Letters

Animal Research: A Choice

Donald J. Barnes (Letters, 19 Aug., p. 888) believes that his position on antivivisectionism is "the most ethical and scientifically innovative . . . " for the human condition. However, his call to place more emphasis on disease prevention through dietary and other life-style changes is hardly innovative. I would be hard pressed to find one scientist who would disagree with that position. As for the anthropocentric ethics in the scientific community regarding vivisectionism, the men in the white coats avoid the use of animals in biomedical research whenever possible. Animals are expensive to maintain.

Despite the highly selective use of data by Barnes that points to the contrary, enormous strides have been made in improving human health through the use of animals. Are we justified in using animals? Do we have the right? This is not much different than asking does a fox have the right to eat chickens or does a chicken have the right to eat corn? Each species is driven to survive. Because we have the ability, mankind has *chosen* not only to survive, but through biomedical research (some involving the use of animals) to survive with as little disease, pain, and suffering as possible. I emphasize the word "chosen" because some day, if antivivisectionism gains favor, society can choose otherwise. The only ethical or moral implications in that decision are those that we, as a species, place on it. To date, society has chosen not only to live, but to live as well as possible. I can live with that.

THOMAS ATHERHOLT
109 West Oak Avenue,
Moorestown, NJ 08057

Global Stratospheric Ozone and UVB Radiation

Joseph Scotto *et al.* (Reports, 12 Feb. 1988, p. 762) present data on the annual average amounts of biologically effective ultraviolet radiation (UVB, 290 to 330 nanometers) for eight geographic locations in the United States. They show that, in general, it has decreased between 1974 and 1985. This result is somewhat surprising in light of published reports based on satellite measurements (*1*), ground-based measurements (*2*), and both (*3*), that global stratospheric ozone may have decreased slightly over the same period. In (*3*) it was concluded from ground-based instrument data that from 1969 to 1986 the annual average ozone had decreased by $1.7 \pm 0.7\%$ in the latitude range from 30° to 39°N and by $3.0 \pm 0.8\%$ in the latitude range from 40° to 52°N. Satellite-based instrument data from 1978 to 1985 yielded a $3.7 \pm 2.0\%$ decrease in the latitude range from 29° to 39°N and $2.7 \pm 1.7\%$ in the latitude range from 39° to 53°N. The authors concluded that "the role of physical and meteorological factors in the troposphere may be greater than expected, and that there may be prevailing conditions that diffuse solar energy and thus reduce the amount of UVB radiation reaching the earth's surface."

A review of the sites listed in Scotto *et al.*'s table 1 leads one to a refinement of their conclusion, namely, that urban pollution is a possible cause of the reduction of UVB at the measurement sites in addition to the effects of ozone. All of the sites appear to be in urban centers where the population has increased since 1974. Several pollutants, including aerosols, nitrogen dioxide, sulfur dioxide, and ozone, can preferentially affect the UVB radiation reaching the surface [see, for example, (*4*) for the ultraviolet spectra and typical concentrations in smog for a number of trace species]. A recent study of 10-year (1973–1982) ozone trends in California and Texas (*5*) indicates that increases in the annual mean of up to several percent per year were observed in several urban centers. While ozone in these cases should be considered more as an indicator of, rather than the cause of, the observed decrease in UVB radiation reaching the ground, the increases indicate the importance of considering the urban pollution. Another study (*6*) indicates that tropospheric ozone may have increased enough in the Northern Hemisphere to compensate for a significant fraction of the decrease in stratospheric ozone. Thus, the role of clouds and aerosols in scattering radiation in the troposphere becomes more important (*7*).

There are at least three ways by which one could separate out the ozone contribution from urban smog. First, one could measure the solar radiation resolved into several spectral bands reaching the same site. That would allow the measurements to be corrected for gaseous species and possibly for the spectral dependence of aerosol extinction. A second way would be to use sites far removed from urban pollution, either at a much higher altitude or geographically remote. Finally, existing air quality monitoring data for each site could be used to help separate out the urban smog contributions.

While the authors have demonstrated that a decrease in global ozone need not necessarily cause an increase in UVB radiation in urban regions, the incomplete analysis of the findings could have serious adverse policy impacts. Politicians and manufacturers might easily point to the findings and state that there is no need to worry about increased skin cancer risks for the majority of Americans (at least those who happen to live in urban centers), so that there is no need to be overly concerned about affecting the ozone layer with chlorofluorocarbons. This result could lead to the idea of replacing the "ozone shield" with the "pollution shield."

