

This is a physicist's book. Lliboutry tries to discuss the physical processes behind the major geodynamic phenomena and to show that many popular theories have fairly weak bases. This often leads him to propose new ideas or hypotheses, sometimes controversial and based on his own prejudices; for example, he insists on a high  $10^{25}$  P viscosity lower mantle against most recent evidence.

In detail, I have found many points where I disagree and a few that are simply not correct. For example, his summary on the present evidence on the viscosity of the lower mantle is biased and does not do justice to the work of Peltier and his collaborators (p. 242). There is no Figure 5-13 (p. 52). He considers guyots and seamounts as synonyms (p. 57). He states that the quasi-totality of the earth volcanisms occurs along subduction zones which ignores all the mid-oceanic underwater volcanism (p. 249). He states that most of the sediments in 'eugeosynclinal' series are of deep oceanic basin origin and have been piled up in the subduction zone by accretion, ignoring the importance of locally derived arc sediments (p. 307). He proposes for the Messinian Mediterranean evaporitic layer a deep basin origin and compares 'un peu' its formation to the formation of the present Red Sea hot brines, which is not compatible with recent geologic evidence (p. 323). And, this list is far from exhaustive.

But these are relatively minor points within this well-constructed and highly readable book. To get its flavor, it may be best to quote Lliboutry on geosynclinal terminology which he finds 'confused, useless and dangerous' or on the notion of orogenic cycle, which he attributes 'to the persistence during a long period, of the order of 100 M.Y., where two continents have been colliding, of a thin lithosphere which reaches the plasticity threshold at each orogenic phase.' This is indeed the main conclusion of this book, which integrates in a satisfactory way continental deformation within a broad plate tectonic framework. Its reader progressively realizes that the geodynamic evolution of the surface of the earth is controlled by the mechanical properties of the plates which, unfortunately, are still poorly known, although we do know a great deal more than a few years ago.

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## Causes and Effects of Stratospheric Ozone Reduction: An Update

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Committee on Chemistry and Physics of Ozone Depletion and the Committee on Biological Effects of Increased Solar Ultraviolet Radiation, National Academy Press, Washington, D.C., xi + 339 pp., 1982, \$13.95.

*Reviewed by Guy Brasseur*

In 1976, the National Academy of Sciences released a report entitled *Halocarbons: Effects on Stratospheric Ozone*. The purpose of this study was to evaluate the likely effect of

chlorofluorocarbons (CFC's) on the ozone layer in the atmosphere.

A number of publications on the same subject have been prepared since then by different official bodies (NASA, World Meteorological Organization, European communities, the British government, etc.). The opinions expressed in these reports were not always in agreement and even sharply differed in certain cases.

More recently, at the request of the U.S. EPA and in accordance with the Clean Air Act, as amended in 1979, the National Research Council has provided an assessment of the state of knowledge on ozone depletion and its effects on public health and welfare. The report whose purpose is to assess the most recent scientific information has been published by National Academy Press.

The report is divided into two parts. The first part, prepared by the Committee on Chemistry and Physics of ozone depletion chaired by Charles H. Kruger, Jr., reviews the processes determining the ozone concentration including the perturbations by chlorine, oxides of nitrogen, and other species. It describes the current status of stratospheric models and discusses our ability to detect trends in ozone in relation with any anthropogenic action.

In its conclusion, the first part of the report states that 'if the production of CFCs continues into the future at the rate existing in 1977, the steady state reduction in total ozone, in the absence of other perturbations, would be between 5 and 9 percent.' These numbers are lower than previous estimates, which shows the necessity of updating frequently our knowledge in stratospheric chemistry. The report also indicates that 'on the whole there have been substantial improvements in the agreement between model predictions and observed profiles of trace species.' There are a few exceptions, however, and, since the uncertainties can be hardly quantitatively estimated, it is suggested that 'the discrepancies should be resolved in the future by an orderly application of the scientific method with appropriate interaction between theory and observation.' Finally, the problem of simultaneous perturbations is considered. Ozone may be altered not only by CFCs but also by an increasing emission level of nitrous oxide in association with agricultural practices, disposal of human and animal wastes, and possible combustion. Moreover, the corresponding ozone reduction might be partly offset by the increased concentration of carbon dioxide or methane. It is therefore recommended (1) to maintain a coordinated research program to understand the spatial and temporal distribution of the key trace species including atmospheric observation, laboratory measurements, and theoretical modeling; (2) to monitor ozone, water vapor, and temperature, using both satellite and ground-base systems; and (3) to assess the consequence for stratospheric ozone of the emission in the atmosphere of all relevant gases such as CFCs, and  $\text{CH}_3\text{Cl}$ ,  $\text{CH}_3\text{CCl}_3$ ,  $\text{N}_2\text{O}$ ,  $\text{CO}_2$ , and  $\text{CH}_4$ . Other vehicles such as balloons and aircraft will also contribute to this task.

The text devoted to the chemistry and the physics of ozone depletion is very clear and well written. It is based on six papers provided by six consultants and published as appen-

dixes: (1) Perturbations of the Stratosphere and Ozone Depletion, by R. J. Cicerone; (2) Stratospheric Perturbations—The Role of Dynamics Transport and Climate Changes, by R. E. Dickinson; (3) Recent Developments in Stratospheric Photochemistry, by S. C. Wofsy and J. A. Logan; (4) The Measurement of Trace Reactive Species in the Stratosphere: A Review of Recent Results, by J. G. Anderson; (5) Trend Analysis of Total Ozone, by H. A. Panofsky; and (6) Detection of Trends in the Vertical Distribution of Ozone, by A. B. Pittcock.

The length of the six appendixes is quite disproportional, which reduces the overall coherence of the text. However, these individual contributions are very readable and contain much useful information. The reader particularly interested by these questions should also refer to the report published by WMO and entitled *The Stratosphere 1981: Theory and Measurements*.

The second part of the report is devoted to the biological effects of increased solar ultraviolet radiation. It has been drawn by a committee under the chairmanship of R. B. Setlow. Three topics are covered: (1) molecular and cellular studies, (2) ecosystem effects, and (3) human health effects. It is concluded that DNA is probably the primary target in animal cells for most deleterious effects of UV-B and that the major injury to DNA appears to be the formation of pyrimidine dimers which distort the normal DNA helical structure. Both UV-A and UV-B are also detrimental to plant growth, but the adaptability of plant species appears to be sufficient to maintain food crop yields. UV-B radiation can also damage aquatic organisms, but there is no information to predict the magnitude of such adverse effects.

The relationship between increased solar radiation and the appearance of skin cancers has been widely discussed in recent years since more than 90% of skin cancers other than melanoma seem to be attributable to sunlight. The report states that a 1% increase in UV-B would give a 1–2.5% increase in basal cell skin cancers and a 2–5% increase in squamous cell skin cancers. The appearance of skin melanoma is partly due to sunlight but probably also to other factors. A prediction of enhanced incidence due to increased exposure to UV can therefore not be made. Models of light-induced melanomas are required together with epidemiological studies based on clinical and histological studies.

In summary, the report accomplishes its intended purpose quite well. It should give the policy makers a good assessment of our present knowledge and of the uncertainties on the causes and effects of ozone depletion.

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