THE HUMAN CONDITION AND THE 21ST CENTURY

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Remembrance and Reflection, how ally'd;
What thin partitions Sense from Thought divide.
Essay on Man—Alexander Pope (1688-1744)

The lines from Pope's famous poem capture the essence of what this essay is about. The second line hints at the basic elements of thought but not the process of thought itself; and the first gives a glimmering of insight into the roots of the human condition. The phrase "the human condition" has come to mean many things to different people, but here it simply refers to what history has shown to be the inescapable features of being human.

In this discussion we take a look at current trends, what they foretell for the remainder of this century, and how the characteristics that make us human might affect the evolution of those trends. The human condition depends on a variety of factors that have evolved along with humans, so this essay briefly reviews several subtopics: our evolution, our modes of thought (the way people think), how and why cultures evolve, the human condition past and present, and whether the human condition is likely to change much in the next hundred years.

All of us already have a feel for some of the problems that are in store for us during the rest of the century. But there is little discussion of them taken as a whole, and their joint effect may be far greater than a simple linear summation—many of the problems are interrelated and reinforce each other. Even attempting to solve some of them in isolation can have serious unintended consequences. One simple-minded example is growing crops for biofuels on farmland that is limited in availability or owned by a few landowners (as in Guatemala). The result is a rise in the cost of corn (maize) and other staples, causing many to go hungry. The original intent was to address the perceived problem of global warming by displacing oil or other fossil fuels to limit carbon dioxide

emissions, but the result is immediate harm to existing populations. Worse yet, once subsidies are in place there are great profits to be made, and it becomes difficult to reverse the increasing use of food for fuel.

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The human condition depends on a variety of factors, including our genetic makeup and our social and cultural heritage. Societies also evolve, and their character and rate of evolution are major factors that must play a role in any discussion of the human condition.

The inheritance of adult humans is framed by four basic factors: their genetic inheritance; the process of development from an egg, known as ontogeny; the education they receive, formal or otherwise; and the society and culture of which they are a part. Our understanding of these broad categories and how they affect individual members of different cultures is far from static—it's changing rapidly.

Take evolution and ontogeny as examples. The concept of variation and selection was introduced in Darwin's theory of evolution as presented in *The Origin of Species*. The merger of that idea with Gregor Mendel's discovery that mutations resulting in trait alterations cannot be diluted because they have a discrete character, is known as the Modern Synthesis. For at least the last fifty years, a gene-centered view of heredity based on this synthesis dominated biological thought.

Today we know that by far the majority of our genes are shared by other animals, and that the enormous variety of species is a result of when and where genes are turned on and off during ontogeny. The genes that make us explicitly human are only a small fraction of our genetic makeup. Another source of the observed variations is now known to be due to what is called "epigenetic inheritance."

The possibility of epigenetic inheritance was only suggested in the mid-1970s; since then it has become a fast growing subject of research. When differentiated cells such as muscle or liver cells divide, the daughter cells are of the same differentiated type even

though each cell carries a full complement of genes. The daughter cells remain specialized because some genes are silenced and others not. This generally happens when small methyl groups are attached to some of the bases of DNA. The resulting methylation patterns determine how easily genes can be turned on, and are part of the system of heredity that passes epigenetic information from mother to daughter cells.

Perhaps most surprising is that environmental and developmental factors can not only affect gene expression and methylation patterns, but that these changes can be inherited. The resulting variants may persist for generations. This means the germ-line cells must carry the epigenetic information, calling to mind the discredited Lamarckian theory of the last century. The details of such trans-generational "*epigenetic*" inheritance are a matter of ongoing research. There are also some suggestions that epigenetic inheritance may play a role in the development of species.

Modes of Thought

Human beings have a variety of senses, including the obvious ones of sight, hearing, touch, smell, and taste. Many other animals have different suites of senses, some in common with humans and some not—like the ability to sense and use electric or magnetic fields for practical purposes like finding prey and navigation, or having extended—or at least different—visual or hearing ranges compared with humans. Animals' interpretation of the world around them can be very different from each other and from human perception. Local sensory neuronal networks associated with sensory neurons that detect signals from the surrounding environment often perform some processing of the received sensory data before the resulting coded information is sent on to the brain; the retina, for example, does a great deal of preliminary processing. The brain itself is organized around receiving, storing, and further processing this information.

The neuronal networks of lower animals such as insects and jellyfish are almost hard-wired, in the sense that little if any learning is required for their full behavioral repertoire to be available after they are fully formed. In the higher animals, much of this ability to

process sensory information is developed during early life and is a learned ability, in that, although the basic architecture of the nervous system is genetically determined, its development depends on early sensory stimulation and is therefore the result of a learned process in the broader meaning of the term.

Thus we learn, for example, to interpret visual information as shapes, and we similarly learn to interpret a sequence of sounds as music or language. This interpretational process involves memory of previous exposure to similar sensory input. A given neural network can have many different patterns of excitation, since individual neurons making up the network may or may not be an active part of a particular pattern of excitation; some are excited and some are inhibited. The number of possible ways of interconnecting even a few thousand neurons is enormous. This allows lower animals to display rather complex behavior although they have only a limited number of neurons.

Recent studies in humans, using functional magnetic-resonance imaging, show that the same neural combinations are activated when viewing remembered visual images, and that repetition improves the correlation. If we listen to a piece of music that has been previously heard, a memory of the piece is retrieved after only the first few notes, and if an incorrect note is played we notice it immediately. Similar responses are observed in other animals: a bird that has learned about a predator's shadow at an early age does not need to carefully categorize its image at a later appearance—it reacts instantly once enough information is available to call up the earlier memory. Sometimes we see an animal on the lawn, only to have it almost instantly replaced by the crumpled paper bag it really is. Such misperceptions are common, and clearly show that a camera is not a good model for vision; at best, the analogy serves to describe the projection of an image by the lens of the eye on the retina. The act of seeing itself involves visual processing by the retina and brain at the moment of seeing, coupled with visual memories embedded in the neural networks of the visual cortex.

