1 *Introduction*

GABRIEL W. LASKER

There is nothing distinctively new about applying bioanthropology to health and welfare issues. Such applications have taken the form of contributions to medical and dental training and research. In the past, however, the contributions have been conceived of as incidental rather than fundamental: for instance, an anthropologist might be asked about the bodily form of schizophrenic patients because of past literature linking constitutional types to mental diseases and the generally held view that what physical anthropologists do is measure people's bodies. However, a more significant potential contribution of anthropology in the study of schizophrenia may lie in unravelling the interrelationships between ways of life, mental health and bodily development. That is, there are important sociocultural factors in the epidemiology of both schizophrenia and (through diet and activity) of body build.

Human population biology

In this book we propose to emphasize the applications of bioanthropology to broad issues rather than mere applications of anthropological techniques. Because of this, the specifically anthropological aspect of the material may not be clearly distinguishable as such; that is, what makes some of these ideas biological anthropology rather than epidemiology, population genetics or physiology may not seem very substantial. Perhaps it is a matter of emphasis.

Characteristically, bioanthropology is concerned with biological variables in human populations. Thus the concern for the individual – so emphasized in medicine and the other healing arts – is an incident of study rather than an object of investigation for the biological anthropologist. Anthropological study is about the population and for that reason relies heavily on statistical reasoning to define the norms and variations within and among human groups.

Other sciences are heavily statistical too, however, so what is the unique contribution of biological anthropology? In the past anthropologists did field work 'at the ends of the earth' and their work spanned human existence. The conditions of the environment in many of these places during much of this time were unknown. Thus the ‘other things being equal’ of other sciences could not legitimately be applied. Instead, anthropologists learned to keep an open mind about a wide array of possible influences. They collected and evaluated, in respect to their questions, information that may not have been anticipated to be relevant. Like historians, rather than like chemists, they investigated plausible connections on incomplete evidence and did not confine themselves to the few problems that might have appeared in preset hypotheses.

In studies of biological problems about living human beings, scientific anthropology has by now largely replaced the speculative kind. What has remained from before, however, is a useful breadth of interest which takes into consideration conditions often considered outside their scope by sister sciences concerned with the same issues. Compared with population geneticists, anthropologists may pay more attention to non-genetic influences and be unwilling to lump all the environmental factors into a single category measured by the concept of penetrance. Compared with epidemiologists, anthropologists may be more concerned with varying qualities of life rather than categorical ‘affected or not’, ‘survived or deceased’. Compared with anatomists, anthropologists may be more interested in the causes of morphology – the dynamic processes of evolution and development – even though this dynamic approach envisages transitional forms and obviates clear typologies. Anthropology is holistic, evolutionary, cross-cultural, comparative and population-based.

The chapters have been designed to cover distinct areas, but some issues might almost as well have been broached in a different chapter. The subheadings and the index should help locate particular topics.

In simple terms, human well-being can be reduced to life and health. The threats to life and health are warfare and disease. The bioanthropological approach to these problems is to show that, although they are an aspect of the human condition and hence natural in biological terms, they vary greatly among societies depending on both physical and cultural conditions. It is therefore relevant to reducing rates of mortality and morbidity to know more about the factors in human nature that augment these rates: what is general for the species, what varies genetically among populations, and what is the impact on people of conditions in the physical environment and of circumstances fashioned by the society of the particular social group? A look at the health statistics collected by the World Health Organization and by governments reveals differences in the mortality and morbidity rates between nations. Among human breeding populations defined in social terms, rather than by national boundaries, the variation is even more extreme. Therefore, to understand the variation it is best to look at specific societies and segments of them in the light of their cultures. After allowing for sex and age, the division of societies into sub-areas and social segments may help explain variations in incidence of diseases.

The problems to which biological anthropology is applied

Take a few examples of pressing problems facing the whole human species and consider how biological anthropology looks at them. For example:

1 Extinction of species of plants and animals.
2 Modification of the earth's climate.
3 Mass slaughter in warfare.
4 Overpopulation and exhaustion of natural resources.
5 Accumulation of chemical pollutants.
6 Radioactive contamination from uses, waste and accidents.
7 Genetic degradation of the human species.

The boundaries between the problems are not sharp: thus, overpopulation leads to malnutrition and the risk of war, and warfare increases starvation, the release of chemical pollutants and the risk of radioactive contamination of the whole world. Some of the anthropological aspects of these problems follow.

1 Extinction of species of plants and animals. The most important relationship of human to other species is their use as human food. Are there adequate resources of kinds as well as amounts of food?

