Creating the Nation's first BioPark

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Letter from the Desk of David Challinor
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My last two letters have discussed the earth's climate, a subject of intense interest because of the way it affects our daily lives. This summer in North America has produced record heat in the mid-Atlantic states and New England, extreme drought in the southeast, and record rainfall in the upper midwest. What does it all mean? The reasons for such anomalies are ambiguous, and although we know that the jet stream is flowing further south than usual in the upper midwest and is thus wringing rain from the moisture-laden air moving up from the Gulf, we really don't know all the reasons why the jet stream flow pattern can vary so much. Our partial knowledge gives little comfort to the flooded inhabitants of the midwest, but even if we truly understood jet stream dynamics, there is probably little we could do to change it.

New technologies such as coring the Greenland ice cap have, however, supported evidence that the climate has changed much more abruptly in the past than it appears to be doing today. By analyzing oxygen isotopes in bubbles of air trapped hundreds of thousands of years ago in the Greenland ice cap, scientists can correlate oxygen isotope types with temperature. Heretofore we had assumed that global warming or cooling was a relatively gradual process with average temperature changing 5° to 8°F over periods of about one century. Current evidence indicates that changes of this magnitude have happened recently in less than a decade. Such rapid variation gives inadequate time for many plants and animals to adapt to new climatic conditions, but there have always been species that live across a wide spectrum of climates. Mountain lions, for example, range from northern British Columbia to Patagonia. Even some tree species have remarkable north-south ranges such as Sweetgum which grows naturally from northern Connecticut south to central Honduras. Although certain individual tree and animal species adapt to varying conditions better than others, those with narrow habitat requirements often disappear. Humans, of course, are one of the most adaptable mammal species because of their ability to clothe and house themselves under such a variety of climatic conditions.

Although our interest in climate is triggered primarily by how it affects our lifestyle, we ought to consider carefully the conflicting evidence on whether the earth is warming as rapidly as has been reported. The evidence is conflicting because there are two principal ways of measuring global temperature. The most obvious one is to read thermometers in as many places as possible. Think, however, about what that action involves. A thermometer is relatively accurate and inexpensive, but it takes someone to mount it and to record the readings periodically.

Most thermometers are located where people are, which in turn means they are convenient to houses, offices, airports, research labs, etc. Thus readings are biased because thermometers are primarily located in manmade heat islands. Of course there are weather stations scattered around the globe and even on ships at sea, but these sites are relatively few and scattered compared to others near man's habitats.

Remember that 3/4's of the globe is ocean, and relative to land reports, weather conditions at sea are covered closely only at widely scattered sites. Most terrestrial temperature readings are made near the ground which may further bias their tendency to report a warming trend, which is indeed the conclusion of continuous ground temperature records for the past 35 years.

Countering these ground temperature records are the results of 15 years of temperature readings by earth orbiting satellites, which survey the Earth's surface several times a day. These satellites measure and record the radiation from oxygen in the first 20,000' above the surface. As the oxygen in this layer warms, it increases its radiation. The advantage of satellite measurement is that it covers the entire planet, even the oceans. This benefit, however, is offset by the fact that the temperature being reported is the average temperature of this 20,000-foot-deep band of air, rather than the actual ground temperature where people are. The satellite data has not yet indicated a warming trend. In fact this data source has shown that this past June and the previous 19 months have all been cooler than the average for the previous decade.

What are we to conclude? First, the two measuring techniques are quite different and may thus explain the warming trend discrepancy, although if the global temperature is truly becoming warmer, as many atmospheric scientists predict, because of the rapid gain of CO_2 emissions, then this temperature gain should also be recorded by the satellite readings. As it has not yet done so, we can only assume that although it may be warming at ground level, the same trend has not yet been observed a few miles up in our atmosphere.

Despite this as yet unexplained discrepancy, most atmospheric scientists agree that increasing CO_2 emissions will certainly better the odds of the Earth being subjected to a greenhouse effect. The satellite monitoring will clearly have to continue for several more decades to spot such a trend. Other anomalies will also have to be resolved.

If the two ways of measuring global air temperature seem to be at odds, the results of measuring ocean water temperatures are even more conflicting. The National Oceans and Atmospheric Administration has data to show that the oceans cooled during the decade of the 1980's, but a similar agency in England reported that their data indicated that the oceans warmed during the same period.

The principal conclusion to draw from these conflicting results is that the meteorological dynamics of the globe are still so great and complicated that scientists have yet to develop a fully satisfactory model to explain what is happening. Knowledge gaps are being rapidly filled, but unforeseen side effects of CO_2 will almost surely increase global warming and have a great effect on plant growth. Scientists at the University of Michigan grew aspen cuttings under controlled conditions in which CO_2 levels were twice as high as normal. Not only did these aspen grow faster than the controls, but the increased carbon from carbon dioxide that entered the potted soil triggered a rapid build-up of soil microbes. This increase in turn expanded available nitrogen. The nitrogen that is normally unavailable to plants in soil organic matter is converted to nitrates and ammonia which are immediately absorbed by growing roots. At the end of this year-long experiment, the photosynthesis rate doubled, the weight of dried roots was 50% heavier, and the carbon and nitrogen levels in the soil were 1-1/2 to almost 2 times as great as the plants grown under ambient CO_2 levels. The next step is to extend the experimental time to three years to see if these short-term gains can be sustained.

From all this information you can see that there is still a great deal to learn about our changing climate. Global weather can change as rapidly as we have found evidence of it doing in the past. Such change may not necessarily be disastrous, but it will require a true test of human cultural and physical flexibility for us to survive and prosper.

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