Animals at the level of cats and dogs clearly have some ability to recall memories of various images, sounds, and other sensations. It is thought that the visual memory of

squirrels is highly developed, since they remember very well where they have buried food (visual or chemical markers that could give an alternative explanation have not been found); some birds also hide food and come back and find it at a later time. However, the ability of such animals to recall memories of past sensations independent of current sensory input, and to correlate and manipulate them as thought, is certainly very limited compared with humans'.

Even among humans, the ability to recall different types of sensory input is quite variable. Some people have superb visual memories both in space and time; they are able to order them so that they can dynamically visualize, for example, complex machinery and its operation. Some visualize in color—the perception of which can be variable—and others do not. Many do not visualize well at all because they have limited ability to discern spatial relations. Beethoven was able to recall music and "play it in his head"; after all, he was deaf when he wrote his late quartets, arguably his best works. While often being able to whistle a tune or recognize a piece of music, few people can actually "play" instruments in their head. But some can, and sometimes with great fidelity. Some can think using internal, silent words that they actually "hear" (known as sub-vocalization); others have only very limited ability to do so. Other variations may appear in the ability to recall tastes, smells, or other sensations.

Such variations are often hidden. We all agree on colors, for example, although experiencing them very differently: mildly color-blind people see red and green, but quite differently from those with normal color vision. The musical experience of young people, able to hear a wide range of sound frequencies, differs greatly from the experience of older people with reduced hearing range listening to the same performance, but they rarely notice the difference in discussing their impressions of the piece. We abstract certain qualities from sensory impressions, be they visual, aural, or other, and give them a common name. But the commonality can be deceptive, in that variations in perceptions and thought patterns can be an important and generally unrecognized factor in miscommunication between individuals and groups—in addition to educational, language, and cultural differences.

While the basic architecture of the nervous system is genetically determined, the information-carrying capacity of DNA is far too small to specify the enormous number of interconnections of the brain. Instead, large quantities of excess neurons and neural connections are produced during early life, to be modified and trimmed in the course of later learning. Gerald Edelman has developed the concept of neural Darwinism to help explain the selection of these neurons to form functional neural networks, and thus the micro-architecture of the brain. Learning involves the formation of memories; how these are formed and stored, a subject with a long history and literature, has now become understood at the neuronal and molecular level. It is well described in Eric Kandel's memoir and scientific exposition, *In Search of Memory*.

As the complexity of the neural structure of brains increased during evolution, consciousness gradually made its appearance. In his book, *Bright Air, Brilliant Fire: On the Matter of the Mind,* Edelman distinguishes two types of consciousness, primary and higher-order. Primary consciousness is "composed of phenomenal experiences such as mental images, but it is bound to a time around the measurable present, lacks concepts of self, past, and future, and lies beyond direct descriptive individual report from its own standpoint." Higher-order consciousness "is based on the occurrence of direct awareness in a human being who has language and a reportable subjective life." Edelman does allow that other animals can think, but since they lack true language, higher-order consciousness cannot "flourish in them as it does in us." Higher-order consciousness is where one is "conscious of being conscious."

Edelman's insistence that true language is necessary for higher-order consciousness should perhaps be more nuanced: The great mathematician Jacques Hadamard has said that "words are totally absent from my mind when I really think" and, quoting Schopenhauer, maintained that "thoughts die the moment they are embodied by words." Roger Penrose, another well-known mathematician and one of the most creative people of modern times, has written in his popular book *The Emperor's New Mind,* "Almost all my mathematical thinking is done visually and in terms of non-verbal concepts, although

the thoughts are quite often accompanied by inane and almost useless verbal commentary." Einstein maintained a similar position on his mode of thought.

Although non-verbal forms of thought may be innate and both underlie verbal thought and in some sense form its basis, language and the ability of humans to communicate may well be necessary for the full development of non-verbal thinking. That is, language and non-verbal thought do not stand alone, but are related and inform each other. Scientists, engineers, carpenters, musicians, and many others use a variety of modes of thought, depending on the subject matter with which they are dealing. Crows have been known to improvise tools, and myriads of animal owners have seen their pets respond to emergencies in ways that could neither be learned nor instinctive, but rather have to be the result of mental problem solving. The idea that true language—as it appears in humans—is necessary for higher-level consciousness appears to be a little too anthropocentric.

What appears to be the case, then, is this: We humans think using a variety of basic elements related to our senses, be they visual images, sub-vocalized words, or other recalled and composite constructs based on the modalities of our senses. Human beings use these elements of thought to enable what is called conceptual thinking—involving abstraction and inference. It includes, for example, inductive and deductive logic, as well as mathematics and symbolic logic. These elements can be used individually, and more often in combination. Penrose's "inane and almost useless verbal commentary" might play a larger role in his mathematical thinking than is readily apparent. How people think of the same concepts, and which elements of thought are used and how they are combined, may vary from individual to individual.

As put by Esther Gardner and John Martin in their on-line article *Coding of Sensory Information*,

> "our perceptions differ qualitatively from the physical properties of stimuli because the nervous system extracts only *certain* pieces of information from each stimulus, while ignoring others, and then interprets this information in

> the context of the brain's intrinsic structure and previous experience. . . . Colors, tones, smells, and tastes are mental creations constructed by the brain out of sensory experience. They do not exist, as such, outside the brain."