Fortunately, human beings are omnivorous and adapt easily to substitution of one food source for another. This capacity is part of the human evolutionary patrimony. Within our memory, anthropologists have demonstrated a much wider range of foods eaten than had previously been known. For instance, until the early years of this century (when the explorer Vilhjamur Stefansson demonstrated – first in the Arctic and then in New York City – that he and his companions could thrive on a meat diet rich in organ foods and fat) nutritionists had believed that human beings needed a vegetarian or mixed diet in order to survive. The higher, non-human primates were then generally thought to be purely vegetarian. Stefansson commissioned a literature search of non-human primate diets and I found, largely from out-of-the-way sources but subsequently repeatedly confirmed in field studies by others, that apes and monkeys also eat insects and even prey on larger game.

Among human groups there are all sorts of diets. Food allergies limit the choice of foods of some individuals, but there is little to suggest that extinction of non-human wild species would have an immediate drastic effect on food availability. The same is not so true of domestic animals and plants. Loss of a species may have grave results, as was evident even from the temporary local loss of the principal crop during the potato blight and famine in Ireland in the 1840s.

Today, one thinks of genetic engineering as the way to deal with such a problem. However, the science of ethnobotany promises access to additional plant species for more general use and tests with new animal species, such as insects, as food have been practically nil.

2 *Modification of the earth's climate.* There is now a prospect of changes in world-wide climates due to the greenhouse effect, and human mobility exposes many more individuals to changed conditions. Can human beings adapt?

Bodily configurations differentially adapt human beings to different climates. Modal body types vary with climate, especially mean temperature in the coldest month in the temperate zones, but also humidity in the tropics. These tendencies follow Allen's and Bergman's 'laws'; that is, that one finds larger body sizes and less surface area per kilogramme body weight in cold climates and the reverse of this in hot ones. However, the situation is complex and there are many exceptions. Geographic variation in human body build is logically related to the need to dissipate heat in hot weather and to conserve heat in cold weather. The logic of nature is that, through repeated elimination by the death of individuals less efficient for these functions, the local gene pools have been culled and have been left, by natural selection, with more of the genes that adapt them to the past climates of the local region. Since past and present climates are correlated – in general, the colder parts of the world having been the colder since the origin of our species – the present geographic distribution of body types would place different kinds of people in the climates where they are best adapted. As a corollary, immigrants would often be less well adapted to the local climate than the sedentes there.

The problem is more complicated, however. For one thing, the principal determinants of body build are not genetic. Height and other linear dimensions of the body are strongly influenced by infant and childhood feeding, and body weight is determined by the ratio of caloric intake to energy expenditure. Different societies have different ways of rationing scarce food; the implications for what is a favourable body build are different if, in times of shortage, food is meted out equally or if larger individuals command larger shares. The relative amounts of lean body mass (the actively metabolizing tissues) and stored fat are also influenced by activity. Thus, overall, relationships of body build to climate and diet may depend on short-term, reversible conditions of food and exercise rather than on genetic tendencies selected by differential survival.

Also, the physiological responses to cold and heat are more significant than body build in the short run. Various studies of physiology and adaptation to temperatures suggest only small differences among human populations; a larger influence seems to be behaviour.

3 Mass slaughter in warfare. What has anthropology to say about war and its causes?

The evidence does not support the proposition that making war is an essential biological trait of the human species. Some oversimplified notions of sociobiology, relying largely on data on selected animal species, pretend that waging war is natural. Of course, it is 'natural' insofar as it occurs. However, a distinguished panel of scientists, including anthropologists Santiago Genoves of Mexico and Philip Tobias of South Africa, concluded in the Statement of Seville that no evidence exists of an inborn human instinct to make war. The killing of others of their own species by some kinds of animals is not closely comparable to human wars and the occasional homicide among hunting and gathering peoples, such as the Inuit, is not warfare. Bioanthropologists and other students of human life need to continue to examine closely each new claim for biological determinism to see whether cultural and other environmental factors are the real cause. Although there is ample evidence against a direct causative link between human biology and war, we have a biology that has allowed us to make war in the past and, in order to avoid repetitions with today's ever more destructive weapons, we need further studies of the ways the proclivity is sometimes channelled in non-destructive directions.

