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Chapter 7 Human Biohistory

Stephen Boyden

Abstract Human biohistory is learning about human situations against the background of the story of life on Earth. One of its key features is recognition that the evolutionary emergence of the human capacity for culture was one of the great watershed events in the history of life. Human culture has become a new kind of force in the biosphere – with profound and far reaching impacts not only on humans themselves but also on the rest of the living world. The chapter briefly discusses some important biohistorical principles, including cultural maladaptation and cultural reform, technoaddiction and the evolutionary health principle. Cultural evolution has recently resulted in patterns of human activity across the globe of a magnitude and of a kind that are unsustainable. If present trends continue unabated the ecological collapse of civilisation is inevitable. The future wellbeing of humankind will depend on big changes in the scale, intensity and nature of human activities on Earth. The best hope for the future lies in a rapid transition to a society that is truly in tune with, sensitive to and respectful of the processes of life which underpin our existence. This is referred to as a biosensitive society. However, there will be no transition to biosensitivity unless there come about profound changes in the world-view, assumptions and priorities of our society's dominant culture.

Keywords Biohistory • Biosensitivity • Environmental education • Human ecology • Sustainability • Transition

S. Boyden (✉)
Fenner School of Environment and Society, Australian National University,
Canberra, ACT 0200, Australia
e-mail: sboyden@netspeed.com.au

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7.1 Introduction

There is an approach to learning about human situations which is of immense relevance to every one of us as individuals and to society as a whole. We call it *human biohistory*. Henceforth in this paper I will refer to 'human biohistory' simply as 'biohistory'.

Biohistory is the study of human situations, past and present, in biological and historical perspective – against the background of the story of life on Earth. Biohistory covers the basic principles of evolution, ecology, inheritance, and health and disease, and it pays special attention to the evolutionary background of our own species.

An especially important feature of biohistory is the fact that it recognises the evolutionary emergence of the human capacity for culture as one of the crucial watersheds in the history of life on Earth – of overriding significance not only for humans themselves but also for the rest of the living world.¹ For, as soon as human culture came into existence it began, through its influence on people's behaviour, to have impacts both on humans and on other forms of life. Biohistory is especially concerned with the constant interplay between human culture and biophysical processes.

We argue that basic biohistorical understanding across the community is an essential prerequisite for the future well-being of humankind. However, at present biohistory is not recognised as a *bona fide* subject in academic circles. It does not appear in school curricula and it does not feature in university degree courses or research programmes.

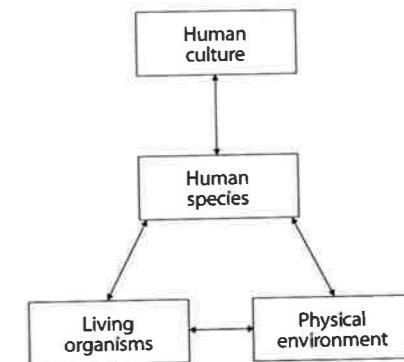
Over recent decades a growing number of writers have emerged who could well be described as leading biohistorians. René Dubos comes first to mind. Others include Hans Zinsser, Jared Diamond, Tim Flannery and Tony McMichael.² However, biohistory has yet to be developed systematically as a field of learning in its own right, and it is a long way from occupying the central place it warrants in educational programmes at all levels.

In this chapter I will focus especially on the work of my colleagues and myself at the Australian National University from 1965 until 1990. In my view, our conceptual approach is especially pertinent to the fast developing field which is the theme of this book – namely, long term socio-ecological research (LTSER) (and see Haberl et al. 2006; Singh et al. 2010).

¹The word culture has many rather different meanings. Here it is used to mean the abstract products of the capacity for culture, such as learned language itself and the accumulated knowledge, assumptions, beliefs, values and technological competence of a human population. This use of the term is consistent with the first definition of 'culture' given in Collins Dictionary: 'The total of the inherited ideas, beliefs, values and knowledge, which constitute the shared bases of social action' (Collins Dictionary of the English Language (1979) Collins, Sydney, Auckland and Glasgow).

²I mention René Dubos first because his writings capture the essence of biohistory as I see it (e.g. Dubos 1968, 1980). However, he makes no attempt to develop a comprehensive theoretical basis for the subject. The same applies to the other authors mentioned (e.g. Zinsser 1935; Diamond 1997, 2005; McMichael 2001; Flannery 1994).

Fig. 7.1 Biohistorical pyramid



I will also discuss biohistory as an important field of scholarship in its own right as well as its potential contribution to community understanding and social change, and I will explain why I believe that the biohistorical paradigm has an important contribution to make to the transition to ecological sustainability.

7.2 Conceptual Starting Point

Our approach to biohistory takes as its starting point the history of life on Earth.

In the beginning there was no life. Only the physical world existed – called the *Physical environment* in Fig. 7.1. Then, perhaps around 4,500 million years ago, the first *Living organisms* came into being.

Eventually, over many millions of years, there evolved an amazing array of different life forms. Among these, emerging some 2,00,000 years ago, was *Homo sapiens*. Because of this animal's special relevance to our studies, it is separated from other living organisms in our conceptual scheme (*Human species* in Fig. 7.1).

Through the processes of biological evolution, the human species had acquired a distinctive and extraordinarily significant biological attribute – the capacity for culture.

The most essential aspect of this capacity is the human ability to invent and learn a symbolic spoken language, and to use it for communicating among ourselves. This linguistic aptitude depends both on characteristics of the human brain and on special anatomical arrangements in the region of the larynx, pharynx and tongue which permit us to utter an amazing range of different sounds.

Another aspect of human behaviour often regarded as an aspect of culture is the ability to invent and learn new technologies and to pass on this technical knowledge from one individual to another and from generation to generation. Some other primates and some birds exhibit a trace of this ability. In humans, this aptitude for technology is greatly enhanced by the use of symbolic language and also by the extraordinary dexterity of our species.

