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Cast Changes on the Ecological Stage of Earth's Evolutionary Theater

The most notable feature of the history of life on Earth for the past 4 billion years has been change, which is why I used the theater metaphor for this commentary. Earth has had a comparatively stable climate for the past 10,000 years; however, it is changing mostly because of human practices.

Earth has already passed two ecological tipping points – acidification of the oceans and melting of glaciers and ice sheets – both caused by anthropogenic emissions of carbon dioxide resulting from the combustion of fossil fuels. The actions and the results are a Faustian bargain – *Homo sapiens* has accessed more energy than any other of Earth's species, but has not used it wisely. Unwise use has produced unprecedented economic growth and exponential growth of the human population, both of which have had deleterious consequences for the human species and the other life forms with which it shares the planet. Politicians and the general public have considered remedial actions, but no effective remedial actions have emerged to date. Even charismatic species, such as the polar bear, may become extinct or reduced to relic populations of little ecological significance within a single human life span.

Although I once believed in sustainable use of the planet, I no longer do. However, under circumstances far different from those characteristic of the early 21st century, I still believe sustainable use might be possible. How should humankind respond if present conditions persist until the middle of the 21st century?

If the human species is truly a part of nature – not apart from it – it should remember that species extinction is a continual process, although impressive species losses did occur during the five great extinctions, followed by dramatic rediversification over evolutionary time. Humans have greatly exceeded Earth's carrying capacity for them, and severe consequences unrelentingly have occurred for any species that exceeded its carrying capacity.

I mourn the loss of ecosystems that I enjoyed throughout the 20th century. The fossil records show that these ecosystems will probably be replaced over evolutionary time by other, quite different, but ecologically unique, ecosystems. Even so, humankind has a moral and ethical responsibility to protect the biosphere in every way possible. If humankind does indeed have a reverence for life, then acting morally and responsibly is the only possible course of action. However, if humankind fails, as E. O. Wilson states it, the result will be another roll of Darwin's dice. In short, humankind should neither hasten evolutionary processes nor impede them.

Earth as a Dynamic, Pulsing System

Even humans with an above average life span have only witnessed a minuscule fragment of life's ecological play. Most of humanity has not acquired a global perspective, and, in the United States, a Gallup Poll taken on the anniversary of Charles Darwin's birthday found fewer than 4 in 10 Americans believe in evolution (Gilgoff 2009). The numbers shrink further when Americans are asked if they believe in Darwin's theory of natural selection – Gallup puts that number at 14%, while the Pew Research Center puts it at 26% (Gilgoff 2009). Evolution is the primary unifying concept in the biological sciences and a central concept for all the sciences. Gilgoff (2009) notes that the strongest predictor of respondents' views on evolution is church attendance. Pitting religious beliefs against science is not healthy for either religion or science, and it distorts the objectivity in using scientific information to make decisions on avoiding ecological catastrophes.

Critics of Charles Darwin miss the excitement of the drama continually unfolding in the metaphor of the ecological stage in Earth's evolutionary theater. Humankind is not spectators but part of the cast, even though it acts more like a spectator than part of the evolutionary play.

Ehrlich and Ehrlich (2009, p. 64) remark: "Four decades of largely ignored population growth and related issues – especially patterns of rising consumption and their environmental effects – . . . make collapse now seem ever more likely and possibly sooner than even many pessimists think." Some prestigious organizations and people have examined the basic drawbacks of exponential population growth. They note that the most serious flaw has been too much optimism about the future. Of course, global heating has not received much attention in the past nor were endocrine disruptors even on the horizon.

Two factors make the situation worse than it was 40 years ago: (1) all global problems are interactive, making simultaneous multiple tipping points a real possibility, (2) events are moving much faster than even scientists expected. Exponential growth and positive feedback loops could easily account for changes in rate processes. Many scientists (e.g., James Hansen 2009) and some political figures (e.g., Britain's Prince Charles,

Agence France-Presse 2009) are deeply concerned about Earth's fate. Prince Charles, the heir to the British throne, has "warned that today's consumer society comes at an enormous cost to the planet and we must 'face up to the fact' that it was no longer sustainable" (Agence France-Presse 2009). Hansen (2009) remarks: "Failure to achieve the actions needed to stabilize global climate will result in great intergenerational injustice. The young and unborn in both developed and developing countries would bear full consequences of the actions of prior generations. We need to help young people draw attention to this great injustice."

The dynamic, pulsing system that is Earth has had a huge number of species on the ecological stage of the evolutionary theater. Most of them are now extinct (as many as 99%). Extinction is an ongoing process and large numbers of species go extinct between the great extinctions. In short, extinction is the norm, although some species survive for exceptional periods of time. This comment is not intended to justify driving species to an early extinction, but to note that extinctions were the norm before *Homo sapiens* appeared on the "ecological stage."

The numerous global crises should be sounding intellectual alarms almost continuously, but "business as usual" seems to be the common response. The news media obsessively pay major attention to political figures, the death of rock stars, the latest infidelities of politicians, and so on. Attention should be placed on many complex global issues: Is society immune to the ecological stress that other species bear? Does technology protect humankind from endocrine disruptors? Can humankind be confident that all climate change will be benign? Will ocean acidification be reversed by natural forces? Will the processes of evolution be suspended for *Homo sapiens*? Can the damage already done to the biospheric life support system be reversed?

