency of material throughput. Within economics, money dominates all other economic considerations. Efficiency, therefore, trumps effectiveness and relevance.
- Human life is seen as a production/consumption function. The good life is defined and measured by one's "*command over goods and services*." Education is valued because a well-educated person has better access to a job, without which one has no access to goods and services. A well-functioning economy is a consumer-based economy. Social policy is primarily about how much access to goods and services the poor and those with special needs should have.
- The bias to reductionism results in a bias to reify human affairs into separate and self-contained realms, e.g. politics, commerce, science, religion, art. Non-overlapping magisteria (NOMA) between these sectors is an expected and widely-held perspective.
- The bias to experience and treat reality in pieces is legitimized by a host of boundaries. One outcome is that all matters beyond the boundaries of our present concerns and purposes are defined as 'externalities' that we can safely afford to ignore for the purposes at hand.
- Critical-mindedness is required in public life. Deep reflexivity is restricted to private life. Even there it is optional.

6. Conclusion

I will conclude by dealing with a matter that may be arising within you. I have said that we need to learn to see, explore, think through, understand and factor into our commitments and decisions the fact that in 2014 there are now four main forms of civilization exemplified on the planet – Small-group Nomadic form, Settled Regional form, Settled Empire form, and our Modern/Industrial form. I have also said that we in the West exemplify the Modern/Industrial form. And I have defined the Modern/Industrial form on the basis of two deep ontological/epistemological assumptions – static and piecemeal reality. Yet, you may have noticed that today's world is also marked by dynamic systems and complexity, not static pieces. In what sense, then, are we in the West still truly Modern/Industrial?

This is a good and important question. My reading of the data suggests the following sketch of a response.

First, I wholly agree that in 2014 there are many emerging features of our lives and societies, including for example, the category of emergence, that are incompatible with our still being seen as a classic and pure form of a Modern/ Industrial culture and form of civilization. Apparently, there is evidence that we are already growing, at least to some degree, into something that is not just a new culture, but a new form of civilization. This, of course, is one of the possibilities to which I want to point. That this notion should come to play a major role in our public policy is an aspiration I wish to mindfully and heartily endorse.

Second, there is evidence that a culture does not shift from one form of civilization suddenly and completely, but slowly, unconsciously and incoherently. This implies that at any

given time in history we have to ask of any given culture, “*To what extent is it deeply coherent?*” By ‘coherent’ I mean that the cognitive contents of the fundamental structures and patterns of its physical artifacts, thought patterns and imagination are essentially aligned and isomorphic; that they reflect and reinforce the same dominant mythic form of civilization. I raise the question of coherence because there are limits to how incoherent a culture can become and still be a well-functioning culture. Since the core of globalization is in fact Modern/Industrial Westernization, much of the societal disorder now readily seen around the world can be read in this light. There is a clash of civilizations going on around the world, but it is not the one that we have commonly taken it to be. See, for example, Samuel Huntington.¹⁰

Third, regarding any given society at any given time we need to learn to distinguish between two profoundly different types of diversity and incoherence. The first type of diversity arises because a society encounters artifacts, thoughts and mythic structures that, while different from its own, are from cultures that also exemplify the same form of civilization. Up until roughly 10,000 years ago, this type of diversity was the only type experienced by our species. Today, I think of encounters between the Mohawk and the Cree, or the modern Greeks and modern Germans.

The other type of diversity arises from encounters with cultures that exemplify a form of civilization different from one’s own. I note again that we now have four forms of civilization encountering one another. I think of encounters today between Americans and Chinese or European-rooted Canadians and Canadian Aborigines. By and large these types of encounter do not go well. In large part this is because, while each can see that the other has a quite different culture, as yet, neither has the capacity to understand, much less grasp the significance of, the differences in their forms of civilization. Therefore, those engaged in such encounters are prone to systematically misconstrue the other and therefore the encounter with the other.

Finally, I must reinforce the fact that one can misunderstand one’s own experiences of cultural change without leaving home; without encountering others from cultures that exemplify a different form of civilization. The reason, of course, is that inappropriate conduct will almost certainly be an outcome when one is unable to discern which changes in one’s self and one’s culture are within the paradigm of one’s inherited form of civilization and which are paradigm bursting at the level of our form of civilization.[†]

Any serious journey that bills itself as a *transition to a new society* must keep these things in mind.

Or so it seems to me.

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The Urgent Need for Renewable Energy

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Abstract

The transition to 100% renewable energy must take place within about a century because fossil fuels will become too rare and expensive to burn. But scientists warn that if the transition does not happen much faster than that, there is a danger that we may reach a tipping point beyond which feedback loops could take over and produce a catastrophic increase in global temperature.

1. Geological Extinction Events and Runaway Climate Change

The melting of Arctic sea ice is taking place far more rapidly than was predicted by reports of the Intergovernmental Panel on Climate Change (IPCC). David Wasdell, Director of the Apollo-Gaia Project, points out that the observed melting has been so rapid that within less than five years, the Arctic will be free of sea ice at the end of each summer. It will, of course continue to refreeze during the winters, but the thickness and extent of the winter ice will diminish.

It has also been observed that both the Greenland ice cap and the Antarctic ice shelves are melting much more rapidly than was predicted by the IPCC. Complete melting of both the Greenland ice cap and the Antarctic sea ice would raise ocean levels by 14 meters. It is hard to predict how fast this will take place, but certainly within 1-3 centuries.

Most worrying, however, is the threat that without an all-out effort by both developed and developing nations to immediately curb the release of greenhouse gases, climate change will reach a tipping point where feedback loops will have taken over, and where it will then be beyond the power of human action to prevent exponentially accelerating warming.

By far the most dangerous of these feedback loops involves methane hydrates or clathrates. When organic matter is carried into the oceans by rivers, it decays to form methane. The methane then combines with water to form hydrate crystals, which are stable at the temperatures and pressures which currently exist on ocean floors. However, if the temperature rises, the crystals become unstable, and methane gas bubbles up to the surface. Methane is a greenhouse gas which is much more potent than CO₂.

The worrying thing about the methane hydrate deposits on ocean floors is the enormous amount of carbon involved: roughly 10,000 gigatons. To put this huge amount into perspective, we can remember that the total amount of carbon in world CO₂ emissions since 1751 has only been 337 gigatons.

A runaway, exponentially increasing feedback loop involving methane hydrates could lead to one of the great geological extinction events that have periodically wiped out most of the animals and plants then living. This must be avoided at all costs.*

The worst consequences of runaway climate change will not occur within our own lifetimes. However, we have a duty to all future human generations, and to the plants and animals with which we share our existence, to give them a future world in which they can survive.

