

The case for developmental gerontology — Thompson's octad

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'I find myself let down by all those bright ideas that we are taught,
The customers refuse to need the sort of help we thought they ought!'¹

Introduction

THIS is a time of crisis for general practice — the problems faced are so great that many eminent practitioners have come to view their resolution as the subject matter of the discipline. Honigsbaum believes that the main problem lies in the type of care offered by general practitioners rather than the quantity.² He distinguishes between the programme proposed by the British Medical Association which would draw general practice closer to hospital medicine and the campaign of the RCGP for preventive medicine. He considers that general practitioners would gain security by the treatment of priority groups such as the aged and mentally ill, delegating routine work to nurse practitioners. Hart asserts that we are overtrained for what we do in general practice because the definition of good doctoring in teaching hospitals is inappropriate to work in the community³ and Wilkes believes that we must accept the failure of vocational training schemes to instil any pattern of genuine continuing education.⁴ Howie has suggested that emphasis should be placed on behavioural instead of cellular research,⁵ while Freeling has made a plea for increased understanding of patients by improving communications between doctor and patient.⁶

Thus, this is a period of transition during which the profession is changing its view of its field, its methods and its goals. The proposals for change presented here concern general practitioners and not hospital doctors, for whom traditional methods of medical practice remain adequate. For them the teaching of medicine remains a function of hospital based specialists and patients are studied at the molecular level. General practitioners, however, seek to understand their patients as whole people. The difference between specialist teaching in hospitals and the needs of general practitioners is increasing. Many patients are now turning to alternative medicine and many doctors are embracing holistic medicine, and this demonstrates the need for a new medical model.

This century has seen major biological changes. The young mature earlier and human fecundity can be controlled, but of greater importance is the ageing of populations in developed countries. The future of medicine lies in geriatric medicine, despite the silence of the College on this important change and the lack of a section devoted to geriatric medicine in the Royal Society of Medicine. This is a new specialty, which is not yet clearly differentiated from general medicine. Geriatricians have made remarkable developments but they work in artificial communities concerned mainly with rehabilitation, and are therefore unable to teach general practitioners what they need to know — the natural history of diseases affecting the elderly and measures to prevent these diseases.

Practice audit

I began a practice disease index in 1979, and while it was fairly successful for those under 50 years of age, for those over that age it was less so, owing to multiple pathology requiring a complex system of cross reference. I noted that a small number of diseases were preponderant. I therefore decided to carry out a practice audit of patients aged over 70 years for the following three years. In 1968 150 patients had been screened and their records were still available. A case-finding programme was organized, excluding 41 of the original 150 patients who were still alive, to assess another 150 patients, bringing the total to 300. Details of 273 patients over the age of 70 years who had died in hospital and for whom there were full reports of investigations or post-mortem examinations were also recorded. I had issued 178 death certificates during 30 years of practice, and after duplicate information had been removed 114 of these were included, particular attention being paid to the contributory causes of death. In total 687 records were studied of which 84 were excluded (12%) because of accidental death.

Diseases affecting the elderly

Thus it was possible to study the diseases affecting 603 patients aged over 70 years. The mean number of diseases was 3.2 per patient and it was interesting to note that they could not be classified into mutually exclusive categories. Although there were numerous cases of osteoarthritis, one case of motor neurone disease, two cases of Parkinson's disease and several patients with asthma, there emerged eight diseases affecting 86% of these elderly patients which could be called 'diseases of ageing'. These diseases were distributed uniformly in the elderly practice population and this suggested that they were of intrinsic, rather than extrinsic origin. They were:

- Essential hypertension
- Atherosclerosis/hyperlipidaemia
- Obesity
- Late onset (type II) diabetes
- Immunological failure
- Autoimmune disease
- Cancer
- Endogenous depression

All eight diseases have features in common, suggesting that there might be a common factor in the pathogenesis. It is well known that there is a relationship between obesity and both diabetes and hypertension. Even depressive illness is sometimes correlated with oversecretion of cortisol and a tendency to obesity.^{7,8} All of these diseases were of uncertain aetiology and while the time of their onset could not be stated it is certain that they were evolving long before they could be observed clinically. Furthermore, the effects of these diseases can be said to lie on a continuum between apparent normality and gross disturbance, with differences in the degree of severity of the disease depending on the rate of their progression. Frustration and scepticism still exist among doctors who have been trained to diagnose and cure disease,⁹ and the role of the modern general practitioner is held back by the old medical model derived from teaching hospitals.