The elements of thought in animals, including humans, are ultimately related to their sensory impressions as recorded in patterns of neurological connections. Memory allows us to conceive of objects independent of immediate sensory input; and the ability to project our thoughts into the past and into the future enables us to imagine objects and possible events as they might have been (beyond the extent of memory) and to project the present into the future. Memory itself is composed of at least three different types: procedural—concerned with sequential operations; episodic—remembering personal events in the sequence they occurred; and semantic—often identified with symbolic knowledge, dealing with ideas, concepts and meanings. These divisions are somewhat arbitrary. They are useful for purposes of analysis, but real memory will be a synthesis of the three types. The ability to recall information related to each type of memory can be expected to vary widely among individuals.

What thinking may exist in non-human animals will reflect the elements of thought available to them from the neural cognates related to their often very different senses.

The Evolution of Humans, Race, and Culture

The achievements of each generation, using whatever combination of modes of thought, would be lost to succeeding generations were it not for culture as a moderately effective means of passing down that knowledge. Because individuals have varying capabilities, culture is a collective phenomenon; passing it on to succeeding generations takes a variety of social subgroups—it cannot be done by one or a small number of individuals.

Modern humans arose some 150,000 years ago in Africa—most likely in East Africa. The early spread through the African continent was followed by a major migration out of Africa around 50,000 years ago (although, somewhat earlier, there apparently had been smaller migrations to the east coast of the Mediterranean). Modern humans replaced

Neanderthals in Europe only about 30,000–40,000 years ago, and it is now known that there was some interbreeding: most Europeans have a few percent Neanderthal DNA. All the racial divisions of humanity were formed after the migration from Africa.

Race

Today race is often thought of as a "social construct" rather than a scientific division of humanity. This thought is captured in the observation by population geneticist Richard Lewontin in 1972 that there is more genetic variation among the individuals belonging to a given race than there is between races. But if one compares variations using groups of several hundred genes simultaneously, divisions corresponding to the older categorizations of race by traditional anthropology emerge: patterns characteristic of those native to Europe, East Asia, Africa, Australasia, and America. This should not be surprising, since we can all recognize the usual divisions from anatomical features. Of course there has been a great deal of mixing in modern times, so that this sort of differentiation has become much more problematic.

In the past, the basic racial categories were thought by some to reflect multiple origins for humans. This is now known to be incorrect. *Homo sapiens* originated in Africa, and the races came into being because some of the early humans migrated and became isolated in various parts of the earth, where they adapted to local conditions by the usual means of Darwinian selection. In the north, for example, the need to form vitamin D from the limited sunlight led to the development of lighter skins—a liability in regions with intense sunlight because of skin cancer. As people domesticated animals for milk and meat, lactose tolerance evolved to allow milk to be consumed beyond childhood. Interestingly enough, this also occurred in parts of Africa.

Not all genetic variations have survival value; some may be coupled to other variations that are important, and some may simply be due to sexual preferences or the result of genetic drift in isolated populations.

Racial divisions have been used for the most horrendous purposes, which explains why—based on Lewontin's observation—many people today maintain that the divisions do not exist or are social constructs. Taking all factors into account, there is no solid evidence that there are any significant constraints on human mental capacities that derive from racial differences. Nonetheless, racial divisions may be important for public policy reasons, for example with regard to medical practice. For the purposes of this essay, race is only important as it relates to culture and its evolution.

Human Capabilities and Culture

This is perhaps a good time to say a few words about the nature of human capabilities and general intelligence. First and foremost, human intelligence cannot properly be encapsulated in a single factor like I.Q. Intelligence has a multi-dimensional nature, the components of which vary across populations. Whatever capability one chooses to measure (the most often mentioned being verbal and spatial abilities), the results of the measurements taken across populations will fall in roughly bell-shaped curves known as normal distributions, with the peak at the mean value. In a normal distribution, half the population will have a given capability above the mean and half will be below. Any given person will have a range of capabilities, some above the mean and some below. Each capability will be due to a mixed inheritance, both genetic and cultural, including upbringing, nutrition (whether *in utero* or after), interaction—particularly at an early age—with parents and other adults, general and formal education, and the general physical and social environment. In other words, the result of both nature and nurture.

Human culture evolved slowly in several stages. The use and making of tools is one of the oldest achievements. Various animals from birds to simians use tools of the simplest sort, such as a stick or rocks, and even pass specific skills on from generation to generation, but not at the level of even the earliest humans. The use of fire also appeared among early humans, along with as the use of dogs in hunting; some say the latter represented a type of symbiosis. But most important was the use of language. Some 50,000 to 80,000 years ago there was a flourishing use of symbols, believed to be a result of neural changes and reorganization in the brain that led to an enhanced ability to use

language in a way that greatly improved communication. This created an enormous selective advantage that rapidly spread through the population. The result was the development around the globe of sophisticated hunting and gathering cultures. Each showed variations in terms of tools, shelter, and other cultural adaptations to local conditions. Finding food and the activities associated with it left little time for doing anything else, but nonetheless these societies developed religions and oral traditions.

As the use of these new language skills grew, and languages increased in sophistication, it became clear that the gift represented a type of Faustian bargain. Language could not only be used as a mode of thinking and for enhanced communication of higher-level thought, but also for darker purposes. Powerful emotions can be evoked by those skilled in using language, and because human beings often make quick decisions, and form opinions based more on emotions and past personal experiences than on reason, a channel for manipulation of large populations was also created. This use of language is called "demagoguery." Language also allows the communication of powerful utopian dreams that can form the basis for real political actions and movements.