2. Preventing a Human-initiated 6th Geological Extinction Event

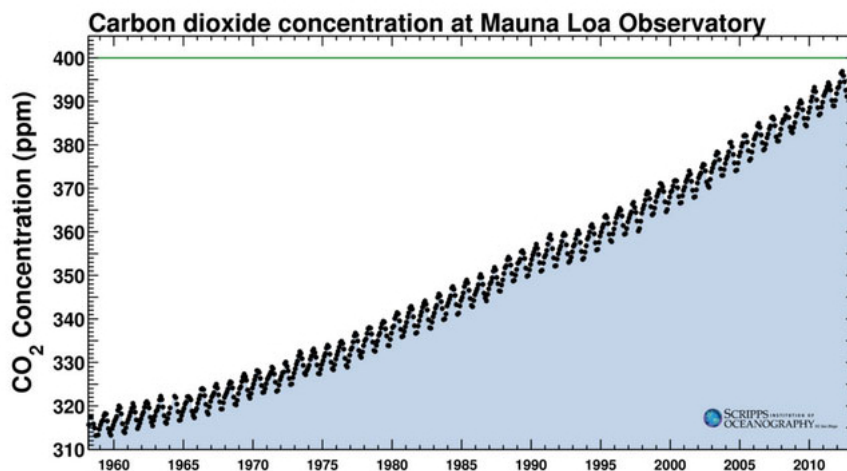


Figure 1: Despite the efforts of scientists to warn of the dangers of runaway climate change, the atmospheric concentration of CO₂ continues to increase steadily. We need more public debate of the dangers, and a sense of urgency.

Geologists studying the strata of rocks have observed 5 major extinction events. These are moments in geological time when most of the organisms then living suddenly became extinct. The largest of these was the Permian-Triassic extinction event, which occurred 252 million years ago. In this event, 96 percent of all marine species were wiped out, as well as 70 percent of all terrestrial vertebrates.

In 2012, the World Bank issued a report warning that without quick action to curb CO₂ emissions, global warming is likely to reach 4 degrees C during the 21st century. This is dangerously close to the temperature which initiated the Permian-Triassic extinction event: 6 degrees C above normal.†

* Here are links to some videos which discuss these dangers:

<https://www.youtube.com/watch?v=MVwmi7HCmSI>

<https://www.youtube.com/watch?v=AjZaFjXfLec>

<https://www.youtube.com/watch?v=m6pFDu7ILV4>

† Here is a link to the World Bank report: <http://www.worldbank.org/en/news/feature/2012/11/18/Climate-change-report-warns-dramatically-warmer-world-this-century>

The Permian-Triassic thermal maximum seems to have been triggered by global warming and CO₂ release from massive volcanic eruptions in a region of northern Russia known as the Siberian Traps. The amount of greenhouse gases produced by these eruptions is comparable to the amount emitted by human activities today.

Scientists believe that once the temperature passed 6 degrees C above normal, a feedback loop was initiated in which methane hydrate crystals on the ocean floors melted, releasing methane, a potent greenhouse gas. The more methane released, the more methane hydrate crystals were destabilized, raising the temperature still further, releasing more methane gas, and so on in a vicious circle. This feedback loop raised the global temperature to 15 degrees C above normal, causing the Permian-Triassic mass extinction.[‡]

No reputable doctor who diagnoses cancer would keep this knowledge from the patient. The reaction of the patient may be to reject the diagnosis and get another doctor, but no matter. It is very important that the threatened person should hear the diagnosis, because, with treatment, there is hope of a cure.

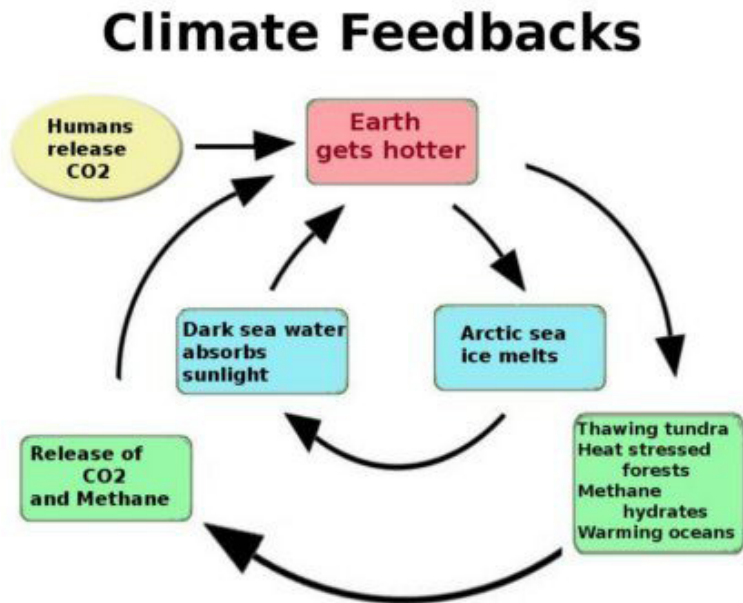


Figure 2: There is a danger that a runaway methane hydrate feedback loop might initiate a 6th geological extinction event.

Similarly, the scientific community, when aware of a grave danger to our species and the biosphere, has a duty to bring this knowledge to the attention of as broad a public as possible,

[‡] Here is a link to a short, important and clear video discussing the danger that a 6th mass extinction event could be caused by human activities: <https://www.youtube.com/watch?v=sRGVTK-AAvU>

Other videos discussing this very grave danger can be found on the following links:

<https://www.youtube.com/watch?v=MVwmi7HCmSI>

<https://www.youtube.com/watch?v=AjZaFjXfl.ec>

<https://www.youtube.com/watch?v=m6pFDu7ILV4>

even at the risk of unpopularity. The size of the threatened catastrophe is so immense as to dwarf all other considerations. All possible efforts must be made to avoid it.

Consider what may be lost if a 6th mass extinction event occurs, caused by our own actions: It is possible that a few humans may survive in mountainous regions such as the Himalayas, but this will be a population of millions rather than billions. If an event comparable to the Permian-Triassic thermal maximum occurs, the family trees of virtually all of the people, animals and plants alive today will end in nothing.

The great and complex edifice of human civilization is a treasure whose value is almost above expression; and this may be lost unless we give up many of our present enjoyments. Each living organism, each animal or plant, is a product of three billion years of evolution, and a miracle of harmony and complexity; and most of these will perish if we persist in our folly and greed.

Let us, for once, look beyond present pleasures, and acknowledge our duty to preserve a future world in which all forms of life can survive.

“A shift to 100% renewable energy has to happen within about a hundred years.”