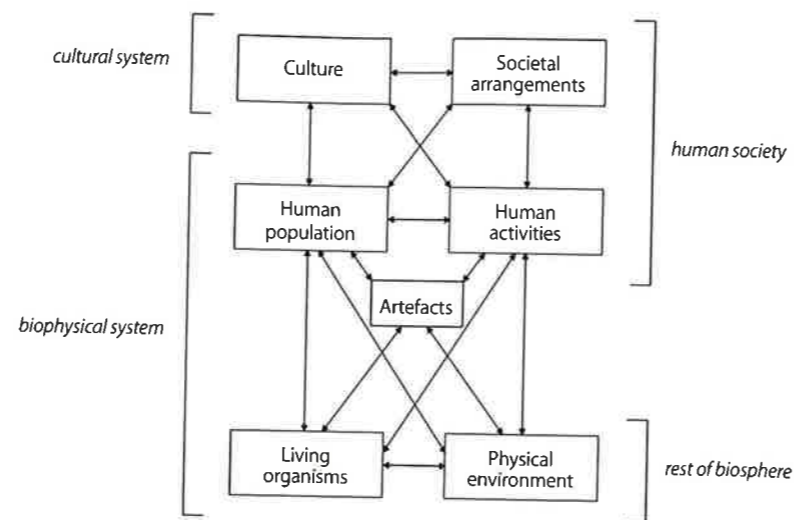


Fig. 7.2 Biohistorical conceptual framework

As soon as human culture came into existence it began, through its influence on people's behaviour, to have impacts not only on humans themselves but also on other living systems. It evolved as a new kind of force in the biosphere, destined eventually to bring about profound and far-reaching changes across the whole planet.

For the purposes of this discussion, it is useful to complicate the scheme a little. Because we are especially interested in the impacts both on humans and on the environment of what people actually do, it is useful to split the *Human species* into the *Human population* and *Human activities* (Fig. 7.2).

It is also useful to divide *Human culture* into two parts.

The first part is *Culture* itself, which is the information stored in human brains and transmitted through language. Although relatively abstract, human culture is an extraordinarily powerful force in the total system. For a proper understanding of human situations today, it is essential that we take account of the interplay between culture and the processes of life.

In our work the focus has often been on the dominant culture of a society – that is, the culture that largely determines the patterns of human activity in that society.

Culture includes knowledge of language itself, and general knowledge of the environment, history, the arts and technologies, as well as assumptions, priorities and religious beliefs.

The second part is designated *Societal arrangements*, which includes society's economic, regulatory, political and educational arrangements and its institutional structure. Societal arrangements are largely determined by, and to some extent determine, the characteristics of the dominant culture.

In Fig. 7.2 we have added another set of variables – namely *Artefacts*, by which we mean 'things made by humans', including buildings, roads, all kinds of machines and electronic devices, as well as clothes, utensils and works of art.

Although this conceptual framework is based on the sequence of happenings in the history of life on Earth, it can also be applied to the here and now. The same sets of variables are involved. Located at the base of the model are the physical environment and living organisms (the biosphere) – underpinning and supporting the human population, which in turn creates and maintains human culture.

We attempted in our own work to apply an early version of this framework in our study of the ecology of Hong Kong (Boyden et al. 1981). Recently we have adapted it for use as a device to facilitate planning for the future – at the level of individuals and families through to city planning and government policies. It ensures that, in considering different options we take account of their implications both for human wellbeing and for the health of ecosystems (see Appendix).

7.3 Why Is Biohistory So Important?

Here in a nutshell are some of the reasons why I believe that biohistory is so crucially important for us all today – at the level of individuals and families and at the level of society as a whole.

7.3.1 Biorealism

First and foremost, biohistory is important because it constantly reminds us that we are living organisms, products of nature and totally dependent on the processes of life, within us and around us, for our very existence.

It reminds us that life processes underpin, permeate and make possible our whole social system and everything that happens within it. Keeping them healthy must be our first priority – because everything else depends on them.

The dominant culture of our time has lost sight of these fundamental realities – with grave consequences for humankind and the rest of the living world. They are not reflected in governmental policies, political platforms, the structure of educational programmes or the lifestyles of the majority of people.

7.3.2 Human History

Biohistory tells us that our species has been in existence for some 200,000 years (McDougall et al. 2005).

It shows us that the history of *Homo sapiens* falls into four distinct ecological phases, which differ both in the relationships between human populations and the rest of the living world and in the biological conditions of life and health of humans themselves. Although the dividing lines between the different phases are not always

sharp, and occasional societies do not fit neatly into any one of them, the classification is a useful one. The four phases are not mutually exclusive and all of them can exist at the same time.

Ecological Phase 1: The hunter-gatherer phase

The hunter-gatherer phase of human existence was by far the longest of the four ecological phases, lasting some 1,80,000 or more years (over 7,000 generations).³

Ecological Phase 2: The early farming phase

The introduction of farming in some parts of the world around 12,000 years ago (480 generations) marked a turning point in cultural evolution. It was a precondition for all the spectacular developments in human history since that time.

Ecological Phase 3: The early urban phase

This phase began around 9,000 years ago (360 generations), when fairly large clusters of people, sometimes consisting of several thousand individuals, began to aggregate together in townships. Many of these people played no part in the gathering or production of food.⁴

Although the new conditions offered protection from most of the hazards of the hunter-gatherer lifestyle, malnutrition and infectious disease became much more important as causes of ill health and death.

Ecological Phase 4: The high consumption phase

This phase was ushered in by the industrial revolution, which began a little over 200 years ago (eight generations). It has been associated with profound changes in the ecological relationships between human populations and the rest of the biosphere.

