Contemporary Themes

A basis for health strategies

A classification of disease

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A few years ago attention was drawn to a remarkable paradox: at a time when medical knowledge is greater and technology more powerful than ever before, medicine is assailed by doubts about its role and purpose.¹ Some reasons for the doubts are clear enough: disagreement about the respective responsibilities of public and private agencies for the finance and delivery of health services; rapidly rising costs of medical care and the lack of an acceptable basis for limiting them; gross inequalities in health between continents, between countries, and between different sections of the population of the same country; ethical issues which arise particularly from the ability to prolong or terminate life; and formidable problems of litigation attributable to the difficulty of distinguishing clearly between errors of clinical judgment and negligence. But perhaps the most telling source of uncertainty is the possibility that we have overestimated what has been achieved, indeed what can be achieved, by treatment of the sick. We begin to suspect that some disease problems may prove to be, as has been said of the universe, "not only queerer than we suppose but queerer than we can suppose."²

The doubts are reflected in ambiguities and differences of opinion about the best approach to the control of disease, particularly the balance between preventive and therapeutic measures. For example, it has been implied that treatment must take priority over prevention ("Prevention is better than cure only if you have not got something that needs curing"), that the contribution of prevention and treatment should be considered separately ("Prevention is needed for its own sake and not as an alternative to someone else's cure"), and that all medical activities should be guided strictly by tests of their effectiveness and efficiency.⁴ Equally remarkable are conclusions concerning the relative effectiveness of different methods of prevention. In coronary heart disease, for example, it was stated "When one goes beyond stopping smoking and the detection and treatment of hypertension, tangible evidence is not only difficult but is also liable to be influenced by commercial pressures."⁵ A contrary view was expressed in a report of a recent meeting, where "Professor Geoffrey Rose and other speakers from the United States seemed agreed that *in population studies* dietary changes had the most important effect on the incidence of coronary heart disease—much more than did changes in smoking."⁶

The reasons for such differences in viewpoint are undoubtedly

complex, but I believe they are largely due to the fact that there is no generally agreed analysis of the determinants of health that would provide a basis for health strategies. (In Kuhn's terminology, the old paradigm is changing, but the new one is not yet clearly defined.) What is needed is a classification of disease that distinguishes diseases determined at fertilisation from those—the large majority—not so determined and manifested only in an appropriate environment. Whereas the latter are in principle preventable, the former must be dealt with by contraception, abortion, treatment, or, some would add, modification of genes or chromosomes. As a basis for a strategy of preventive and therapeutic measures, however, and having regard for the predominant influences on man's health at different periods of his existence, a threefold classification is more instructive, taking together all diseases established before birth—whether at fertilisation or in utero—and dividing conditions determined after birth into two major classes, according to whether they are due to deficiencies and hazards or to maladaptation.

Diseases determined before birth

The conditions determined at fertilisation are mainly the single gene defects and chromosomal aberrations, but they include some other abnormalities, particularly associated with aging, which are also independent of environmental influences. It is unlikely that they include any of the so called "common diseases." The conditions determined in utero are congenital abnormalities, such as most types of malformations and some forms of mental subnormality, which are not established irreversibly at fertilisation and must be attributed to other prenatal influences. Their inclusion in this class rests on a judgment, admittedly arguable, that as most of the adverse influences operate early in pregnancy they are unlikely to be identified and controlled. These abnormalities can therefore be tackled more successfully by prevention of conception or birth or by treatment, rather than through control of the uterine environment. The relatively intractable character of conditions determined prenatally is evident from the fact that there has been little improvement in spontaneous abortion and stillbirth rates or in the incidence of congenital malformations and mental subnormality.

Diseases due to deficiencies and hazards

As a background to an analysis of postnatal influences it is useful to have in mind the determinants of health of other animals. Living in their natural habitats they do not appear to be appreciably affected by non-communicable diseases.⁸ The main causes of death discussed by population biologists are food shortage, predation, parasites, and disease. But the disease referred to is that caused by parasites, so that the major influences are really three. And as both parasites and predators are living things in search of food—distinguished largely by size—they too can be regarded as a single cause. That is to say the sickness and death of other animals in their natural habitats are due mainly to

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food deficiency, acting directly through malnutrition and starvation or indirectly through hazards from other living things seeking food.

