NEW CONCEPTS IN HUMAN NUTRITION IN THE TWENTIETH CENTURY

The special role of micronutrients

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TRIBUTE TO CAROLINE WALKER

I wish to thank the Trustees for inviting me to give this, the fourth annual lecture in memory of Caroline Walker. I feel highly honoured to have been invited. Caroline Walker was a charismatic and remarkably fine communicator both on television and in print, with imaginative skills in the interpretation of nutrition to the public.

She was ahead of her time. She realised that too many decisions in food processing were being taken for short-term marketing rather than nutritional reasons and she had the courage to say so, a campaign which led on to many improvements.

Nutritionists are more effective than most other scientists in reaching the public, and women are particularly perceptive where science impinges on daily living. She joins the ranks of those in history with vision and drive, needing so much persistence and courage in gaining acceptance of their ideas.

SUMMARY

This paper reviews new ideas on human nutrition in the twentieth century, particularly noting any clues to explain the unexpected postwar rise in the 'diseases of western civilisation'. The review demonstrates the great importance of the micronutrients – the vitamins, trace elements and the two essential fatty acids in relation to health and disease. Their reduction in the diet as a result of over-refining and processing of food may have been a significant factor in the changing pattern of food-related diseases in this century; there is need to increase the proportion of whole foods consumed. A plea is made for a return to a former Ministry of Food concept and practice of having a core of 'protective foods' day by day, so ensuring an abundant supply of the important micronutrients.

It is likely that the increase in coronary heart disease and other conditions has been accentuated by the reduced intake of the health promoting micronutrient-rich fibre foods, just when there was an increased need for them due to the rise in consumption of fats and free sugars.This has led to a relative deficiency of the energy-releasing and protective micronutrients; the imbalance being further accentuated by 'unwitting overconsumption' from eating softer convenience foods needing less mastication, so delaying the onset of a sense of satiety.

If so the advice needed is positive and simple – increase the consumption of crunchy, munchy chewy whole foods by doubling the nation's intake and variety of fruit, salads, vegetables, pulses, nuts and seeds; and having more unrefined cereals. Then, rather less room may be left in the shopping basket for the higher energy, processed, convenience made-up foods. The general pattern of personally preferred foods and flavours can remain unchanged; weight control becoming so much easier.

NEW CONCEPTS IN HUMAN NUTRITION IN THE TWENTIETH CENTURY

INTRODUCTION

In this lecture I shall review important new concepts in human nutrition and their protagonists during the twentieth century.

My main conclusion is that advice to the nation on healthy eating essentially should be positive rather than in restrictive terms. Clear advice is needed on those foods which protect not only against disease but also ensure vitality, joie de vivre and full intellectual and physical development. The present policy aimed mainly to restrict certain fats is proving impractical, unsuccessful, and off-putting. There is a simple alternative.

This century has seen years of scientific success and improvement in the health of the nation, followed by years of controversy and frustration. Now, nearing the end of the century I believe the answers are emerging.

There have been three phases in the nutritional health of the nation. In the first forty years there were considerable social and medical problems with much under-nutrition and evident deficiency states. In the second phase during World War II the nutritional health of the nation improved remarkably. In the last forty years a number of diet-related diseases including coronary heart disease, have become a serious problem needing better understanding.

Throughout my professional life as a gastroenterologist I have maintained a keen interest in food, nutrition and health. Even as a boy I remember my mother's interest in Dr Tom Allinson who mounted a campaign promoting the medical virtues of wholemeal bread. It attracted so much public interest that his name was crossed off the medical register for advertising himself! He was tactless, to say the least, in denouncing he doctors as 'professional poisoners'. But his name has come down the century with Allinson's bread.

THE FOUNDATIONS OF MODERN NUTRITION 1900–1950

The Accessory Food Factors

I turn to the first great scientific success. By the turn of the century much was already known about the proteins, fats, starches and sugars, all had been extensively studied. It had already been shown that certain foods were needed for the prevention of scurvy, rickets and beri beri.

In 1906, the father of British biochemistry, later Sir Frederick Gowland Hopkins,President of the Royal Society and Nobel prizewinner, postulated the existence of accessory food factors which would cure scurvy and rickets, and foresaw the discovery of other factors in the future.[2,3] By the time of his death in 1947 he had lived to see the discovery of more than half of the micronutrients, the vitamins, trace elements, important fatty acids and amino acids now know to be essential for health. For many years he masterminded this field of research and his influence continues today, with promising work still in progress in this field.

It was gradually being realised that the essential preventive factors might be present in trace amounts. In 1912 Funk [4] was more precise in suggesting that scurvy, beri beri, pellagra and possibly rickets were due to a deficiency of 'special substances which are the nature of organic bases which we will call vitamins'. It was later realized that the amine groups were not essential and in 1920 J.C. Drummond, later Sir Jack, proposed the omission of the e and 'vitamin' passed into universal use. The interest and excitement of those years is well recorded in E.V. McCollum's book 'A History of Nutrition'. A vast field of scientific work was opened up by Gowland Hopkins, leading to thousands of research papers and reference works including the great compilations on the composition of foods by McCance and Widdowson and the recent Coma Report in 1991 on Dietary Reference Values, both making all this knowledge concisely available to the whole world.

Comment. Gowland Hopkins was a truly great British scientist, the founder of human biochemistry and the science of nutrition. He made a further invaluable practical contribution to the nation in advising the Government on food in World War I.

What is a Good Diet and a Bad One?