Especially significant ecologically was the introduction of machines for performing different kinds of work and depending on the use of extrasomatic energy, especially fossil fuels. The discoveries and applications of electricity and radioactivity and the spectacular growth of the chemical industry have also been extremely important.

Largely as a consequence of improved living conditions the global population increased from about one billion in 1800 to two billion in the 1930s; and it is now almost seven billion. This population growth, along with the explosive increase in intensity of techno-industrial activities, is resulting in severe ecological disturbances across the whole planet.

The crucially important factor, which should be a central consideration in all government planning and economic deliberations, is the inescapable fact that the days of ecological Phase 4 are numbered. This phase is simply not sustainable ecologically. Either humankind will move into a very different, ecologically

³ In this paper a generation is taken to be 25 years.

⁴ One of the most interesting of these very early townships from the socio-ecological standpoint is Çatalhöyük in Anatolia, which was inhabited for approaching 2,000 years from about 9,500 BP (Mellaart 1967; Hodder 2006). The population ranged from 5,000–8,000. There were no apparent social classes. The economy was based primarily on the cultivation of barley, wheat, peas, and lentils, and the breeding of sheep, goats and, later in the period, cattle. Hunting was also still important for meat.

sustainable and healthy fifth ecological phase of human existence, or human civilisation will collapse.

7.3.3 Human Culture as a Force in Nature

The rapidity of the evolutionary development of the capacity for culture indicates that, once a rudimentary ability to invent and use symbolic spoken language emerged, it was at once of major biological advantage for its bearers under the prevailing conditions. The nature of this advantage has been the subject of a good deal of speculation among evolutionary biologists (e.g. Dunbar 1997).

In my view, its chief advantage probably lay in its role in the exchange and storage of useful information about the environment. This information was not only communicated within the group, but was also passed on to members of subsequent generations, increasing the likelihood of their good health and successful reproduction. However, it is possible that the aptitude for culture had a number of different biological advantages which collectively contributed to its rapid evolutionary development.⁵

Apart from its practical advantages, culture adds richness to human experience. It did so in the days of our hunter-gatherer ancestors – as in storytelling, musical traditions, dancing and other forms of artistic expression – and it does so today in so many ways. It makes a huge contribution to the sheer enjoyment of life.

However, especially under conditions of civilisation, cultural evolution has often resulted in activities that have caused a great deal of unnecessary distress to humans or damage to ecosystems. Such undesirable culturally-inspired activities are referred to as *cultural maladaptations*.

Biohistory reveals countless examples of cultural maladaptation in human history (Boyden 1987, 2004).

A particularly tragic example of cultural maladaptation was the ancient Chinese custom of foot-binding, which prevented the normal growth of the feet of young girls and caused them excruciating pain. This extraordinary practice well illustrates the propensity of culture to influence people's mind-sets in ways that result in activities that are not only nonsensical in the extreme, but also sometimes very cruel and destructive and contrary to nature. This particular cultural maladaptation was mutely accepted by the mass of the Chinese population for some 40 or more generations.

Throughout the history of civilisation, different cultures, including our own, have come up with a fascinating range of delusions about how social wellbeing, or prosperity, can best be achieved, and some of these delusions have led to blatant examples of cultural maladaptation. Here I will mention only one instance.

⁵ The fact that the capacity for culture was of biological advantage during the tens of thousands of generations of our species before the advent of agriculture does not mean, of course, that it will necessarily be an advantage under conditions quite different from those of the evolutionary habitat.

According to the dominant culture of the Mayan civilisation, prosperity could best be achieved by pleasing the gods, and the best way to please the gods was to torture, mutilate and then sacrifice human beings. This behaviour can be regarded as a cultural maladaptation, because it certainly caused a great deal of unnecessary human suffering, and it clearly did not do the Mayans' society any good. Their civilisation collapsed suddenly, probably for ecological reasons, around 900 AD.

Again, the point to be emphasised is the fact that while there may well have been a handful of sceptics among the Mayans, the great majority of them really believed that the torture and sacrifice of humans was an entirely appropriate behaviour. Cultural gullibility is indeed a fundamental characteristic of our species.

Biohistory thus alerts us to the need for us to be constantly vigilant – checking that the assumptions of our society's dominant culture are in tune with the processes of life and that they are not leading us to behave in ways that are against nature and against the interests of our species.

7.3.4 Cultural Reform

One of the themes of biohistory is human adaptability. Our species shares with all other animals a series of adaptive mechanisms, which include genetic adaptation through natural selection (adaptation of populations over many generations), many kinds of physiological adaptation and adaptation through learning.

However, humans have an extra string to their bow – namely cultural adaptation, which is defined as adaptation through cultural processes.

In the present context we are especially interested in cultural adaptation aimed at overcoming the undesirable consequences of culture itself – that is, adaptation to cultural maladaptations. We refer to this as *cultural reform*.

The processes of cultural reform are often quite complicated, involving prolonged interactions between different interest groups in society. A key role is often played initially by minority groups, occasionally by single individuals, who start the ball rolling by drawing attention to an unsatisfactory state of affairs. We can refer to these people as first-order reformers. A prime example of a first-order reformer is Rachel Carson who, in her ground-breaking book *Silent Spring*, drew attention to the insidious and destructive ecological impacts of certain synthetic pesticides (Carson 1962, see Krausmann and Fischer-Kowalski, Chap. 15 in this volume).

Almost invariably, the expressions of concern coming from first-order reformers are promptly contradicted by others, the *anti-reformers*. This backlash often involves representatives of vested interests who fear that the proposed reforms will be to their disadvantage. They are likely to argue that the problem does not exist or that it has been grossly exaggerated, and they try to ridicule the reformers by calling them alarmists, fanatics, scaremongers and prophets of doom. Nowadays some of these anti-reform forces are extraordinarily powerful.

