

Disease and the Environment in Britain

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It is hardly necessary to define 'disease' in the company of physicians but the term 'environment' should be clarified as it suggests different things to different people. To the meteorologist it means the atmosphere, the gaseous envelope that surrounds the earth. To the environmental engineer, concerned with heating and ventilation, it usually means the atmosphere in an enclosed space. Environment, to the ecologist, is synonymous with the habitat or home within which plants and animals live. Historically the term has been frequently associated with sanitation. Such views as to what constitutes environment are restricted. Rather does the term embrace the totality of external influences, natural and man-made, that impinge on man and affect his well-being. Thus, environment embraces the life support systems—air, water, food and shelter—and also the multiplicity of stimuli and hazards, direct and indirect, that man experiences. This, the external environment (nurture), stands in contrast with man's internal environment (nature) which relates to an individual's biological system or genetic make-up. Problems of health and disease are invariably expressions of the effect of nurture on nature, of the external environment on the genetic apparatus. And this is no less true in the twentieth century than it was in the fourth century when, in *On Airs, Waters and Places*, Hippocrates wrote:

'... Whoever wishes to investigate medicine properly should proceed thus—In the first place to consider the seasons of the year and what effect each of them produces (for they are not at all alike but differ much from themselves in regard to their changes). Then the wind, the hot and the cold such as are common to all countries and then such as are peculiar to each locality. We must also consider the qualities of the waters for as they differ from one another in taste and weight so also do they differ much more in their qualities. In the same manner when one comes to a city to which he is a stranger he should consider its situation. How it lies as to the wind and the rising sun for its influence is not the same whether it lies to the North or the South, to the rising or to the setting sun. These things one should consider most attentively and concerning the waters which the inhabitants use whether they may be marshy or soft or hard and running from elevated and

rocky situations, and then if saltish and unfit for cooking and the ground whether it be naked and deficient in water or wooded and well watered and whether it lies in a hollow confined situation or if elevated and cold, and the mode in which the inhabitants live and what are their pursuits. Whether they are fond of drinking and eating to excess and given to indolence or are fond of exercise and labour and not given to excess in eating and drinking.

From these things he must proceed to investigate everything else for if one knows all things well or at least the greater part of them he cannot miss knowing when he comes into a strange city either the diseases peculiar to the place or the particular nature of common diseases so that he will not be in doubt as to the treatment of the diseases or common mistakes as is likely to be the case provided one had not previously considered these matters. And in particular, as the seasons and the year advance he can tell what epidemic diseases will attack the city, either in summer or in winter, and what each individual will be in danger of experiencing from the changed regimen, for knowing the change of the seasons, the risings and settings of the stars, how each of them takes place, he will be able to know beforehand what sort of year is going to ensue. Having made these investigations and knowing beforehand the seasons such a man must be acquainted with each bit and must succeed in the provision of health and would be by no means unsuccessful in the practice of his art, and if it shall be thought that these things belong rather to meteorology it will be admitted on second thought that astronomy contributes not a little but a very great deal indeed to medicine for with the seasons the digestive organs of man undergo a change. . . .’

If, as the World Health Organisation claims, health is ‘a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity’ it represents a balanced relationship of body, mind and environment, or body-mind harmony within an environment. Disease, on the other hand, reflects imbalance, a lack of harmony between the body-mind complex and its external environment. It is a response conditioned by the genetic make-up or internal environment of the individual. The internal environment of healthy human organisms remains essentially constant even when the external environment fluctuates widely.

What environmental influences or stimuli are there in Britain which are likely to prejudice health? Space permits consideration of only a severely restricted selection of examples which may be categorised as (a) physical, (b) human, and (c) biological.

PHYSICAL ENVIRONMENT

Over the ages weather and climate have been postulated as influencing, either favourably or unfavourably, man's well-being. The problem is to isolate such components as solar radiation, air movement, moisture, etc., which have direct and/or specific influences on man. Take, for instance, solar radiation. This includes cosmic rays, gamma rays, X-rays, ultra-violet rays, luminous rays and infra-red rays. Prolonged exposure to radiations can induce skin burns, cancers, genetic mutations and other biological changes (Fig. 1).