The concept of what is a good diet and a bad one was studied and answered in one of the many papers written by Major-General Sir Robert

McCarrison between 1919 and 1935 while serving in the Indian Medical Service. Having qualified in Belfast, he undertook a lifetime of medical research work in India making valuable contributions in nutrition, thyroid disease and renal stones. He was impressed by the excellent physique and virility of the well-fed Sikhs of the north in contrast with the Madrassi and other peoples in the south with their stunted stature, frequent illness and high mortality; and also in contrast with many poorly fed people in England. He knew that genetic or environmental factors other than nutrition might play a role so he decided to test the role of diet and devised a series of simple key experiments. He knew that the Sikhs, whose diet consists of whole wheat, milk, milk products, green leafy vegetables and fruit, with meat occasionally, provided examples of the highest physical efficiency found in India, or indeed in any part of the world. He suspected that this was due to the high nutritive quality of the wheat in comparison with other staple food grains, such as rice. He studied colonies of half-grown omnivorous rats. Half received the suspected 'good' diet as consumed by the Sikhs and half the suspected 'bad' diet, designed to resemble that eaten by Indians in the south or by poor people in England. The differences between the two groups of rats in growth, fertility, and morbidity were striking, reflecting the characteristics of the Sikhs as against those of the seemingly ill fed populations. His figures and photographs provided striking evidence in favour of the 'good' diet. He believed that good nutrition needed whole food if it were to provide all the essential nutrients needed to prevent the common prevalent deficiency diseases.

He was a remarkably fine scientist, keeping meticulous records, an inspiring teacher and author of many papers. His life's work has been well recorded by Dr Hugh Sinclair. On his return to England he gave the three Cantor lectures to the Royal Society of Arts in 1936 summarising his work.[5,6,7] Sadly his message on the importance of whole foods was an unpopular one in those years; whole foods, wholemeal and natural foods for many more years remained only in the vocabulary of cranks. The importance of his careful well controlled scientific studies did not at that time receive the recognition it deserved from his British academic peers. However, Dr Reg Passmore, then a second year medical student, was so enthused by a lecture given by McCarrison that he got permission to go to his Laboratory in Coonoor in South India with Peter Meiklejohn where some of their great work was undertaken. [1] McCarrison's name in history is ensured by the small but increasingly influential McCarrison Society.

Comment. The nutrition scientists of his day were deeply involved in identifying the vitamins and other essentials in the diet. For anyone to

study whole food without measuring individual nutrients was 'unscientific'. They were wrong. Food is the final common path of all the essential factors including those not yet identified. McCarrison was way ahead of his time, not only in nutrition but also in his studies on thyroid disease.

Food, Health and Income

The next major concept, the socio-economic dimension of food, health and income, was opened up by John Boyd Orr's realisation that no food is of value to health if people cannot afford it; a simple point which had yet to be fully translated into daily living.

In the early years of the century, with only minimal social support, there was real poverty and often great hardship. Recruitment into the army in 1914-18 had revealed that many recruits for the army were short, thin and below par. There was some anxiety that as a race we might be becoming puny. Boyd Orr (later Sir John and then Lord Boyd Orr) showed that health could be restored by better feeding. He defined the problem of health and the ability to afford the basic health-promoting foods in his classic study of a thousand British families set out in his monograph 'Food, Health and Income'.[8] It was clear that many were not getting sufficient nourishment, with at least four and a half million people on the lowest income level being deficient in nutrients. It was this work which ultimately led on later to Churchill's acceptance of school milk and lunches as an important responsibility of Government. It also led on to the farmers being able to achieve a sustainable living. The story of those earlier years is well recorded by Professor Philip James and Ann Ralph.[9] Orr became a great national and international statesman as well as our leading nutritional scientist. He founded the Imperial Agricultural Bureau later and his influence continues to this day.

This recognition of the link between food and health needed the support of the medical profession which fortunately came from the British Medical Association who set up their first Nutrition Committee in 1933.[10]

The deepening recession in the thirties was creating many difficulties. Boyd Orr's campaign was having an impact causing increasing anxiety as to whether the unemployed and the poorer-paid workers were in fact suffering from malnutrition and if so whether the purchasing power of these individuals was sufficient to procure adequate food for themselves and their families. Apparently the wife of an unemployed man in Newcastle-on-Tyne wrote to the BMA asking how she could keep her family fit on their meagre income. In response a Committee was set up in April 1933, the terms of reference being: 'To determine the minimum weekly expenditure on foodstuffs by families of varying size if health and

working capacity are to be maintained, and to construct specimen diets'. The Committee reported remarkably quickly, in November 1933. It was most practical and detailed advice; inexpensive porridge and North Sea herrings making an important contribution both for energy and nutrients.

Comment. Lord Boyd Orr, as well as being a visionary scientist was a most astute politician and a canny Scot. He get some voluntary support initially for his school meals campaign before putting it forward to Churchill. Fortunately the same is happening again with the initiative of the Caroline Walker Trust in publishing 'Nutritional Guidelines for School Meals', repeating history today. Our record on feeding school children is at a low ebb, yet it is so essential for the rising generation's health, now and into the 21st century. We have much to learn from the French, who seems to have got their priorities right!

Protective foods

The concept of 'protective foods' was introduced in World War II. By 1939 the importance of vitamins and of a suitably balanced diet was recognised.[10-13] The need for central control and possibly rationing having been anticipated, Lord Woolton became Minister of Food in 1940 and appointed Jack Drummond as his chief scientific adviser.