3. Is a shift to 100% Renewable Energy Possible?

One answer to the question of whether a shift to 100 percent renewable energy is possible is that it has to happen during this century because fossil fuels are running out. Within a century or so they will be gone in the sense that they will be much too expensive to be burned. Therefore, a shift to 100% renewable energy has to happen within about a hundred years. The vitally important point is that if the shift does not happen quickly, if we do not leave most of our fossil fuels in the ground instead of burning them, we risk a climatic disaster of enormous proportions, perhaps comparable to the Permian-Triassic thermal maximum, during which 70% of terrestrial vertebrates and 93% of marine species became extinct. Thus the shift must happen, and will happen. But we must work with dedication, and a sense of urgency, to make it happen soon.

4. What are the Forms of Renewable Energy?

The main forms of renewable energy now in use are wind power, hydropower, solar energy, biomass, biofuel, geothermal energy and marine energy. In addition, there are a number of new technologies under development, such as artificial photosynthesis, cellulosic ethanol, and hydrogenation of CO₂.

At present, the average global rate of use of primary energy is roughly 2 kilowatts per person. In North America, the rate is 12 kilowatts per capita, while in Europe, the figure is 6 kilowatts. In Bangladesh, it is only 0.2 kilowatts. This wide variation implies that considerable energy savings are possible, through changes in lifestyle, and through energy efficiency.

4.1. Solar Energy

Biomass, wind energy, hydropower and wave power derive their energy indirectly from the sun, but in addition, various methods are available for utilizing the power of sunlight

directly. These include photovoltaic panels, solar designs in architecture, solar systems for heating water and cooking, concentrating photovoltaic systems, and solar thermal power plants.

Solar photovoltaic cells are thin coated wafers of a semiconducting material (usually silicon). The coatings on the two sides are respectively charge donors and charge acceptors. Cells of this type are capable of trapping solar energy and converting it into direct-current electricity. The electricity generated in this way can be used directly (as it is, for example, in pocket calculators) or it can be fed into a general power grid. Alternatively it can be used to split water into hydrogen and oxygen. The gases can then be compressed and stored, or exported for later use in fuel cells. In the future, we may see solar photovoltaic arrays in sun-rich desert areas producing hydrogen as an export product.

The cost of manufacturing photovoltaic cells is currently falling at the rate of 3-5% per year. The cost in 2006 was \$4.50 per peak Watt. Usually photovoltaic panels are warranted for a life of 20 years, but they are commonly still operational after 30 years or more. The cost of photovoltaic electricity is today 2-5 times the cost of electricity generated from fossil fuels, but photovoltaic costs are falling rapidly, while the costs of fossil fuels are rising equally rapidly.

Concentrating photovoltaic systems are able to lower costs still further by combining silicon solar cells with reflectors that concentrate the sun's rays. The most inexpensive type of concentrating reflector consists of a flat piece of aluminum-covered plastic material bent into a curved shape along one of its dimensions, forming a trough-shaped surface. (Something like this shape results when we hold a piece of paper at the top and bottom with our two hands, allowing the center to sag.) The axis of the reflector can be oriented so that it points towards the North Star. A photovoltaic array placed along the focal line will then receive concentrated sunlight throughout the day.

Photovoltaic efficiency is defined as the ratio of the electrical power produced by a cell to the solar power striking its surface. For commercially available cells today, this ratio is between 9% and 14%. If we assume 5 hours of bright sunlight per day, this means that a photocell in a desert area near the equator (where 1 kW/m^2 of peak solar power reaches the earth's surface) can produce electrical energy at the average rate of $20\text{--}30 \text{ W}_e/\text{m}^2$, the average being taken over an entire day and night. (The subscript e means "in the form of electricity". Energy in the form of heat is denoted by the subscript t, meaning "thermal".) Thus the potential power per unit area for photovoltaic systems is far greater than for biomass. However, the mix of renewable energy sources most suitable for a particular country depends on many factors.

4.2. Wind Energy

Wind parks in favorable locations, using modern wind turbines, are able to generate $10 \text{ MW}/\text{km}^2$ or $10 \text{ W}_e/\text{m}^2$. Often wind farms are placed in offshore locations. When they are on land, the area between the turbines can be utilized for other purposes, for example for pasturage. For a country like Denmark, with good wind potential but cloudy skies, wind turbines can be expected to play a more important future role than photovoltaics. Denmark is already a world leader both in manufacturing and in using wind turbines. The use of wind power is currently growing at the rate of 38% per year. In the United States, it is the fastest-growing

form of electricity generation.

The location of wind parks is important, since the energy obtainable from wind is proportional to the cube of the wind velocity. We can understand this cubic relationship by remembering that the kinetic energy of a moving object is proportional to the square of its velocity multiplied by the mass. Since the mass of air moving past a wind turbine is proportional to the wind velocity, the result is the cubic relationship just mentioned.

Before the decision is made to locate a wind park in a particular place, the wind velocity is usually carefully measured and recorded over an entire year. For locations on land, mountain passes are often very favorable locations, since wind velocities increase with altitude, and since the wind is concentrated in the passes by the mountain barrier. Other favorable locations include shorelines and offshore locations on sand bars. This is because onshore winds result when warm air rising from land heated by the sun is replaced by cool marine air. Depending on the season, the situation may be reversed at night, and an offshore wind may be produced if the water is warmer than the land.

The cost of wind-generated electrical power is currently lower than the cost of electricity generated by burning fossil fuels. The “energy payback ratio” of a power installation is defined as the ratio of the energy produced by the installation over its lifetime, divided by the energy required to manufacture, construct, operate and decommission the installation. For wind turbines, this ratio is 17:39, compared with 11 for coal-burning plants. The construction energy of a wind turbine is usually paid back within three months.

4.3. Biomass

Biomass is defined as any energy source based on biological materials produced by photosynthesis – for example wood, sugar beets, rapeseed oil, crop wastes, dung, urban organic wastes, processed sewage, etc. Using biomass for energy does not result in the net emission of CO₂, since the CO₂ released by burning the material is already absorbed from the atmosphere during photosynthesis. If the biological material had decayed instead of being burned, it would have released the same amount of CO₂ as in the burning process.

Miscanthus is a grassy plant found in Asia and Africa. Some forms also grow in Northern Europe, and it is being considered as an energy crop in the United Kingdom. Miscanthus can produce up to 18 dry tons per hectare-year, and it has the great advantage that it can be cultivated using ordinary farm machinery. The woody stems are very suitable for burning, since their water content is low (20-30%).

Jatropha is a fast-growing woody shrub about 4 feet in height, whose seeds can be used to produce diesel oil at the cost of about \$43 per barrel. The advantage of Jatropha is that it is a hardy plant, requiring very little fertilizer and water. It has a life of roughly 50 years, and can grow on wasteland that is unsuitable for other crops. The Indian State Railway has planted 7.5 million Jatropha shrubs beside its right of way. The oil harvested from these plants is used to fuel the trains.

For some southerly countries, honge oil, derived from the plant *Pongamia pinnata* may prove to be a promising source of biomass energy. Studies conducted by Dr. Udishi Shrinivasa at the Indian Institute of Sciences in Bangalore indicate that honge oil can be produced at

the cost of \$150 per ton. This price is quite competitive when compared with other potential fuel oils.