The effects of temperature on the human body are largely a matter of

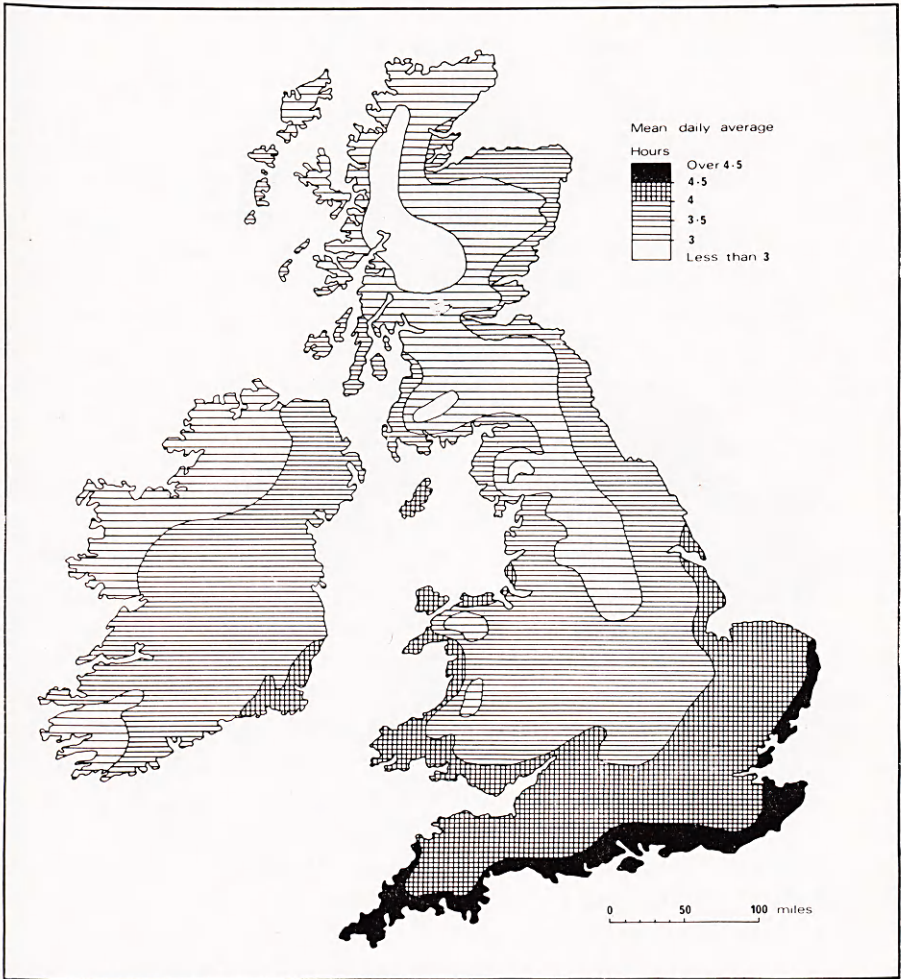


Fig. 1. Average number of hours of bright sunshine per day in the British Isles (based on Meteorological Office data).

metabolism and respiratory function. Because internal heat generated by metabolic functions must be dissipated, any impediment to heat loss such as occurs with the high temperatures of tropical heat can depress body functions, lower general vitality, and predispose a person to infectious disease. Conversely, greater ease of body-heat loss associated with the lower temperatures of temperate latitudes directly stimulates vitality and quickens body functions. Minimum metabolism is observed at 20°C to 25°C. Below 20°C and above 25°C there is a tendency to increased metabolic rate. The only certain prediction is that extremes of heat and cold are definitely harmful, and that

