imbalance between intake and expenditure is appearing even in childhood. The schoolboy no longer creeps 'like snail unwillingly to school', he is whisked from home in public transport, he finds sedentary recreation gazing at the television screen. The adult at his desk or at the wheel of his car finds difficulty in disposing of the energy in the food for which his alimentary canal clamours. The elderly, deprived of their occupations, with growing physical disabilities, are increasingly faced with this very problem. Intake of energy has to be adjusted to a new level of expenditure. Inactivity itself has grave metabolic repercussions. Voluntary simple reduction of intake only too often throws the machinery of the gut out of gear. The fear of constipation is a very real phobia and we do not know what are the effects of the almost universal recourse to the frequent, even daily, use of purgatives.

In the elderly, too, there may be more subtle disturbances, changes, for example, in endocrine activity with effects on metabolism.

There is much active day-to-day empirical therapy of the elderly, but little hard fact to justify our practice. Inevitably the energies and resources of the National Health Service are for the moment fully occupied with the daily care of elderly patients. But we lack a real understanding of the physiology, biochemistry and pathology of senescence. Without such knowledge we have little hope of preventing, or treating successfully, the disabilities of the elderly. We must have intensive clinical observation in the wards and biochemical metabolic studies in attached laboratories.

Initially at least the need is for the old-fashioned type of balance study, so that we may know what goes into the patient, how he deals with the nutrients and through what channels and in what quantities he loses materials of essential nature.

Above all, we must see the elderly in continuity with youth and middle age. We accept that the child is father of the man. We could equally well say the elderly person is the child of his youth and years of maturity. The elderly do not form a special isolated section of the community: we must continually hark back to the earlier years. When studying the disabilities of those who are growing old we must probe the past history. Can the present state be explained by past practices especially in nutrition? Above all, an unusually fit elderly person ought to arouse our inquisitiveness to the maximum. Can the fitness be all ascribed to a wise choice of parents?

The physiological changes which occur in a man as he grows older

By K. J. FRANKLIN (EMERITUS PROFESSOR OF PHYSIOLOGY, UNIVERSITY OF LONDON), *Broomfield, Yarnton, Oxon*

The Hon. Programmes Secretary of The Nutrition Society graciously invited me some time ago to contribute to this symposium an article on 'The physiological changes which occur in a man as he grows older'. I accepted partly because I had written about the formation of the Society in my biography of the late Sir Joseph Barcroft, and was glad to have the opportunity of a personal meeting with the present members. At a Ciba Colloquium on the General Aspects of Ageing which I attended

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in London in July 1954, one of the speakers spoke of those who 'pontificated' as they grew older, and I hasten to assure you that such is far from being my intention. Rather is my attitude more in accord with that of an annotator who wrote in the *Lancet* (Anonymous, 1953): 'As we grow older we get acquainted with infirmity; but we do not, on that account, class ourselves as old and infirm; we think of ourselves as we have always thought of ourselves, and of our ailments as passing ailments. This proper and stalwart attitude needs fostering . . .' and, though I shall use the chapter on *Physiology in Old Age* in the late Sir Humphry Rolleston's (1932) book, *Medical Aspects of Old Age*, as a partial source of information for this address, I find it somewhat depressing reading. The late Sir Charles Sherrington, when 90 years old, modestly wrote, 'To live to be my age is no act of merit . . . The years do indeed "run" . . . Youth's the time.'

In an earlier publication (Rolleston, 1927), *Concerning Old Age*, Sir Humphry had written: '*Functional activity*, mental and physical, plays a great part in keeping the body, when free from disease, trim and slim and in postponing the advent of morbid old age. Occupation with a keen desire to carry it through is so beneficial that some, such as Karl Marx, would regard old age as largely a question of will power.' In speaking of the circle in which Madame de Deffand had lived, Lytton Strachey (1922) said 'They refused to grow old; they almost refused to die. Time himself seems to have joined their circle, to have been infected with their politeness, and to have absolved them, to the furthest possible point, from the operation of his laws', and all the members of the circle lived to be well over 80, with the full zest of their activities unimpaired. Rolleston went on 'The advice then to give others, and even to practise ourselves, should include a judicious choice of parents, avoidance of disease and worry, moderation in all things, mental and physical exercise, an open-air life, serenity and charity to all men', or if Leonard William's epigrammatic summary is easier to remember: 'Fresh air, meagre food, freedom from care.'