Recent studies have also focused on a species of algae that has an oil content of up to 50%. Algae can be grown in desert areas, where cloud cover is minimal. Farm waste and excess CO₂ from factories can be used to speed the growth of the algae.

It is possible that in the future, scientists will be able to create new species of algae that use the sun's energy to generate hydrogen gas. If this proves to be possible, the hydrogen gas may then be used to generate electricity in fuel cells, as will be discussed below in the section on hydrogen technology. Promising research along this line is already in progress at the University of California, Berkeley.

Biogas is defined as the mixture of gases produced by the anaerobic digestion of organic matter. This gas, which is rich in methane (CH₄), is produced in swamps and landfills, and in the treatment of organic wastes from farms and cities. The use of biogas as a fuel is important not only because it is a valuable energy source, but also because methane is a potent greenhouse gas, which should not be allowed to reach the atmosphere. Biogas produced from farm wastes can be used locally on the farm, for cooking and heating, etc. When biogas has been sufficiently cleaned so that it can be distributed in a pipeline, it is known as "renewable natural gas". It may then be distributed in the natural gas grid, or it can be compressed and used in internal combustion engines. Renewable natural gas can also be used in fuel cells, as will be discussed below in the section on Hydrogen Technology.

Biofuels are often classified according to their generation. Those that can be used alternatively as food are called first-generation biofuels. By contrast, biofuels of the second generation are those that make use of crop residues or other cellulose-rich materials. Cellulose molecules are long chains of sugars, and by breaking the inter-sugar bonds in the chain using enzymes or other methods, the sugars can be freed for use in fermentation. In this way ligno-cellulosic ethanol is produced. The oil-producing and hydrogen-producing algae mentioned above are examples of third-generation biofuels. We should notice that growing biofuels locally (even first-generation ones) may be of great benefit to smallholders in developing countries, since they can achieve local energy self-reliance in this way.

4.4. Geothermal Energy

The ultimate source of geothermal energy is the decay of radioactive nuclei in the interior of the earth. Because of the heat produced by this radioactive decay, the temperature of the earth's core is 4300 degrees C. The inner core is composed of solid iron, while the outer core consists of molten iron and sulfur compounds. Above the core is the mantle, which consists of a viscous liquid containing compounds of magnesium, iron, aluminum, silicon and oxygen. The temperature of the mantle gradually decreases from 3700 degrees C near the core to 1000 degrees C near the crust. The crust of the earth consists of relatively light solid rocks and it varies in thickness from 5 to 70 km.

The outward flow of heat from radioactive decay produces convection currents in the interior of the earth. These convection currents, interacting with the earth's rotation, produce patterns of flow similar to the trade winds of the atmosphere. One result of the currents of

molten conducting material in the interior of the earth is the earth's magnetic field. The crust is divided into large sections called "tectonic plates", and the currents of molten material in the interior of the earth also drag the plates into collision with each other. At the boundaries, where the plates collide or split apart, volcanic activity occurs. Volcanic regions near the tectonic plate boundaries are the best sites for collection of geothermal energy.

The entire Pacific Ocean is ringed by regions of volcanic and earthquake activity, the so-called Ring of Fire. This ring extends from Tierra del Fuego at the southernmost tip of South America, northward along the western coasts of both South America and North America to Alaska. The ring then crosses the Pacific at the line formed by the Aleutian Islands, and it reaches the Kamchatka Peninsula in Russia. From there it extends southward along the Kuril Island chain and across Japan to the Philippine Islands, Indonesia and New Zealand. Many of the islands of the Pacific are volcanic in nature. Another important region of volcanic activity extends northward along the Rift Valley of Africa to Turkey, Greece and Italy. In the Central Atlantic region, two tectonic plates are splitting apart, thus producing the volcanic activity of Iceland. All of these regions are very favorable for the collection of geothermal power.

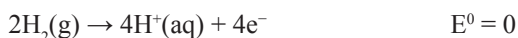
4.5. Hydrogen Fuel Cells

Electrolysis of water to produce hydrogen gas has been proposed as a method for energy storage in a future renewable energy system. For example, it might be used to store energy generated by photovoltaics in desert areas of the world. Compressed hydrogen gas could then be transported to other regions and used in fuel cells. Electrolysis of water and storage of hydrogen could also be used to solve the problem of intermittency associated with wind energy or solar energy.

Fuel cells allow us to convert the energy of chemical reactions directly into electrical power. In hydrogen fuel cells, for example, the exact reverse of the electrolysis of water takes place. Hydrogen reacts with oxygen, and produces electricity and water, the reaction being



The arrangement of a hydrogen fuel cell is such that the hydrogen cannot react directly with the oxygen, releasing heat. Instead, two half reactions take place, one at each electrode, as was just mentioned in connection with the electrolysis of water. In a hydrogen fuel cell, hydrogen gas produces electrons and hydrogen H^+ ions at one of the electrodes.



The electrons flow through the external circuit to the oxygen electrode while the hydrogen ions complete the circuit by flowing through the interior of the cell (from which the hydrogen and oxygen molecules are excluded by semipermeable membranes) to the oxygen electrode. Here the electrons react with oxygen molecules and H^+ ions to form water.



In this process, a large part of the chemical energy of the reaction becomes available as electrical power.

The theoretical maximum efficiency of a heat engine operating between a cold reservoir

at temperature T_C and a hot reservoir at T_H is $1 - T_C/T_H$, where the temperatures are expressed on the Kelvin scale. Since fuel cells are not heat engines, their theoretical maximum efficiency is not limited in this way. Thus it can be much more efficient to generate electricity by making hydrogen and oxygen react in a fuel cell than it would be to burn the hydrogen in a heat engine and then use the power of the engine to drive a generator.

“A rapid shift to renewable energy could provide the needed jobs to replace lost jobs.”

Hydrogen technologies are still at an experimental stage. Furthermore, they do not offer us a source of renewable energy, but only means for storage, transportation and utilization of energy derived from other sources. Nevertheless, it seems likely that hydrogen technologies will have great importance in the future.

5. Economic and Political Considerations

In our present situation, a rapid shift to renewable energy could present the world with many benefits. Ecological constraints and depletion of natural resources mean that industrial growth will very soon no longer be possible. Thus we will be threatened with economic recession and unemployment. A rapid shift to renewable energy could provide the needed jobs to replace lost jobs in (for example) automobile production. Renewable energy is becoming competitive with fossil fuels, and thus it represents a huge investment opportunity.