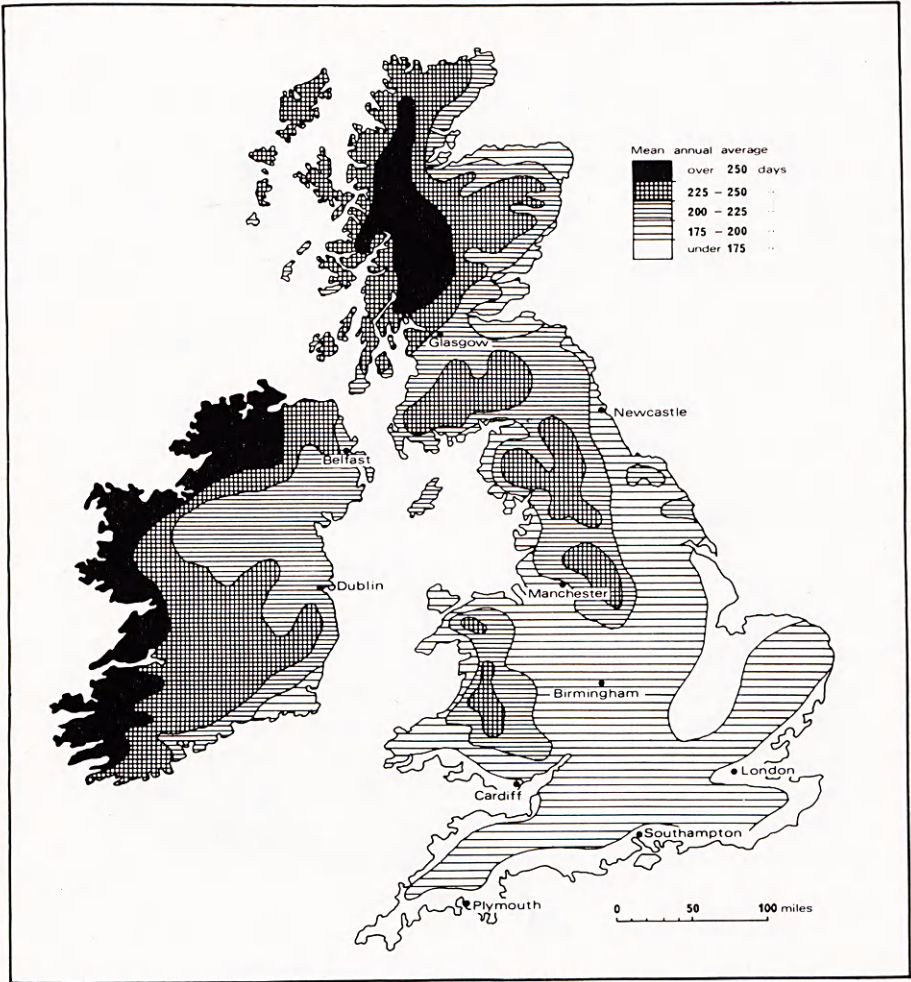


Fig. 2. Mean annual average of days with rain in the British Isles—days on which 0.25 mm or 0.01 inch or more of rain is recorded (based on Meteorological Office data).

moderately hot conditions increase susceptibility to intestinal diseases and moderately cold conditions increase susceptibility to respiratory diseases. Injury produced by excessive heat includes prickly heat, tropical neurasthenia, heat exhaustion and heat stroke, but these are rare in Britain. Cold injury includes chilblains, frost bite and hypothermia.

'Windchill', a term used to describe the cooling effects of air movement and low temperature (the dry convective power of the atmosphere) is a good measure of about 80 per cent of total body heat loss. Thus, windchill correlates more closely with sensations of cold than does crude temperature. The chilling produced by a 45 mile/hr (72 k/hr) wind at $+20^{\circ}\text{F}$ (-7°C) is about the same as that of a wind moving at 5 mile/hr (8 k/hr) with a temperature of -20°F (-30°C).