Ivy (1945) repeated Sir Humphry's view in 1932, though in other words, about the place of heredity as the most important factor, barring specific accidents of injury or infection, in determining the age which we are likely to reach, or 'the span of life' (Rolleston, 1927).

In general I am diffident about discussing the changes which occur in a man as he grows older, not for reasons of shyness or the like, but because my criteria may possibly have changed in consequence of a cerebral infarct which I collected as the result of misguided overworking in late 1956. I am, therefore, summarizing on the whole Chapter 6 in Rolleston's (1932) book, while noting that his Chapter 7, on *The Description of Old Age in the Twelfth Chapter of Ecclesiastes* is vivified by what one who used to be sub-Librarian of the Bodleian Library told me was the true translation of 'Remember now thy Creator in the days of thy youth.'

Rolleston (1932), then, said that the basis of the physiology of old age is progressive diminution in functional activity, and 'whatever may be said in favour of it', to quote Thomas Bernard, 'old age is a losing game'. The response to stimuli of all kinds is diminished, the skin is dry and the hair usually more scanty and often getting whiter,

there is less intestinal secretion of mucus, and perhaps thereby a tendency to constipation; thyroid secretion is less. Sensibility to pain decreases, but there is increased sensitivity to cold. Taste and smell are impaired, presbyopia and a contracted state of the pupils and sluggishness of the irides arise, while weakness of the orbicularis palpebrarum muscle may tend to ectropion and epiphora, there may be reduction in the acuteness of hearing, and the appetite may be capricious. Muscular movement is slow and somewhat uncertain, the tendon-jerks sluggish and tending to go, and sleep is less continuous. Psychical activity diminishes, and the higher faculties go first; initiative, originality and sense of humour fail, new ideas and fresh lines of thought are assimilated with difficulty. There is mental fatigue and less agile memory for names, anecdotage, a tendency to mislay things, and unconscious carelessness about personal appearance and habits. Affection wanes, and new friendships are formed with difficulty. There is selfish dependance and demands on friends. Senile vanity is not uncommon; all old people love to be in the centre of the stage, one of the most pathetic things in life being that they are seldom allowed to be there. There is a passionate, absorbing, almost bloodthirsty clinging to life, the pulse rate is usually raised, high blood pressure without renal disease is common. The urine is somewhat less in quantity and there is a fall in its solids. Sexual activity is usually less after 50, and wounds and fractures heal more slowly, though age per se is no bar to operations. The physiological response to drugs is slower and more prolonged.

I think you must agree with the remark I made earlier on, that *Medical Aspects of Old Age* (Rolleston, 1932) is somewhat depressing.

So too is it to reflect upon the change in our distinguished Bart's physiologist, William Harvey (1578–1657), referred to by Lord Arundel in 1636 as 'that little perpetual movement Dr. Harvey', to the somewhat tired man revealed in his letters from 1653 to 1657. For on 3 November 1653 he wrote to Dr Giovanni Nardi, of Florence, 'I am myself now almost an octogenarian, my physical powers are tottering with my body broken, yet with my mind active.' Then on 1 February 1654–5 he said to Dr Johann Daniel Horst, Chief Physician of Hesse-Darmstadt: 'I could wish that it might be given me to satisfy your request in the way that you would like. But in fact my age denies me that pleasure, partly because I have not many more years to go, partly because I am often unduly distressed by recurrence of ill health.' The following year he wrote on 13 July to the same physician: 'My now too long a tale of years causes me to repress from sheer weariness any desire to explore new subtleties, and after long labours my mind is too fond of peace and quiet to let myself become too deeply involved in an arduous discussion of recent discoveries . . . As to your suggestion that I should deal with the true use of the newly-discovered ducts, that is indeed a matter of greater moment than befits a broken old man entangled in other cares'. Finally, on 24 April 1657, he wrote, just before his death, to Jan Vlackveld, of Haarlem, 'But it is useless to spur me on . . . when I am not only ripe in years but also—let me admit—a little weary.'

But there is a further interesting excerpt from Harvey's biographical details, namely, the account of the autopsy findings in 1635 in the Shropshire smallholder,

named Thomas Parr, who was reputed to have been the unbelievable age of almost 153 years at his death, a claim which Rolleston (1927) described as fabulous. The passage, translated by Arnold Muirhead, read as follows, and is given with his kind permission.