On the other hand, fossil fuel companies have a vested interest in monetizing the assets that they own, as Thom Hartmann points out in the video mentioned at the start of this essay in a footnote. Professor Noam Chomsky of MIT also explains this difficulty very well.[§]

These considerations point to a fight that will have to be fought by the people of the world who are concerned about the long-term future of human civilization and the biosphere, against the vested interests of our oligarchic rulers. This fight will require wide public discussion of the dangers of runaway climate change. But at present, our corporate-controlled mass media refuse to touch the subject.

6. Our Duty to Future Generations

Many traditional agricultural societies have an ethical code that requires them to preserve the fertility of the land for future generations. This recognition of a duty towards the distant future is in strong contrast to the short-sightedness of modern economists. For example, John Maynard Keynes has been quoted as saying “In the long run, we will all be dead”, meaning that we need not look that far ahead. By contrast, members of traditional societies recognize that their duties extend far into the distant future, since their descendants will still be alive.

Here is an ethical principle of the Native Americans: “Treat the earth well. It was not given to you by your parents. It was loaned to you by your children.” They also say: “We must protect the forests for our children, grandchildren, and children yet to be born. We must protect the forests for those who cannot speak for themselves, such as the birds, animals, fish and trees.”

[§] See <http://www.youtube.com/watch?v=NCAsxphZoxE>

In some parts of Africa, a man who plans to cut down a tree offers a prayer of apology, telling the tree why necessity has forced him to harm it. This preindustrial attitude is something from which industrialized countries could learn. In industrial societies, land “belongs” to someone, and the owner has the “right” to ruin the land or to kill the communities of creatures living on it, if this happens to give some economic advantage, in much the same way that a Roman slave-owner was thought to have the “right” to kill his slaves. Preindustrial societies have a much less rapacious and much more custodial attitude towards the land and its non-human inhabitants.

“Our economic system is built on the premise that individuals act out of self-interest.”

On April 22, 2010, the World People’s Conference on Climate Change and the Rights of Mother Earth in Cochabamba, Bolivia, adopted a Universal Declaration of the Rights of Mother Earth.[¶]

Contrast this expression of the deep ethical convictions of the world’s people with the cynical, money-centered results of various intergovernmental conferences on climate change!

Our economic system is built on the premise that individuals act out of self-interest, and as things are today, they do so with a vengeance. There is no place in the system for thoughts about the environment and the long-term future. All that matters is the bottom line. The machine moves on relentlessly, exhausting non-renewable resources, turning fertile land into deserts, driving animal species into extinction, felling the last of the world’s tropical rainforests, pumping greenhouse gases into the atmosphere, and sponsoring TV programs that deny the reality of climate change, or other programs that extol the concept of never-ending industrial growth. But the economists, bankers, bribed politicians and corporation chiefs who destroy the earth today, are destroying the future for their own children, grandchildren and great-grandchildren. Does it make sense for them to saw off the branch on which they, like all of us, are sitting?

Must there be a human-initiated 6th geological extinction event? Is it inevitable that the long-term future will witness the disappearance of human civilization and most of the plants and animals that are alive today? No! Absolutely not! It is only inevitable if we persist in our greed and folly. It is only inevitable if we continue to value money more than nature. It is only inevitable if we are afraid to question the authority of corrupt politicians. It is only inevitable if we fail to cooperate globally, and if we fail to develop a new economic system with both a social conscience and an ecological conscience.

We are living today in a time of acute crisis. We need to act with a sense of urgency never before experienced. We need to have great courage to meet an unprecedented challenge. We need to fulfill our duty to future generations.

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[¶] See <http://therightsofnature.org/universal-declaration/>

Book Reviews

Climate Concerns Expanding in 2014: The CNA/MAB Report and Six Others. National Security and the Accelerating Risks of Climate Change.

CNA Military Advisory Board. Foreword by Michael Chertoff and Leon Panetta.

Alexandria VA: CNA Corporation, May 2014, 37p.

(download at www.cna.org/reports/accelerating-risks).

Review by Michael Marien

Director, Global Foresight Books;
Fellow, World Academy of Art and Science

1. Introduction

The early months of 2014 have seen several new reports on climate change, all more worrisome than earlier reports. The best-known is the **Fifth Assessment Report** (AR5) of the Intergovernmental Panel on Climate Change (www.ipcc.ch), which provides a voluminous survey of the three IPCC Working Groups: WGI: **The Physical Science Basis**, WGII: **Impacts, Adaptation, and Vulnerability**; and WGIII: **Mitigation of Climate Change**. A Summary is available for each of these three reports, and a **Synthesis Report** will soon be available.

In May 2014, the third **National Climate Assessment** was issued by the U.S. Global Change Research Program (www.globalchange.gov), described as “Thirteen Agencies, One Vision: Empower the Nation with Global Change Science.” The report involved more than 300 experts, with analysis and excellent maps projecting regional variations as concerns future climate, sea level rise, human health, infrastructure, extreme weather, water supply, oceans, ecosystems, and biodiversity.

At about the same time, the American Association for the Advancement of Science, the largest organization of scientists in the world with 140,000 members, issued a simply-written 28-page statement on **What We Know: The Reality, Risks and Response to Climate Change** (<http://whatweknow.aaas.org>). It stressed the reality that climate change is happening and “very likely” to be worse over the next 10-20 years and beyond, and that 97% of scientists agree with this view (a rebuttal to the deniers who still say that the science is not settled).

The statement also covers potential scenarios (including permafrost melt in the Arctic as “a key uncertainty”), wildfires and the growing chance of a “mega-fire,” and climate change and national security. We face the risks of abrupt and potentially irreversible changes, and “the sooner we act, the lower the risks and costs.”

An emphasis on economic risk is the focus of **Risky Business: The Economic Risks of Climate Change in the United States** (www.riskybusiness.org), issued shortly after writing

this long review of the CNA Military Advisory Board report. An EPILOGUE to this review provides a brief look at the “Risky Business Project” co-chaired by former NYC Mayor Michael R. Bloomberg, former US Secretary of the Treasury Henry M. Paulson Jr., and retired hedge fund manager Thomas F. Steyer, and notes important parallels to the CNA/MAB report.

These two reports addressed to American audiences raise alarms about climate change from national security and economic security perspectives. But doing something about it in a major way is left to yet another major report addressed to a global audience: **Pathways to Deep Decarbonization** from SDSN and IDDRI (Interim 2014 Report, July 2014, 195p; www.deepdecarbonization.org). This report is also briefly covered in the EPILOGUE. And still to follow is **The New Climate Economy Report** of the Global Commission on the Economy and Climate, to be published in September 2014, focusing on urban development, energy systems, and agricultural land use.

2. Background to CNA and its Military Advisors

CNA Corporation (www.cna.org) was originated in 1942 as the non-profit Center for Naval Analyses, and became CNA Corporation in the 1990s. It employs nearly 400 staff and now includes the Institute for Public Research, which does studies on education, energy, water and climate, air traffic management, and security. The Military Advisory Board, which is part of the Institute, includes 15 retired Generals and Admirals from the US Army, Navy, Air Force, and Marine Corps, and one retired British Rear Admiral.