4 Overpopulation. Will we soon be standing several deep on each other's heads?

The study of population growth has largely been the province of demography, a branch of sociology. However, many anthropologists are now engaged in the study. All agree that the population problem can be approached only through the control of fertility, not by increasing mortality. Fecundity, the strictly biological component of fertility, cannot ordinarily be separated from other factors affecting birth rates. Even the concept of 'non-contracepting populations' is theoretical rather than real since all societies have some means of birth control such as the periodic taboos on sexual intercourse, use of abortifacients, coitus interruptus, or by knowledge of modern methods. As with many other issues, the search for culture-free human biology is futile and anthropologists approach the study of such variables as fertility in as wide a variety of societies as possible: that is, in the context of cultural determinants of patterns of marital and extramarital sexual behaviour as well as such biological determinants as sterility and ages at menarche and menopause. Already there is a large body of information from many parts of the world to supplement national statistics on birth rates. Such anthropological data on particular social groups relate fertility to social status. There is little known variation among groups in purely biological (that is, hereditary) fecundity, although the existence of individual genetic differences in sterility, twinning and other components are well established and make some group differences plausible. These are overshadowed, however, by sociocultural factors such as age at marriage and by the interaction of biological with sociocultural factors such as diet and lactation. However, population pressure is often expressed as land shortage and poverty; delaying marriage to acquire bride price or dowry feeds back to reduce fertility. Such mechanisms may be of more influence than the biological mechanisms that reduce fecundity during a period of starvation. Patterns of temporary separation of the sexes may lead to fluctuations in birth rates. For instance, a sharp seasonal variation in numbers of first births occurs in members of one Amish religious sect in which half the marriages occur in the two winter months. More effect on the natural rate of increase in the population is seen, however, where a late age of marriage is traditional, as in Ireland.

One influence on fertility statistics is the unlikelihood of superfecundation. That is, a regular result of pregnancy is not to begin another pregnancy until the previous one is terminated. There is also a biological impediment to another pregnancy during the early post-partum period. Lactation amenorrhea has been well documented by anthropologists. Since the very societies where nursing is extended are often the ones with problems of nutrition and since malnourishment also suppresses ovulation, there is still some controversy about the extent of lactation amenorrhea under various conditions. Thus, those who oppose abortion, stertilization and contraception on allegedly 'moral' grounds may have been led to exaggerate the efficacy of lactation as a way to control population growth. In any case, no one denies the immorality of neglect of unwanted babies, so further evidence on the biological effects of lactation and other aspects of fertility is needed to help guide the formulation of public policy. As a Roman Catholic priest once put it: 'What is not true cannot be right.'

5 *Accumulation of chemical pollutants.* What is the effect on human beings of the increased complexity of our chemical environment?

Efforts at dealing with pollution problems have been aimed largely at reducing contamination by specific chemicals in the workplace. In the United States there are few controls on introducing new chemicals (except into foods and drugs) and in most countries no action is taken until a specific disease is linked to a causative chemical agent, such as berylliosis, the pneumonias caused by inhaling beryllium; there is a high incidence of the disease in exposed individuals, such as those working in the factories that handle it. Tests of a suspected substance by exposing animals to large doses may confirm an adverse effect, but large doses of most chemicals tend to have adverse effects, so such tests may not persuade those making policy decisions to stop exposure of humans. It takes even more effort, cost and time to collect significant evidence of an increased mortality rate when many contaminants are present. On the other hand, smaller doses of one or several substances acting together may show up statistically in the morbidity or growth statistics of entire local populations, and this is where anthropologists can contribute.

However, the joint effects of various chemicals have proven difficult to deal with effectively by social and legal means. Mortality from a number of specific malignancies is considerably elevated in industrial areas where there are multiple contaminants of air and water, such as the Eastern Seaboard Corridor, the Industrial Midwest and the Mississippi and Ohio River Basins of the United States. Although no specific pollutant can be implicated where so many are involved, the problem may be even more important than contaminants in the workplace because it affects whole populations, including the children and pregnant women, of the most densely populated parts of the country. Furthermore, the effects may be especially serious in children and foetuses with rapidly growing tissues and a long life expectancy during which to manifest delayed responses. Specific chemical poisons, such as thalidomide and areas of intense chemical pollution such as the landfill of Love Canal, are well worth investigating, of course, but the more general problem of low-level pollution of large areas by many substances is particularly subject to bioanthropological approaches, approaches necessary for research on relatively small variations in whole populations in the face of numerous compounding variables (age, sex, social class, diet, activities, etc.).

6 *Radioactive contamination from uses, waste and accidents.* Are there risks of radiation for the future of the species as well as for individuals?

The relationship of radiation to leukaemia, other cancers and genetic mutation is now understood. Furthermore, there is reason to believe that there is no threshold dose; in other words, no radiation dose, no matter how small, can be considered completely safe. As greater precision has been achieved in studies of the effects, smaller and smaller doses of X-ray and other ionizing radiation have proven to be deleterious. Projection of the dose-damage curve downward shows that even minimum levels of radiation – for instance, the amount coming from radon gas seeping into many modern homes – will lead to some increase in radiation-induced sicknesses. What is the role of biological anthropology in the study of this? The evolutionary perspective states that we are as we are by natural selection and hence are presumably well adapted to conditions as they have been. Increased levels of radiation exposure may be upsetting the balance by increasing the rate of mutation. Most mutations are deleterious to individuals, but a certain low level is advantageous for the survival of the species. An evidence for this is the presence of mutation, but at low levels, in all species that have been studied. Thus, an increase in radioactive exposure with its increase in mutations would not only harm individuals but could also disrupt the equilibrium between individual harm and the good of the species.