A remarkable exercise in publicity and nutrition education was soon undertaken by the Ministry of Food supported by the Ministry of Health under Sir Wilson Jameson who was Chief Medical Officer 1940-50. The aim was to explain nutrition in simple terms to the nation. Soon everyone became familiar with energy giving foods, body building foods, together with the protective foods ensuring the supply of vitamins and minerals. These were dairy foods, fruit and vegetables and whole grains and pulses, (both with their germ seed with their concentration of nutrients essential for reproduction). It explained how to make the most of the nutrients and how to deal with the extra problems of catering in wartime. It was positive, not negative restrictive advice, achieved by a continuing flood of leaflets, posters, radio talks, cinema flashes and cartoons, being put over with a pleasingly light touch, the leaflet on food and health for women in wartime being a particularly good example. Anything went, including jingles:

'Those who have the will to win
Cook potatoes in their skin
Knowing that the sight of peelings
Deeply hurts Lord Woolton's feelings'

The protective micronutrients are also concentrated just under the skin in apples and other fruit too.

The Ministry of Agriculture were equally active with their 'Dig for Victory' campaign, ensuring a fresh supply of fruit and vegetables. The regular radio programme played an invaluable role in the agriculture and food wartime effort enabling the protective food campaign to be successful. Potato Pete and Dr Carrot became familiar figures but the star performer was Dr Charles Hill, the radio doctor, with his many memorable phrases. 'Cows milk was meant for calves, mother's milk for us'.

Within the year of the campaign by the Ministry of Food starting, the mortality rate began to fall in all age groups, continuing to fall throughout the war, reaching levels well below what might have been expected from the steady decline which had begun in the previous century.[14]

On the balance of probabilities it seems likely that better nutrition was largely responsible for much of the benefit. They were probably the only years in the twentieth century when the entire population, young, old and especially the vulnerable groups had the probability of achieving a near-optimum intake of the known vitamins and other essential nutrients, in addition to having sufficient protein and energy foods. The consumption of fats and sugar were down and the National Loaf (85% extraction, the equivalent of brown bread) and potatoes were unrationed. This may well have been achieved as a result of the great publicity and educational campaign by the Ministry of Food, including the 'protective foods'.

The remarkable reduction in mortality by 1942 occurring so quickly and so uniformly at all ages may best be explained by the increased intake of protective nutrients, particularly Vitamin C, tipping the scales in favour of survival when medical crises like pneumonia or surgical operations occurred.

The wartime experience was reviewed soon after the war in the second BMA Nutrition Committee, reporting in 1950, on which I served.[14] It documented the record of nutrition and health during the war and assessed the postwar needs of the country. A number of recommendations were made to promote better nutrition; these including 'Meals on Wheels', and better nutrition in hospitals, schools and industry. Unfortunately the advice in the BMA Report to devise a system for nutritional monitoring of the nation was not accepted.

Comment. We really have a lesson to learn from the wartime experience of protective foods, putting the emphasis on those protective foods which ensure a good supply of the essential nutrients. It is simple, positive, non-controversial; It worked well then and could do so today. It could be introduced together with existing nutritional strategies.

THE DISEASES OF WESTERN CIVILISATION 1950–

The remaining concepts all relate to the change in the pattern of disease in the post war years. The background to these will be briefly recalled. First, it was assumed by the government that because the wartime health record had been so good, most of the support for research into human nutrition should be diverted to the problems of agriculture to ensure that the country became self sufficient in food. (The wartime experience of having to import 70% had been a salutary lesson). Secondly, instead of continuing with the concept of encouraging the consumption of protective foods, the nutritional education of the public became based on a 'balanced diet'. It provided a new look to the postwar era, but lacking any advice on priorities did nothing to stem the postwar fall in the protective vitamins and minerals from the increasing refining of foods, or to counter the continued rise in the proportion of energy being supplied by fats. With hindsight it was the worst decision on human nutrition in this century. If the nutritional education on protective foods had continued it would have gone far to control or abort the postwar epidemic of coronary heart attacks and other disease too.

After rationing had ceased in the early nineteen fifties the public lost no time in returning to their white bread, sugary and rich diet.

Gradually it was realised over the next two decades that new health problems were emerging, with the unexpected increase in a number of disparate but seemingly diet-related conditions, becoming known as the diseases of Western civilisation. These included coronary heart disease, hypertension, diabetes, dental caries, peptic ulcer, diverticular disease, gallstones, obesity, cancer in certain sites including colon, pancreas and breast, constipation and haemorrhoids. The dietary factors which may be involved are summarised in the conclusions.

The hazards of refining staple foods

The concept of the rise in these diseases being due to the refining of staple foods was introduced by Surgeon-Captain T.L. Cleave RN in 1956.[15-18] In the battleship King George V he had used bran most successfully in treating constipation so prevalent among the sailors, due to lack of fruit and vegetables at sea. He then asked himself a question which had never been asked before. What is the effect on the health of the nation if bread, an essential part of the diet, is refined with the removal of the bran? He was a keen and well informed naturalist profoundly influenced by the writing of Charles Darwin. He felt that humanity, like the rest of the animal

kingdom has evolved on a particular pattern of food. If that pattern changed, adaptation can take place over countless generations while in the meantime health problems quickly emerged. After years of collecting evidence from all around the world he came to the conclusion that the refining of carbohydrate staple foods was responsible for the pattern of the epidemic of Western diseases. He recommended keeping our staple foods like bread whole and unrefined, retaining their physical consistency, with its roughage (fibre) and protein and other nutrients unchanged. He did not recommend taking bran except for constipation. In his last paper in 1977 he developed the theme of the role of unwitting overconsumption consequent on the refining of foods as a further contributory factor.[19] Dr Ken Heaton's scientific studies at Bristol, Dr Martin Eastwood at Edinburgh and others too, have confirmed the importance of his concepts. These are two clues which could go far towards solving the enigma of the postwar increase in these diseases.