An initial 63-page report of the Military Advisory Board, **National Security and the Threat of Climate Change**, was issued in 2007, finding that “climate change poses a serious threat to America’s national security”; it can act as a threat multiplier for instability in volatile regions, it will add to tensions even in stable regions, and it is linked to energy dependence and national security. Five recommendations were made.

After nearly a decade of scientific discoveries in environmental science and a burgeoning scholarly literature on the complex interdependence among nations, the MAB felt “compelled” to provide an update, where “we validate the findings of our first report and find that in many cases the risks we identified are advancing noticeably faster than we anticipated. We also find the world becoming more complex in terms of the problems that plague its various regions... We see more clearly now that while projected climate change should serve as catalyst for change and cooperation, it can also be a catalyst for conflict. We are dismayed that discussions of climate change have become so polarizing and have receded from the arena of informed public discourse and debate.”(p. iii)

The Foreword by Michael Chertoff (former Secretary of Homeland Security) and Leon Panetta (former Secretary of Defense) states that “projected climate change is a complex multi-decade challenge. Without action to build resilience, it will increase security risks over much of the planet. It will not only increase threats to developing nations in resource-challenged parts of the world, but it will also test the security of nations with robust capability... Even though we may not have 100% certainty as to the cause or even the exact magnitude of the impacts, the risks associated with projected climate change warrant taking action today... When it comes to thinking through long-term global challenges, none are more qualified than

our most senior military leaders... (who are) experts in geopolitical analysis and long-range strategic planning.” (p. 1)

“Coordinated, wide-scale, and well-executed actions are required—now.”

3. CNA/MAB Major Findings

“We gather again because of our growing concern over the lack of comprehensive action by both the United States and the international community to address the full spectrum of projected climate change issues.”

1. **Insufficient Action.** Climate mitigation and adaptation efforts are emerging in various places around the world, but the extent of these efforts is insufficient to avoid potential water/food/energy insecurity, political instability, extreme weather events, and other manifestations of climate change. Coordinated, wide-scale, and well-executed actions are required—now.
2. **Cooperation or Conflict?** The potential security ramifications should be serving as catalysts for cooperation and change; instead, “climate change impacts are already accelerating instability in vulnerable areas of the world and are serving as catalysts for conflict.” As identified in the 2007 report, the projected effects of climate change are “threat multipliers that will aggravate stressors abroad such as poverty, environmental degradation, political instability, and social tensions.”
3. **Population Challenges.** “Rapid population growth, especially in coastal and urban areas, and complex changes in the global security environment, have made understanding the strategic security risks of projected climate changes more challenging.” Since research began for the 2007 report, the world has added more than half a billion people, geopolitical power has become more dispersed, and non-state actors are having increasing impacts.
4. **Arctic Ice Melt.** Accelerated melting of “old ice” in the Arctic is making the region more accessible to a wide variety of human activities. “The US and the international community are not prepared for the pace of change in the Arctic.”
5. **Water/Food/Energy Nexus.** As the world’s population and living standards continue to grow, projected climate impacts on the nexus of water, food, and energy become more profound. By 2030, worldwide demand will call for 35% more food and 50% more energy, which will stress resources across a growing segment of the world.
6. **U.S. Homeland Security.** Heat waves, intense rainfall, floods, droughts, rising sea levels, more acidic oceans, and melting glaciers and Arctic sea ice will not only affect local communities, but challenge key elements of National Power to protect national assets and influence others.
7. **Military Impacts.** Climate change could be detrimental to military readiness and strain base resilience, as more forces are called on to respond in the wake of extreme weather events at home and abroad; climate change will also make training more difficult, and put at greater risk critical military logistics, transport systems, and infrastructure.
8. **National Infrastructure.** Extreme heat is already damaging roads, rail lines, and airport runways. Much of the nation’s energy infrastructure (oil and gas refineries, stor-

age tanks, power plants, electricity transmission lines) is located in coastal floodplains increasingly threatened by more intense storms and rising sea levels. Increased temperatures and drought across much of the nation will strain energy systems with more demand for cooling, and possibly dislocate and reduce food production.

9. **Economic Impacts.** Most US economic sectors in every region, including international trade, will be affected by projected climate change.
10. **Social Support Systems.** As coastal regions become increasingly populated and developed, more frequent or severe storms will threaten vulnerable populations in these areas and increase requirements for emergency first responders. Simultaneous or widespread extreme weather events and/or wildfires, accompanied by mass evacuations and degraded critical infrastructure, could require increased use of military and private sector support.

4. CNA/MAB Recommendations

Risks posed by predicted climate change “represent even graver potential than they did seven years ago and require action today to reduce risk tomorrow.”

1. **U.S. Leadership.** To lower national security risks, the US should take a global leadership role in preparing for climate change. “At the same time, the US should lead global efforts to develop sustainable and more efficient energy solutions to help slow climate change.”
2. **Planning.** US Combatant Commanders should factor in the impacts of projected climate change across the full spectrum of planning and operations, and focus on building capacity and sustained resilience with partner nations.
3. **The Arctic.** The US should accelerate and consolidate efforts to prepare for increased access and military operations in the Arctic, which is already becoming viable for commercial shipping and increased resource exploitation. To provide itself with better standing in resolving future disputes in the Arctic, the US should become a signatory to the UN Convention on the Law of the Sea.
4. **Water/Food/Energy.** Adaptation planning should consider this nexus to ensure comprehensive decision-making for these vital resources.
5. **National Risk Assessment.** Projected impacts of climate change should be integrated fully into the National Infrastructure Protection Plan and the Strategic National Risk Assessment. “As military leaders, we know that we cannot wait for certainty. The failure to include a range of probabilities because it is not precise is unacceptable.” [Note: This responds to the deniers who insist on perfect or near-perfect certainty.]
6. **New Metrics.** The Department of Defense should develop plans to adapt to impacts of climate change, including developing metrics for measuring climate impacts and resilience. Climate impacts should be considered in all vulnerability assessments.
7. **Recognizing Risks.** The risks associated with climate change are accelerating, and the effects of climate change are becoming more than just threat multipliers: without action to build resilience in the most vulnerable parts of the world, the projected impacts of climate change will likely serve as catalysts for conflict. “On the positive side, recog-

nitition of the risk can lead to increased collaboration; thus we see climate change also serving as a catalyst for cooperation and change.” In the past seven years, the world has moved toward a greater understanding of the threats, and “most countries now identify climate change as a national security threat.”