After the evolution of sophisticated language, the innovation that had the most dramatic effect on human cultural evolution, living conditions, and the ability to support relatively large populations was the development of agriculture and the domestication of animals. This occurred around 10,000 years ago and forms the basis of all subsequent social and technological development. As agricultural innovation increased crop yields, a growing number of people were able to engage in activities other than food production. The result was a freeing of the human mind that led to the great achievements of the early river civilizations of Mesopotamia, Egypt, and the Indus valley. The basic patterns of our civilization were established at that time.

Hunting and gathering requires little in the way of social organization. The settled life that comes with agriculture and the relative abundance of things to eat requires the storage of food and a primitive economy for its distribution. Also needed is a form of government that both creates and enforces laws to protect the wealth that is based on

storable surplus food and the goods produced by people freed to engage in activities beyond food production. Wealth from storing grain led to the differentiation of labor, the rise of social classes, and a vast increase in population. Before the invention of agriculture and associated domestication of plants, urbanization, with its concentrated populations, was not possible, since hunting and gathering rapidly consumes the food available in any one location.

The Old World civilizations that resulted from this revolution were fundamentally alike in that they remained primarily agricultural, with economies that depended on the power of men and animals to pull plows and carry heavy loads. The craftsmen of that world depended on their own skills in woodworking, metal production and forging, and the weaving of cloth. Over time, with the introduction of a variety of metals, chemicals and processing techniques, these skills became more sophisticated and specialized.

The early river civilizations of Mesopotamia, Egypt, and the Indus valley not only established the basic patterns of our civilization, they also invented writing, which allowed the transmission of cumulative knowledge across generations beyond what had been possible with only oral explanation and example. But it was only with the invention of the printing press that knowledge could be widely distributed, and moreover preserved through wars and natural disasters.

Anthropology and history have shown that people generally identify by family, tribe, sect, and religion. Race, where it matters, is generally included in these categories and need not be called out separately. Nationalism is relatively new and many people living today, for example in countries created after World War I and after the collapse of colonialism, do not have a primary identity with the state within which they live. This pattern of identity seems to be a fundamental characteristic of the human condition, or at least one that is a framing factor.

It was only a few hundred years ago that the Enlightenment allowed humanity to understand the world in scientific terms, and the Industrial Revolution, with its enormous

impact on productivity, permitted most people, at least in the developed world, to engage in something other than production, storage, and distribution of food. Today, in the most developed societies only a few percent of the people are directly involved in food production. But this evolution did not begin in much of the rest of the world until relatively recently, and its rapidity has caused much difficulty.

One of the most important contributions of the Enlightenment to the future development of modern society was made by Francis Bacon in the 17th century. His ideas changed the very relationship between humanity and nature: he introduced the concept of empiricism and popularized the inductive method of scientific inquiry. This, of course, is the basis of the scientific method, an approach to nature that was unheard of in his time. In Bacon's words: "At the foundation we are not to imagine or suppose, but to *discover* what nature does or may be made to do." Loren Eiseley, in his 1973 book *The Man Who Saw Through Time* describes Bacon as "preeminently the spokesman of *anticipatory* man. The long reign of the custom-bound scholastics was at an end. Anticipatory analytical man, enraptured by novelty, was about to walk an increasingly dangerous pathway".

When cultures collapse—which can happen for a variety of reasons, including deliberate destruction by others—many of their achievements are likely to be lost. However physical destruction is not the only way cultures and their beliefs can be destroyed or forever changed: left to themselves, cultures evolve with the passage of time. Until relatively recently, built-in social inertia has ensured that cultural changes take a long time. Take western civilization. For some five millennia, western culture has had a set of beliefs, which—while they may have changed somewhat over the years, more in some places than others—still provide a core of faith that holds civilization together and, for a large fraction of the population, have given life meaning and direction. But now circumstances are changing at an increasing rate.

While in the western world these ancient beliefs were already beginning to fade by the nineteenth century, it was the publication of Darwin's *Origin of Species* that destroyed much of what was left by showing that humanity had a natural rather than divine origin.

Modern civilization has yet to come to terms with the implications of evolution and modernity based on the secularism of the Enlightenment. Only in the western developed world is there a formal separation between church and state. Some countries have attempted for ideological purposes to eliminate formal religion, but they have only driven it underground. Even in the west, a religious worldview is still held by a majority of the people.

Globally, most people continue to embrace the idea that there is another, parallel, ghost world in close proximity to ours, and that interaction between the two is not only possible but also routine. Mythopoeic thought, is alive and well. It continues to instruct the outlook of most of humankind, including many in western secular society. Western secular culture—so strongly influenced by the scientific worldview—is not common: it is an aberration. [The concept of Mythopoeic thought is discussed more fully by Henri Frankfort and others in their 1959 book *Before Philosophy*.]

Along with the many benefits in health, technology, longevity, and wealth that development and modernity offers, beliefs and customs are rapidly being destroyed. Many who are exposed to the consequent dislocation and anomie, or loss of social norms and standards, do not believe that what the modern world has to offer is worth the loss of their way of life.

The western world has had ample time to adapt gradually to the changes wrought by the transition from an agrarian to an industrial society; there has been time to come to terms with market capitalism and the industrial revolution; and most especially, time for at least the educated elite segments of the population to absorb the changes in worldview associated with the Enlightenment. The developing world did not, and does not, have that time, and it is being forced to absorb cultural dislocations of a magnitude almost unparalleled in history. At first glance it all seems to be working. Cell phones and other forms of modern technology seem to be readily integrated into developing nations. But absorbing what lies behind that technology is not at all easy.