British winters are commonly associated with an increase in upper respiratory infections. Cold and lack of natural light curtail many forms of outdoor recreation and there is the tendency for people to crowd together more in places of public entertainment. Natural ventilation in such places, and indeed in the home, factory, office, train and bus, is frequently reduced to conserve heat, and at the same time there is a tendency to excessive central or artificial heating. Conditions of crowding, under-ventilation and overheating are particularly favourable for droplet infections.

Mean annual rainfall in Britain is highest over the north and west of the country. The number of days with rain is also greater in these areas (Fig. 2). Popular opinion holds that dampness increases individual susceptibility to infection, but volunteers at the Cold Research Unit in Salisbury sitting in draughty passages and wearing damp clothing have been none the worse for the experience. Rheumatic disorders in their several manifestations have long been associated both by the general public and the medical profession with dampness and sudden change of temperature.

The qualities that make some parts of the country 'relaxing' and others 'bracing' are not well understood. Wind, humidity and temperature are probably involved, though the frequency of weather changes locally is another consideration. The main factor in a relaxing or sedative climate is probably the moist equable west or southwest winds from the Atlantic (Fig. 3).

Rocks, together with their overlying soils, may have anomalous trace-element contents. The essential trace elements are more important in the nutrition of man than their organic micro-nutrient counterparts, the vitamins. The former cannot be synthesised as can the vitamins but must be present in the environment within a relatively narrow range of concentration. Trace-element deficiencies and excesses both kill. Soils derive their trace elements from the parent rock, and from applied fertilisers, agricultural dusts and sprays. They

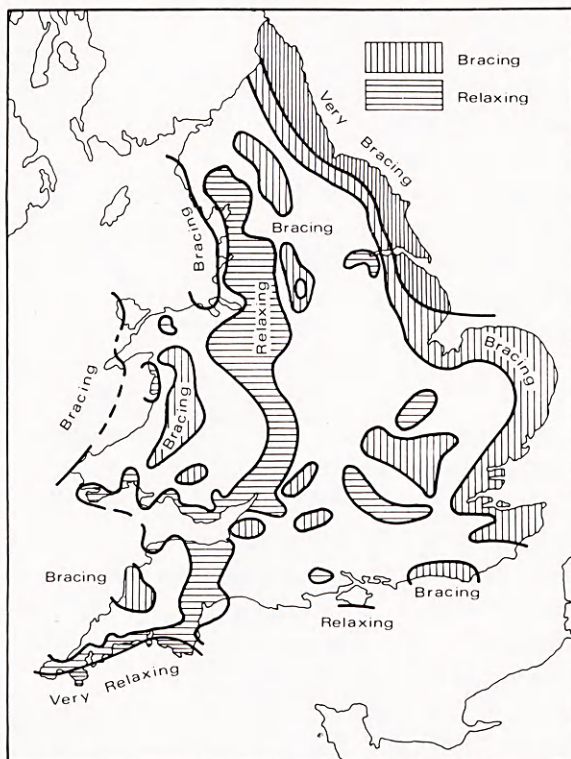


Fig. 3. Bracing and relaxing climates in England and Wales (based on Brooks, 1954).

pass on their trace-element characteristics to vegetable matter growing on them. Vegetable matter used as food may thus repeat the trace-element peculiarities of the soil and of the parent geological material. An excess of mercury, lead, cadmium and selenium, whether eaten in vegetable matter or animal food, can seriously affect health. Deficiencies of, for example, copper, iron, manganese, zinc, iodine, fluorine, cobalt and molybdenum may give rise to nutritional problems. A deficiency of iodine leading to goitre is well known (Fig. 4). Fluorine, as fluoride, occurring in concentrations above 5 ppm can lead to bizarre sclerosis, followed by fixation, crippling arthritis and sometimes paraplegia, far beyond the mild effects of the mottling of permanent teeth noted when concentrations exceed 2 ppm.

