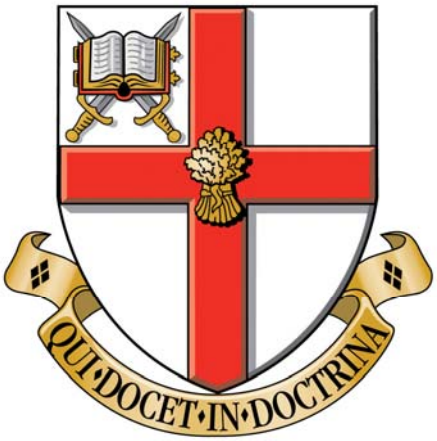

University of Chester

Solving the Conundrum of Health and Disease

Poster Presentation - Science Week 1997

Finding a concise and accurate definition of 'health' has proved illusive. This may in part be due to the desire to describe a concept which, although based upon a physical organism, does not adhere to the characteristics of a strictly quantitative entity.

To suggest that health is the absence of disease is similarly quite unsatisfactory and requires one to begin this time with a definition of disease. As one student recently put it, "disease is a constructed concept - a notion to describe the outcome of our interaction with 'agents of damage.'" This echoes the scenario proposed by Alasdair Govan and colleagues that disease might be considered as a result of:

Agent of Damage + Body's Response = Disease

Rather than clarifying matters, this typifies the conundrum for the whole equation; in fact, hinges upon the *Body's Response*. The *Agent of Damage* receives its distinction as such only if the *Body's Response* is one that conforms to the constructed concept of *Disease*. In like manner, defining disease and suggesting that the absence of disease is health does not work either.

A third and more radical approach open to the scientist may be to disregard the emotive terms 'health' and 'disease' altogether and concentrate instead upon the biological manifestations of human 'living systems.' By using the rather general yet deliberately vague term, 'living system,' one is seeking not so much to be as inclusive

as possible but rather to avoid the exclusion of factors which influence human biology.

As the consequence of a considerable evolutionary past which shaped the very bodies that the more recently acquired emergent phenomenon of consciousness seeks to describe in terms of 'health' and 'disease,' our approach is at best incomplete - and more likely to be woefully inaccurate.

Seeking A New Synthesis For Health and Disease – An Evolutionary Approach

'Nothing in biology makes sense except in the light of evolution.' (Theodosius Dobzhansky, 1973.)

Although originally meant as an explanation of how biological forms change with time, the scope of the theory of evolution has been found to be applicable to a wide range of biological phenomena. Perhaps the simplest definition of evolution, and one that has frequently been used, is 'descent with modification.' This definition is useful in its simplicity and its absence of ambiguity and directionality. 'Descent' simply refers to a progression from one generation to another and 'modification' refers to any form of change which then becomes available, under the appropriate circumstances, for descent to subsequent generations. There is no sense of a target form or function or any other quality at which an organism is aimed - it is a blind process.

An evolutionary approach to health and disease is one which views both equally and without preconceived value-judgements. The average individual will desire good health and wish to avoid disease as being a bad thing. From an evolutionary point of view, neither takes precedence over the other; they are both biological states. That which confers greater opportunity to produce viable descendants is that which is biologically advantageous. Thus,

definitions of health and disease become relative and distinct from those which call upon some notion of 'quality of life.'

Such an approach is primarily mechanistic in character - with the term 'mechanistic' being used quite deliberately, for one is concerned with the machine that is the human being and how this functions. Although it might be argued that such an approach leaves humans incomplete, lacking their psychological, social and even spiritual dimensions, it is an approach which excludes these aspects so that factors in human experience, which would be otherwise overlooked by more 'qualitative' approaches, can be better understood.

The evolutionary approach is not taken because it is a prevailing biological dogma which should, therefore, be applied to the study of health and disease. Rather, it allows a distinct perspective on the relationships between human beings and the environments in which they live. No species exists in total isolation. Frequently, external factors are found to have subtle influences shaping them. The evolutionary approach, as applied to humans, is also one which questions constantly why they are as they are and seeks to explain current health problems in the light of how they have evolved. Whilst, for example, humans have evolved many unique capabilities which set them apart from other species, some characteristics have remained essentially unchanged, persisting, in effect, as remnants of a former mode of existence. At some stage in human history, when salt, fat and sweet foods were not as readily available as they are now, a physiological mechanism that produced a craving for these substances so that they were consumed whenever possible, was advantageous in ensuring the maintenance of necessary physiological stores. This mechanism has not been lost. Compared with the pace of biological evolution, there has been a rapid

transition to a society where such foods are now in abundance, such that consumption of excess quantities of dietary salt, fat and sugar are now implicated in a number of modern health problems.