There is little that can be done to smooth the transition of these cultures to the modern world, since the forces driving the change are not under anyone's control. The transformation of the world economy is a result of what goes under the rubric of "globalization." Beginning with manufacturing, this transformation was made possible by the revolution in communication and transportation over the last few decades—it is now profitable to manufacture goods and transport them to markets from many different locations around the world. As the cost of communications drops, the same is becoming true of services. Globalization is comparable to the industrial revolution in its scope and its impact on the societies of the world. And it is no more controlled by individual corporations than the industrial revolution was by the barons of that age. Globalization is a historical process made possible by the evolution of modern technology. And while the world as a whole may ultimately benefit, the transitions may be difficult and painful for many people, as was the case during the industrial revolution. The problem is that many may not have time to adapt.

The Human Condition: Past & Present

The human condition, however one may choose to interpret the phrase, has clearly changed over the last 10,000 years. Perhaps most transformative was the discovery of agriculture and the domestication of animals. With that came the first hierarchical societies, with their unequal division of wealth, their power to protect that wealth, and the accompanying social divisions. Whatever the type of hierarchical society, be it authoritarian, democratic, or socialist, some people—given the inevitable distribution of capabilities mentioned above—will end up at the bottom of the social structure. This is what is captured in the popular phrase, "the poor will always be with us." That was true of the first great river civilizations and it has been true ever since—the inevitable consequence of converting to a hierarchical society after the development of agriculture, aggravated by perceived "scarcity" (a term whose meaning depends on context).

How the poor, as well as most of the rest of any society, actually live depends on the technology of the time—using "technology" in its broadest sense—and the economic structure that determines how the wealth is shared. As discussed earlier, all wealth is in

the end based on agriculture; the more efficient the agriculture, the more people are freed to do other things.

A given type of agriculture can only feed so many people per acre. The small-plot farming still practiced throughout much of the world is very limited in the population it can support: the small holdings make it economically difficult to employ anything other than human and animal labor, and good roads and food-storage facilities are generally absent or very limited. In the past this was not as big a problem as it is today, with population increase forcing further division of the land, the global agricultural economy encouraging the use of land for growing products for export, and central governments subsidizing the use of foodstuffs for fuel.

And here we come to a very sensitive topic. The introduction by the developed world of basic sanitation and medical practice into the developing world, without compensating changes in cultural norms, has led to a rapid and unsustainable increase in population. Even in much of Africa or countries like India or China, where poor sanitation and quality of drinking water often lead to the spread of disease and parasites, the population has increased beyond what current agricultural practice can support.

Today some wealthy countries believe they can increase their populations beyond their own food producing capability and import the rest. But this is only viable so long as they have the foreign exchange and there is somewhere to import the food from. It is one thing to import luxury or out-of-season foods, it is quite another to have to import basic grains in order to survive.

Africa is the poster child for famine. Yet even in the worst of the African famines there is food, often enough for the population to survive on, but availability is another issue. As poor conditions cause a decrease in the food supply the price goes up, and, out of fear of future scarcity, food may be hoarded. The rich don't starve. Famine is inextricably linked to poverty. And that is an economic and developmental problem. One classic example comes, not from Africa, although there are many there, but from Bangladesh. In

1974 many people died from famine, although there was more food that year than in the previous one. Past experience with shortages, and the possibility of future ones, convinced those with food to hoard it until the price went up.

The Human Condition and the 21st Century

Today we face a looming, serious crisis. Unless a massive, coordinated, worldwide reform is undertaken, the conditions under which humans live is going to deteriorate dramatically over the next forty years or so. The global population is projected to reach some nine billion by 2050. There is currently no hope of providing a decent standard of living in 2050 for even the majority of people unless the non-western world resolves its problem of poor governance, changes its agricultural practices, and invests massively in food science and production, in energy sources, and in international regulatory structures. Our current economic and political structures, both in the west and globally, are not up to the task.

The hope has been that, as people become richer and don't have to depend on their children for labor and old age security, it will be in their own interest to have fewer children. While this has been true in the western world, such economic arguments are suspect in that they exclude widely different cultural and religious factors. But even if true, it all depends on timing: can development outpace population growth so that the standard of living actually increases for the poor? If not, population growth in the underdeveloped world will indeed moderate—but by the usual means: famine, disease, and epidemics, from which the rest of the world will not necessarily be safe.

The world is fully capable of supporting 10 billion people at a good standard of living. But if that comes to pass, it would be the first time in human history that cultural, religious, and sectarian divisions were overridden to do what is necessary. We also have the means to produce the food, goods, and energy needed for such a large population, and to do it without destroying the environment through overfishing the oceans, polluting the atmosphere by burning vast amounts of fossil fuels (particularly coal), polluting the water with industrial waste, or destroying aquifers and farmland with poor farming practices.

Although we lack the necessary economic and political structures, as well as the will, to make it happen, the technology is there. For success, cultures will have to change quickly, and reason will have to inform policy decisions—although, given the reality of the human condition, it is hard to see how reason will prevail any time soon. Yet, if we are to be able to provide a decent standard of living for the majority of people in this twenty-first century, we must restructure our woefully inadequate domestic and global economic and political structures so as to transcend the constraints set by the current human condition. Unfortunately, these constraints cannot be expected to change significantly in the next hundred years.