8. **Better Data, but Wild Cards Remain.** Improved models and better data collection systems are contributing to increased confidence levels of projected changes. Growing risks measured with greater accuracy since 2007 include longer and stronger fire seasons, an acceleration of sea-level rise (the 100-year storm surge associated with Superstorm Sandy can now be expected every 10-20 years), the continued collapse of sea ice in the Arctic Ocean, the movement of plant and animal diseases toward higher elevations and latitudes (posing a greater risk to crops from pests and invasive species), precipitation becoming more irregular and intense, increased drought frequency and stress to freshwater systems.

Although scientists are coalescing around standard climate change predictions, some wild cards remain, the most significant being the melting West Antarctic Ice Sheet, which “has the potential to raise sea levels by several meters within a few decades.” A second wild card is the ability of the ocean to adapt to increased acidification, which affects the entire aquatic food chain, and “could cause food shortages around the globe, with considerable security implications.” [Note: Expanding the list of potential wild cards, and roughly assessing their likelihood, are unfortunate omissions to the list of recommendations. Especially important is methane released by permafrost melt in the Arctic, described in the AAAS report as “a key uncertainty.”]

5. Comment on the CNA/MAB Report

The key word in this important report is “*acceleration*,” which has not been used by other official and quasi-official reports on climate change written by perhaps overly cautious scientists. Another distinctive and useful phrase in this report is “*threat multiplier*,” which is more likely to be seen by military planners than by scientists.

The theme of **Climate Change and National Security**, edited by Daniel Moran (GlobalForesightBooks.org Book of the Month, March 2013), is forcefully demonstrated by thoroughly assessing potential negative impacts of climate change in 19 regions and nations beyond North America. The US National Research Council has issued a recent report, **Abrupt Impacts of Climate Change: Anticipating Surprises** (GFB Book of the Month, Jan 2014), which considers the likelihood of 14 “wild card” changes in the ocean, the atmosphere, higher latitudes, and ecosystems. **Bankrupting Nature: Denying Our Planetary Boundaries** by Anders Wijkman and Johan Rockstrom, a recent report to the Club of Rome (GFB Book of the Month, Jan 2013), not only introduces the concept of nine “planetary boundaries” (such as ocean acidification and biogeochemical loading), but warns of a possible tipping point in the Arctic as permafrost continues to melt, and the melt becomes “self-accelerating.” Thus, there are still more plausible threat multipliers and wild cards—if one bothers to look for them.

A further addition to these concerns is the probable advent of El Nino in Fall 2014, as reported by Nate Cohn in *The New York Times* (20 May 2014, A3). “Above average sea-surface

temperatures have developed off the west coast of South America, and seem poised to grow into a full-fledged El Nino event, in which unusually warm water spreads across the equatorial East Pacific. Models indicate a 75% chance of El Nino this fall, which could bring devastating droughts to Australia or heavy rains to the southern US.” The Pacific Decadal Oscillation, which favors more frequent and intense El Ninos during its “warm” or “positive” phases, has been “cool” or “negative” since the historic El Nino of 1998. The oscillation between El Nino and its cold-water cousin, La Nina, is part of the reason for slower atmospheric warming in recent years. “But this year’s El Nino might represent a turning point.” Kevin Trenberth of the National Center for Atmospheric Research believes that it is reasonable to expect that 2015 will be the warmest year on record if this fall’s El Nino event is strong and long enough. It could at least double the rate of surface temperature increases, and “unleash a new wave of warming that could shape the (climate) debate for a decade, or longer.”

The CNA’s Military Advisory Board calls for climate action now, and AAAS warns that the sooner we act the lower the costs. In **America’s Climate Choices** (GFB Book of the Month, Oct 2011), the National Research Council called for global-scale efforts, due to “a pressing need for substantial action to limit the magnitude of climate change and to prepare to adapt to its impacts.”

The Obama Administration has recently issued new rules to reduce CO₂ emissions from US power plants by 30% by 2030, compared with the 2005 base. But, as reported by Eduardo Porter in “A Paltry Start in Curbing Global Warming” (*The New York Times*, 4 June 2014, B1), the proposed rules—even if realized despite expected political pushback—“fall far short” of what is needed. “Rather than a bold stride into the vanguard of the battle against climate change, the new proposals from the E.P.A. offer just enough progress to shuffle along with a world that unfailingly falls short of delivering what is needed.” Perhaps a strong El Nino in 2015 will sharply boost the necessary global response. Viewing climate change as a major threat to national security everywhere can certainly help.

6. Epilogue: Two New Reports

Shortly after preparing this review of the CNA/MAB report, yet another report on climate change was issued that has important parallels. The CNA/MAB report by 15 retired generals and admirals was introduced by a former Republican Secretary of Homeland Security (Chertoff) and a former Democratic Secretary of Defense to emphasize the focus on national security aspects of climate change.

Risky Business: The Economic Risks of Climate Change in the United States (June 2014, 36p, www.riskybusiness.com) is co-chaired by Michael R. Bloomberg (recent New York City Mayor), Henry M. Paulson Jr. (former Republican US Treasury Secretary), and Thomas F. Steyer (a retired billionaire hedge fund manager and head of NextGen Climate Action). The seven politically-balanced Risk Committee members are Henry Cisneros (former Democratic US Secretary of Housing and Urban Development), Gregory Page (Executive Chairman and former CEO of Cargill, Inc.), Robert E. Rubin (Co-Chair of the Council on Foreign Relations and former Democratic Treasury Secretary), George P. Shultz (Distinguished Fellow at the conservative Hoover Institution, former Republican Secretary of State, Treasury, and Labor), Donna E. Shalala (President, University of Miami; former Democratic US Secretary of Health and Human Services), Olympia Snowe (former Republican US Senator from Maine), and

Dr. Alfred Sommer (Dean Emeritus and Distinguished Professor, Johns Hopkins University School of Public Health).

“Our findings show that, if we continue on our current path, many regions of the U.S. face the prospect of serious economic effects from climate change... (and) our climate risks will multiply and accumulate as the decades tick by.” (pp. 3-4) These risks to specific business sectors and regions of the economy include:

1. Large-scale losses of coastal property and infrastructure. “If we continue on our current path, by 2050 between \$66 and \$106 billion worth of existing coastal property will likely be below sea level nationwide, with \$238 to \$507 billion worth of property below sea level by 2100. There is a 1 in 20 chance that more than \$701 billion worth of existing coastal property will be below mean sea levels by 2100, with more than \$730 billion of additional property at risk during high tide.”
2. Extreme heat across the US—especially in the Southwest, Southeast, and Upper Midwest—threatening labor productivity, human health, and energy systems. Demand for air conditioning will surge, straining regional generation and transmission capacity. Changes in temperature will likely necessitate construction of roughly 200 new power plants costing ratepayers up to \$12 billion per year.
3. Shifting agricultural patterns and crop yields, with likely gains for Northern farmers offset by losses in the Midwest and South. Some states risk up to a 50-70% loss in average crop yields, agricultural adaptation being absent. (The Report assesses risks for six US regions, as well as for Alaska and Hawaii.)