I got to know Cleave well, being one of the few to give early recognition of the importance of his work. To many he seemed outrageously unscientific; working singlehanded mainly by correspondence he collected differences in prevalence of disease around the world. By looking for big differences he built up a pattern supporting his thesis on the hazards of refining staple foods. It was an outstanding achievement.[20] I believe Dr Ken Heaton's assessment of Cleave will be universally recognised by the turn of the century: 'Cleave was one of the most original medical thinkers of the twentieth century. His rare combination of panoramic vision, piercing logic and bulldog tenacity deserves the title of genius. He was a true pioneer who started a major revolution in scientific thought.'[21] It was all done at his own expense!

Comment. It was a grand hypothesis of Darwinian dimensions. Cleave too was way ahead of his time. Some of his contemporaries thought he had gone round the bend and wondered if his evidence might be too selective. It was not – but hence the delay in his visionary ideas being accepted. Gowland Hopkins had started the discovery of the essential nutrients. Cleave led the way in insisting that nutrients should not be removed by the refining of our staple foods. We did so at the peril of increasing the postwar epidemic of diseases. He quoted Horace Epistles, Book 1. X 24. 'You may drive out Nature with a pitchfork, yet she will ever hurry back to triumph in stealth over your foolish contempt'.

Dietary fibre

Are the Western diseases the result of a deficiency of the structural fibre

removed during the refining process or are they due to the changed qualities of the refined food as Cleave has postulated? Would the giving of extra fibre prevent or cure these diseases? This was the alternative interpretation supported by Mr Denis Burkitt, a surgeon, and Dr Hugh Trowell, a physician, who had worked many years independently in Africa.[22] Both had been aware of the rarity of the 'Western diseases' in Uganda where the basic foods were rich in roughage, later to be known as dietary fibre. Having both Cleave on their return to England they were greatly stimulated by his concept of diseases being due to the refining of food which they interpreted as essentially causing a deficiency of fibre. Soon both became well known from their prolific writing and lecturing, with the emphasis on the benefits of dietary fibre, bran seemingly being an important source.

It had an instant appeal with the public, providing simple positive advice, a likely panacea and of special help for weight control. The hope that dietary fibre would control coronary heart disease, gallstones and obesity was not confirmed, but it did lead on to further improvements in the management of diabetes, obesity, dental caries and bowel problems. Dietary fibre was initially interpreted just as the cellulose complex which gives the plant its firmness and rigidity. Now it is realised that the structural components themselves provide the valuable physical benefits of chewiness but the main health benefits are largely due to the many associated components enmeshed in the interspaces of the sponge-like structural framework. These included vitamins, trace elements, fatty acids, a remarkable number of starches, gums, mucilages, soluble fibres, pectin as well other minerals; all being released gradually during the process of digestion.[22-38]

Today, some may prefer the term 'fibre-rich foods', to dietary fibre. Fibre-rich foods with their endless permutations of different fibres, starch, minerals and vitamins are each making their own individual contribution to human nutrition. It is so important to have a wide mix of different fibre-rich whole foods in influencing the prevention or management of disease.

However, fibre-rich foods may soon be replaced by 'NSP-rich fibre food'. This new terminology is set out in the Coma report.[98] Non-starch polysaccharides (NSP) offers a new chemical definition of the fibre group of foods covering the active components of fibre which mainly provide the health promoting qualities on fat and carbohydrate metabolism. It is set to displace the earlier estimations of fibre in food. The NSP-rich fibre foods will dominate the scene: Fibre-rich will describe bran: 'complex carbohydrates' will still cover the starch-rich fibre foods like potato.

The relative poor response to the Burkitt and Trowell campaign in reducing diseases was possibly due too much emphasis having been given

to bran which is rich in structural fibre but in only some micronutrients, including iron, zinc and magnesium. However its prime use should be for constipation, not nutritional.

Comment. Fibre foods are of special importance for three reasons; first, because so many important micronutrients and other substances are enmeshed in them: secondly, for their contribution to the normal absorptive and excretory mechanisms of fats and carbohydrates in the digestive tract: thirdly because their chewiness contributes to an earlier sense of satiety.

Burkitt and Trowell did remarkable work in introducing the concept of dietary fibre to the medical profession and to the public but a much wider meaningful perspective has now been achieved.

For those who do not wish to be confused by new chemical names and figures, the answer is simple. Merely replace much of the white bread by brown or wholemeal forms, and gradually double the amount and variety of fruit and vegetables in your menu, continuing with your preferred main dishes.

Masticatory foods

Professor S.L. Malhotra, a prolific research worker in India over many years, revived the concept of the importance of foods having the consistency to need mastication, so stimulating mucus secretion from the salivary glands, providing better protection for the upper gastrointestinal tract, postulated a special role for mucus in the saliva. In the alimentary tract the mucus is part of the protection against peptic ulcer. Recent studies have indeed shown the presence of a powerful healing factor in the saliva, the Epidermal Growth Factor, adding weight to this mucus concept. The need for more masticatory foods was important in increasing the protection against large bowel cancer, a subject he studied intensively.

His other main interest concerned the possible importance of short chain fatty acids in the diet, another possible explanation for the wide variations in coronary heart disease.[36-40]

Comment. The importance to health and digestion of thoroughly masticating food is rediscovered every few decades. It really is important as Malhotra has stressed. His studies provided further support for the role of the fibre-rich crunchy foods. Many of his other ideas like the short chain fatty acids are most interesting and need further study.