Cardiovascular mortality is thought to be inversely correlated with hardness, or more specifically with the calcium content of the water supply. A study (Crawford *et al.*, 1968) found more atherosclerosis in man in Glasgow

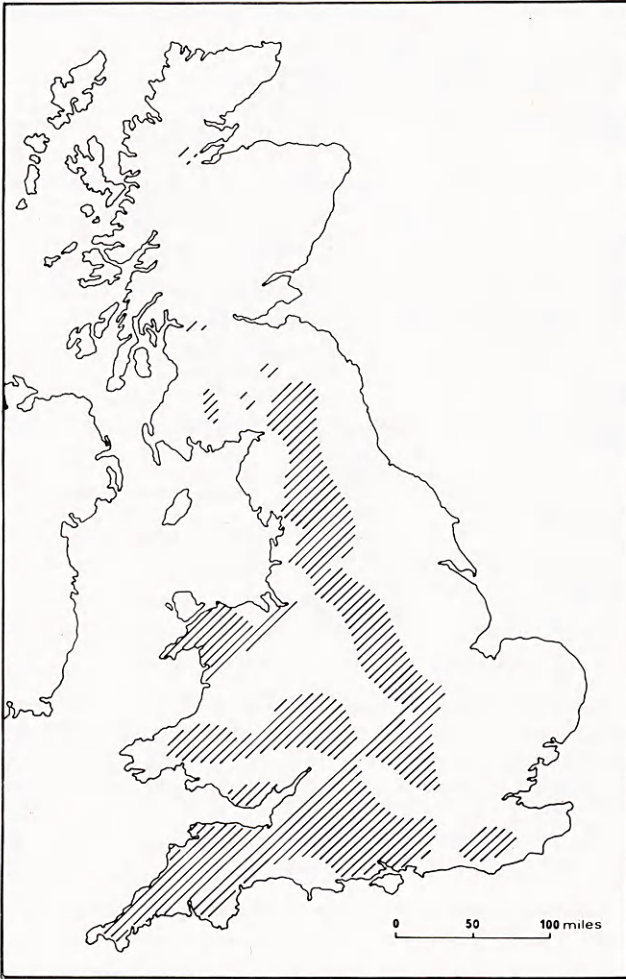


Fig. 4. Areas in Britain where endemic goitre has been found (after WHO, 1960).

with its soft water supply than in London with a hard water supply. And yet a detailed local investigation within Glasgow (Howe, 1968) revealed that some wards within the city had mortality experience from ischaemic heart disease 20 per cent or more *below* the UK average (Fig. 5).

HUMAN ENVIRONMENT

The human, or socio-cultural, environment is essentially man-made and relates to the density, geographical distribution and mobility of populations, to