In sum, “we call on the American business community to rise to the challenge and lead the way in helping reduce climate risks.” To plan for climate change, we must plan for volatility and disruption. If we act now, “the U.S. can still avoid most of the worst impacts and significantly reduce the odds of costly climate outcomes—but only if we start changing our business and public policy practices today.” However, the Risky Business Project “does not dictate the solutions to climate change...rather, we document the risks and leave it to decision-makers in the business and policy communities to determine their own tolerance for, and specific reactions to, those risks.” (p. 7)

Although the Project offers no proposals for action, co-chair Henry Paulson, chair of the newly-formed Paulson Institute at the University of Chicago, followed up the report with an essay on “The Coming Climate Crash” in *The New York Times* (Sunday, 22 June 2014, SR1), warning of “a crisis that we can’t afford to ignore” and the “profound economic risks of doing nothing,” and calling for a tax on CO₂ emissions.

A few weeks after **Risky Business**, yet another report was issued by the Sustainable Development Solutions Network (SDSN) of the United Nations and the Institute for Sustainable Development and International Relations (IDDRI) of Sciences Po in Paris. **Pathways to Deep Decarbonization: Interim 2014 Report** (July 2014, 195p. www.deep-decarbonization.org) is a collaborative initiative of 15 Country Research Teams showing how individual countries can transition to a low-carbon economy and how the world can meet the internationally agreed target of limiting the increase in global mean surface temperature to less than 2 degrees Celsius before 2050. The 15 countries in this Deep Decarbonization

Pathways Project (DDPP) represent 70% of global GHG emissions. The Interim report includes 12 country chapters from Australia, Canada, China, France, Indonesia, Japan, Mexico, Russia, South Africa, South Korea, the UK and the USA. Chapters on Brazil, India, and Germany will be in the complete report to be published in September 2014.

The 2014 DDPP report addresses such topics as taking the 2°C limit seriously (“a solemn responsibility of the global community”), catastrophic climate change as likely under business-as-usual, CO₂ energy budgets for the 2011-2050 and 2011-2100 periods, emissions reduction trajectories to 2050, pathways to deep decarbonization (the High Renewable Scenario of 75% renewables, the High Nuclear Scenario of 60% nuclear energy, the High CCS Scenario), low-carbon technologies (advanced nuclear power, carbon capture and sequestration, advanced biofuels, energy storage and grid management, new industrial processes, negative emissions technologies), developing country-level DDPs, sectoral shares of total emissions, etc.

The 2015 DDPP report will take a broader perspective by considering integrated approaches, national and international financial requirements, and policy frameworks for implementation. “Above all, we hope that the findings will be helpful to the Parties of the UN Framework Convention on Climate Change (UNFCCC) as they craft a strong agreement on climate change mitigation at the Conference of the Parties (COP-21) in Paris in December 2015.”

As a final comment, everyone involved with forecasting, planning, policy analysis, new ideas and paradigms, investments, and general concern for the future should stay abreast of the accelerating threats of climate change and the wide-ranging responses that are necessary and likely in the years ahead. The seven 2014 reports covered here, written in a variety of styles for a variety of audiences, should help to point the way forward.

No single report is sufficient. The IPCC **Fifth Assessment Report** provides all of the scientific detail, but will be daunting to most readers. The US **National Climate Assessment** focuses on a single nation that plays a critical part in addressing the climate question. The 28-page **What We Know** report from AAAS is a simple, authoritative, and easily-read introduction to the problem by America’s leading scientific organization. The Military Advisory Board report extensively reviewed here describes climate change as a “threat multiplier” affecting national security. The **Risky Business** report addresses various economic aspects in eight US regions. The interim **Pathways to Deep Decarbonization** report describes how 15 countries representing 70% of global GHG emissions can each help to keep global temperature rise to less than 2°C by 2050. And **The New Climate Economy Report** published in September 2014 will focus on urban development, agricultural land use, and energy systems. Many more reports will surely follow, especially if the many impacts of climate change worsen in the years ahead.

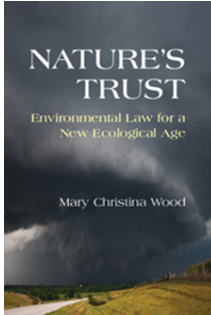
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Wood, Mary Christina. (2014) *Nature's Trust: Environmental Law for a New Environmental Age*. New York: Cambridge University Press.

Review by Robert Hoffman

President, WhatIf? Technologies Inc.;
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Nature's Trust is a must read for those interested in the issues of governance of the commons and the rule of law that were important topics for discussion at the Annual General Congress and Conference of the Club of Rome held in Ottawa, September 2013.

Mary Christina Wood, University of Oregon School of Law, makes the case that the spate of environmental laws enacted in the 1970s have not only failed to protect the environment as was intended but they have legalized its destruction. Many of these laws established agencies, such as the Environmental Protection Agency, with mandates to establish regulatory frameworks for protecting endangered species, ensuring clean water and clean air and for promoting stewardship of natural resources. Often these agencies issue permits giving corporate interests the right to take water, to release pollutants into air and water, to harvest fish, and to take timber from crown lands.

These agencies have been easy prey for corporate interests and the politicians whose campaigns are funded by those interests. A number of strategies are used that have been effective in perverting the original intent of these agencies. Insofar as regulatory frameworks are based on scientific consensus, corporate interests have succeeded in casting doubt in scientific consensus, thereby delaying the adoption of regulations and weakening their provisions. Senior agency officials are political appointees often appointed from senior positions in the industries subject to regulation, resulting in failure to prosecute violators, reduced enforcement effort, lack of due diligence in permitting, suppression of agency scientific findings, and dismantling of monitoring programs. The agencies are fragmented and overlapping in jurisdiction adding layers of complication and opportunity for corporate interests to obtain permits from one agency that negates the mandates of other agencies.

The establishment of these environmental laws represented a major shift in power from the judiciary to the executive. The long established legal principle known as public trust doctrine rests on a civic and judicial understanding that some natural resources are so vital to public welfare and human survival that they should not serve private interests to the exclusion of the public good. Under public trust doctrine, such natural resources remain common property belonging to the people as a whole. Such assets take the form of a perpetual trust for future generations. Public trust law demands that governments act as trustee in controlling and managing natural assets. Governments are obligated to promote the interests of citizen beneficiaries and ensure the sustained resource abundance for society's endurance.

The author concludes that instead of incremental reform, the present circumstances call out for a fundamental reform that infuses all government decision making with its responsibility for stewardship. Citizens must tap a wellspring of legal obligation to compel their governments to act accordingly.

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- papers that are reasonably well developed and which may serve as a stimulus, among the Fellows, for the development of new project proposals for the World Academy;
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