Harvey's notes, so rendered, state, *inter alia*, that Parr's 'testes were large and sound and good enough not to give the lie to the story currently told of him that, after reaching his hundredth year, he was actually convicted of fornication and punished. Moreover, his wife, a widow whom he had married in his hundred and twentieth year, in reply to questions, could not deny that he had had intercourse with her exactly as other husbands do, and had kept up the practice to within twelve years of his death . . . Until just before it, although he had been blind for twenty years, he could hear very well and understand what he heard, answer questions readily, and react normally to situations. He was even able to walk when lightly supported between two men. His power of memory [however] had failed considerably . . .'

'It was consistent to attribute the cause of death to a sudden adoption of a mode of living unnatural to him. Especially did he suffer harm from the change of air, for all his life he had enjoyed absolutely clean, rarefied, coolish and circulating air, and therefore his diaphragm and lungs could be inflated and deflated and refreshed more freely. But life in London in particular lacks this advantage—the more so because it is full of the filth of men, animals, canals and other forms of dirt, in addition to which there is the not inconsiderable grime from the smoke of sulphurous coal constantly used as fires. The air in London therefore is always heavy, and in autumn particularly so, especially to a man coming from the sunny and healthy district of Shropshire, and it could not but be particularly harmful to one who was now an enfeebled old man.

Moreover he had always hitherto existed on one kind of diet and that of the simplest; therefore after he had gradually taken to a generous rich and varied diet, and stronger drink, he ruined the functions of almost all his natural parts. Finally, as the result of an increasingly sluggish stomach, less frequent expulsion of excreta, a slowing-up of the process of digestion, congestion of the liver, a less vigorous circulation of blood and numbness of his spirits, suppression of the activity of his heart which is the fount of life, constriction of the lungs which allowed no free passage of air, and the growing bulk of his body that prevented easy breathing and perspiration, it is not surprising that his soul was far from happy in such a prison and left it.

'. . . Even in his one-hundred and thirtieth year in order to be able to earn a livelihood it was his custom to be vigorously engaged in some work on the land, and he even threshed wheat.'

One can scarcely write on old age, I think, to a learned Society like this without referring to that delightful work penned by Marcus Tullius Cicero, and named *De Senectute*. He wrote that 'When I consider the several causes which are usually supposed to constitute the infelicity of old age, they may be reduced, I think, under four general articles. It is alleged that it incapacitates a man from acting in the

affairs of the world; that it produces great infirmities of body; that it disqualifies him from the enjoyment of the sensual gratifications; and that it brings him within the immediate verge of death.' But let us read the whole essay, which is not unduly saddening, and remember a quotation which I personally find an excellent antidote to pontificating about age; it is 'On a toujours vingt ans dans quelque coin du coeur.'

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The social medicine of old age

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An ageing population can be regarded as an indication of the healthiness of a nation for it is usually to be found in those countries with a high standard of living and with well-developed medical and social services. The existence in the community, however, of a large and growing number of old people can create strains and tensions which appear formidable; these may be aggravated by such factors as smaller families, dispersal of families, increasing employment for women, and an attitude of mind which maintains that the State should accept more responsibility for its dependants.

The problem

The estimated mid-1959 population of England and Wales was 45 504 000 including 5 369 000 (11·8%) persons aged 65 years or more. Nearly 2 million persons, there being twice as many women as men, were aged 75 years or more. The rapidity of this development can be appreciated when it is remembered that the proportion of elderly people in the population at the beginning of this century was one in twenty-one; now it is one in nine, and it has been estimated by the Government Actuary in consultation with the Registrar General that after another two decades an additional 2 million old people will raise the proportion to one in seven. This changing pattern has resulted from a gradual fall in the birth rate since the end of the last century and from a steady fall in the death rate; more people, including the less robust, are reaching retirement age though, from that point, their expectation of life is little longer than that of their forefathers in the nineteenth century. Similar trends can be observed in most civilized countries, but the pattern in Britain shows two special features—the rate of increase in the number and proportion of old people is faster than in most other countries, and the elderly women far outnumber the men.

It is generally accepted that old people should not be isolated but should remain integrated with the rest of the population, but some will require a considerable