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IMPLICATIONS OF EXPECTED CLIMATIC CHANGES ON THE ISLAND OF MALTA

PREDICTED HEALTH PROBLEMS ASSOCIATED WITH CLIMATE CHANGE

by

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INTRODUCTION

The effects of climate on health were already appreciated and commented upon centuries ago. Climate may not only influence somatic conditions but is well known to affect mood as well. The Jewish physician, Rabbi Moshe ben Maimon (Maimonides) born in Cordoba, Moorish Spain, in 1135 and court physician to Saladin, was already well aware of the negative effects which certain climatic aspects had on such respiratory conditions as bronchial asthma. This 'prince of physicians' wrote in Arabic, a treatise on asthma, 'Makalah Pi Alrabo' in 1190 for the benefit of Saladin's son Alfadhel, who was an asthmatic. Amongst other measures, Miamonides recommended a change from the humid air of Alexandria to the dry heat of Cairo (Rosner, 1973). Malta, because of its favourable climate, has often in the past been considered as an ideal place of residence for invalids, especially those suffering from chronic respiratory disorders (Domeier, 1810; Sankey 1893). Man, by tampering with his immediate environment, has frequently affected negatively his own health (Ellul-Micallef & Al Ali, 1984).

EFFECTS OF TEMPERATURE RISE

Possible adverse effects from predicted climatic changes affecting Malta could occur because of the 'greenhouse' effect (Broecker, 1987; Cicerone 1988) and the depletion of the ozone layer (Molina & Rowland, 1974; Farman, Gardener & Shanklin, 1985). Changes in the global atmosphere may occur even sooner than some scientists have predicted and are mainly the result of man's industrial activities over the centuries and the scant regard he has at times paid to the effects resulting from his intimate interactions with his environment. It is immediately obvious that the magnitude of such changes is a function of the world population - still increasing at an alarming rate, the increasing demand for energy, and the clearing of forestland for cultivation by means of burning. The occurance of climatic changes resulting from these activities is now generally accepted. What appears to be still somewhat controversial is the rate at which such changes will occur. This rate of change appears to be related mainly to the ability of the oceans to absorb carbon dioxide, the effect of increased cloud cover as well as the destabilising effects of increasing water vapour, and the melting of polar ice-caps. The latter will result in altering the course of ocean currents and in the elevation of sea levels. Sea-level rise is one of the most disturbing possible consequences of global 'greenhouse' warming. Estimates suggesting that a rise of about 1 metre will occur, by the time of doubling of carbon dioxide and other trace gases in the atmosphere, appear somewhat exaggerated. However, even a 30cm rise will bring about social and economic problems in low lying areas (Meier, 1990).

It has been predicted that there may be a local mean sea-level rise of about 50cm. If this occurs it is to be expected that a number of localities in Malta will suffer inundation and shore line recession, this, together with storm surges may damage our sewage systems. New systems will have to be developed to protect public health against possible flooding of drainage systems. The danger of epidemics of typhoid fever as well as other enteric disorders has to be kept in mind. There will also be increased intrusions of salt water resulting in the spoiling of our ground water aquifers. The negative effect which the lack of a readily available, good and safe water supply will have on human health in these islands hardly needs emphasising.

The majority of computer models predict a global temperature increase of between 1.5 and 4.5EC by the middle of the next century. The main changes will occur at the Poles. This rise in temperature will have an enormous impact on global ecosystems seriously hampering world food production. The worst-case Malta scenario predicts a mean summer temperature rise of 3.5EC. An increased frequency of higher temperatures, especially when combined with spells of high humidity, will put particular population groups at risk from heat stress. The number of deaths during heat waves are known to be especially high amongst the elderly. Infants below 1 year who are known to dehydrate very quickly are also at risk.

Diseases which have so far been confined to the tropics may spread to higher latitudes as global temperatures rise. Insect-borne diseases may well become more widespread, either because the vector will be able to survive better at higher latitudes or because parasites may be able to complete their life-cycle more easily. Temperature increases will lengthen the breeding season and survival rates of a number of insect species, including the Anopheles mosquito. Malaria may reappear in Europe (Grant, 1988).

Leishmaniasis is a zoonotic endemic infection involving dogs in the Mediterranean littoral, its prevalence in dogs varies between 4 to 10 per cent. The disease is spread to man through the bites of female sandflies of the genus Phlebotomus and affects mainly children. This condition which had been well controlled in the recent past, seems to be on the increase once again (Figure 1). An increase in temperature and humidity may well result in increased breeding rates of phlebotomines and an increased incidence of leishmaniasis.

PREDICTED EFFECTS OF OZONE LOSS

Observations from satellite and ground-based instruments appear to indicate that between 1979 and 1990 there have been statistically significant losses of ozone at mid- and high altitudes in the lower stratosphere (WMO/UNEP, 1991). Anthropogenic emissions of chlorofluorocarbons (CFC's) and other halocarbons are thought to be largely responsible for the observed ozone depletions (Rowland & Molena, 1974). Such a loss of stratospheric ozone means that there may well be more harmful ultraviolet radiation (UV-B 290-320mm) at the earth's surface. Of course, on a regional scale, the issue is not so simple, because factors such as tropospheric ozone (Bruhl, 1989), sulphate particles (Liu, 1991) and even cloudiness (Crutzen, 1992) may produce an opposite effect. Until an integrated global network of monitors for ultraviolet radiation is set up, it will not be possible to measure this directly (Crutzen, 1992). It is only recently that it has been possible to estimate in a theoretical manner the intensification of UV-B radiation over the globe due to the measured losses of ozone in the years 1979-1989 (Madronich, 1992).