The first-order reformers are, in time, joined by *second-order reformers* who also take up the cause. Eventually, if they are successful, a change comes about in the

dominant culture and members of governmental bureaucracies and other organisations set about working out ways and means of achieving the necessary changes. Their efforts may still be hindered to some extent by the stalling tactics of anti-reformers.

Biohistory provides many examples of cultural reform and anti-reform in recent history and at the present time. A well-documented instance of cultural reform from the past is the Public Health Movement of the later part of the nineteenth century (Flinn 1965; Frazer 1950). Other more recent examples include the anti-smoking campaign and the current debates about climate change. In the latter case, the anti-reformers are often referred to as climate change deniers and it is noteworthy that there is often a smattering of scientists among them (Oreskes and Conway 2010).

7.3.5 Evolution and Health

Biohistory reminds us that our species has been in existence for some 8,000 generations and that we are basically the same animal as our ancestors who lived long before the advent of farming – that is, an animal genetically adapted through natural selection to the life of the hunter-gatherers.⁶ This fact has many important implications – for understanding ourselves and our problems.

One of the outcomes of the processes of evolution is the fact that animals become well adapted in their biological characteristics to the habitat in which they are evolving. In other words, the biological characteristics of any species are such that the individual animals are likely to experience good health in their natural environment.

If an animal is removed from its natural environment, or if its environment changes significantly, then it is likely to be less well adapted to the new conditions, and consequently some signs of physiological or behavioural maladjustment can be expected. This *evolutionary health principle* is a fundamental law of nature (Boyden 1973, 2004).

Ill health or pathological behaviour due to an animal experiencing conditions which deviate from that of its natural environment are referred to as examples of *phylogenetic maladjustment*.

It follows from the evolutionary health principle that if we wish to identify the health needs of any particular kind of animal, the first thing to do is to examine the conditions under which it evolved, because we can be sure that these conditions are capable of providing all the essential ingredients for maintaining and promoting health in that species.

⁶This does not mean that evolutionary change in the human species has come to a halt. There has been a relaxation of some selection pressures that were powerful in the hunter-gatherer environment and in the long term this will result in genetic changes in human populations (Rendel 1970). There have also been some new selection pressures associated with the advent of farming that have produced changes in some populations. A well-known example of this is the emergence and spread in European populations of lactase production into adulthood in response to the availability of bovine milk as a food source. For discussion of this change and for other examples, see Cochran and Harpending (2009).

In the case of humankind there is, for example, no diet better for humans than the typical diet of our hunter-gatherer ancestors. Or if we take much more, or much less physical exercise than a typical hunter-gatherer, or if we inhale chemical fumes that were not present in the evolutionary environment, then we are likely to experience ill health.

The evolutionary health principle is of enormous relevance to the health professions, public health policies and personal lifestyle choices. However, it is seldom mentioned in the medical literature.⁷

There are good reasons for believing that the evolutionary health principle applies not only to such physical health needs as clean air and the need for physical exercise, but also to psychosocial aspects of life conditions. For example the lives of hunter-gatherers are usually characterised by the experience of conviviality, effective emotional support networks, incentives and opportunities for creative behaviour and a sense of personal involvement in daily activities. Most of us would agree that such conditions are likely to promote health and well-being in our own society. It is important that we take them into account in assessing the quality of life today and in considering options for the future.⁸

In this context, something must be said about the concept of stressors and meliors. The term 'stressor' is commonly used for an experience that causes anxiety and distress. When stressors are excessive and persistent they can interfere seriously with both mental and physical health. During our work on the ecology of Hong Kong, we became aware of the immense importance of experiences which have the opposite effect to stressors, and which are associated with a sense of enjoyment. We decided to call such experiences *meliors*.

The well-being of individuals at any particular time can be seen to be largely a function of their position on a hypothetical continuum between a state of distress at one extreme and a sense of well-being at the other. While stressors tend to push the individual towards a state of distress, meliors push in the opposite direction, so that a person's position on the continuum is the outcome of the balance between stressors and meliors. Social changes that result in the erosion of meliors are therefore just as undesirable as those that result in an increase in stressors.

There is nothing particularly original about the melior-stressor concept. It is no more than everyday common sense. However, in academic discussion and research, much more emphasis has been placed on stressors than on the opposite kinds of experience. Giving them the name 'meliors' simply serves to remind us to take them properly into account in assessing existing conditions or options for the future.

One of the features of ecological Phase 4 society today is the fact that the achievement of meliors is frequently much more costly, in terms of energy and resources, than it was in the past. The pursuit of meliors makes a substantial contribution to a society's technometabolism (see below).

⁷ An exception is Cleave and Campbell (1966), who drew attention to the fact that diets containing refined carbohydrates deviated from the natural diet of the human species and consequently gave rise to various forms of maladjustment.

⁸ Working lists of the universal health needs of humans, both physical and psychosocial, based on this principle are available on www.biosensitivefutures.org and in Boyden (1987, 2004).

In summary, many cases of ill health in our society today are examples of phylogenetic maladjustment – including most cases of lung cancer, coronary heart disease, obesity and probably much mental depression.

7.3.6 Human Behaviour

The fact that humans are basically the same animal today, genetically, as their hunter-gatherer ancestors of, say, 15,000 years ago also has relevance to human behaviour.

The innate behavioural characteristics of our species are the outcome of evolution in an environment very different from that in which we now live. While it can be assumed that these innate behavioural characteristics, such as the capacity for culture, were of biological advantage under the conditions in which they evolved, it is questionable whether this is still the case in the modern setting.

This is an extremely important topic; but because it is complicated and extraordinarily controversial it is not feasible to discuss it further in this short essay (for a discussion see Boyden 2004, Chap. 6).

7.3.7 Biometabolism and Technometabolism

An important aspect of biohistory is the study of changing patterns of resource and energy use and waste production by human populations.