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The need for new intellectual tools

Much of the frustration felt by doctors when practising clinical medicine in the community is derived from the emphasis placed by teaching hospitals on discrete abnormalities rather than on those characteristics found to a greater or less extent in everyone. General practitioners should no longer pursue a disease in a patient. Instead they should construct new concepts of illness composed of overlapping sets. Feinstein put it as follows: 'I wanted to find mutually exclusive clinical categories for classifying patients, but I could not get the different categories separated. They all seemed to overlap, and I could find no consistent way to separate the overlap.'¹⁰ He then tells of a solution that struck him after an evening spent struggling with the problem: 'I did not have to remove the overlap; I could preserve and classify it. Boolean algebra and Venn diagrams were a perfect intellectual mechanism ... to distinguish multiple properties that could be present or absent, alone or in combination.'

Therefore, those intending to enter general practice should have a basic training in these aspects of mathematics. The teaching of Boolean algebra began in schools in this country in 1962 but few young doctors or trainees, if any, have been encouraged to apply it to medical practice. Let us consider how Venn diagrams might be applied to hypertension and obesity, and their relationship.¹¹

If set A represents obesity, and set B represents essential hypertension there are five possible relationships (Figure 1). Because overlapping is the most common and important relationship among biomedical sets, it is instructive to look at those patients in the subset represented by the shaded area in Figure 1(b). However, there will still be the obese patient with sustained high blood pressure who loses three stone in weight but whose blood pressure remains unchanged.

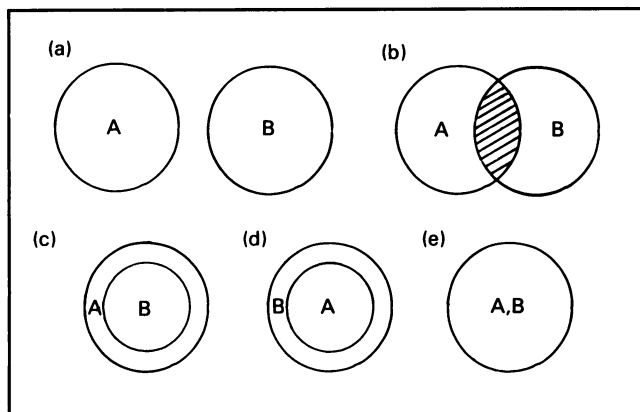


Figure 1. Set A represents obesity and set B essential hypertension. The five possible relationships between these two sets are shown. (a) A and B are mutually exclusive. (b) A and B intersect. (c) B is a subset of A. (d) A is a subset of B. (e) A and B are identical.

Human development and gerontology

We are all taught that for a multicellular organism to be independent of environmental factors it must have a stable internal environment.¹² The general principle behind the maintenance of this stability is negative feedback control. It is now equally important to understand that an organism cannot develop and grow in a stable homeostasis but only where there is a programmed deviation, and that development can only be ensured when the activity of homeostatic systems increases with growth. In the old medical model the life cycle has three phases — development, maturity and degeneration. However, as it cannot be determined when development ends and degeneration begins this sug-

gests that this model is wrong. The old model also explains why, in the general practice setting, there is great interest in human development in patients of pre-school years and why this interest fades away when these patients reach puberty. Furthermore, the unpopularity of geriatric care is understandable, for who wishes to look after patients who are 'degenerating'?

Of interest is the advantageous effect of pregnancy on diseases such as rheumatic disease, and its prevention of infectious mononucleosis in young women; while other pregnant women, especially older primigravidae, are more vulnerable to obesity, hypertension and glycosuria. In pregnant women the mechanism of development is localized in the placenta.

In 1961 Robertson and colleagues published a paper demonstrating degenerative change in the cardiovascular system of the spawning Pacific salmon.¹³ Before it spawns, the Pacific salmon accumulates considerable fat stores in the liver and muscles, forming a hump. During spawning, blood glucose levels double, levels of 11-hydroxysteroids rise nine times and blood cholesterol levels rise to as much as 1000 mg per 100 ml. These changes occur irrespective of age. Shortly after spawning, the Pacific salmon dies from natural causes and infarct damage histologically similar to those of an ageing mammal. This suggests the natural death of the Pacific salmon due to violation of the law of constancy of the internal environment, and the confluence of what might be called 'natural' diseases — hyperlipidaemia, diabetes, hyperadrenocorticism, arteriosclerosis and intimal thickening.