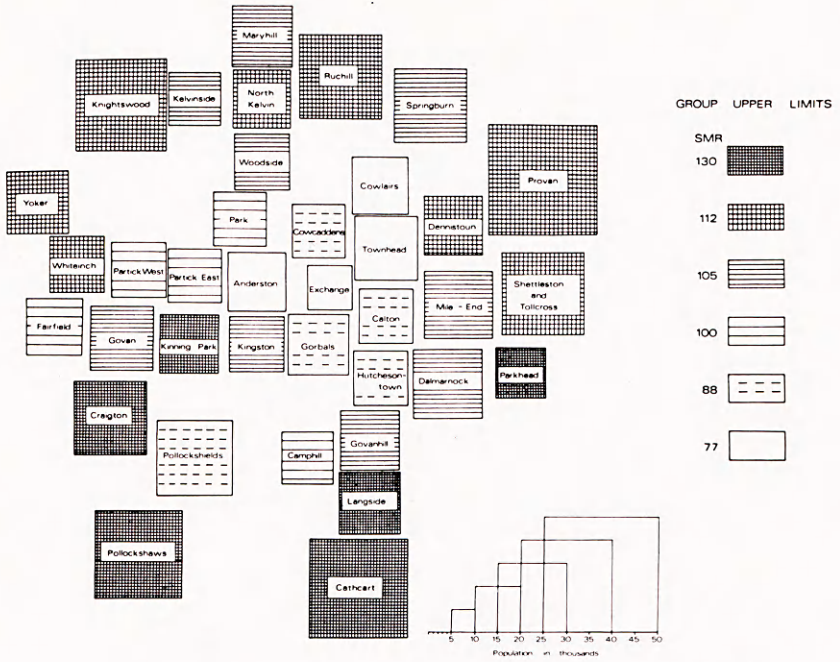


Fig. 5. Ischaemic heart disease in Glasgow (males only, 1959–1963). Standardised mortality ratios (SMR), related to the UK average of SMR 100 (26.1 male deaths per 10,000 living), are plotted within squares representing the 37 wards of the city. The areas of the squares are in proportion to the populations ‘at risk’ in the several wards (after Howe, 1968).

occupations, to socio-economic status, to housing, to diets, to habits and to customs.

The size of a country’s population is obviously important in that the larger the number of people the more they are at risk of exposure to disease. Overpopulation does not depend merely on total numbers or the density of population. A population density of 60 persons to the square kilometre may mean overpopulation in one area but underpopulation in another. A country is not necessarily overpopulated simply because it is incapable of providing sufficient food to support its people; such a country may be able to employ its labour force more effectively in manufacturing industry, exporting its surplus of manufactured goods in exchange for food-stuffs. Britain is one such case. This country is the ninth most densely populated in the world; England and Wales together come third, behind Bangladesh and Taiwan. Over 80 per cent of the population of the UK lives in towns and 7.4 million out of a total popu-

lation of 55·34 million (1971), i.e. 13 per cent, live in Greater London. If the optimal population for a country is assumed to be the maximum which can be maintained indefinitely without detriment to the health of individuals from pollution or from social or nutritional stress, then clearly Britain is overpopulated.

People in Britain are mobile to a remarkable degree and there is a slackening of close family ties and social relationships. Many urban dwellers have moved farther away from centres of towns and their places of work and have taken up residence in suburbs, in nearby market towns, and in the so-called 'new towns'. Change of place of residence involves both physical and social disturbance, since people are obliged to create entirely new social environments for themselves. At the same time, there is the inevitable journey to work. Whether long or short, it involves extra energy and takes toll of physical and mental reserves.

Wandsworth, an inner London suburb, probably represents many inner city areas in Britain in 1973. Characteristics of population density and mobility within inner city areas are well illustrated. Population density in the borough is almost double the Greater London average and the proportion of electors with a different address from a year ago increased from 15·1 per cent in 1971 to 17·7 per cent in 1972. Such figures are not surprising, but when they are taken with others—nearly a quarter of the households shared (compared with a Greater London average of 13·4 per cent); almost 6 per cent of the homes with more than 1·5 persons to a room; 10·5 per cent (excluding council houses) without hot water; 12 per cent with no fixed bath; 11·2 per cent with only an outside water closet; and the illegitimate births numbering twice the national average (in spite of a free family planning service provided by the council); the suicide rate nearly 50 per cent above average; the number of children in care almost three times the average for England and Wales—they indicate both vulnerability and stress within the community. Such conditions are repeated in many of Britain's larger cities.

Many occupations carry with them health hazards. As early as 1775 Percival Pott drew attention to soot as a cause of scrotal cancer in chimney sweeps. In quarrying and glass manufacture there is a risk of silicosis, and among coal miners there is above-average incidence of pneumoconiosis. Lead, mercury, arsenic, fluoride, asbestos and chromium are among the several recognised toxic materials used in modern industry. These and hundreds more new chemicals are being introduced into the environment each year. Man's reaction to such chemicals depends on the toxicity and concentration of the chemical, the duration of exposure, and the genetic susceptibility of the individual. Diseases or disorders commonly associated with atmospheric

pollutants and thought to be aggravated by them include chronic bronchitis, pneumonia, lung cancer, emphysema, and asbestosis.

