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*CO₂ and the Biosphere:
The Incredible Legacy of the
Industrial Revolution*

Dr. Sherwood B. Idso

Research Physicist

U.S. Water Conservation Laboratory

Agricultural Research Service

U.S. Department of Agriculture

Phoenix, AZ

Introductions H.H. Cheng
Head, Department of Soil, Water, & Climate

Family Introductions Gerald Kuehn

Introduction of Speaker Donald G. Baker
Professor, Department of Soil, Water, & Climate

Keynote Speaker Sherwood B. Idso

Results from hundreds of laboratory and field experiments demonstrate that increasing the carbon dioxide content of the air helps plants grow faster, bigger and more profusely. A large body of data also indicates that the percentage growth enhancement due to atmospheric CO₂ enrichment is generally greater when plants are subjected to various environmental stresses, or when essential resources such as light, water or nutrients are less than adequate for optimal growth. It has additionally been observed that there is typically no decline in the growth-enhancing effects of elevated levels of atmospheric CO₂ when plants are grown for long periods of time in natural settings out-of-doors; and it appears that the growth rates of trees and shrubs are generally more responsive to increases in the air's CO₂ content than are the growth rates of herbaceous plants. These experimental observations suggest three things that should have occurred as the air's CO₂ content rose in tandem with the burning of fossil fuels that powered the engines of the Industrial Revolution. First, there should have been concurrent increases in the growth rates of nearly all of earth's plants. Second, trees and shrubs should have gained a competitive advantage over non-woody vegetation. And third, as the rate of rise of the air's CO₂ content has accelerated over the past few decades, so also should these biospheric changes have been greatest in recent years. Numerous studies have produced three impressive pillars of support for this "greening of the earth" scenario. First, they reveal the existence of a worldwide invasion of grasslands by trees and shrubs that began approximately two centuries ago and has closely followed the upward trend in the air's CO₂ content. Second, they demonstrate that the growth rates of many forests around the globe have increased concurrently, with the past few decades exhibiting the greatest responses. And third, they indicate that the amplitude of the seasonal oscillation of the air's CO₂ concentration -- which is driven primarily by the metabolic activity of the terrestrial biota -- has risen hand in hand with the air's CO₂ content over the past three and a half decades, thereby demonstrating that the vitality of the entire biosphere has also risen hand in hand with the air's CO₂ content over this period. Scores of ecosystem studies reveal two other pertinent facts. First, with increasing productivity, ecosystems typically produce a more diverse flora that supports greater populations of herbivores and other animals. Second, with the increased plant turnover rates that appear to be a common consequence of vegetative stimulation, ecosystem detrital mass generally declines. Consequently, as the air's CO₂ content rises, enhancing plant biodiversity, productivity and turnover rates, there is a significant transfer of organic carbon from earth's non-living reservoir, where most of it currently resides, to the living portion that animates the planet. It may confidently be concluded, therefore, that as the air's CO₂ content and the deposition of anthropogenically-produced nitrogen and other nutrients have risen in phase with the industrial development of the past two centuries, so also, as a direct consequence of those phenomena, has the vitality of earth's biosphere increased, where man has not damaged it directly by overt actions, such as deforestation or localized pollution. Hence, there is reason to believe that if the direct ecosystem impacts of our mechanized society can be managed successfully, we can indeed live in harmony with nature. In fact, the CO₂ emitted by our energy-consuming activities can actually enhance both the quantity and quality of life on earth.