These changes and specific illnesses may also be programmed to take place in human beings, but over a longer period, their frequency increasing regularly with advancing age. The vague and socially unacceptable term 'ageing' should therefore be abandoned and we should think in terms of development proceeding to the end of life. Development occurs most rapidly in early life and slows in the elderly; it is accelerated at puberty and by certain departures from normal living, such as prolonged stress. Accelerated development is also seen when the fetus of a diabetic mother develops hyperinsulinaemia, converts glucose into fat, and is delivered as a fat baby weighing more than 4 kg, its biological age temporarily exceeding its chronological age.

Preventive medicine and the natural history of disease

Preventive medicine is the main function of general practice and it depends upon a knowledge of the natural history of disease. Unfortunately, most research into ageing (or development) has been conducted at the molecular level on cells cultured outside the body in an artificial environment. It would generally be agreed that interactions between tissues are as important to the pathology of ageing as they are to the physiology of embryonic development. However, embryonic development progresses by non-damaging interactions whereas age-dependent disorders appear to result from errors in central control systems which subsequently give rise to strong pathogenic interactions.

The system of teaching in hospitals, designed to produce specialists skilled in intervention with a view to early discharge of patients from hospital, is unsuited for general practice. In general practice a modification of biological ageing should be attempted so that a number of diseases are affected concomitantly. General practitioners are uniquely placed to study age-specific pathology and disturbances of homeostasis. Research and teaching should therefore move into the community where longitudinal studies can be carried out. Ten years of education is required for the position of principal in general practice and this period should be spent where human development takes place. At present most of this time is lost studying relatively uncommon conditions requiring acute intervention.

Specialty education for general practitioners

It is increasingly felt that the general practitioner's role is becoming blurred, or even eroded as much of his work can be performed by others, such as social workers, health visitors, attached midwives, local opticians, and more recently by pharmacists. What cannot be delegated is continuity of care, and this becomes increasingly important the longer a doctor remains in his practice. I have spent 30 years in my practice and I now spend 50% of my time with older patients. These patients are a different generation from those I first encountered in 1955. I believe that for the first time in human history there are important measurable differences between one generation and another. This has already been noted by cross-sectional sampling and is continuously observed by general practitioners who are the most durable members of primary health care teams. It is only recently that a large proportion of women in developed countries live beyond the reproductive phase.

Crisp has shown that the menarche occurs when a critical weight of 47 kg is reached¹⁴ and puberty can begin at the age of nine years with an increase in weight and a widening of the pelvis. It is important to understand that fat is stored in order to provide cholesterol which is a vital requirement of the mammalian cell wall. Therefore, fat is deposited before a growth spurt, and females normally have more subcutaneous fat than men, so that they are always primed for pregnancy. Howie may have been too severe in discounting the cellular approach in preference to the behavioural,⁵ because the former would readily explain normal deviations of appetite, such as the cravings of pregnancy. It is also worth noting that up to a certain age the yellow marrow is a fat store for cytopoiesis, and also that the only cells unable to synthesize cholesterol, the cerebral neurones, never divide, or become malignant.¹⁵

The energy and reproductive homeostats

These homeostats are closely associated in the hypothalamus, as exemplified by girls suffering from anorexia nervosa, and the fact that obese women have a later menopause than non-obese women. Tissue sensitivity to insulin reduces with advancing age and this results in postprandial hyperinsulinaemia and the deposition of fat as age advances, of the type that is resistant to dietary management. Robertson noted hypertrophy of the islets of Langerhans with increasing age,¹³ but Reaven and colleagues showed that the increased incidence of atherosclerotic heart disease observed in patients with abnormalities of carbohydrate tolerance is related to hyperinsulinaemia.¹⁶ Nestel and Whyte reported that the plasma free fatty acid turnover rate is related to the degree of obesity rather than to the total body weight in older people and women in late pregnancy.¹⁷ Therefore, with ageing glucose is used less for energy while free fatty acid is used more. This situation is also found in early development when growth hormone output rises at night during fasting.

It might be true to assume that, like the Pacific salmon, women start to degenerate after the menopause, when appetite no longer adequately regulates food intake. The fat content of the body increases with age even when body weight remains stable,¹⁸ and this produces a prediabetic state.

The striking constancy of factors associated with ageing, and the regular finding of older people suffering from eight overlapping diseases, suggests that ageing is governed by regular patterns and hormonal shifts, rather than probability factors.

The adaptive homeostat

Adaptive changes are effected by the neuroendocrine system. It should be noted that a high blood cortisol level is found in

those prone to coronary thrombosis. In addition, the decrease in the tolerance of carbohydrates associated with ageing is to a considerable extent a result of excessive glucocorticoid action. There is a link between all of the eight diseases commonly found in the elderly, for example, between psychic depression and hypercortisolaemia,⁷ and hypertension is described by Dyer and colleagues as a risk factor for cancer mortality.¹⁹ The ability to adapt decreases with increasing age, and in general practice the doctor is increasingly involved with states characterized by an elevated output of glucocorticoids which is not caused by external, but by internal factors.