Food is yet another important aspect of the human environment deserving of the closest attention in the context of human health. It has been suggested that, compared with man's total evolutionary history, the relatively short time since he changed from a protein-rich to a carbohydrate-rich diet has not permitted adaptation. Over-consumption of refined carbohydrate, especially in the form of sugar and white flour (deprived of its fibre) is thought to be responsible for constipation, possibly leading to diverticular disease and appendicitis, for the appalling rise in the incidence of dental caries, and probably plays a significant role in the causation of obesity and diabetes.

The unrestricted use on the land of powerful chemical pesticides based on organo-phosphorus compounds and chlorinated hydrocarbons, while revolutionising the chemical attack against harmful insects and pests, upsets the balance of soil ecosystems and may well prove a serious source of contamination of food supplies. DDT, dieldrin, aldrin and related substances persist in soils and accumulate in animal and body fat.

Atmospheric pollution is a major hazard within the human environment. Sources of the pollution include motor vehicles, railway trains, aircraft, domestic heating, chemical plants, fuel-burning factories and offices, refuse disposal and thermo-electric generating stations. Though the effects of acute air pollution incidents have in the past been dramatic (e.g. 3,500 to 4,000 more deaths than would have been expected under normal circumstances occurred in London during the fog of 5th to 8th December, 1952) it is the chronic effects that are probably the more important. A relationship between bronchitis and air pollution has been demonstrated and also between the inhibition of enzyme activity and excessive amounts of atmospheric lead, between hypertension and other cardiovascular diseases and airborne cadmium, and between asbestosis and mesotheliomata and the inhalation of asbestos.

There has been a marked decrease in the amount of smoke and sulphur dioxide pollution in Britain since the implementation of the Clean Air Act (Figs 6 and 7). It is to be hoped that the lower levels of urban air pollution will have a favourable influence on the incidence of bronchitis in Britain. Nevertheless, man continues to interfere with the atmosphere, particularly by emitting new chemicals, without striving to determine the real and lasting effects of such actions on his health. Such is the price of technological advances within modern industrialised societies—one reaps the 'effluent of affluence'.

One can only note some of the other environmental hazards *en passant*. Cacophonous noises from a multiplicity of man-made sources contribute to 'stress' which is considered to be a factor in ischaemic heart disease and

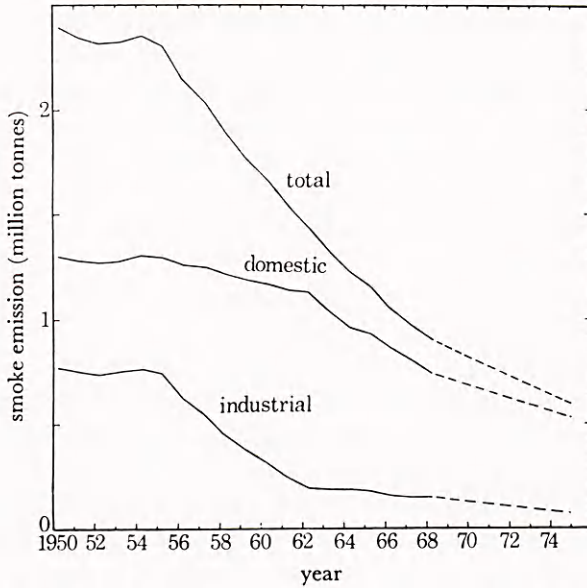


Fig. 6. Smoke emissions in the United Kingdom. The solid lines show emissions estimated from actual fuel consumption; the broken lines show estimated emissions based on forecast fuel consumption (Craxford and Weatherley (1971). Courtesy *Philosophical Transactions of the Royal Society*).