It is not a large step from these conclusions to recognition that the same influences were probably predominant on human health during man's evolution, and are still predominant in developing countries in the present day. Nevertheless, a distinction must be made between their modes of operation before and after the first agricultural revolution initiated by the domestication of plants and animals 10 000 years ago.

For almost the whole of his existence man lived as a hunter-gatherer, well adapted to his environment through natural selection, suffering mainly from direct or indirect effects of food deficiency, which could not be countered by genetic adaptation. The causes of ill health were distinguished from those of the agricultural period that followed chiefly by a different experience of infectious disease. In an illuminating discussion of the effects of changing social organisation on the infectious diseases of man Fenner wrote: "In contrast to other types of disease (genetic, traumatic, degenerative, neoplastic), the infectious diseases are dependent upon contact, either directly or indirectly through fomites, between individuals of the same species or, in the zoonoses, individuals of different species. For this reason social organisation, particularly community size and the degree of frequency of contact between individuals of the same and different communities, has played a significant part in determining the nature and prevalence of the infectious diseases of man."⁹ As early man lived in small bands with infrequent contact with other closed bands, numbers were not large enough to maintain directly transmitted microparasitic diseases; but living in tropical areas (it was not until cereals were planted and stored that man could move easily into temperate zones) he was plagued by debilitating tropical infections caused by parasites that complete their life cycles by passing from one human host to another via one or more intermediate species. (The statement that some of the few surviving hunter-gatherers appear to be healthy is based on the observation that they do not have diseases such as hypertension, diabetes, heart disease, and cancer. Of course they do not, as these conditions have become common only since industrialisation.) Nevertheless, the infections were less conspicuous as causes of sickness and death than in the historical period.

There have been two major changes from the conditions of life of early man, and both had profound effects on health and population growth. One was associated with the first agricultural revolution and the other with the agricultural and industrial developments of the last three centuries.

The increase of food supplies that resulted from the first agricultural revolution led to a decline of mortality and a growth of population to the size needed to maintain directly transmitted infections; a large, closely knit society living in poor hygienic conditions facilitated the spread of faecal oral and respiratory organisms. As fertility was uncontrolled, populations expanded to the size at which food resources again became marginal. Hence the causes of sickness and death resembled those of the earlier hunter-gatherer period in that food deficiency was still critical, but differed in that its effects were manifested chiefly through response to infectious disease. In these circumstances an increase in food supplies became a necessary condition for a substantial reduction of mortality from infectious diseases, and limitation of numbers would have to follow if the reduction was to be maintained.

These, with hygienic measures, were the critical advances made in the past three centuries. The increase in food resulted from the advances in agriculture that spread throughout the Western world from about the end of the seventeenth century. Improvements in hygiene were initiated in the second half of the nineteenth century by sanitary reformers and greatly extended by the understanding of the nature of infection provided by medical science. Limitation of numbers followed the decline of the birth rate, which began, fortunately if apparently quite fortuitously, in the same period, indeed in the same decade (in England and Wales), as the hygienic measures. It is one of the remarkable coincidences of history that the indispensable control of numbers appeared at precisely the time needed to ensure that the most important advances ever made in human health were not lost.

As a result of these advances diseases due to deficiencies and hazards are no longer the principal causes of sickness and death in developed countries. In much of the world, however, the picture remains essentially unchanged. The World Health Organisation recently reported that in the 31 least developed countries life expectancy at birth is 45 years and infant mortality 160 per 1000 liveborn children; only 31% of the populations have a safe water supply, and the adult literacy rate is 28%. Infectious disease is still the predominant cause of death, and malnutrition, defective hygiene, and excessive growth of populations are the major influences.

Diseases due to maladaptation

Conditions of life during the past few thousand years, and particularly during the past few hundred, have changed profoundly from those under which man evolved. Present estimates suggest that toolmaking animals have existed for a few million years, creatures physically similar to modern man for about 300 000 years and the human subspecies for 60 000 years. On this time scale the intervals in which the major changes in conditions of life have occurred are very small: 10 000 years since the end of the hunter-gatherer period and the beginning of agriculture, and 300 years since the onset of industrialisation. In these short intervals there has not been time for genetic adaptation, so that modern man is exposed to the hazards of industrial life with the genetic equipment of a hunter-gatherer. The maladaptations that have resulted from recent economic and industrial developments must be added to the deficiencies and hazards that were predominant during the evolutionary period as postnatal determinants of sickness and premature death.