A further example of the adaptive homeostat is that from the age of 25 years onwards men have increasing levels of cholesterol in the blood so that the risk of myocardial infarction has increased by several hundred per cent at the age of 50 years. However, women remain stable in this respect until their menopause, although a late menopause is associated with an increased risk of breast and endometrial cancer.

The rate of ageing

It is clear that in general practice we are concerned with a limited number of diseases of ageing and chiefly with the rate at which they develop. In addition to blood pressure screening, monitoring and control it would appear that the whole individual will need to be monitored in future. The diseases identified here and to which attention is increasingly directed are often called the 'diseases of civilization'. They are not caused by civilization; but changes in life-style have introduced greater uncertainty into the mechanism which establishes diseases of ageing. Health education stresses that smoking, overeating, stress and lack of exercise should be avoided. These four might be said to accelerate the appearance and course of diseases of ageing, some of which might not otherwise have appeared during the life-cycle, only in projected time after death from some other cause.

Smoking

It is an oversimplification to state that such disparate diseases as ischaemic heart disease and bronchial cancer are caused by smoking. In a general practice study Tyler and colleagues found that all patients with malignant disease of all kinds, apart from skin cancer, smoked more than controls.²⁰ Smoking accelerates the ageing process, and its sympathomimetic action is similar to stress — diseases that are latent are brought forward in the life-cycle. It is not surprising that the RCGPs' Oral Contraception Study showed that smoking increased the risk of arterial disease in both pill users and controls, and the risks were greatest in older women.²¹

The menopause should be regarded as a normal disease of ageing and I have confirmed in my own practice the work of Jick and colleagues that women who smoke have an earlier menopause than those who do not.²² Allowing for the fact that obese women have a later menopause than non-obese women, my study showed that the great majority of women smokers reached their menopause when they were less than 50 years of age, although the average age has remained at 50–51 years since medieval times.²³

Stress

Stress results in intensified activity of the hypothalamic–pituitary–adrenal complex. Excessive cortisol leads to the predominant use of free fatty acids for energy, and to a metabolic pattern favouring immunodepression, with reduced function and numbers of T lymphocytes. Stress is often followed by depression, and equilibrium — including such factors as mood and blood pressure levels — is regained more slowly

by older people. It is interesting to note that young people lose their appetite when under stress, while there is usually an increase of intake in older people.²⁴ There is some evidence to suggest that the effect of dietary restriction in prolonging the life of rats by extending the period of immaturity²⁵ may also occur in human beings.

While specific immune reactions, such as hay fever and new cases of asthma, diminish with advancing age, the capacity for autoantibody synthesis is unimpaired. As many as 10% of the population aged over 60 years have one or more antibodies to self-antigens, such as antitissue antigens, antinuclear antibodies or rheumatoid antibodies.

Conclusion

As Ludwig suggests,²⁶ the current model of medicine is ecological, stemming from an era of specific diseases caused by specific microorganisms or dietary deficiencies. The medical student must learn details of hundreds of diseases, and become proficient in the skills of identification and classification. Adherence to this model is producing a sense of crisis in general practice today. The student should be taught an understanding of overlapping phenomena, and have to assess human developmental change throughout life to the point at which the internal environment becomes too unfavourable to sustain it. This involves a reconstruction of education and training. To teach developmental gerontology would be difficult in hospitals. Instead, such teaching should be gradually transferred to general practice for the study of the eight major diseases of ageing, which are of intrinsic origin, but of which little is known at present.

I have attempted to show that the unattractive aspects of geriatric medicine derive from the concept of deterioration, whereas senescence is in fact a programmed development and a normal disease process since it can be assumed that the human organism would die, even in a perfect artificial environment. Living is in itself stressful, and death results when the deviation from homeostasis is too great and the internal environment can no longer sustain life. It is this concept which will serve general practice best — the knowledge of the natural history of disease, preventive medicine, monitoring and caring, rather than intervening. It will make prognosis more accurate than at present, and perhaps more important than diagnosis.

During the transition period there will be an overlap between the problems capable of solution by the old and by the new methods, but when the transition is complete the profession will have changed its view of geriatric medicine, its goals and its methods. It has been suggested that emphasis be placed on new intellectual tools such as Boolean algebra and set theory in order to understand overlapping abnormalities and multiple pathologies of which eight occur individually or in combination so regularly in the elderly as to suggest some general cause.