The greatest relative ozone losses have occurred over the Antarctic, and therefore well away from us. The annual average depletion has been calculated to be around 3 per cent. These calculations have been based on data derived from the satellite-borne Total Ozone Mapping System (TOMS) which integrates the ozone concentrations over the depth of the atmosphere (Stolarski, 1991). For our part of the world, the disquieting news is that limited losses of ozone - but as yet no hole, have also been detected over the Arctic. Reductions in ozone that cannot easily be explained by transport processes seem to have taken place in the Arctic stratosphere during the winter of 1990 (Hoffman & Deshler, 1990). The decreases in ozone mixing ratio reported so far do not dramatically affect total ozone but if a full-blown ozone hole does occur here as well, it may of course slide south to affect densely populated areas of Europe including our islands (Kerr, 1992).

The precise relationship between UV-B intensity near the ground and the amount of ozone in the stratosphere and troposphere is still to be determined. The potential impacts of increased UV-B radiation arising from ozone depletion appear to be all negative ones. Effects on terrestrial vegetation as well as on marine organisms are likely to result in reduced food supplies because UV-B radiation is known to reduce a plant's photosynthetic activity. Similarly, increased UV-B radiation may result in a reduction in the productivity of phytoplankton with dramatic negative effects on the marine ecosystems.

Much has been written about the potential direct impact upon human health resulting from increased UV-B radiation. The lack of data on doses of UV-B radiation received, not just in Malta , but worldwide, prevents the carrying out of a proper quantitative study on sound epidemiological lines, of the effects on human health of increased UV-B radiation. It is only comparatively recently that the dangers associated with prolonged over-exposure to sunlight have started to be appreciated by the average man in the street. Increased UV- B radiation is likely to result in a higher incidence of skin malignancies, of ocular damage as well as of immunological disturbances.

Exposure to UV light appears to be closely linked to the aetiology of non-melanoma skin cancer (Russell Jones, 1987; Mackie, Elwood and Hawk, 1987; Mackie, 1988; Urbach, 1989; Crosby, 1990). It has recently been predicted that an ozone depletion of 1 per cent will result in an increase in the incidence of basal cell carcinomas of 1.6-2.1 per cent and of squamous cell carcinoma of 1.3-1.7 per cent (Moan, Dahlbeck, Henriksen and Magnus, 1989). Unfortunately non- melanoma skin cancer is very infrequently recorded in cancer registers worldwide. At least, the serious public health implications of these malignancies, particularly in terms of morbidity and expense, are being appreciated. Increased recreational sun exposure, when combined with possible ozone layer depletion is a growing cause for concern. An increasing incidence of skin cancer, resulting from this exposure, has been reported in Europe (Henriksen, Dahlbeck, Larsen and Moan, 1990; Staelhelin, Blumthaler, Ambach and Torhorst) in North America (Urbach, 1989) as well as in Australia and New Zealand (Giles, Marks and Foley, 1988, McKenzie and Elwood, 1990). Figure 2 shows the incidence of skin cancer in Malta over the past 12 years.

The relationship between UV exposure and melanoma, the other form of cutaneous malignancy, is far more complex (Loggie and Eddy, 1988; Lee, 1989). Of the four clinicopathological types of this skin malignancy, only lentigo maligna melanoma appears to be directly related to cumulative UV exposure, but the other types of melanoma may also, in some ways, be affected by UV light. There seems to be a consistent inverse relationship between the incidence of melanoma and latitude. Accurate predictions are difficult to establish, but it seems reasonable to suggest that further rises in melanoma incidence will be among the first biological effects seen with ozone depletion. Empirically derived relationships between UV-B exposure and the incidence of cutaneous melanoma predict that a 1 per cent depletion of ozone will result in an increase of 1-2 per cent in melanoma incidence (Longstreth, 1988).

Most of the available evidence suggests that nucleic acids (DNA) are the primary targets for UV radiation. The principal epidermal DNA photoproducts are pyrimidine dimers (eg thymine dimers). An action spectrum for the frequency of pyrimidine dimer formation induced in the DNA of human skin per unit dose of UV incident on the skin surface has been recently determined (Freeman et al, 1989). The peak of this action spectrum is near 300nm and decreases rapidly at both longer and shorter wavelengths. It appears that chronic exposure to UV irradiation and a high total cumulative dose may be less deleterious than are periodic bursts of large amounts of sun exposure (Ross and Carter, 1989). This would appear to be of particular relevance to fair-skinned tourists visiting Malta during the summer months.

Exposure to increased ultraviolet radiation will be expected to cause a higher incidence of cases with impaired vision as a result of damage inflicted to the cornea and the lens. Studies carried out by UNEP and WHO have estimated that for every 1 per cent decrease in stratospheric ozone, there will be between 0.3-0.6 per cent increase in cataracts. Ozone changes of the order predicted would be expected to have a negligible effect on the amounts of solar radiation reaching the retina (Charman, 1990).

A far less well understood phenomenon is the effect of UV-B radiation on the human immune system. In experimental animals, exposure to UV-B radiation is known to produce selective alterations of immune function, mainly in the form of suppression of normal immune responses (Morison, 1989). This immune suppression may be important in the development of non-melanoma skin cancer, may influence the development and course of infectious disease and possibly protects against autoimmune disorders. The evidence that such immune suppression occurs in humans is less compelling and somewhat incomplete. However, it is a well accepted fact that UV- light, possibly through DNA damage, is an important precipitating factor in the autoimmune condition, systemic lupus erythematosus.

CONCLUSION

A new awareness of man's fundamental reliance on the integrity of the world's ecosystems and the need for a change in his way of life and his use of energy resources is now a matter of some urgency. Man's interaction with his environment may otherwise lead to changing patterns of disease. The costs in terms of human suffering are likely to be considerable. To quote Seneca, 'Animum debes mutare non caeleum'.

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