Any population of living organisms takes up nutrients and energy from its environment, makes use of them in the processes of life and then discharges wastes and gives off energy in the form of heat. This set of processes is referred to as *population metabolism*.

In the case of the human species, cultural evolution has led to an extra dimension to population metabolism. Thus, in addition to a population's *biometabolism*, which consists of the inputs, internal uses and outputs of energy and materials involved in the biological processes within human bodies, there is also a significant *technometabolism*, which consists of the inputs, uses and outputs of energy and materials resulting from technological processes taking place outside human bodies. Technometabolism is a new phenomenon in the history of life on Earth – of tremendous significance ecologically and in many other ways.

Already in the hunter-gatherer phase of human existence technometabolism became important through the regular use of fire. This development resulted in biologically significant changes in the life conditions of humans, not only by providing them with warmth but also because it led to the consumption of cooked foods, especially meat.

The use of fire by hunter-gatherers sometimes resulted in important ecological changes. In some regions it resulted in the replacement of large areas of woodland

with grassland and in big increases in herds of grazing animals, and consequently in the supply of animal protein for humans (Dimbleby 1972; Sands 2005). Fires resulting from human activities had a major impact on vegetation in parts of Australia long before the European invasion of the continent (Jones 1969).

Massive intensification of technometabolism has become an outstanding feature of human society during the fourth high consumption ecological phase of human history, involving a huge surge in resource and energy use and technological waste production. The most evident manifestation of this is anthropogenic climate change – but there are many others.⁹

In 1965, Abel Wolman introduced the concept of urban metabolism and described the metabolism of a hypothetical city of one million inhabitants (Wolman 1965). In the 1970s, studies were carried out on the metabolism of Tokyo (Hanya and Ambe 1976), Brussels (Duvigneaud and Denaeyer-De Smet 1977) and Hong Kong (Newcombe et al. 1978). The last project, which involved a detailed analysis of both technometabolism and biometabolism in an urban system was carried out as part of a broad study on the ecology of Hong Kong and its human population.

In the final report of this work on Hong Kong, attention was drawn to the long-term unsustainability of the ever increasing intensity of resource and energy use and waste production in this city (Boyden et al. 1981). This conclusion is shared by the authors of a more recent study of the metabolism of Hong Kong who write:

Per capita food, water and materials consumption have surged since the 1970s by 20%, 40%, and 149%, respectively. Tremendous pollution has accompanied this growing affluence and materialism, and total air emissions, CO₂ outputs, municipal solid wastes, and sewage discharges have risen by 30%, 250%, 245%, and 153%. As a result, systemic overload of land, atmospheric and water systems has occurred. While some strategies to tackle deteriorating environmental quality have succeeded, greater and more far-reaching changes in consumer behaviour and government policy are needed if Hong Kong is to achieve its stated goal of becoming 'a truly sustainable city' in the 21st century. (Warren-Rhodes and Koenig 2001).

Perspectives such as these are crucially significant for our understanding of the true nature of the human predicament today and for planning for sustainability.

Since the 1970s there has been much work on urban metabolism, all of it indicating a progressive increase in the intensity of urban metabolism (Kennedy et al. 2007).

7.3.8 Technoaddiction

Another important biohistorical concept is the principle of technoaddiction. In human history it has frequently been the case that new techniques have been introduced simply for curiosity, or sometimes because they have benefited a particular individual or group within society. However, with the passing of time societies have

⁹In our work we have described and discussed the technometabolism of Hong Kong (Newcombe et al. 1978; Boyden et al. 1981), Australia (Boyden et al. 1990) and the world (Boyden 1992).

organised themselves around the new techniques and their populations have become progressively more and more dependent on them for the satisfaction of simple, basic needs. Eventually a state of complete dependence is reached.

The dependence of the populations of high-energy societies on fossil fuels is an obvious and extremely serious example. Others include our dependence on electricity and, quite recently, on computer technology.

This insidious form of addiction passes largely unnoticed. It is of immense economic and ecological significance and it explains why our attempts to introduce effective measures to overcome anthropogenic climate change are fraught with so many difficulties.

It is noteworthy that in the present cultural setting the following basic human behaviours usually require significantly more energy and create much more pollution than they did at other times in history: eating; seeking in-group approval; seeking to conform; seeking novelty, excitement and comfort; visiting relatives; being selfish; being greedy and being generous.

7.3.9 Cultural Maladaptations Today

Biohistory helps us to appreciate that the worldview and assumptions of our dominant culture today are resulting in cultural maladaptations on a scale and of an intensity never seen before in the history of humankind – maladaptations that are totally incompatible with the survival of civilisation. All the main threats to human wellbeing and survival in the modern world are consequences of cultural maladaptations.

Biohistory also draws attention to the astonishing rate of acceleration in the increase in intensity of humans activities on Earth, and to the fact that very recently *Homo sapiens* has become the first species of animal in the history of life on Earth to bring about significant changes in the ecology of the whole planet.

There are two sets of changes underlying the major ecological difficulties facing humankind today:

- The huge increase in the human population. There are now about 1,000 times as many people on Earth as there were when our ancestors first started farming around 450 generations ago. 70% of this increase has occurred in the past 80 years.
- The massive intensification, especially in the developed countries, of energy and resource use and technological waste production associated with industrialisation, consumerism and economic growth.¹⁰ The human species is now using about 18,000 times as much energy and emitting about 9,000 times as much CO₂ as was the case when our ancestors started farming around 10,000 years ago. 90% of this increase has occurred in the past 80 years.

¹⁰ Figures for energy use provide a fair indication of the overall impact of humans on the biosphere. People in some of the developed countries today are using around 50 times as much energy per capita as was the case when farming began. Most of this increase has occurred very recently.

