

## Stratospheric Ozone Doubts

In March 1988, the Ozone Trends Panel, in a dramatic Washington press conference, announced evidence of global depletion of the stratospheric ozone layer. Such a depletion had long been anticipated as the result of the expected increase of chlorine in the stratosphere; the announced depletion, however, was several times greater than had been calculated from the CFC-ozone theory (R.A. Kerr, 1988).

Since the original announcement, the depletion trend hypothesis has had to contend with two major problems: the quality of the data, and the proper elimination of the natural ozone variability that contributes to the 'noisiness' of the record. Unlike the Antarctic ozone 'hole', the reality of *global* ozone depletion is still disputed (Muer & Backer, 1992; Singer, 1993). It was expected that a depletion of ozone would be accompanied by a corresponding increase in the UV-B portion of the solar spectrum (280–320 nanometers), which is subject to absorption by ozone. But up until now there has been no experimental evidence for an upward trend in UV-B (Scotto *et al.*, 1988) reaching the Earth.

The 12 November 1993 issue of *Science* featured a paper by two Canadian researchers, James B. Kerr & Thomas McElroy, entitled 'Evidence for large upward trends of Ultraviolet-B radiation linked to ozone depletion.' The abstract of the paper mentions a trend as large as 35% per year between 1989 and 1993 (for winter data at 300 nm) (J.B. Kerr & McElroy, 1993). *Science* even issued a news release before the paper appeared. It seemed to many that the 'smoking gun' had at last been found. In interviews, a number of well-known scientists endorsed the Kerr-McElroy paper: for example, F. Sherwood Rowland, co-Author of the CFC-ozone depletion theory, enthused: 'Now we have good data to point to.' (Rowland, 1993).

*Science* reporter Tim Appenzeller quotes me as commenting (before the paper appeared) that 'assuming Kerr & McElroy's UV-B increase is real, the ozone losses and the UV-B rise might have resulted from an unusual combination of natural causes, including the volcano [Pinatubo]. Four years of measurements isn't enough to establish a trend.' (Appenzeller, 1993). This judgment has turned out to be correct. Closer examination of the published paper revealed that the 'smoking gun' was mostly smoke. The paper shows no error bars. The reported 'trends' are based on increases that took place only towards the end of the record, while the startling winter increase of 35% is based on just four high readings, out of more than 300, in late March of 1993. These were undoubtedly connected to a severe weather disturbance — the 'storm of the century' — that swept over eastern North America at that time (Michaels *et al.*, 1994). The Authors had confused a short-lived increase with a long-term trend.

This experience illustrates the difficulty of extracting trends from a short-time record of a geophysical quantity, be it UV-B, ozone, temperature, precipitation, etc. One fully expects to see some decrease in global ozone, particularly if stratospheric chlorine levels rise. In spite of absorption from many other causes besides ozone, one would also expect a long-term rise in UV-B. But one must maintain perspective on these matters: the UV-B rise by the next century is predicted at only 10%, equivalent to moving just 100 kilometres towards the Equator (WMO, 1991).

I conclude that policies should not be applied too hastily and might well benefit from a firmer science base. Furthermore, policies should be flexibly constructed so as to accommodate a science base that inevitably undergoes change as new discoveries are made. A case in point is the recent discovery that melanoma is induced by UV radiation of wavelength greater than 320 nanometers, a region of the solar spectrum not absorbed by ozone and thus unaffected by any ozone depletion (Setlow *et al.*, 1993). While lip-service is often paid to those principles, in practice they are outweighed by the precautionary principle ('We must act now, even if we are not sure that this policy will do us any good') or by the 'public choice' paradigm ('Policies self-reinforce and entrench themselves as they build up constituencies'). The unfortunate outcome may be an unconscionable waste of resources, a consequent loss of public trust, and a real setback to the environmental effort.

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## GUEST COMMENT

### The New Environmental Determinism

In the last few years, particularly with the collapse of communist regimes in Eastern Europe, much has been made of the so-called 'new world order'. This, Alistair Cook (BBC radio) recently referred to as 'new world disorder' because of the many internecine and intranecine battles that are currently razing *inter alia* much of the former Soviet Union, its satellites, and what was Yugoslavia, to rubble. Resource destruction and the creation of refugees go hand-in-hand to bring about disorder, in stark contrast to the comparatively rigid system that obtained pre-1989. The scene changes as life's drama is played on the world stage. However, there are other but no less significant ways of destroying resources and engendering refugees. Alterations to The Biosphere are a case in point. These have the potential of creating disorder on a grand scale in both society and the biota.

Recent news from the Mauna Loa observatory in Hawaii should allay any doubts there may be about the rapidity with which Earth's surface (including atmosphere) processes react to perturbation. It should also serve as a warning to governments world-wide. The continuous monitoring at Mauna Loa, since 1958, of atmospheric carbon dioxide concentrations, indicates an apparent decline in the growth-rate of anthropogenic emissions of the gas. However, this news is tempered by the fact that actual anthropogenic emissions of carbon dioxide have not in the least decreased. The apparent decline seems likely to be due to changing flux-rates between the various pools of carbon — particularly those in living matter, the atmosphere, and the ocean (Sarmiento, 1993). Indeed, the reason why such changes should occur may well be connected to the eruption of Mount Pinatubo in 1991, possibly *via* iron enrichment of the oceans by the volcano's ejecta. That a single, albeit substantial, event in Earth history could affect atmospheric composition to such an extent makes the living world of The Biosphere appear fragile and vulnerable on one hand, and remarkably dynamic on the other. This same dynamism and fragility are apparent in the terrestrial, ocean-sediment, and ice-core, records of the last 2 million years. Moreover, even politicians and policymakers are becoming increasingly aware of the role of heat-trapping gases in the atmosphere and the social implications of global warming.

#### *The Old Environmental Determinism*

Charles Darwin's discourses on evolution in the middle 1800s spawned many new and reformulated ideas on the relationship between society and its environment. One of these was *environmental determinism*, the basis of which is that Nature, particularly climate, is the most important arbitrator of Biosphere characteristics and processes. Several important contributions to the natural sciences were influenced by this notion of climatic control as well as elements of dynamism. The geographical cycle of William M. Davis (1850–1934), for example, which is concerned with landscape development, invokes an idealized landscape beginning with mountain uplift and terminating in lowland plains. Another example is that of Frederick E. Clements' (1874–1945), and others, theory of vegetation succession and climax. This envisages the progressive development of vegetation communities until a climax community is established which is in equilibrium with the prevailing climate. In addition, environmental determinism, under the title of social Darwinism, was considered to be a fundamental control on human activities. Such ideas, however, had fallen out of fashion by the 1950s when the focus shifted to the apparent ability of human economic and social development to 'overcome' the forces of Nature. Nevertheless, as a philosophy, environmental determinism contains much to commend it: covertly, it embodies the concept of The Biosphere and society as mutually dependent parts of an environmental system — a relationship termed 'the noosphere' by the Russian scientist V.I. Vernadsky. Implicit is the idea that the relationship could be self-perpetuating or self-destroying. Thus it contrasts with a notion of dualism, a construct dating from Classical times. *Dualism* separates people and place and bestows pre-eminence on people who, it claims, have an absolute right to tame Nature for society's ends.