

Letter from the Desk of David Challinor
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A decade ago two of my letters (January and November 1996) considered global warming and the future of potable water resources, respectively. The two topics are closely related and I pondered what, if any, change in the public's perception of these two issues had occurred during this interval. My first impression was not much, despite an impressive accumulation of evidence—both scientific and anecdotal—on both warming trends and increases in hurricane ferocity. Further thought, however, has modified my initial reaction, and now I detect a small shift in public attitude away from the *laissez faire* proclivity of our current administration. This letter will consider examples of this shift in views towards global warming and infinite potable water availability.

To summarize briefly, mean global temperature has slowly cooled since the earth began about 4 ½ billion years ago. Gases then rising from the earth's surface created a relatively thin atmospheric veneer (seven or eight miles thick) that trapped the escaping heat to keep our planet warm. However, fluctuating levels of what we call greenhouse gases today have influenced change in mean global temperatures. The spread of forests in the evolving earth absorbed CO₂, but as forest trees matured and died from disease or fire, CO₂ was also released in the atmosphere. At the same time, methane, also an odorless greenhouse gas, was accumulating underground as a result of bacterial metabolic activity. Accumulation of methane below ocean bottoms can be enormous and is released irregularly, sometimes spaced by millions of years. One such massive release occurred about 55 million years ago and with methane saturating the atmosphere, global surface temperature rose by 10°F or more, thereby triggering mass extinctions of those organisms that could not adapt quickly enough. Since then, the planet has gradually cooled and the plants and animals that once occupied Antarctica were displaced by an enormous ice cap that, along with that of Greenland's, locks up two-thirds of earth's potable water. Ice caps and glaciers have waxed and waned in cycles of roughly 10,000 years; these are caused by many factors, including the earth's wobbling solar orbit, which alters the sun's angle at the poles thus affecting ice accumulation.

Greenhouse gas concentration, however, seems always to have been an important component of determining global temperature cycles. Composition and density of methane and CO₂ in the distant past is calculated by analyzing air bubbles in the ice that lies deep below a glacier's surface. The Pleistocene era of dynamic continental glaciers in the northern hemisphere ended 12 to 13,000 years ago and since 7 or 8 thousand years ago, global climate has not changed much. Many would argue that this long-benign climate that we still enjoy allowed *Homo sapiens* to blossom and become, arguably, the world's dominant organism. Today we are starting to pay the price of our extraordinary evolutionary "success." The delicate equilibrium between the natural release of stored carbon into the atmosphere and its entrapment and storage in carbon sinks of oceanic

phytoplankton and terrestrial forests has now been overwhelmed by human-generated release of CO₂ from the profligate burning of fossil fuels, by methane released from livestock and other sources, as well as from oxides of nitrogen and sulphur from jet engines into the stratosphere.

So many dire predictions, however, have failed to materialize—why should we worry about climate change? Many will remember the Club of Rome's 1972 book *The Limits to Growth* that postulated economic disaster from the perceived unsustainable use of raw materials; humans were using up the globe's stored resources so fast that economic disaster was predicted within a few decades. It turned out that not only were underground resources greater than realized, but that we are still ignorant of how much might yet be retrieved.

Climate change, however, is a loaded issue and quite a different one from that considered by the Club of Rome. Only thirty years ago even experts could not agree on whether the earth was warming or cooling. Early computer models in the mid-1970's were somewhat ambiguous, although they did indicate that a doubling of atmospheric CO₂ would raise global mean temperature about 5°F. Then as modeling techniques improved, climate scientists resolved to issue quinquennial reports and their third one (2001) was alarming. Their concern with the increasing evidence from their evermore sophisticated models of rapid global warming was buttressed by a stream of scientific reports of retreating glaciers, oceanic salinity declines from larger volumes of melt water, earlier plant blossoming and northward migration of both fauna and flora. Few can still argue against the accumulating evidence, and yet the U.S., Australia, Monaco and Lichtenstein are the last four nations still unwilling to sign the Kyoto Protocol. Its weaknesses are evident and its goals are over-optimistic, but it is at least a start. A global consensus to take action is what is important. The future climate of the globe as we have known it is being threatened with significant change. The U.S. can no longer thwart the concerns of the rest of the globe by refusing to sign not only the Kyoto Protocol, but the Nuclear Non-Proliferation Treaty and the global agreement to ban land mines, whose victims are more often innocent civilians than military. How long can we be intransigent?