The effects on human biology of other kinds of radiation – light (lasers), sound (airport noise), microwaves (ovens, electronic surveillance) – are so far not well understood.

7 *Genetic degradation of the human species.* Is our species deteriorating?

The question of changes in genetic fitness is speculative. The eugenics movement, based on the idea that some genes are good and others bad, has been discredited. The interaction of genetic factors with each other and with environmental factors is complex. What is known about it leads to the conclusion that, for human adaptation, biological similarities are more important than any genetic differences between populations. Through migration, the human gene pool is shared by the whole species, and heterozygosity within individuals is often beneficial. Interaction with environment is the important aspect of human adaptation, however, and the genetic variation between local populations is apparently less meaningful in this respect. Any study of adaptation of populations must therefore be biosocial and biocultural and cannot be left to a purely genetic analysis. Thus, the subject falls into the anthropological domain. This is not to imply that those trained as geneticists, for instance, cannot make a useful contribution; what it does mean is that they should apply an anthropological perspective, just as anthropologists need to use human genetics when they approach this subject. Baker (1982) emphasized this transdisciplinary nature of the science that equips biological anthropologists to play a central role in studies of the above-listed kinds of issues.

The examples selected

The chapters which follow are roughly in order of the human life cycle: applications of biological anthropology to problems of fertility, childhood development, adult health, degenerative diseases and aging.

Anthropological studies of human fertility began, essentially, as typical demographic studies as far as methods are concerned, but the objects of study were populations of anthropological interest: tribal and other societies with only local or recent vital statistics (Kaplan, 1974). From the outset, such studies were important for questions such as the maximum level of human fertility in populations (Eaton & Mayer, 1953). Furthermore, these very populations exhibit a wider variety of environmental (and probably also genetic) contexts for variations in fertility patterns than do national populations.

It eventually developed that the wide variety of settings for such studies also provided opportunities for more detailed analysis of human reproductive physiology in relation to fertility; that is, fertility as part of the integrated species biology of *Homo sapiens*. It is this fertility and the causes and results of its variability which Ellison reviews in Chapter 2.

In Chapter 3, Mascie-Taylor deals with childhood growth under conditions of a dearth of food. Whereas the poor growth of children often signifies undernutrition and the problems that cause it, the ability to postpone some growth in size helps meet the problem of reduced availability of food for intake. At older ages, the relationship of body size to food required persists, of course, but it is complicated by any relationship that may exist between body size and the ability to acquire food. Estimating lean body mass of whole populations in kilotonnes may be a way to translate body stature, weight, and skinfold thicknessess into amounts of cereal grain needed (Lasker & Womack, 1975).

Partitioning the variance in young childhood growth into components for environmental and genetic factors usually shows a large environmental component for height as well as weight, at least in studies where the environments are diverse. For this reason, human growth has long been a subject where biological anthropologists have engaged in applied studies, typically in application of anthropometric methods to the practice of paediatrics and orthodontics (Tanner, 1955; Garn and Shamir, 1958). More fundamental applications of anthropological theory are to the understanding of the evolution of the human growth pattern (Bogin, 1988).

In Chapter 4, Schell raises the question of how growth responds negatively to chemical or noise pollution. Do such responses occur at levels of pollution below those resulting in a measurable influence on mortality or morbidity? In theory, evolution 'views' stunted growth as preferable to a threat to life and some studies suggest that this actually happens with several kinds of pollution stress.

The Human Adaptability Project of the International Biological Program (IBP) provided an impetus to studies of adaptation during the decade 1967–1976. From an anthropological point of view, the most prominent component was the study of altitude adaptations. That was not so much because of the millions of individuals whose welfare is affected; rather, it was because the low oxygen tension encountered by residents at high altitude is the only stressor that cannot ordinarily be modified by human management. Hence, altitude is especially useful in studies of adaptation to stress in general. In addition, the effective research work of Baker and his students (Baker & Little, 1976), 28 of whom authored a recent book on the effects of altitude and other stressors (Little & Haas, 1989), has called further attention to the importance of these studies. It is the example selected by Greksa in Chapter 5 to exemplify adaptation to stress. The initial impetus for such studies was the IBP; the need for a review of the subsequent research is now attacked.

As Weiner (1975) pointed out, '[Human] biological adaptation takes place in an ecological setting which has a predominantly cultural and technological component. In man Darwinian fitness and physiological fitness are in many ways sociological phenomena.'

Of course, the two kinds of fitness have very different significance. Mazess (1975) noted that a great deal of confusion ensues from direct extrapolation from individual adaptation to notions about adaptation of populations. In theory, at least, reversible individual adaptations tend to