Impressive evidence of the effects of maladaptation has been brought together by Trowell and Burkitt in *Western Diseases*.¹⁰ They invited contributors to describe their experience in several countries as Westernisation occurred. There are four main lines of evidence. Firstly, until recently many of the non-communicable diseases now predominant in the West were uncommon or absent in hunter-gatherers and peasant agriculturists. Secondly, when these populations change from their traditional ways of life to those of the developed countries they begin to exhibit the Western pattern of disease. Thirdly, the incidence of some of the diseases has declined in Western populations which have reversed certain features of their lifestyle to bring it closer to that of peasant agriculturists. And finally, of the multiple influences responsible for the Western pattern of disease, dietary changes are probably the most important.

The evidence assembled, particularly on the first two points, is impressive. Before 1940 in Africans of Kenya and Uganda blood pressure did not rise with age and essential hypertension was rarely seen; it is now a common disease. Obesity was almost unknown in 1930 when Julian Huxley noted with amazement that almost the only fat woman he saw in Africa was in the Nairobi brewery; the towns of East Africa now contain many fat upper class Africans and their leaders are often grossly obese. In Kenya in the 1930s, diabetes was rare in Africans (but not in Europeans and Indians); today there are large diabetic clinics in all town hospitals. Cerebrovascular disease was the first arterial disease of clinical importance to emerge in Africans: before 1948 a case due to essential hypertension was rarely or never seen; in 1970 it was the commonest cause of death in a large series of neurological patients in a Ugandan hospital. Coronary heart disease is said to be the last major cardiovascular Western disease to appear—the first clinical reports of cases were made quite recently in Uganda (1956) and in Kenya and Tanzania (1968).

The most important medical advance in the nineteenth century was the discovery that infectious diseases were largely attributable to environmental conditions and could often be prevented by control of the influences which led to them; the most significant advance in the twentieth century is the recognition that the same is true of many non-communicable diseases.

Discussion

The high level of mortality until recently indicates that for almost the whole of his existence man's control of his environment was insufficient to enable him to advance his health appreciably beyond that of other living things. But as numbers born were greatly in excess of numbers that survived, through natural selection he was well adapted to the conditions under which he evolved. It was lack of food, which could not be met by genetic adaptation, that was chiefly responsible for a high death rate and slow growth of population.

The domestication of plants and animals and the transition to a settled way of life were the beginning of a degree of control of the environment unique to man, and it led to a decline of mortality and expansion of populations. As reproduction was uncontrolled, however, numbers increased to the level at which food supplies were again marginal; and with aggregated populations and defective hygiene, infectious disease became the predominant cause of sickness and death. The agricultural and industrial developments of the past three centuries brought still greater control of the environment, an increase in food supplies

from advances in agriculture, and protection from hazards, particularly from infective organisms. This time, however, the advances were not lost, as they had been 10 000 years before, by an increase in numbers, because the agricultural and hygienic improvements were accompanied by a fundamental change in behaviour—namely, the control of reproduction, which led to declining birth rates. For the first time it could be said that numbers and resources were in balance so that the Malthusian adjustment through high mortality was no longer applied.

The industrial and economic developments that led to the decline of the infections, however, brought new threats to health from profound changes in conditions of life for which the genes are not adapted. Many are hazards over which the individual has little control: atmospheric pollution; chemicals used in industry, agriculture, and as food additives; adverse working conditions; road traffic; radiation from nuclear processes; risks associated with medical investigation and treatment. Other hazards are due to changes in behaviour, many of which are made possible or encouraged by the affluence that resulted from industrialisation: smoking; sedentary living; use of drugs; excessive or ill balanced diets. Hence some of the contemporary health problems can be resolved by public action, whereas others require also modification of personal behaviour.

This is the background against which future prospects must be assessed. Health depends essentially on removal of the longstanding deficiencies and hazards associated with poverty, without incurring the risks of maladaptation that have appeared under modern conditions, particularly in relation to affluence. Can man control for health purposes an environment that is largely his own creation? And will he modify those features of his behaviour for which the genes are not adapted?