I could not conclude better than with the words of Claude Bernard:

'We shall never have a science of medicine as long as we separate the explanation of the pathological from the explanation of normal vital phenomena.'¹²

References

- Wallis J. The model member's song. *J R Coll Gen Pract* 1985; **35**: 111.
- Honigsbaum F. Reconstruction of general practice: the way forward. *Br Med J* 1985; **290**: 904-907.
- Hart JT. The world turned upside down: proposals for community-based undergraduate medical education. *J R Coll Gen Pract* 1985; **35**: 63-68.
- Wilkes E. Is good general practice possible? *Br Med J* 1984; **289**: 85-86.

- Howie JGR. Research in general practice: pursuit of knowledge or defence of wisdom? *Br Med J* 1984; **289**: 1770-1772.
- Freeling P. My doctor. *J R Soc Med* 1985; **78**: 8-17.
- Feinberg M, Carroll B. Biological markers for endogenous depression in series and parallel. *Biol Psychiatry* 1984; **19**: 3-11.
- Kretschmer E. *Physique and character*. London: Kegan Paul, 1936.
- Rothapel G. BP Press Fellowship Paper. 1985: 11.
- Feinstein AR. Boolean algebra and clinical taxonomy. Analytical synthesis of the general spectrum of human disease. *New Engl J Med* 1963; **269**: 929.
- Anonymous. Weight reduction in hypertension. *Lancet* 1985; **1**: 1251.
- Bernard C. *An introduction to the study of experimental medicine*. Greene HE (Trans.). New York: Henry Ackerman, 1949.
- Robertson OH, Wexler BC, Miller BF. Degenerative change in the cardiovascular system of the spawning Pacific salmon. *Circ Res* 1961; **9**: 826-834.
- Crisp AH. Anorexia nervosa. *Br Med J* 1983; **288**: 855-858.
- Bortz WM. On the control of cholesterol synthesis. *Metabolism* 1973; **22**: 1507-1524.
- Reaven GM, Olefsky JM, Farqhar JW. Does hyperglycaemia or hyperinsulinaemia characterise the patient with chemical diabetes? *Lancet* 1972; **1**: 1247-1249.
- Nestel PJ, Whyte HM. Plasma free fatty acid and triglyceride turnover in obesity. *Metabolism* 1968; **17**: 1122-1128.
- Dudl RJ, Ensinnck JW, Palmer HE, et al. Effect of age on growth hormone secretion in man. *J Am Endocrinol Metabolism* 1973; **37**: 11-16.
- Dyer AR, Stamler J, Berkson DM, et al. High blood-pressure: a risk factor for cancer mortality. *Lancet* 1975; **1**: 1051-1056.
- Tyler SJ, Finch RM, Finch J, Patel B. Smoking and malignant disease: a general practice study. *J R Coll Gen Pract* 1984; **34**: 589-592.
- Royal College of General Practitioners' Oral Contraception Study. Incidence of arterial disease among oral contraceptive users. *J R Coll Gen Pract* 1983; **33**: 75-82.
- Jick H, Porter J, Morrison AS. Relation between smoking and age of natural menopause. *Lancet* 1977; **1**: 1354.
- Utian WH. *Menopause in modern perspective*. New York: Appleton-Century-Crofts, 1980.
- Johnson WM. Different weight responses to the same provocation. *JAMA* 1947; **133**: 1238.
- McCay CM. In: Lansing AI (ed). *Problems of ageing*. Baltimore: Williams and Wilkins, 1952.
- Ludwig FC. What to expect from gerontological research. *Science* 1980; **209**: 1071.

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How effective was No Smoking Day?

National No Smoking Day 1984 was sponsored for the first time by a coalition of national organizations, with a budget of £50 000. The aim of the event was to obtain maximum publicity for smoking and health and to encourage smokers to attempt to give up, at least for the day.

An evaluation of the campaign has revealed that the day generated considerable publicity, stimulating at least 1140 reports in the media, with 13 each on national TV and radio. It was also widely supported at local level. Up to 1.8 million smokers took part by giving up, attempting to give up, or reducing consumption on the day. An estimated 500 000 reported that they were smoking less three months later, as a result of hearing about the day. Follow-up research suggested that these results could be improved by laying greater emphasis on helping smokers to give up, rather than on 'anti-smoking', in future.

The event was repeated in 1985 and, according to preliminary analysis, similar levels of awareness and participation were achieved.

Source: National No Smoking Day Steering Committee, 1984. How effective was National No Smoking Day, 1984? *Health Educ J* 1985; **44**: 59-65.