The essential fatty acids (EFAs)

The concept of the importance of two polyunsaturated fatty acids, alpha linolenic and linoleic fatty acids, was put forward in 1956 by Dr Hugh Sinclair in Oxford.[41] He believed that a deficiency or relative deficiency of these two groups of fatty acids could be the underlying cause of the rising tide of diseases of Western civilisation and much of his later work was devoted to their study. Both serve vital functions in relation to the health of the blood vessels, to normal blood clotting and to the defence mechanisms of the body. Coronary heart attacks are due not only to damage to blood vessels but also can be precipitated by an increase in the clotting tendency in the blood.[41-46,91] Related compounds are essential for the development of the brain and retina.

Alpha Linolenic acid (omega 3 family) is the predominant fatty acid of green leaves and also found in fish, particularly fatty fish because they live on the plankton, the sea equivalent to the leaf on land. The main food sources are the fibre-rich foods linoleic acid (omega 6 family) is the predominant fatty acid in seeds and hence found in many domestic oils. They are two of 25 nutrients which have to be present in our food and are well represented in the fibre-rich foods, green leaves, seeds, some vegetable oils (e.g. corn oil and sunflower oil) and in fish.

Comment. These two EFA families serve a vital function both in our development in utero and throughout life and must be present in our food; there is much more to be learned about them. Sinclair, a seemingly eccentric Oxford don, a brilliant after dinner speaker (in verse!) stimulated extensive international research, three international conferences on EFAs so ensuring recognition of their importance in human nutrition. He was a key figure in the wartime monitoring of nutrition and food on the home front.

The role of cholesterol and fats

In 1965 Professor Ancel Keys [47] opened up the debate on fats and cholesterol in relation to coronary heart disease, starting an explosion of research activity which has continued ever since.

Cholesterol is a vital component of every cell in the body. It is formed within the liver, the amount being controlled by enzyme regulatory mechanisms; the level in the blood being little influenced by dietary intake. A raised cholesterol is often associated with an increased risk of coronary heart disease so every effort has been made to reduce the amount in the blood. But it seems that insufficient attention has been given to

encouraging the excretory process by the bowel by increasing the consumption of various fibre-rich foods. Furthermore, antioxidant micronutrients may protect the blood vessels against the early changes leading to coronary heart disease. These are associated particularly with the fibre-rich foods. So the focus on dietary cholesterol is lessening but still remains on dietary fats.

The various divisions, polyunsaturated, monounsaturated and saturated fats have had great publicity with particular attention to the saturated fats. Actually, nearly all fats are a mixture of all three in varying proportions. Increasingly, it is being appreciated that the really important objective must be to reduce the total amount of fats consumed, at least to providing only 30-35% instead of 35-42% It does seem that an overgenerous intake of fat does predispose to being overweight and may increase the risk of developing certain cancers, gallstones and diabetes. Efforts to reduce the intake of fats has met with only limited success. Indeed the number of people who are overweight continues to rise.

The alternative approach is to give positive advice encouraging more whole grain cereal starchy foods, more fruit and vegetables and at least doubling the daily intake for most people. Three important benefits could be achieved. First, it is known that some of the micronutrients in fruits and vegetables have antioxidant actions inhibiting the early stage of damage to blood vessels by certain fats. Secondly, by increasing the consumption of the lower calorie fibre-rich foods, it is easier to have smaller helpings of the higher calorie foods containing more fats or sugars.[47-55]

Comment. Throughout nature where there is aggression there is defence. It seems that micronutrients may provide the defence. Good protection will safely allow British traditional dishes to be enjoyed in moderation.

Protective antioxidants

The potential for free oxygen radicals to damage tissues has long been recognised but the possibility of such radicals initiating the coronary artery disease process and protection being conferred by antioxidants emerged with the work of Gey.[57-58]

The micronutrients and other chemicals in food involved in this protective action include Vitamins A, C, and E; folate, retinoid and the yellow/red carotenoid pigments found in many fruit and vegetables; the trace elements, selenium and zinc. Other factors including plant terpenes, indoles and isoflavones may also contribute to the protective influences on blood vessels and as an anti-mitotic protecting against the early stages

of cancer. Another dietary facet is the evidence that a low fibre intake, as well as slowing cholesterol excretion processes, also reduces the absorption of the important antioxidant fat soluble vitamins A and E. Gey has recently demonstrated an inverse ration between Vitamin E and the mortality from CHD in a cross-cultural epidemiological study.

It seems that a good mix of fibre-rich foods can have an important role to play in preventing coronary heart disease.[50-63]

Comment. Present intense research activity is producing remarkably interesting dividends.

The amazing colon

Research at the Dunn Laboratory, Cambridge under Dr John Cummings has been opening up an important new field of digestive activity in the right side of the colon, of special nutritional interest.[64-71] We have an extra stomach to digest all residual starches and most fibres undergo digestion, with the formation of short-chain fatty acids providing protection against the early changes of cancer, and providing a further source of energy. Other chemical products stimulate the growth of colon bacteria, in addition to hydrogen and methane gases. The bacteria in turn produce further chemicals including two vitamins. This work, stimulating research elsewhere, is throwing much light on the role of the different fibre-rich foods in protecting our health. There are remarkable differences between the different cereal and vegetable digestive residues in the colon. The unit has pioneered new methods to measure dietary fibre. Much work in this colon field has also been done particularly by Dr Martin Eastwood [68] and others.

Comment. The younger generation of scientists is keeping us well ahead on the frontiers of knowledge – and leading to better understanding of food, fibre and health.