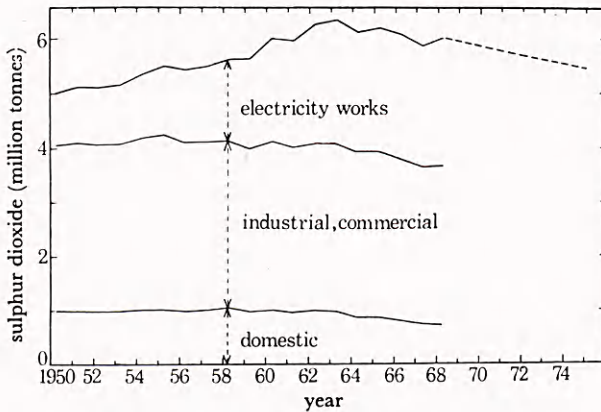


Fig. 7. Emissions of sulphur dioxide in the United Kingdom. The solid lines show emissions estimated from actual fuel consumption; the broken lines show estimated emissions based on forecast fuel consumption (Craxford and Weatherley (1971). Courtesy *Philosophical Transactions of the Royal Society*).

cerebrovascular disease. Excessive indulgence in alcohol results in cirrhosis of the liver, delirium tremens and obesity. Cigarette-smoking contributes to lung cancer, promiscuity to venereal disease, and the abuse of opiates, heroin, cocaine, amphetamine, LSD and cannabis and various other 'soft' and 'hard' drugs leads to alterations in mood, consciousness, psychological effects, bizarre behaviour and paranoia.

BIOLOGICAL ENVIRONMENT

Despite his apparent aloofness from the biological world man, fundamentally, is still an animal. He occupies a place in the economy of Nature and is part of the ecosystem. He exercises vast influence and much control over the environment but, in his turn, he is influenced by it and, as with other animals, has to contend with natural enemies. Disease agents such as virus, bacterium, spirochaete or rickettsia, the intermediate hosts and vectors—elements in the disease complex—each have specific environmental requirements. Each element, including man, is inescapably bound up with the environment. Disease in any given locality is the result of a combination of geographical circumstances which bring together disease agent, vector, intermediate host, reservoir, and man, at the most auspicious (or inauspicious) time. Knowledge of these relationships and of each element in the complex is an essential prerequisite to a true understanding of infectious disease, its distribution and control. But relationships are rarely simple or static; rather are they complex and continuously changing.

Serious infectious disease is now largely absent from Britain, as are the environmental conditions likely to bring about its return. Even so, in an age of rapid air travel, a person can acquire a serious infectious disease and travel thousands of miles in a fraction of its incubation period. He may thus enter Britain in the silent stage of an infection without exhibiting clinical symptoms. This kind of situation is likely to be exacerbated in the future with the greater use of jumbo-jets and supersonic aircraft, and with a general increase in the frequency of air travel.

CONCLUSION

The traditional approach to medicine has always been the steadfast assumption that the primary role of the doctor is the treatment of the individual patient, i.e. curative medicine. Now it would seem that the practice of medicine is moving rapidly into an era where environmental factors in relation to disease may come to be regarded as of paramount importance. The health of the patient can be affected by his environment in a subtle and arcane manner. As the medical profession becomes increasingly disenchanted with an approach

to disease dominated by high technology and massive feats of 'medical engineering' it is inevitable that the pendulum will swing back to a much more detailed consideration of the basic factors of the environment which operate to produce pathological conditions in man.

This article is based on a paper read at the College Conference on Individual and Geographical Differences in Susceptibility to Disease and Response to Drugs held in Norwich in September 1973.

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So much for the Community

In these political days of registration and its varied controls, it is comforting to find that we are not the only generation to be so bothered. The great Osler himself had strong feelings on the subject. His *New World* did not look kindly on the old. 'My feeling on the subject of international, inter-colonial, and inter-provincial registration is this—a man who presents evidence of proper training, who is a registered practitioner in his own country, and who brings credentials of good standing at the time of departure, should be welcomed as a brother, treated as such in any country, and registered upon payment of the usual fee. The ungenerous treatment of English physicians in Switzerland, France, and Italy, and the chaotic state of internecine warfare existing on this continent, indicate how far a miserable Chauvinism can corrupt the great and gracious ways which should characterize a liberal profession.'