In the preface to *The Doctor's Dilemma* Shaw advised that one should take care to get born well. This advice is easier to follow in relation to environment than to genes. A perceptive fetus would come about as near to immortality as human genes permit by electing to become the wife of a rural clergyman; well to do but living frugally; fertile but with few children; physically active but avoiding field sports, especially hunting; taking no drugs, alcohol, or tobacco; and keeping to a diet low in salt, fat, sugar, and meat, and so rich in fruit, vegetables, and grains that the addition of bran would be an indulgence. Of course we cannot all be wives of rural clergymen; nevertheless, it is possible to progress towards ways of life that retain the advances on which our present health largely depends but to remove some of the environmental and behavioural hazards that threaten health because they depart radically from the conditions under which our ancestors evolved.

In discussions of the changing pattern of disease it is generally assumed that the infections were the diseases of the past and that the non-communicable diseases which have partially replaced them are the problems of the indefinite future. Except in relation to conditions determined before birth this assumption is questionable; it is unlikely that the infections were predominant before the historical period and in time the roles may again be reversed. For if we are correct in thinking that the new pattern of disease is largely the result of environmental and behavioural changes associated with industrialisation, many of the influences could be removed without prejudice, and in some cases with benefit, to the quality as well as to the duration of life. To assume that behaviour will not be modified for health purposes is not only to take a low view of man's educability; it is also to overlook the enormous changes that have occurred in the past few centuries. It is not long since our ancestors burnt witches, prescribed capital punishment for minor offences, and employed small children for 14 hours a day in mines and factories.

Man's long term relation to his parasites is a much more open question. Where it is possible to prevent contact with them, as in the case of organisms spread by water and food, there is no reason to doubt that control will continue to be effective. We cannot have the same confidence about diseases caused by organisms normally found in the body or conveyed by vectors such as the mosquito, tick, or snail. J B S Haldane said that the Almighty

must have been inordinately fond of beetles. On the evidence of the ability of some of the common disease vectors to resist the measures directed against them, He must have had a strong attachment to invertebrates in general. (In Hiroshima the earthworms survived unharmed near the hypocentre, and after a prudent withdrawal for a few days the flies and mosquitoes returned in greater numbers.) Moreover, the disappearance of an infectious disease provides no certainty that it has gone forever. Smallpox, for example, is said to have been eradicated, but we can hardly believe that the virus, or others capable of evolving into it, has disappeared forever from the animal reservoirs from which presumably it initially emerged. Predictions about future health trends are notoriously unreliable, but my own guess is that 100 years from now it is more likely that wholemeal will have replaced refined flour, that environmental hazards will be strictly controlled, that the dairy industry will have contracted to a modest size, and that smoking will be assigned a place somewhere between spitting and the taking of hard drugs—about as unpleasant as the one if not quite so lethal as the other—than that diseases such as influenza, malaria, and the common cold will have been eradicated.

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Is there any evidence that selenium yeast is of value in treating arthritis?

The quick answer is "no." I know of no evidence that selenium yeast is of value in treating any type of arthritis now known to man. A recent leader in the *Lancet*¹ reported on selenium being effective in the prophylaxis and treatment of an endemic cardiomyopathy in the Peoples Republic of China and the use of selenomethionine in the treatment of muscle pains and tenderness in a woman from New Zealand on intravenous feeding. The biological role of selenium in animals and man was discussed in this leader. Selenium deficiency possibly plays a part in altering immune and inflammatory responses in man but I know of no proper scientific controlled trial of this substance having been reported in any form of arthritis. A product is available in Britain that contains selenium yeast and vitamins A, C, and E but it has no official recognition as an antirheumatic agent. Selenium is available as a shampoo in the treatment of dandruff and seborrhoeic dermatitis of the scalp and has also been used to treat blepharitis and some ocular conditions, but in excess it is toxic and may prove fatal. *Martindale* states that when taken by mouth it is highly toxic²; symptoms of poisoning include an odour of garlic in the breath, anorexia, vomiting, anaemia, and fatty degeneration of the liver. Many so called health foods are introduced consisting largely of vitamins with some other constituent. None may make a claim to be considered as an antirheumatic agent until proper controlled animal work and human clinical trials have been performed. No such trials have to date been reported in Britain.—F DUDLEY HART, consultant rheumatologist, London.

¹ Anonymous. Selenium perspective. *Lancet* 1983;i:685.

² *Martindale: The Extra Pharmacopoeia*. 27th ed. London: Pharmaceutical Press, 1977:451.