The Mediterranean diet

The concept that the Mediterranean diet has a significant contribution to make to the food and health debate had been raised earlier but effectively began with the seminal paper by Professor Philip James in 1989 'The Mediterranean Diet: Protective or Simply Non-Toxic?' [69,70] Compared with the northern European countries the prevalence of coronary artery disease was considerably less in the Mediterranean countries. This is still true in those countries like Greece, where a high fat diet is not associated with

an increased risk of cardiovascular disease but it does reveal those with a genetically determined tendency to obesity. Their fat intake is predominantly the mono-unsaturated olive oil, with considerably lower proportions of saturated fats but with more fish oil in the diet. Another seemingly important variant is the considerably higher intake of fruit and vegetables, many being eaten fresh. These would be making an important extra contribution in providing the protective antioxidants from their vitamin and mineral contents.

Comment. The need for more and more variety of fruit, salads(with olive oil dressing!) and vegetables is the emerging message. Perhaps slower, rather than faster meals too.

Early diet and late disease

This concept was first promoted by Professor Andrew Wilkinson and Dr Elsie Widdowson in a conference in 1974. Interest has been renewed recently by studies relating to the importance of the micronutrients not only to the foetus in utero, but also their availability at the time of conception. Work is in progress by Professor Michael Crawford in London on the prevention of low birth weight, with the added risks of brain damage and mental retardation, recording the correlation with availability of the essential nutrients in the food before and during pregnancy.[71-72] This is proving to be an important current development of research on the essential fatty acids with special reference to the importance of derivatives of linolenic (omega 3 family of fatty acids) in the development of the retina and brain. Professor David Barker at Southampton is correlating low birth weight with delayed organ development in early life with adult diseases, including diabetes and cardiovascular disorders.[73-77] Some well kept medical records in the early years of the century are being used for this and other studies to great effect in his unit.

Comment. Much of benefit for the next generation is rapidly emerging.

The evolutionary dimension

The scientist who is also a naturalist may detect a conceptual unity in the disparate problems of food and health by looking back at our evolutionary history. Life in its ever increasing complexity has evolved over millions of years because Nature invariably has been able to evolve defence against successive physical and chemical environmental hazards besetting living organisms. The protection may take many forms, often involving an

interaction with a chemical in food, then needed to become part of the normal food for the plant, insect or animal if it is to survive. Provided their accustomed food supply is available, animals and birds in the wild remain in good health, but once their natural environment, including their food is changed, they may become subject to diseases seldom if ever occurring in their fully natural state. It has become increasingly clear that the basic micronutrients play a key role in maintaining health. Professor Dennis Parke,[83-84] who has done much in this field, has highlighted the great range of these mechanisms involving nutrients in the diet. The defence mechanisms against an excess of fat, thought to contribute to coronary heart disease has probably existed for millions of years with the earlier emergence of the antioxidant mechanisms associated with certain vitamins and trace elements needing to be present in the food for survival.

Comment. We were evolved from the 'hunter-gatherers'. To restore the balance for health we need to consume less from the 'hunters' and more from the 'gatherers'

Micronutrients

These are Gowland Hopkins' accessory food factors. They consist of 13 vitamins, 10 trace elements, and two families of polyunsaturated fatty acids (omega 3 and omega 6). (Appendix 1) [85-93]

These 25 micronutrients, of which all must be present in our food as few, if any, can be formed within the body. They are important, not just because they prevent clinical deficiency diseases like scurvy, but to optimum health. They actively relate to vast numbers of the complex enzymes which activate every chemical reaction in the body. The micronutrients in many instances, are part of the physical structure of the complex enzymes. Zinc for example is a component of hundreds of enzymes. They can be thought of partly as fuel but more especially as lubricators of the complex chemical machine supporting life, some needing renewing day by day. When available in abundance in food, the body's chemical machinery is kept running in top gear; If in short supply many chemical processes may be hindered. Vitamins, trace elements and these two families of fatty acids are not optional extras, they are an absolute essential constituent of the normal diet. They are far better taken in natural whole foods, so avoiding any problems of competitive absorption as may happen with some factory-made tablets. Among all the aliments the body needs, the micronutrients are the 'first among equals'. They keep all the vital chemical processes working throughout the body.

We have a reasonably good idea of our needs because we know

they must have been present in the food available to early humans in their basic foods: whole grain, salads, vegetables, pulses, roots, nuts, seeds, fruits and berries. Once hunting had become possible, meat and fish became valuable 'second hand' sources of the same micronutrients. Today, we need the same basic core of fibre-rich foods, preferably, augmented by dairy products, meat and fish.

It is interesting but not necessary, to know the chemical names and precise functions of the micronutrients; nor is it necessary to know exactly how much of each is being consumed today What is essential is knowing which groups of foods and roughly how much, to put in the shopping basket.

The term Micronutrients is convenient as it covers all the three subdivisions; it is accurate as the amounts needed can be very small indeed (Table 1).

It is to be noted that the changes in the pattern of diseases in this century can be closely related to the availability of micronutrients in the national diet. In the early years there were many who could not afford an allowance of food adequate to meet all their basic needs for health. Many did not receive sufficient protein and vitamins. In World War II with the policy of protective foods, the micronutrients were well maintained and the health record was good. In the last four decades it is likely that there has been a relative deficiency of micronutrients, being reduced by refining just at the time when energy foods were increasing. In 1991, for the first time key information regarding the function, structure, sources and requirements of all nutrients, including the micronutrients was brought together in the Coma report to the Department of Health.[98] It is an invaluable document, but one important criticism can be made. The individual requirements are mainly related to the amount required to prevent deficiency states. Now it is realised that so many vital functions served by micronutrients are directly relating to good health. It is a problem the committee recognised but failed to give a lead. Vitamin C is needed for positive enjoyable health, not just for prevention of scurvy. There is a long list of vital functions served by Vitamin C, recently annotated by Padh.[80] Other yardsticks for the amount required are less precise scientifically but may seem more realistic. It seems likely that 150-200 mg daily, from natural sources would not only provide the necessary abundance needed but also ensure a generous intake of fibre-rich foods needed for full health. 40-50 mg would seem to leave little room for any needed increased turnover.