Currently the most critical sign of this insensitive over-exploitation of the planet's resources is rapid global climate change. Other areas of serious concern include massive loss of biodiversity on land and in the oceans, thinning of the ozone layer, global pollution of ecosystems with persistent organic pollutants, and various severe forms of land and water degradation – involving distortion of nutrient cycles, loss of topsoil, salinisation, progressive large scale deforestation, biological impoverishment of soil and acidification of the oceans.¹¹

The biosphere as a system capable of supporting civilisation will not tolerate this onslaught indefinitely. If present trends in human activity continue unabated the ecological collapse of human civilisation is inevitable.¹²

Apart from these ecological issues, cultural developments during the past 70 years have resulted in the manufacture of weapons of mass destruction which now constitute another horrendous threat to the future of our species and the rest of the biosphere. According to recent estimates, there are around 24,000 nuclear war-heads in existence. It would not take many of these to bring an end to civilisation.

Biohistory also shows us how cultural evolution has resulted in the current gross disparities in conditions of life across human populations. Today vast swaths of people live in abject poverty, while some individuals have incomes of millions of dollars a year. Such disparities have been common in the early urban and high consumption ecological phases of human history, but they were not a feature of societies in the preceding 190,000 years of human existence.

7.4 Hope for the Future

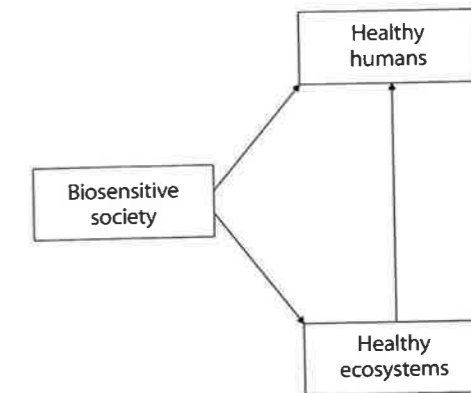
Biohistorical understanding leads to an appreciation that the best hope for humankind lies in a rapid transition to a society that is really in tune with and sensitive to the processes of life – a society that satisfies the health needs of all sections of the human population as well as those of the ecosystems of the biosphere. My colleagues and I call this a *biosensitive society* – that is, a society that in tune with our own biology and in tune with the living systems of the biosphere on which we depend.¹³

¹¹ See Rockström et al. (2009) for an interesting discussion of the full range of interlinked ecological changes resulting from human activities that are causes for serious concern. These authors recognise nine interlinked 'planetary boundaries', three of which have already been transgressed – namely climate change, rate of biodiversity loss and interference with the nitrogen and phosphorus cycles.

¹² In 1992 over 1,500 members of the Union of Concerned Scientists (UCS), including 101 Nobel Prize winners, issued a statement entitled *World's scientists' warning to humanity*. The following extract from the press release that accompanied the publication of this statement summarises their position: "The scientists emphasise the urgency of the problem. As they note in their appeal, 'No more than one or a few decades remain before the chance to avert the threats that we now confront will be lost and the prospects for humanity immeasurably diminished.'"

¹³ For further discussion on biosensitivity see Boyden (2005, 2011) and www.natsoc.org.au/biosensitivefutures.

Fig. 7.3 Biosensitivity triangle



Some explanation is needed of why it was felt necessary to coin the words 'biosensitive' and 'biosensitivity':

The growing concern about our ecological predicament over the past few decades has resulted in a range of important new expressions coming into use. They include, for example, ecological sustainability, environmentalism, carbon footprint and being green.

However, there is a need for a broader, more inclusive term which encompasses both human and ecological wellbeing (Fig. 7.3) and which evokes a positive vision of a society that is based on a real understanding of the living world and the human place in nature and that is truly in tune with the processes of life within us and around us.

The biosensitive society will promote health in all sections of the human population and in the ecosystems of the natural environment.

The transition to a biosensitive society will require sweeping changes in the intensity and nature of human activities, in economic arrangements and in the occupational structure of society. Biosensitivity will be the guiding principle in all spheres of human activity – individual and collective. It will mean biosensitive lifestyles, biosensitive governments, biosensitive technologies and fuel use, biosensitive farming, biosensitive cities, biosensitive design, and a biosensitive economy. Eventually it will also mean moving towards a smaller human population globally (1,000 million?).

Unfortunately the worldview, priorities and assumptions of the dominant cultures that determine patterns of human activity across the world today are totally incompatible with any transition to an ecologically sustainable, healthy and equitable society. They are simply not attuned to ecological realities.

Paramount among the maladaptive assumptions of the dominant culture of our own society is the ideology of 'ever-moreism' – associated with an economic system that results in rampant, continually increasing consumption of resources, use of energy and discharge of technological wastes. This ideology is ecologically absurd. It is leading us faster and faster in the direction of ecological oblivion.

The necessary changes in societal arrangements and patterns of human activity will therefore require revolutionary changes in the dominant culture. That is, our hope for the future lies in the processes of cultural reform. Biosensitivity cannot be achieved until this culture comes to embrace at its heart a sound understanding of the human place in nature and a profound respect for the processes of life. Biosensitivity will be what matters most.

Only then will there be sufficient motivation at all levels of society to make the major changes in societal arrangements and human activities that will be necessary to achieve a sustainable relationship with the ecosystems of which we are a part and on which we depend.

However, in turn, this crucial cultural transformation will not come about until there is widespread understanding right across the community of human situations in biohistorical perspective. Therefore by far the most urgent need is in the realm of learning and education.

Apart from its influence on the cultural worldview, assumptions and priorities, of the dominant culture, biohistory also provides information of enormous practical value for society in its efforts to achieve biosensitivity. It makes clear what 'being in tune with the processes of life' means in practical terms, such as maintaining the biological integrity of soils and natural nutrient cycles, protecting biodiversity and avoiding pollution of the atmosphere. Moreover, it helps us to select lifestyle options that not only promote our own health, but that are also consistent with the health of the natural environment.