Having previously excluded non-mechanistic factors so as to understand human function and dysfunction, it then becomes possible to take a more informed approach to healthy living and to the prevention and cure of disease when the more 'qualitative' interpretations are reintroduced to form a pertinent synthesis.

'Never were so many facts explained by so few assumptions. Not only does the Darwinian theory command superabundant power to explain. Its economy in doing so has a sinewy elegance, a poetic beauty that outclasses even the most haunting of the world's origin myths.' (Richard Dawkins, 1995.)

The duty of the physician, it has been suggested is 'to cure, sometimes; to help, often; to console, always' (on a statue to the physician E.L. Trudeau). To this, Darwinian Medicine can add a much broader level of understanding.

The Adaptationist Program – (Darwinian Medicine's *bauplan*)

A program of research based upon the demonstration, or otherwise, of the adaptedness of individuals and their characteristics has been referred to as an 'adaptationist program.' The questions investigated consider what are or might have been the selective advantages responsible for the presence and shaping of particular anatomical and physiological features. The application of the adaptationist program has led to important discoveries in many branches of biology and is now being applied to the study of health and disease under the banner of Darwinian Medicine.

Almost any change that occurs in the course of evolution may, however, be the result of chance rather than natural selection. Whereas one is unlikely ever to be able to prove the action of

chance, it is possible to show that the possession of a certain feature might be favoured by natural selection. Hence, it is from this direction that research proceeds. Only after there has been failure to show a role for natural selection in the production of a given feature may one venture to propose that chance is its cause.

But it is not a program for the faint-hearted. As Ernst Mayr puts it, 'the student of adaptation has to sail a perilous course between a pseudoexplanatory reductionist atomism and stultifying nonexplanatory holism' - a voyage which he also likens to sailing between Scylla and Charybdis.

Branches for Study

Randolph Nesse and George Williams, in 'Evolution and Healing', proposed that, for purposes of study, evolutionary explanations for disease may be addressed via relatively few categories, each forming the basis for a whole new field of research.

Defences - It is essential to be able to differentiate between a physiological defect and a defence. A mechanism such as a cough may be a painful manifestation of a disease process but it also has an important function - that of expelling harmful organisms from the throat. Medication which suppresses a cough without, at the same time, attacking its cause may do more harm than good - the defence mechanism would be suppressed simply to allow the harmful organisms an easier time.

Infection - In Darwinian terms, the relationship between humans and micro-organisms is a complex one, frequently seen in terms of an 'arms race' where each is trying to keep one step ahead of the other. Thus, the relative advances in attack and defence form a co-evolutionary relationship. Organisms which elicit a cough, as above,

may also be utilizing that mechanism as a way of spreading themselves via the droplets discharged.

Novel Environments - Human bodies evolved slowly over millions of years in response to environmental influences experienced within a relatively confined geographical area. Such an environment is called an environment of evolutionary adaptedness (EEA) and may be viewed as that to which a species is best (although not necessarily perfectly) suited. The rapid spread of humans over the whole planet, away from their particular EEA, and their ability to further modify the new environments that they have entered, means that humans are now commonly found in settings quite unlike those for which they were 'designed.'

Genes - Many genes that may lead to disease do so only under particular circumstances. A genetic constitution which may predispose to arterial disease may do so only when there is also a diet high in certain foodstuffs. That is not to say that these genes should be considered as faulty. Their presence in the genome may be due to their confirming positive benefits in the original EEA. Other genes known to lead to disease do so only when two copies of that gene are inherited - one from each parent. But, while inheriting two copies certainly leads to disease, inheriting just one copy seems to confer positive benefits on an individual - more so than had no copies of that form of the gene been inherited. Thus, at the foundation of certain diseases, there is really a mechanism which seeks to confer benefit.

Design Compromises - There are many costs associated with making fundamental modifications to any machine - be it a car or a human being. The aim in all redesign work is to keep these costs to a minimum. This principle also applies to biological change. What may, therefore, seem to be design flaws in the human body may be

better understood as cost-cutting design compromises. Therefore, to understand the apparent dysfunction in certain body components or processes, it is better first to understand why there should be such compromises and what were the cost benefits that led to them.

Evolutionary Legacies - Evolution is an incremental process; a process which has also been referred to as 'tinkering.' Depending upon what is available for this tinkering, it is often impossible to go back and start again. The evolutionary process has to make do and use the material and processes that are available. This, in turn, may lead to features that could conceivably have been better designed.

Darwinian Medicine is still very much in its infancy. Whether some of these categories will merge as others split remains to be seen. Whatever happens, it is evident that new ways of understanding what we currently call 'health' and 'disease' are opening up - familiar experiences are being viewed through new eyes which are taking the time to ponder.

'Poor man, he just stands and stares at a yellow flower for minutes at a time. He would be far better off with something to do.' Charles Darwin's gardener.