Consider what we face with ocean-fishing practices. Ten thousand years ago, before the advent of agriculture, humanity lived by hunting and gathering. To a large extent we still do that in the ocean, and, just as humanity killed off the mega-fauna, we are destroying ocean fisheries by overexploitation and habitat destruction—the polite term is "fisheries collapse." The response, for the most part, has been nothing but talk about fishery management, with little by way of worldwide enforcement, although there have been a few success stories. The ocean is a prime example of what is known as the "tragedy of the commons." We need to introduce ocean farming methods that are sustainable. Current industrial aquaculture is limited in scope, and, rather than benefiting wild fish, may be contributing to declines in ocean fisheries and their supporting ecosystems. The ocean has enormous future potential as a source of food for humanity, the role it has played for thousands of years, but that promise will soon be lost unless the fishing industry worldwide eliminates its destructive practices.

Nuclear Energy

Now we turn to the need for energy and how to get it. In the United States, about 50% of the electricity is generated by burning coal. Currently something like 24,000 excess deaths per year are caused by coal-plant emissions—mainly oxides of sulfur and nitrogen. Here's an example of a coal-caused disaster in the not-too-distant past: In London in 1952, a temperature inversion that prevented the dispersal of the emissions

from burning coal caused an estimated 12,000 deaths, and some 100,000 fell ill. This event led the U.K.'s Clean Air Act of 1956.

Much of the public views nuclear energy with apprehension, stemming partially from fear that routine radioactive emissions are a health hazard. Little known, however, is the fact that coal plants emit more radioactivity than nuclear plants—even when 95% of the fly ash is precipitated. This is mostly radium, whose radioactive lifetime is far longer than the gases occasionally emitted by nuclear plants. Neither the radium nor radioactive gases are at a level that would pose a danger to the public—but if there were reason to fear such low-level radiation, coal plants should be the first to be eliminated, not nuclear.

Another interesting fact is that there are trace quantities of uranium in the fly ash, and there is more potential energy in that uranium than comes from burning the coal. It has been seriously suggested that extracting that uranium would be commercially feasible.

The only long-term alternative to coal for producing base-load electricity is nuclear power—but currently that option is largely off the table, at least in the west. The reason has nothing to do with safety or environmental impact. Nuclear power has a much better safety record than natural gas, and it has a very much smaller environmental impact. In comparison with coal, the amount of real waste is negligible. And, as shown in our December 2005 *Scientific American* article titled *Smarter Use of Nuclear Waste*, 95 percent of what is called "waste" today is really used fuel that can be recycled into advanced reactors that can use almost 99 percent of the energy in the mined uranium, rather than the less-than-one-percent that we get today. And with those advanced reactors, nuclear power is inexhaustible. Yet, primarily because of the negative coverage of the subject by the main-stream media, much of the public is afraid of nuclear, not coal, for generating electricity.

To support the claimed advantages of nuclear power, an example is in order—and there are many. Consider Fukushima. There were something like 20,000 deaths and another 25,000 injured by the tsunami, which also destroyed just over a million buildings. Yet,

once the tsunami retreated, all we heard about from the media for weeks on end was the nuclear "disaster"—although not one person died or was sickened as a result of radiation released from the accident, nor are any delayed casualties expected.

While the nuclear component of the Fukushima event did cause some precautionary and largely unnecessary displacement and tragic social disruption, it was nothing in comparison with the tsunami. The scare approach used by the media might have been useful for gaining attention, but it served the public interest very, very poorly.

As we move away from using coal as a source of electricity, which we ultimately must do for environmental reasons, there are other sources of energy to be considered, including very large reserves of natural gas and shale oil. Also wind and solar. But none of these is suitable for base-load electricity. Even the large quantities of natural gas in known reserves that have now become available would not last long if they were to be used for base-load electricity. Shale oil, of which the reserves in the United States alone are comparable to the oil reserves in Saudi Arabia, will become available when the market guarantees a minimal price that's high enough to justify the needed investment—but even that will not last forever, and both mining and end use have an appreciable environmental impact.

Solar and wind are inadequate because of efficiency limitations, intermittency, and cost. Although there are niche applications and regions where solar and wind can play economically significant roles, it is hard to see how they could realistically supply the energy needed, for example, to produce aluminum, steel, or cement, or to power increased electrically driven transportation. In the end it will be a choice between coal and nuclear, and nuclear is the only truly inexhaustible and environmentally benign source of electricity and heat that we have for large-scale centralized production of energy.

There is another factor. While the dire predictions from those who worry about global warming may be exaggerated, it is nevertheless true that the continued burning of fossil

fuels will ultimately have a significant effect on climate. Over the last 570 million years, known as the Phanerozoic eon, carbon dioxide concentrations below 500 ppmv (parts per million by volume) are associated with the two longest-lasting glaciations of the earth. One occurred during the Permo-Carboniferous some 300 million years ago, and other during the Cenozoic era, in which we are now living. Cool climates are found to be associated with carbon dioxide concentrations below 1000 ppmv, while no cool periods have been associated with concentrations above 1000 ppmv. Current concentration is about 390 ppmv, so continued burning of fossil fuels might have an upside. We are approaching the end of an interglacial period, and higher carbon dioxide concentration might be good rather than bad, because it may moderate the slide into a new ice age over the next few thousand years.

Automation and Education

In addition to the looming shortages of food, energy, and fresh water, perhaps the greatest problem we and other developed nations of the world will face in the next few decades is the coming revolution in automation. Many of the average, routine jobs will soon be permanently eliminated, in both manufacturing and services. Knowledge workers will increasingly be affected as well. This will lead to a dramatic increase in productivity, but also to fewer jobs, especially for those with limited education. Already, more than half of America's recent college graduates are either unemployed or working in a job that doesn't require a bachelor's degree. There will certainly be jobs for the best and the brightest in this century, and for some others there will be jobs that cannot by their very nature be automated over this time scale—but what about all the rest? In the United States we are already on a collision course.