So, in summary, shared biohistorical understanding across the whole community is a key prerequisite for the achievement of biosensitivity and hence the survival of civilisation.¹⁴ Until this happens there is unlikely to be any significant change in the dominant culture and therefore no significant move towards sustainability and biosensitivity.

Biohistory should be at the core of every school curriculum – reflecting the reality that we are living beings, products of the processes of life and totally dependent on them for our survival and wellbeing; and by far the most useful role of concerned individuals and community groups at the present time is to actively encourage this kind of understanding in the community and to promote the vision of a biosensitive society.

7.5 Biohistory and the Academic Disciplines

Biohistory is, by its very nature, integrative. It requires that we pay attention to the interconnectedness of different parts of the total system – biophysical and cultural – and of the broad classes of variables that determine the overall characteristics of human situations and the life experience of every one of us.

¹⁴ Elsewhere, for the sake of brevity, 'biohistorical understanding' has been contracted to 'biounderstanding' (www.natsoc.org.au/biosensitivefutures and Boyden 2011).

Thus biohistory can be said to be 'multidisciplinary' – in that it involves learning about the interplay between different parts of the total system that are conventionally studied by different groups of specialists in the different so-called academic disciplines.¹⁵

However, it can be argued that biohistory, rather than being seen as 'multidisciplinary', should be regarded as an academic discipline in its own right – but a comprehensive one that has crucial links with most, if not all, other disciplines. I suggest that it deserves a place alongside the various fields from the natural and social sciences, such as ecology, ecological anthropology and ecological economics, that are considered to have the potential to make a useful contribution to long-term socio-ecological research (LTSER) (Singh et al. 2010).

The existence of these disciplines, each focusing on a relatively narrow aspect of reality and each with its own set of methods and theory, is an outcome of the vicissitudes of cultural evolution. In fact, of course, the variables and processes studied in these different areas of specialism are interacting parts of a whole, and the interplay between them is of utmost significance for understanding ourselves, our society and our problems. Especially important are the interactions between the culturally inspired human activities and the underpinning processes of life within us and around us.

While there have been increasing calls for multidisciplinary in academia over recent years, there has not been a great deal of progress in achieving this goal. In my opinion, this is partly due to the fact that it is not sufficient merely to bring together representatives of different disciplines to sit around a table to talk about an issue or topic, only to return afterwards to the security of their own particular academic silos. We need more people who stay at the table and whose full-time professional interest is the interplay in the system between the different sets of components and processes.

Certainly there has been much important work aimed at developing a systems approach to the study of human situations.¹⁶ However, it seems to me that much of this work lacks a sound conceptual base that reflects either the total dependence of human society on the underpinning processes of life or the crucial role of human culture as a determinant of the health and wellbeing of people or of the ecosystems on which they depend.

It is worth noting that social scientists have been very wary of biology ever since they had their fingers burned by social Darwinism. Yet to ignore the life processes which underpin, permeate and make possible all social situations makes no sense. We cannot hope to understand what is going on if we neglect the interplay between this fundamental dimension of the system and the cultural and socio-cultural components.

¹⁵ The expressions 'multidisciplinary', 'transdisciplinary' and 'interdisciplinary' are now in common usage, and they have slightly different meanings. However, here 'multidisciplinary' is used to cover all three meanings.

¹⁶ See, for example www.complexsystems.net.au/wiki/Complex_Dynamics_of_Urban_Systems.

In my view the biohistorical framework provides a good starting point for developing a logical conceptual approach to the integrative study of human situations. This is partly because:

- it recognises that the whole social system is life-driven and life-dependent
- it provides a framework for investigating and understanding the interplay between the parts of the system that are conventionally studied by different groups of specialists in the life sciences, social sciences and humanities
- it appreciates the significance of the evolutionary perspective for understanding current situations

Appendix

A Transition Framework

This Appendix introduces a framework designed to facilitate thinking and communicating about the ecological and health implications of different options for the future. It recognises the crucial role of human culture in the system, and it is based on biohistorical principles discussed in this chapter.

The transition framework is depicted in Fig. 7.4. It is basically an extended version of the 'biosensitivity triangle' (Fig. 7.3) and it also incorporates some of the features of the 'biohistorical framework' depicted in Fig. 7.2.

Human Health Needs and Ecosystem Health Needs

In the biosensitivity triangle (Fig. 7.3), the two boxes on the right-hand side are Healthy people and Healthy ecosystems, which are our ultimate goals in planning for a biosensitive future. However, from the planner's standpoint what is actually more relevant are the immediate requirements for health (e.g. clean air and water for human health, and maintaining biodiversity and soil fertility for ecosystem health). These health requirements are called Human health needs and Ecosystem health needs in Fig. 7.4.

Options for the future must be assessed ultimately in terms of their impacts on these health needs. Boxes 7.1 and 7.2 are working check lists of important health needs of humans and of ecosystems respectively.

Biophysical Environment

This set of factors has been inserted into the triangle because the impacts of human activities on the health needs of people and ecosystems are sometimes indirect, in that the ultimate effect on health is the result of changes brought about in the biophysical environment.

