Creating the Nation's first BioPark

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Letter from the Desk of David Challinor
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In my last month's letter, I described how scientists could plot ancient climates by using ice cores, tree rings and other sources dating back several hundred thousand years right up to the time when humans were evolving. This letter deals with the troublesome aspects of predicting future climates, especially in the temperate northern hemisphere where we all live. There are so many variables which impact on our climate that foresight is difficult at best, but I have heard such exaggerated claims about future disasters that it may be useful to record what we think we know at this point.

A prime example of a dire prediction was told to me by a young person not long ago. She was concerned that the highly publicized destruction of the world's tropical forests would dangerously reduce the amount of oxygen in the atmosphere. I tried to reassure her that to achieve such a significant reduction of oxygen, all the world's forests would not only have to be felled, but would have to be paved over as well to avoid new growth. Even under such extreme conditions, the surfaces of oceans and lakes are home to a rich soup of minute plants called phytoplankton, which probably produce the bulk of the globe's oxygen. We are dealing with such vast scales in studying the oxygen balance of the earth that it is hard to be precise.

There is no question that most life thrives on earth because it is enclosed in a thin atmospheric envelope which is about 20% oxygen at sea level. The rest of the atmosphere is virtually all nitrogen; all other gases comprise less than 1% of the total. It must have taken a couple of billion years (the earth is about four billion years old) for the earliest photosynthetic organisms to evolve and produce enough oxygen to raise the ancient atmosphere to the current oxygen levels. Scientists are still not clear how this was achieved because it is hard to explain how these early organisms survived before there was enough oxygen in the atmosphere to form ozone to shield them on the earth's surface from ultra-violet radiation. Such radiation would normally be lethal to most surface life as we know it today.

Nonetheless, while the atmosphere was becoming oxygenated, other organisms evolved to breathe it as an energy source. Today the world's oxygen balance is maintained by plants, which absorb carbon dioxide. Through a complicated photochemical process called photosynthesis, plants take in carbon from the carbon dioxide, and with the addition of water and sunlight, convert the carbon to carbohydrates. These carbohydrates, in turn, are changed to sugars and other compounds which are key to plant growth. I have drastically simplified this process, but the

important point to remember is that plants, and of course trees, absorb carbon dioxide and release oxygen. Mammals and other air breathers do the opposite; they take in oxygen and release carbon dioxide. More carbon dioxide is being released by ever more humans exhaling, but this amount of carbon dioxide is trivial compared to that released into the atmosphere by human activities such as cooking, heating and air conditioning, transportation, carbon fuel power generation, etc.

The rapid increase in carbon dioxide concentration in the atmosphere is a relatively recent phenomenon (since the 1950's) and is primarily caused by burning solid (coal) and liquid (oil and gas) fuels. Computer models indicate that when the carbon dioxide content of the atmosphere doubles during the next century, the earth's climate might become warmer on the average by 5°F. I must stress that these are not hard predictions. Nonetheless, during this century there have been measurable climatic changes. Hanson and his colleagues at NASA's Institute for Space Studies have found that global warming is greatest in the winter and least in the summer. Further evidence indicates that warming is greater at night than during the day.

If these conditions continue to develop, we can expect more frequent weather extremes such as droughts and their concomitant fires, and rainstorms causing floods. Such natural disasters will affect more people than they do now as human populations continue to grow and occupy more marginal land, such as flood plains and hillsides.

What can be done to mitigate the effect of these weather extremes on human beings? Global population control is the most obvious answer, and with the increasing empowerment of women, rates of increase in population growth are declining in many countries. The two facets of life-empowerment of women and decreasing population growth go hand in hand. More modest energy consumption is another solution, but so far that has been politically unlikely, especially in the U.S. which is the greatest contributor to carbon dioxide in the atmosphere. Although we account for only 5% of the world's population, we consume around 2/3's of the world's energy to maintain our lifestyle. We have become so addicted to our way of living that even a relatively modest BTU tax to reduce energy use and furnish federal income was successfully defeated by well-organized lobbyists from a handful of industries. There is at least one bright spot for the future: the Montreal Protocols call for a phasing out of the production of chlorofluorocarbons (CFC's) in the next ten years. They are the second greatest contributor to the greenhouse effect after carbon dioxide.

Because the threat of significant climatic changes from increased warming seems so far in the future, it is hard politically to take more vigorous action now. Even if only some of the predictions prove to be accurate, the changes are likely to occur at a rate faster than the vegetation can handle. For example, the present vast boreal (northern) forests of Canada and Russia are composed of trees and plants that have evolved over millennia. The migration north of less cold-tolerant tree species will fall far behind what will likely be a vast vacant niche of dead or dying spruce-fir forests, unable to adapt to significantly warmer winter and nighttime temperatures. We do not really know exactly what the effects of the warming trend will be, but because it seems to be triggered primarily by humans, we do have a responsibility to mitigate the dangers. Concern for the future environment is being increasingly manifested, especially in the Eastern Block countries of Europe where industrial pollution was officially tolerated for decades to achieve maximum production. Environmental concern is politically acceptable in almost all cultures today, and grass-roots efforts, such as tree plantings, to control environmental degradation have proliferated. Such activity is spreading, particularly in the tropics where trees grow rapidly and lead to favorable changes in soil nutrient quality, control of erosion, and other amenities.

Trees seem to be an even greater "carbon sink" (a source for storing carbon) than originally thought. Wofsey and his colleagues at Harvard recently found that carbon uptake in a Massachusetts forest was about a third greater than had previously been calculated in global carbon exchange models. This is good news, but it is important to remember that this uptake occurred in a vigorously growing forest that is recovering from a massive blowdown caused by the 1938 New England hurricane. The more actively growing the forest, the greater the carbon uptake. Over-mature forests with slow growing or dying trees release more carbon than they accumulate.

The trade-offs are clear. The world may be indeed a living organism as the supporters of Gaia theory propose. We are part of life on a very delicately balanced structure. We cannot practically move elsewhere and thus are stuck here. If succeeding generations are to survive and live in a style even remotely approaching ours, we must acknowledge the risk of global warming in whatever form it may ultimately manifest itself and be prepared to confront some of the myriad consequences to human well-being as we have known it.

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