CONCLUSIONS

I believe the following conclusions may be drawn from this review.

Micronutrients

The micronutrients are incredibly important for full health. We need an abundant supply in our daily food to 'lubricate' the chemical machinery of the body, ensuring its smooth running. They are all concentrated in a few groups of foods which must be well represented in our daily menu - the health-promoting protective foods.

Whole foods

It is important to have foods as fresh, and as near as possible to their natural state. Their physical structure determines the optimum rate of absorption of their constituents. Some each day should be fresh and uncooked. Once they are refined they inevitably lose a proportion of their micronutrients. The scale of the loss of micronutrients in the refining of wheat flour is shown in Appendix 2.

Protective foods

We need to revive the former successful policy of the Ministry of Food for protective foods with the same enthusiasm as in the forties. As then, nutrition education should be positive, based on the importance of the 'protective foods'providing an abundance of micronutrients from natural sources. Micronutrients are present in most foods but are concentrated in the fibre-rich foods and in dairy produce; these should provide the core of our daily menu. The fibre-rich foods should be taken whole as far as possible as they will have more essential micronutrients than the asset-stripped refined and processed foods. With this firm basis of protection then all can enjoy favourite foods in moderation safely and without feelings of guilt. Convenience foods and fast dishes will continue to play an indispensable role in the life of many busy people and can be continued modestly, always having a fibre-rich alternative if appropriate. (see 'Healthy eating' below).

The diseases of Western civilisation

Coronary heart disease is still of much concern to the nation. The evidence

incriminating saturated fats and cholesterol has been considerably weakened by the realisation that some micronutrients provide protection against the early stage of damage to blood vessels. The fibre components in fibre-rich food also facilitate the excretion of any excess cholesterol. This underlines the need for scrutinising one's diet to maintain a good proportion of protective foods.

Cleave's concept of 'unwitting overconsumption' as a hazard is still not sufficiently appreciated. Factory processing has tended to make food softer and quicker to eat. The addition of attractive chemical flavours and colours and hidden fats and sugar has made it so much easier to consume more energy-dense foods unwittingly. Furthermore, the normal satiety processes are blunted. Overconsumption (customary or unwitting) but without sufficient protecting micronutrients is likely to have been a prime precipitating factor in susceptible persons in initiating some of the diseases of western civilisation. The various dietary mechanisms contributing to the maintenance or increase of diet-related diseases are listed (in Appendix 3) Their increase has been a sad but unnecessary price to have paid for the benefits of refining foods. If the concept of protective foods had been continued after 1950 and not replaced by the toothless 'balanced diet', the remarkable epidemic of coronary heart disease, the increasing problem of obesity and rise of various cancers might have been far less serious or might never have happened. At least we should do more to control it in the coming years. The campaign for protective foods worked so well in World War II; it could do so again.

Healthy eating

With the concept of protective foods, healthy eating is simple, enjoyable and need not cause any feeling of guilt. It does not need food tables and pocket calculators, it does not require anyone to calculate how much energy is coming from fats or how much fibre or individual vitamins one is having today.

Healthy eating ensures energy and vitality, diminishes risk and severity of infections, inhibits degenerative cardiovascular diseases, aborts early stages of certain cancers – and helps to maintaining a healthy weight.

It should give pleasure, interest and social enjoyment all so necessary to acquire a wide variety and exploration of new flavours, particularly savoury ones.

The fibre-rich protective foods, between them, can provide all the basic essential vitamins, trace elements and essential fats needed. These are: whole grain cereals, a wide choice of fruits, leafy green, yellow and

red vegetables, pulses, starchy root vegetables, salads, nuts and seeds. With a generous daily core of these foods, dairy products, meat, offal and fish can be enjoyed. Apart from personal sensitivities there are no foods which cannot be eaten. But more of some and less of others should be heeded. In general, energy-dense fat or sugar laden foods need controlling.

It is preferable to make dietary changes gradually to suit and please the whole family. Three months could be appropriate to build in more of the protective foods while retaining all the familiar personal dishes. For those who wish to avoid animal foods, health can be maintained by having a wide choice of vegetarian dishes.

In today's world some fast, convenience foods play an important role in daily living but it is wise to restrict their use when possible. Some factory made fresh foods are perfectly healthy. Sandwiches for instance are made and packed in superstores with the greatest care. Hidden fats and sugars e.g. biscuits, puddings and cakes need careful watching, otherwise weight control can be difficult even with extra fibre foods.

It is not essential to memorise exact nutrient contents of food, provided the right groups of foods are included appropriately. If one needed a target, aim at having at least 200 mg of Vitamin C a day from natural sources.

By the end of three months one should be attuned to enjoying wholemeal or brown bread, muesli with its added fruits and nuts, whole grain cereals with white bread occasionally if wished. Extra seasonal fruit, vegetables, salads and nuts instead of sweets, biscuits, and crisps. Main meals should be supplemented by a wide variety of salads and interesting vegetables, to go with the preferred main dishes.

For joie de vivre, energy, and performance, healthy eating is not enough. One also needs simple exercise, a balance between work and relaxation, avoiding the hazards of smoking and overindulgence in alcohol.