Companies operating in the US are complaining that they cannot find qualified workers and are forced to look outside for their needs. Donovan A. McFarlane, writing in the *Journal of Business Studies Quarterly* on the current state of education, states that,

> "There is still a high rate of dropout among 16-24 year old students in high schools and colleges in the United States. Furthermore, 33% of children in California are projected to never finish high school; the educational careers of 25 to 40 percent of American children are imperiled because they do not read well

> enough, quickly enough, or easily enough; since 1983, more than 10 million Americans have reached the 12th grade without having learned to read at a basic level, and in the same period more than 6 million Americans dropped out of high school altogether; 50 percent of the nation's unemployed youth age 16-21 are functionally illiterate, with virtually no prospects of obtaining good jobs; 44 million adults in the United States cannot read well enough to read a simple story to a child; more than 20 percent of adults read at or below a fifth-grade level—far below the level needed to earn a living wage; *nearly half of America's adults are poor readers or "functionally illiterate"*; 21 million Americans cannot read at all, 45 million are marginally illiterate and one-fifth of high school graduates cannot read their diplomas; 46% of American adults cannot understand the label on their prescription medicine; and 50 percent of American adults are unable to read an eighth grade level book" [emphasis added].

Why would this be surprising? For years we have neglected real education in preschool, elementary, and high school.

The educational crisis also affects the nature of our democracy and the political process. Many people today are so alienated from politics that they no longer vote, and those who do are increasingly swayed by self-interested media or the winds of an uninformed populism.

Today it is fashionable to blame teachers for the educational problem. And while there are indeed some problems with teachers, the real difficulty is that many of the children they are asked to educate come into school with severe social and mental deficiencies. They come from segments of our society that have profound social pathologies, children who, by the time they enter school at five years of age, have been badly neglected in terms of nutrition, emotional development, self-control, and language acquisition—or worse. Many have been both mentally and physically abused, and will continue to be as they grow up. Even given adequate resources, it would be difficult to help many of these children, due to developmental damage done during their first five years and continued exposure to the abuse that led to their condition in the first place. Others, not so disadvantaged, are molded by far too much exposure to television, by inappropriate

targeting by media, and by popular culture, none of which encourage children to have a real interest in education or its subject matter, or provide them with imagination-capturing role models.

These problems do not exist, in any meaningful sense, for the elite schools and the segment of society they serve. Students entering these schools generally have been given every advantage during the first few years of their life, and the method of instruction and the curriculum are vastly different from what prevails in the troubled public schools. Nor do the elite schools have the burdensome responsibility of educating children from dysfunctional families and pathological social conditions.

In addition to the problems already mentioned, the public schools labor under poor management, uninformed political interference, badly written books, and a poor and counterproductive curriculum. Standards are often lowered to accommodate the poor performance of the unprepared students; worse yet is "teaching to the test," an approach guaranteed to destroy any love of learning students may start out with. Cultural factors often limit what may be taught by imposing careful avoidance of any subjects or concepts that might offend someone's beliefs. The country desperately needs a national curriculum and a move away from standards that promote comprehensive but superficial teaching of any given field at the price of eliminating in-depth learning that might capture a student's imagination. As put by Bruce Alberts, the Editor-in-Chief of *Science*, the textbooks that result from the current approach "are skin-deep and severely flawed. The factoid-filled textbooks that most young U.S. students are assigned for biology class make science seem like gibberish—an unending list of dry, meaningless names and relationships to be memorized." The same might be said for other subjects, such as history and literature.

Better and increased social services to eliminate the social pathologies of many segments of our population would certainly help alleviate part of the educational crisis, and a national curriculum and a change in the approach to teaching would also make a big difference, but these reforms would not likely be adequate to allow many people to earn wages compatible

with a decent quality of life. Many will simply not be able to reach the level of education required for the better paying jobs in the future.

The current crisis in education gives companies an increasing incentive either to automate or to move jobs to other places around the world, when that is cheaper than investing in automation. Because cheap labor can substitute for automation, in much of the developing world the impact of advanced automation will be somewhat slowed. But as the cost of such automation drops, and wage expectations in the developing world rise, those countries will face the same problem as the developed world.

The unpleasant fact is that the current economic model in the United States will not be able to deliver a decent standard of living in the face of advanced automation, distribution, and off-shoring. This means the current trend of increasing concentration of wealth in a small fraction of the population will continue, and is likely to lead to significant social unrest and conflict during the rest of this century. We can expect an increase in personal and domestic service positions, and that may help alleviate the problem but will by no means solve it. We need a new economic model.

What would a new model look like? And even if one is conceived, could it be implemented? Should it follow the European model of wealth redistribution through increased social services? Would a negative income tax solve the problem? Or should the link between jobs and income and health care be broken altogether by guaranteeing both health care and a minimal annual wage, adequate for a decent standard of living? If so, how will social and cultural norms have to change, especially among those receiving the minimum wage, in order to assure increasing educational and cultural levels across succeeding generations and to avoid the pitfalls of dependency and social unrest?

One impediment to solving the problem is the belief that any of these or other approaches would destroy the free-market mechanism and its incentives. In reality, however, the free market was modified long ago. As put by Robert Theobald in his book *Free Men and Free Markets* some fifty years ago,

> "The great Depression of the 1930's forced the final abandonment of the extreme, Adam Smith version of the free-market mechanism. Western governments found that they had to intervene increasingly in the socioeconomic system as it became obvious that the operation of the market, however efficient, would not

> furnish enough employment; public opinion forced action to provide for those who could not find work. However, the abandonment of *complete* reliance on the free-market mechanism did *not* mean the abandonment of a general belief in the free-market mechanism. Governments therefore found themselves compelled to balance two goals: the preservation of the free-market mechanism and the safeguarding of the basis for individual freedom. . . . The fact that many existing policies are designed *either* to support the continuance of the free-market mechanism *or* to protect the individual, has resulted in increasingly polarized fears about the direction in which the socioeconomic system is moving."