Clear the Stage for Another Act

Suppose the sixth great extinction continues and *Homo sapiens* is one of the unlucky species. An unlucky species may just be reduced to a relic population (James Lovelock speculates a remaining population of about 250 million located somewhere near the Arctic Circle). Paleontology records show that, following a great extinction, the process of evolution produces a new level of biodiversity, sometimes matching the level of species biodiversity that preceded the present one. These species are the components of the new biosphere and, since they are different from their predecessors, they will not function in an identical fashion. Predicting what the next components will be like individually or how favorable they will be to humankind (e.g., atmospheric gas balance) is impossible. Furthermore, most climate change (i.e., post tipping point) is essentially irreversible (Solomon et al. 2009). How incredible that humankind would take such risks!

Reacting to These New Circumstances

From a homocentric viewpoint, horror and despair seem to be probable responses to human extinction. How can these consequences happen to a creative, intelligent species like *Homo sapiens*? It is the dominant species and suddenly seems weak and helpless. Perhaps it lacks perspective to envision 4 billion years of evolution (Ruse and Travis 2009). However, if the human species could envision the consequences, it would be more cautious and respectful of the biosphere. Wilson (as quoted in Ruse and Travis 2009, p. vii) states: "It [*On the Origin of Species* by Charles Darwin] is the masterpiece that first addressed the living world and (with *The Descent of Man* following) humanity's place within it, without reference to any religion or ideology and upon massive scientific evidence provided across successive decades. Its arguments have grown continuously in esteem as the best foundation for human self-understanding and the philosophical guide for human action. . . . The great questions – 'Who are we?' 'Where did we come from?' and 'Why are we here?' – can be answered only, if ever, in the light of scientifically based evolutionary thought."

The history of life on Earth is vast, complex, and intimidating. Still, some points deserve highlighting.
(1) Life on Earth has existed for 4 billion years – *Homo sapiens* has only been present for 160,000-200,000 years.
(2) Natural laws (e.g., limiting factors, carrying capacity) apply to all species – humans are not exempt.
(3) Some species persisted for long periods of time; others did not.
(4) After each great extinction, the process of evolution produced a great diversity of new species, most of which differed considerably from their predecessors.
(5) The process of evolution, as is life itself, is influenced by many random (stochastic) events.
(6) Six of the seven species of the genus *Homo* are now extinct – *Homo sapiens* is the sole surviving species of this genus. Is this situation due to conflicts within the genus or other factors?
(7) *Homo sapiens* has enjoyed many creative accomplishments, such as music, poetry, languages, social organization, literature, technology, and so on. However, other species have many accomplishments, such as

migrating immense distances, complex social systems, extraordinary resource partitioning, adaptation to a wide variety of climate conditions, and so on.

Life Will Continue

Will *Homo sapiens* be one of the many species lost in the sixth great extinction? Lovelock (as quoted by Zaitchik 2009) believes that humans will persist even though billions will suffer and die. Lovelock (2009) believes that humankind has overstressed *Gaia* (his name for the biospheric life support system) and pushed it beyond the point of no return, which will result in a drastic reduction in Earth's carrying capacity for humans. Nevertheless, he hopes that several hundred million humans will survive and preserve a low-carbon civilization and, presumably, a society that nurtures *Gaia*.

My speculations on the future are less optimistic than Lovelock's. Resource wars seem probable, especially if climate change decreases regeneration of natural resources. Add a pandemic disease to the resource wars and millions of refugees, and the social stability needed to preserve the technological components of civilization will be endangered. Of course, if the negotiations in Copenhagen in December 2009 fail to achieve enforceable major reduction in greenhouse gas emissions and if the positive carbon feedback loops worsen, climatic and social disequilibrium seems to be a likely outcome. If this happened, a 3°-6°C increase in global mean temperature appears probable – humankind could probably not cope with this increase. In this case, small tribes of hunter/gatherers are the best outcome to hope for.

Since humankind is the primary cause of the global problems (i.e., climate change, overpopulation, ecological overshoot/excessive consumption, ocean acidification, toxic chemicals), it might have regret but should not weep or wail about its fate. Humans should be pleased, even if life goes on without them. One great satisfaction would be the survival of the human species and another opportunity to develop a harmonious relationship with *Gaia*. If *Homo sapiens* does not survive, it may be that intelligence (as humans define it) does not provide much survival value. *Homo sapiens* was not essential for most of the 4 billion years of life on Earth, and, presumably, life can continue for more billions of years without it.

What to Do Now

Establishing guilt and blame seems to be an unsatisfactory way to spend the remainder of the 21st century. Surely, something can be done to benefit the soon to evolve "cast members" on the ecological stage of the evolutionary theater. By reducing the forcing factors causing the cast change, life could be made easier for the species that will be ancestral to the next cast. "Although Darwinian evolution rejected the Linnaean view of the Great Chain of Being, in which all living organisms were ranged in a God-ordained hierarchy, for Darwin evolution was still progressive, with lower organisms giving way to higher ones. . . . Today's Darwinists prefer the metaphor of the bush, with all currently extant species equally 'evolved.'" (Rose and Rose 2009). From this group, Mother Nature (i.e., natural selection) will determine those species that will form the next biosphere (i.e., *Gaia*). In this case, humankind should not interfere with evolutionary processes. Humans have no idea what future conditions on Earth will be like and are unlikely to choose the "fittest" species for the new conditions. If humankind wishes to preserve "civilization" as human society now defines it, then *Homo sapiens* would have to be given preferential treatment. Have humans done anything to deserve this? The question is rhetorical since Mother Nature (i.e., natural law) selects the fittest.

Conclusions

If human society effectively addresses all five global crises and restricts the global temperature increase to 2°C, civilization may be preserved if a few hundred million humans survive this level of climate change. An increase of 3°C or more will create conditions in which the survival of *Homo sapiens* is problematic. In either case, a new cast will emerge on the ecological stage of the evolutionary theater. That pronouncement should be of some comfort to those with an ecocentric viewpoint, but almost certainly not comforting to those with a homocentric point of view.

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