Actinic rays and aerosol sprays

R. M. YOUNGSON

From the Eye Department, Cambridge Military Hospital, Aldershot

Ophthalmologists working in equatorial regions have long been familiar with the syndrome of solar conjunctivo-keratopathy. This condition, which affects only the interpalpebral area of the conjunctiva and cornea, is characterized by chronic discomfort and irritation, hypersensitivity to wind, dust, smoke, and sunlight, chronic conjunctival injection, fleshy protuberant pingueculae, usually containing collections of hyaline material and, in the most advanced cases, progressive pterygia. Individual response to apparently identical environmental influences is extremely variable and it seems likely that the aetiology may involve factors beyond the purely radiational but it is clear that exposure to ultraviolet light (UVL) in the wavelength range of 290 to 300 nm is an indispensable precursor.

A new factor has now arisen which threatens significantly to increase this hazard and possibly to extend the geographical area in which this minor but apparently incurable syndrome may be encountered. It is the purpose of this note to bring the new circumstances to the attention of ophthalmologists.

Ozone is being formed continuously in the stratosphere by the action of sunlight on O_2 molecules. These are split into single atoms which immediately combine with other molecules of O_2 to form ozone O_3 . The concentration of ozone is controlled by the balance between the rate of formation by this process and the rate of its destruction by reaction with other elements. The ozone belt is confined to the stratosphere between 10 and 40 km and is virtually the only absorber of solar ultraviolet radiation of wavelength between 240 and 300 nm.

Attenuation of UVL intensity varies with the angle of incidence of the light on the ozone belt (which is why effects are currently confined largely to the tropical zone) but if the ozone concentration were to be reduced, UVL-induced ocular lesions may be expected to be encountered over a wider area.

The new factor is the growing threat to the ozone layer from the ever-increasing quantities of chlorofluoromethane gases released into the atmosphere, mainly from aerosol sprays. The gases, $CFCl_3$ and CF_2Cl_2 , which are currently being produced world wide, at the rate of about 1 million ton/yr, give rise to free atomic chlorine radicals which act

catalytically on the ozone in the following way:

It will be seen that the atomic chlorine is again released to take part in further catalytic reactions and it has been shown that each free radical can remove thousands of ozone molecules before being itself removed. The chemically inert chlorofluoromethane gases are, currently, largely unaffected by UVL until they diffuse upwards to a height of 30–50 km. This is a slow process and the maximum effect occurs after about a decade.

The tropospheric reservoir of gases will continue to pass these molecules into the stratosphere, the half-life for CF_2Cl_2 removal being about 80 years. Current estimates are of an ozone depletion of around 5 per cent within 10 years from now, giving rise to a sufficient increase in biologically damaging UVL as to cause 40 000 additional cases of skin cancer per year in the USA alone.

In 1971, Lovelock, then at Reading University, detected chlorofluoromethanes in the troposphere over England and subsequently demonstrated the presence of the gases over the north and south Atlantic. Many further measurements of $CFCl_3$ concentrations have now been made (Lovelock, 1974), and by others, including a group from the US Naval Research Laboratory, and these have confirmed not only that the gas is ubiquitous but also that its concentration is rising rapidly. Molina and Rowland (1974) described the threat to the ozone layer.

The matter is being taken seriously by the US Academy of Sciences, which has convened a panel to investigate it. The Consumer Product Safety Commission has been petitioned to declare the chlorofluoromethanes 'hazardous substances' and thus to prohibit their manufacture.

The depletion of the ozone layer would, of course, have very much wider biological implications than simply an increase in solar keratoconjunctivopathy, but if the threat materializes it is likely that ophthalmologists may be among the first to recognize the clinical manifestations. There may be something to be said for being forewarned.

References

- LOVELOCK, J. (1974) *Nature (Lond.)*, **252**, 292
MOLINA, M. J., and ROWLAND, F. S. (1974) *Ibid.*, **249**, 810