Today we still have this polarization, only in a more extreme form. Nevertheless, government spending since World War II has always remained near twenty percent of the economy, to avoid recessions leading to a repeat of the Great Depression—but the only way consensus could be reached to maintain this level was to spend far too much on national security. Notice that today, even though the Cold War is over, spending on defense and intelligence is close to a trillion dollars a year, far beyond what is needed to deal with any credible threat the country faces from terrorism or nuclear proliferation. Even the broader military guarantees, which only the United States can provide worldwide, do not require this level of funding. In the meantime the country's infrastructure has badly deteriorated, and many public services available in most other developed countries are unavailable in the United States. Examples are adequate public transportation, good public schools, childcare, universal health care, and funding for state colleges.

Preconditions for Reversing Current Trends

It is important to realize that anything that would reverse current downward trends and set the stage for solving the worldwide problems we are facing in the 21st century would constitute nothing less than a multifaceted socioeconomic revolution on a global scale. Unfortunately, existing international organizations are incapable of implementing the changes necessary; they simply do not have the authority to do so, and they will not be given it. National sovereignty is the issue.

As mentioned earlier, people generally identify by family, tribe, sect, and religion. An additional identity was added with rise of national states, which originally were ruled by a sovereign who had a divine status, ancient Egypt and Mesopotamia being good examples. In the modern world this identity is often not the primary one. While the divinity of modern

rulers lasted in some countries into the 20th century, today this is generally not the case. What has been retained is the belief in the sovereignty of states, and in many cases the ruler has absolute authority, exercised through some form of oligarchy. The exceptions are primarily in the west, particularly in the United States, where sovereignty is explicitly reserved to the people, who are governed by their consent. Some would argue, however, that the growing disparity in wealth effectively transforms ostensibly democratic states into oligarchies.

It is the retained concept of sovereignty that allows the rulers of states to use military force against their own citizens in an attempt to retain power, the most recent egregious example being Syria; previous ones were the Soviet Union under Stalin and Nazi Germany under Hitler. After the Nuremberg trials an international framework limiting this right was set up by the United States, although it was of little use in the case of the Cultural Revolution in China, or when some two million people were murdered in Cambodia under Pol Pot and the Khmer Rouge in 1975-1979,.

The sovereignty of a state is not limited to internal affairs, but extends outside its boundary unless explicitly limited by treaties—which states have the choice to sign or not to sign. There is nothing limiting a state's right to destroy whole ecosystems within its boundaries, even though that may affect the rest of the world. States have the right to cause pollution that extends globally, and the right to use fishing methods that deplete the world's oceans of stocks and often destroy for centuries their ability to recover. States not signatory to the Nonproliferation Treaty have an absolute right to develop nuclear weapons to threaten other states, a prominent example being North Korea.

International governmental organizations, many of which owe their existence to the United States, are voluntary in nature and are joined by sovereign states because they view participation as being in their self-interest. Such organizations do not have the power to create policies or enforce decisions; consequently what they do is let states pursue their objectives under a global aegis, conferring legitimacy on actions that might not be seen as legitimate if carried out unilaterally.

Most international organizations by themselves lack the power to back up agreements with physical force on a routine basis. Only the UN Security Council can authorize the

exercise of force, which is generally carried out by member States acting pursuant to the UN's authorization.

The procedure for actually getting the UN to the point of using force is deliberately clumsy. The Security Council may only use force pursuant to a well-defined procedure, designed to act as a constraint, involving first negotiation and then economic and other sanctions. At any step, any one of the five permanent members of the Security Council may veto the action.

Such a structure is unsuitable for enforcing, for example, international pollution rules or fishery agreements, even if they are in the long-term interests of all countries; in many countries short term interests will rule. This type of infraction should be enforceable by international police action. Unfortunately, however, there is no effective international police force, because few if any states will voluntarily give up elements of sovereignty, even when it is in their long-term self-interest. If we are to solve the problems facing us in the 21st century, this must change. As a first step, states must, at a minimum, be held responsible for damage done outside their borders, and timely force must be used if they persist in outlawed actions, including such actions within their so-called exclusive economic zones.

There now exists, of course, no structure of law under which such a police force could act, or under which fines or other deterrents could be enforced. And since such a police force would need global reach, it would have to be constituted of military elements contributed by some group of countries. The legal structure would require convening groups of both scientific and legal experts who would not be beholden to the specific countries from which they are delegated. The resulting proposals would have to be approved by the UN and accepted and ratified by the ruling authorities of each member country. It is very unlikely that this could happen soon enough to alter current trends for the 21st century. The sovereign nation states, with their varying levels of development and culture, are not ready to give up anywhere near enough elements of sovereignty to make such a system work.

Conclusion

The challenges before us in the 21st century are primarily a result of uncontrolled population growth, coupled with our inability to change our basic nature or the world's socioeconomic structures fast enough to accommodate the increasing population. This is true globally and in some cases nationally—Egypt and Kenya being current examples of nations in trouble because the population is growing faster than the economy. Continuation of existing global trends will lead to increasing wars, famine, and disease—the mechanisms, unfortunately, that seem destined ultimately to limit the world's population. The developing predicament seems to be an inevitable consequence of the set of characteristics that history has shown to be innate features of the human condition.