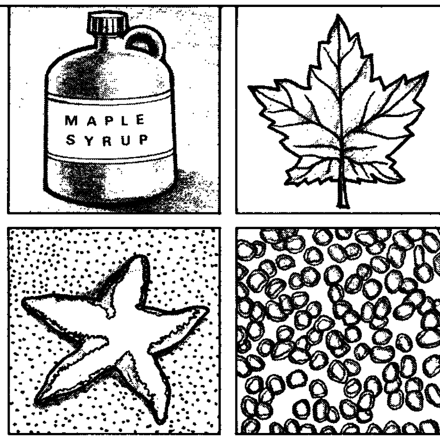
WILLIAM B. GRANT
Jet Propulsion Laboratory,
California Institute of Technology,
Pasadena, CA 91109

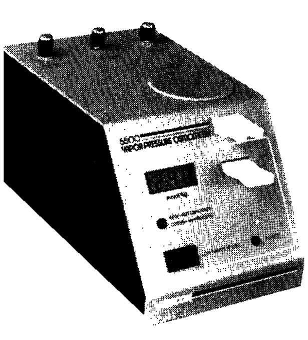
REFERENCES

1. K. P. Bowman, *Science* **239**, 48 (1988); G. C. Reinsel *et al.*, *J. Geophys. Res.* **93**, 1689 (1988).
2. J. K. Angell, *J. Appl. Meteorol.* **27**, 91 (1988).
3. R. T. Watson and Ozone Trends Panel, M. J. Prather and Ad Hoc Theory Panel, and M. J. Kurylo and NASA Panel for Data Evaluation, *Present State of Knowledge of the Upper Atmosphere 1988: An Assessment Report* (NASA RP-1208, NASA Office of Space Science and Applications, National Aeronautics and Space Administration, Washington, DC, August 1988).
4. B. J. Finlayson-Pitts and J. N. Pitts, Jr., *Atmospheric Chemistry: Fundamentals and Experimental Techniques*, (Wiley, New York, 1986).
5. H. M. Walker, *J. Air Pollut. Control Assoc.* **35**, 903 (1985); *ibid.* **36**, 600 (1986).
6. J. A. Logan, *J. Geophys. Res.* **90**, 10463 (1985).
7. J. E. Frederick and D. Lubin, *ibid.* **93**, 3825 (1988).

Response: Grant quotes percentage ozone depletion trends for the north temperate zones that refer to annual averages. The NASA report (*1*) also shows that there is much station to station variability and that the greatest relative changes are found for the winter months, that is, when solar UVB radiation at the earth's surface is at its nadir. Summertime depletion estimates from ground-based Dobson instruments were less than half the amount expected for winter months in the latitudinal range of 40° to 52°N. Thus, for northern geographic locations trends in the annual amount of surface UVB may be more difficult to detect and perhaps negligible over short time periods. Two UVB stations that are also included in the ozone analyses, namely, Bismarck, North Dakota, and Tallahassee, Florida, do not demonstrate compelling ozone trends for the summer months. At the southern location ozone trends for both winter and summer are apparently not significant.

Grant is concerned that atmospheric pollutants may obscure the effects of ozone depletion. Our survey was designed to clarify the amounts and trends of UVB (wavelengths of 290 to 330 nanometers) reaching the earth's surface, thus enabling correlations with the incidence patterns of skin cancer, including melanoma. We share the concern that UVB exposures and skin cancer incidence are likely to increase with further depletion of the ozone layer.





Grant suggests that UVB meters be placed in rural areas far removed from air pollution. Best suited for this purpose is a station in Mauna Loa, Hawaii, which is sparsely populated and lies at 3.4 kilometers above sea level. Preliminary analysis of data from this site shows no apparent increase in UVB radiation from 1974 to 1985. While Mauna Loa is relatively free of urban air pollution, it must be noted that during this same period surface ozone has increased at Mauna Loa (*2*), consistent with the increasing levels of tropospheric ozone observed in other rural areas of the Northern Hemisphere (*3*).

We agree that more research is needed to measure the effects of tropospheric pollution on solar UVB radiation penetrating to the earth's surface. The influence of sulfur dioxide in reducing the erythemal-weighted solar flux at certain urban locations has already been noted (*4*). As data on air pollution, UVB levels, and ozone become available at various locations, it will be important to also take into account air transport, that is, movement of aerosols, cloud cover, and atmospheric pollutants across urban and rural areas. Also useful will be measurements of UVB at several altitudes in different geographic areas. This information, when combined with details of the changes in the vertical distribution of ozone and aerosols, should help us evaluate the impact of atmospheric pollutants that could inhibit the amount of UVB reaching the earth's surface or impair the sensitivity of ultraviolet meters.

JOSEPH SCOTTO
Biostatistics Branch, National Cancer Institute, Bethesda, MD 20892
GERALD COTTON
National Oceanic and Atmospheric Administration, Silver Spring, MD 20910
FREDERICK URBACH
DANIEL BERGER
Health Sciences Center, Temple Unversity, Philadelphia, PA 19140
THOMAS FEARS
Biostatistics Branch, National Cancer Institute

REFERENCES

1. R. T. Watson and Ozone Trends Panel, M. J. Prather and Ad Hoc Theory Panel, and M. J. Kurylo and NASA Panel for Data Evaluation, *Present State of Knowledge of the Upper Atmosphere 1988: An Assessment Report* (NASA RP-1208, NASA Office of Space Science and Applications, National Aeronautics and Space Administration, Washington, DC, August 1988).
2. R. C. Schell and R. M. Rosson, Eds., *Geophysical Monitoring for Climatic Change No. 15: Summary Report 1986* (National Oceanic and Atmospheric Administration, Boulder, CO 1987).
3. A. Volz and D. Kley, *Nature* **332**, 240 (1988).
4. C. S. Zerefos, H. T. Mantis, A. F. Bais, I. C. Ziomas, N. Zoumakis, *Atmos. Ocean* **24**, 292 (1986).