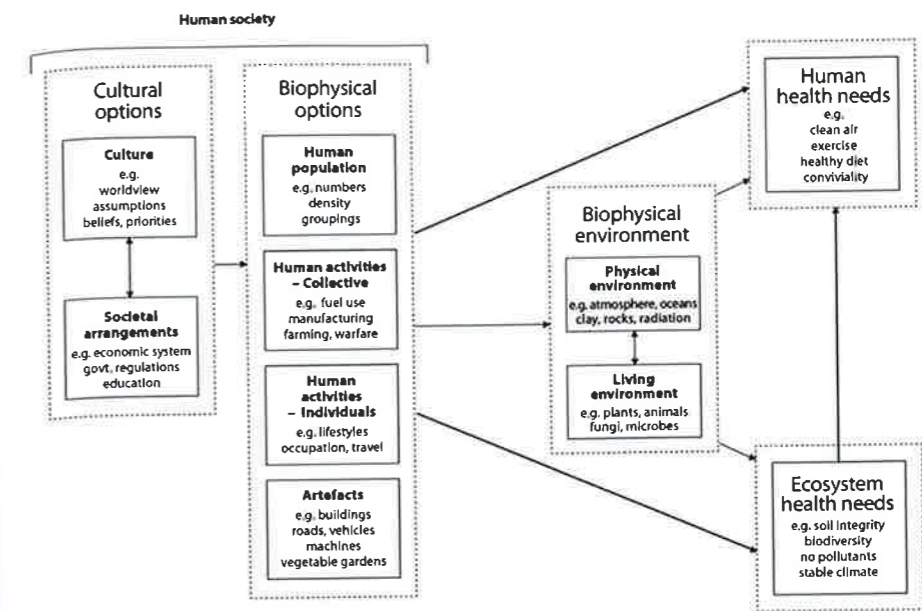


Fig. 7.4 The transition framework

For example, the human activities that result in the release into the environment of CFCs lead to chemical reactions in the atmosphere and the destruction of ozone in the stratosphere. This change in turn results in an increase in the ultraviolet radiation at the Earth's surface, which interferes with the health both of ecosystems and of humans.

Another example is provided by cases when the application of artificial fertilisers to farmland leads to eutrophication in creeks and rivers. The consequent excessive growth of algae results in anoxia in the aquatic ecosystem and then to loss of biodiversity and also to the production of toxins which can cause illness, even death, in humans and other large animals.

On the other hand, of course, many undesirable impacts of human activities on human and ecosystem health are direct – such as the effects of tobacco smoking on human health and the effects of oil spills on local fauna.

Recognising the crucial role of culture in determining the health both of humans and of the ecosystems on which they depend, *Human society* has been divided into two categories: *Biophysical options* and *Cultural options*.

Biophysical Options

Biophysical options include the biological and physical aspects of human situations that can be influenced by people's decisions and that directly or indirectly affect the all-important health needs of humans and ecosystems.

Box 7.1 Human Health Needs¹⁷**Physical**

Clean air
 Clean water
 Healthy (natural) diet
 Healthy (natural) physical activity
 Noise levels within the natural range
 Minimal contact with microbial or metazoan parasites and pathogens
 Natural contact with environmental non-pathogenic microbes
 Electromagnetic radiation at natural levels
 Protection from extremes of weather

Psychosocial

Emotional support networks
 Conviviality
 Co-operative small-group interaction
 Creative behaviour
 Learning and practising manual skills
 Recreational activities
 Variety in daily experience
 Sense of personal involvement/purpose
 Sense of belonging
 Sense of responsibility
 Sense of challenge and achievement
 Sense of comradeship and love
 Sense of security

Box 7.2 The Health Needs of Ecosystems

In light of our knowledge of the effects of various human activities on ecosystem health at the present time, we can put together a check list of ecosystem health needs, as follows:

- The absence of polluting gases or particles in the atmosphere which significantly disrupt natural cycles and processes and change the climate
- The absence of polluting gases or particles in the atmosphere which interfere with living processes (e.g. particulate hydrocarbons from combustion of diesel fuel, sulphur oxides)

(continued)

¹⁷This working list of human health needs is based on the evolutionary health principle and our knowledge of the conditions of life in the long natural, or hunter-gatherer phase of human existence.

Box 7.2 (continued)

- The absence of substances in the atmosphere (e.g. CFCs) that result in destruction of the ozone layer in the stratosphere that protects living organisms from the ultraviolet radiation from the sun
- The absence of chemical compounds in oceans, lakes, rivers and streams in concentrations harmful to living organisms (e.g. persistent organic pollutants – POPs)
- No ionising radiation that can interfere with the normal processes of life and photosynthesis
- The absence of chemical compounds in the soil that can interfere with the normal processes of life (e.g. persistent organic pollutants, heavy metals)
- Soil loss no greater than soil formation (i.e. no soil erosion)
- No increase in soil salinity and soil sodicity
- The maintenance of the biological integrity of soil (i.e. maintaining a rich content of organic matter)
- Intact nutrient cycles in agricultural ecosystems over long periods of time (requiring return of nutrients to farmland)
- The maintenance of biodiversity in regional ecosystems (including aquatic ecosystems)

Biophysical options are subdivided into four sub-categories:

- *Human population* – such as numbers of people, population density, population age structure
- *Human activities – collective* – such as manufacturing, farming, military activities and transportation.
- *Human activities – individuals* – such as lifestyle options, travel patterns, physical exercise and consumer behaviour
- *Artefacts¹⁸* – such as buildings, roads, machines, vehicles and furniture.

Cultural Options

Human activities are to a large extent governed by *Societal arrangements*, such as the prevailing economic system, governmental regulations and the institutional structure of society.

These social arrangements are in turn determined by the worldview, assumptions and priorities of the dominant *Culture*.

¹⁸Artefacts is used to mean 'things made by humans'.

For example, the cultural assumption that the best thing for our society is continuing economic growth, involving ever-increasing use of resources and energy, is a major factor affecting governmental economic policies, and consequently influencing human activities and, ultimately, the health of our planet's ecosystems.

Making Use of the Transition Framework

The transition framework emphasises the fact that the ultimate objective in planning for a biosensitive society is the health both of humans and of the ecosystems on which they depend.

The framework provides a useful starting point for assessing policy options for the future – from the level of individuals and families through to the level of national governments.

In our own work we have made use of the framework to construct a check list of the essential changes that will be necessary in different parts of the total system for the achievement of biosensitivity (see www.natsoc.org.au/biosensitivefutures/vision).

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