As a nation we may need to double our consumption of fruit and vegetables – with all their valuable protective micronutrients and increase the proportion of brown or wholemeal bread. Fortunately there are ways to do this on a budget. What a help this would be for our hard-pressed farmers.

There is a small price to pay. Accepting a personal responsibility for checking and maintaining an appropriate healthy weight. Those who tend towards being over weight, will need more whole crunchy munchy foods and less soft foods that slip down too easily – and getting their energy from more starchy foods like bread, cereals, pasta and potatoes and having less from energy-dense fatty and sugary foods.

The booklet published by the Guild of Food Writers 'Eat Well, Live Well!' and the Health Education Authority's 'Enjoy Healthy Eating' provide admirable practical advice but the role of micronutrients could be strengthened.

If the rising generation is to escape the same epidemic of premature coronary heart disease and other diseases which involved many of their parents and grandparents they will need advice which is simple, practical and makes sense. The concept and practice of protective foods could meet their needs – particularly with advice on food and sport.

Remember the old adages!

'Variety is the spice of life'
'A little of what you fancy does you good'
'All work and no play . . .'
'An apple a day keeps the doctor away'

Make certain it is an English apple. For variety of size, colour and flavour, acceptability for all ages – and crunchiness they have no peer. Why should we continue to grub up our lovely old orchards?

APPENDIX 1

MICRONUTRIENTS

Vitamins

Water Soluble	Fat Soluble
Thiamin – B1	Retinol – A
Riboflavin – B2	Calciferol – D
Niacin and tryptophan	Vitamin E
Pyridoxine – B6	Phylloquinone – K
B12	
Pantothenic acid	
Biotin	
Folate	
Ascorbic acid – C	

Trace Elements

Zinc	Iron	Copper
Selenium	Manganese	Chromium
Iodine	Fluoride	Molybdenum
Cobalt		

The number is arbitrary, phosphorus and magnesium perhaps could be included.

Essential Polyunsaturated Fatty Acids (EFAs)

Alpha Linolenic acid (Omega 3 family)	Linoleic acid (Omega 6 family)
including:	
Eicosapentaenoic acid (EPA)	Arachidonic acid (AA)
Docosahexaenoic acid (DHA)	Docosapentoenoic acid

APPENDIX 2

Percentage losses in vitamins and minerals in the refining of whole wheat to produce 70% extraction flour (white bread).[93]

Thiamine B1	77.1	Calcium	60
Riboflavine B2	80	Phosphorus	70.9
Niacin	80.8	Magnesium	84.7
Vitamin B6	71.8	Potassium	77
Pantothenic acid	50	Sodium	78.3
Alpha tocopherol	86.3	Chromium	40
		Manganese	85.8
		Iron	75.6
		Cobalt	88.6
		Copper	67.9
		Zinc	77.7
		Selenium	15.9
		Molybdenum	48.0

The wartime national loaf was enriched with Vitamin B1 and calcium. Today thiamine, niacin and iron are partially replaced. Is it really right to 'asset strip' a staple food so heavily? The micronutrients play a vital role in human metabolism.

Some EC countries forbid enrichment. So should we! Brown or wholemeal flour is a far better alternative. Admittedly there are some problems of storage which in some countries may be difficult.

APPENDIX 3

In adddition to genetic and lifestyle influences the main dietetic factors in each disease are:

Coronary heart disease

- Excess saturated fats with:
- Insufficient protective antioxidant and other micronutrients (especially Vitamin E).
- Insufficient fibre foods.
- Overconsumption

Diabetes

- Overconsumption.
- Too rapid absorption of sugar from refined carbohydrate foods (Saccharine effect).
- Selective dietary fibre deficiency, with lack of certain fibre associated mucilages.
- Micro-nutrient deficiency – perhaps chromium.
- Nutritional influences during pregnancy.

Gallstones

- Overconsumption with unnecessary increase in weight.
- Too little dietary fibre, so adversely affecting the circulation of bile salts in the bowel.

Hypertension

- Insufficient fibre-rich foods resulting in too little potassium-containing foods (mainly fruit and vegetables), relative to the sodium intake.
- Excess alcohol.
- Overconsumption with unnecessary increase in weight.
- Nutritional influences during pregnancy.

Congenital deformity or deficient development

- Micronutrient insufficiency during pregnancy.

Dental care

- Simple refined sugars encourage the growth of acid forming bacteria in the mouth. They should be avoided, especially between meals.
- Natal and neonatal nutritional deficiency causing enamel hypoplasia.

Peptic ulcer

- Insufficient fibre-rich foods, with two adverse consequences. First, with a soft diet there is less need to masticate sufficiently to promote a good flow of the salivary secretions with their own protective constituents. Secondly, it also seems increasingly likely that some of the fibre-rich foods may provide specific protection for the gastro-duodenal mucosa.

Constipation. Haemorrhoids

- Lack of a good variety of fibre and starch-rich foods means that there is insufficient stimulus to promote the normal functioning of the colon. Bran, a concentrated form of fibre is particularly beneficial in many individuals with established constipation. The better policy is prevention by including a good variety of fruit and vegetables in the daily diet.

Diverticulosis

- Insufficient fibre and starch-rich foods.

Cancers at certain sites [94-97]

- These include colon, breast, and possibly pancreas and prostate.
- There appears to be a complex interrelation between metabolic end products of fats, fibre and sex hormones now the subject of research activity. The need for Less fat and more fibre-rich foods seems to be the likely outcome.
- Fibre may adsorb carcinogens from damaged food or charring.

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