We have the technology to reduce anthropogenic CO₂ emissions fairly rapidly—within a few decades—even without a significant loss of lifestyle, if only there is sufficient political will. Economic incentives by the federal and state governments are necessary, but only political pressure can bring about such a change. France has already started to reduce emissions with more than half the country's electricity generated by nuclear power. The risks associated with this energy source are well-known, but I think they can be significantly controlled once political agreement is reached on the storage of spent fuel. Sweden and Finland are close to achieving acceptable safe storage. Despite the insistence of the current administration that our paramount position in the world is still dependent on oil and, as many citizens believe, the huge cost of our enormous military presence in the Middle East is justified to ensure our access to that energy source, other citizens, with little help from the federal government, have taken alternate energy initiatives on their own. *The New York Times* (3/13/06, p.A21) had a

half-page article on Maple Ridge Wind Farm about 35 miles east of Lake Ontario. It is already the largest alternative energy project east of the Mississippi. Next summer 75 more wind turbines will be added to the 120 already operating. This twelve-mile-long line of turbines, when fully operational, will generate a total of 320 megawatts of pollution-free electricity—about the same amount as a mid-sized conventional power plant. Prevailing westerly winds off the lake furnish the energy. Although some people consider the towering turbines unsightly (compared to an oil rig or power plant smokestack?), dairy farmers in this part of economically strapped rural New York are delighted with the five to ten thousand dollar annual lease fees that each turbine generates for the landowner.

Although wind-generating capacity has tripled in the United States over the past five years, it still supplies only less than one percent of our electricity, in contrast to Denmark where twenty percent is furnished from this source. Clearly, we have a way to go, but progress in reducing greenhouse gas emissions will not approach a critical rate until enough Americans, the greatest contributors of CO₂ to the atmosphere (about one-quarter of the world's total), take serious steps towards cutting emissions.

Why should we be so concerned? Within the past month the evidence has been pouring in about melting of the Arctic and Antarctic ice sheets. Between April 2002 and August 2005, the latter shrank by more than 150 cubic kilometers (about 32 cu. mi.) annually or enough to raise the world's sea level by .4mm yearly. For the second year in a row Arctic Ocean sea ice has failed to cover its normal winter range. For the northern hemisphere, where the bulk of the globe's people live, this could be more serious than the Antarctic melting because the climate of heavily populated northeastern Europe is kept relatively mild by the pumping action of the great ocean current conveyor belt (see June 1998 *Letter from the Desk of...*). The transfer of ocean heat (generated by the current's passage through the Atlantic's equatorial belt) to the European atmosphere would cease if the conveyor belt was interrupted. Dilution of the hypersaline water south of Greenland by massive fresh water inflow to the north Atlantic from melting Arctic ice would slow or stop its sinking and interfere with the pumping action that has maintained Europe's mild climate since the last ice age. Many oceanographers worry that such a "shut down" might occur in decades once a tipping point is reached, rather than the centuries that had heretofore been considered. Once the "shutting down" started, there would probably be no way to stop it.

Elsewhere on the globe, increased warming and population pressure have exacerbated the problems of fresh water distribution. Year-long droughts in the Texas panhandle have triggered uncontrolled prairie wildfires this spring despite this area once overlaying the huge Ogallala aquifer, now virtually depleted from excessive crop irrigation. In Arizona, the area around Phoenix went for over 140 days without measurable rain and the city's water supply was stretched to the limit. Mexico City, initially built on a shallow lake, can no longer furnish running water to all its 20 million citizens (*The New York Times*, 3/16/06), but has to truck it into its low income neighborhoods.

There are solutions and perhaps the easiest is reducing consumption by raising prices or rationing water distribution in the cities. In rural areas the advent of inexpensive gasoline-powered pumps is rapidly lowering the aquifer levels with the result that more water is pumped out than is being recharged. In India, where much of the heavy monsoon rain floods out to sea, isolated patches of fertile green are appearing in Gujarat (a state north of Bombay) where farmers have joined a series of ponds, called tanks, to catch monsoon rains. As the highest tank becomes full, it overflows into the next tank and so on down the line. By thus trapping the rain, it has time to soak into the ground to replenish the water table. Where initiated, the process has been rewardingly successful. A similar effort has succeeded near Mexico City where local farmers restored a part of the ancient Aztec Lake Texcoco.

All is certainly not lost. Human initiative is virtually limitless and with concentrated effort and strong incentives, such threats as global plague, yellow fever, polio, etc. have been controlled or eliminated. Current threats such as AIDS, avian flu, and even cancer and malaria are being battled with some successes. As a fortunate grandfather of six healthy and loving grandchildren, I worry about the conditions in which they will live their adult lives. The optimist in me says they will make it fine, but still—I worry.

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