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THE MINERAL DEPLETION OF FOODS AVAILABLE TO US AS A NATION (1940–2002) – A Review of the 6th Edition of McCance and Widdowson*

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> "A knowledge of the chemical composition of foods is the first essential in the dietary treatment of disease or in any quantitative study of human nutrition"

ABSTRACT

Over the past 60 years there have been fundamental changes in the quality and quantity of food available to us as a nation. The character, growing method, preparation, source and ultimate presentation of basic staples have changed significantly to the extent that trace elements and micronutrient contents have been severely depleted. This trend, established in a review of the 5th Edition of McCance & Widdowson's The Composition of Foods, is still apparent in this review of the 6th edition of the same work. Concurrently there has been a precipitous change towards convenience and pre-prepared foods containing saturated fats, highly processed meats and refined carbohydrates, often devoid of vital micronutrients yet packed with a cocktail of chemical additives including colourings, flavourings and preservatives. It is proposed that these changes are significant contributors to rising levels of diet-induced ill health. Ongoing research clearly demonstrates a significant relationship between deficiencies in micronutrients and physical and mental ill health.

Key Words: essential minerals, micronutrients, trace minerals, health, mental

*The data used as the basis for this study was published in six editions, initially under the auspices of the Medical Research Council and later the Ministry of Agriculture Fisheries and Foods, the Foods Standards Agency and the Royal Society of Chemistry: Authors R.A. McCance and E.M. Widdowson.

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An essential nutrient is one that must be obtained from the diet because the human body cannot make it in sufficient quantity, or at all, to meet its needs for normal human metabolism and reproduction: most commonly some amino acids, fats, vitamins and minerals.

Micro-nutrients and trace elements are required in 'minute' amounts – such as some vitamins, and minerals eg selenium (up to 200mcg/d) rather than in larger quantities, like the essential mineral calcium (up to 1.5g/d), whereas selenium in larger quantities becomes toxic. Some 90 or so minerals in the soil are essential.

INTRODUCTION

In a paper 'A Study of the Mineral Depletion of the Foods available to us as a Nation over the period 1940 to 1991'[1] published in Nutrition and Health in 2003, I compared and contrasted the statistics of the essential mineral and trace element contents of foods presented in the 1st to the 5th editions of McCance & Widdowsons' 'The Composition of Foods',[2,3,4,5,6]. In the 6th edition[7], published 2002, new analytical data have been incorporated in the 'Milk and Milk Products' and 'Meat and Meat Products' sections. This paper provides an updated look at these data with specific reference to micronutrients.

In the current paper I also provide a response to certain critical reviews of my earlier work.

It is important to note that McCance & Widdowson provide the most detailed and sophisticated historical records of the nutrient values of foods available to any nation worldwide. Currently there is a pan-european[8] research project that will provide nutritional information on the chemical composition of foods within the EU. There is a danger that the data from this research will be seen as the benchmark against which future studies will be measured. McCance & Widdowson show that, in the UK at least, there has been a considerable depletion in minerals and trace elements in foodstuffs during the period 1940–2002.

Since the publication of my initial paper, concern and debate regarding the relationship between the quality of the food available to us and the health of the nation has gained momentum and a large number of research papers have been published detailing the close relationship between good nutrition and mental well-being. In January 2006 the McCarrison Society organized a conference entitled 'Generating Healthy Brains' the aim of which was to integrate the results of different fields of research relating nutrition to mental health. The current paper was presented to that conference. At the same time Sustain published their book – on a similar theme – 'Changing Diets, Changing Minds: how food affects mental well being and behaviour'.[9]

Refer to Appendix 1 for the specific changes 14 Meat cuts and products, Appendix 2 for the changes in 9 Cheeses and to Appendix 3 for the changes in 4 Dairy products.

Review of selected data from the 6th Edition

TABLE 1

Beef – topside roast: trace elements in mg per 100gm 1940 to 2002

	1940	1978	1991	2002	1940 to 1991 % change	1991 to 2002 % change	1940 to 2002 % change
Sodium	76	48		62	–37	29	–18
Potassium	370	350		410	–5	17	11
Phosphorous	286	200		230	–30	15	–20
Magnesium	28	23		27	–18	17	–4
Calcium	6.2	6		8	–3	33	29
Iron	4.7	2.6		2.9	–45	12	–38
Copper	0.25	0.13	0.14	0.04	–48	–69	–84
Zinc		4.9	5.5	6.5		33	
Water (gm/100gm)	56.2			56.9			1

Table 1. This table illustrates the significant decline in essential minerals between 1940 and 2002. Closer inspection reveals very significant decreases in Na, K, P, Mg, Fe and Cu in roast topside from 1940 to 1978. This trend reverses sometime between 1978 and 2002 with the exception of copper which has virtually disappeared by 2002.

TABLE 2

Beef – rump steak: trace elements in mg per 100gm 1940 to 2002

	1940	1978	1991	2002	1940 to 1991 % change	1991 to 2002 % change	1940 to 2002 % change
Sodium	80		54	71	–33	31	–11
Potassium	371		360	360	–3	0	–3
Phosphorous	257		220	220	–14	0	–14
Magnesium	25		24	23	–4	–4	–8
Calcium	5.2		7	5	35	–29	–4
Iron	6		3.2	3.7	–47	8	–38
Copper			0.15	0.02		–87	
Zinc			5.3	4.7		–13	
Water (gm/100gm)	56.9			57.2			1

Table 2. This table illustrates the significant decline in essential minerals between 1940 and 2002. Closer inspection reveals a similar picture to Table 1. With the exception of Mg and Ca, trace element contents in rump steak decline significantly until at least 1991. Thereafter, Na, K, Mg and Fe stabilise or even increase. On the other hand Ca and Zn continue to decline and Cu all but disappears completely.

TABLE 3

Roast Chicken: trace elements in mg per 100gm 1940 to 2002

	1940	1978	1991	2002	1940 to 1991 % change	1991 to 2002 % change	1940 to 2002 % change
Sodium	80		81	100	1	23	25
Potassium	355		310	300	–13	–3	–15
Phosphorous	271		210	200	–23	–5	–26
Magnesium	23		24	23	4	–4	0
Calcium	14.5		9	17	–38	89	17
Iron	2.6		0.8	0.8	–69	0	–69
Copper			0.12	0.08	–48	–33	0
Zinc			1.5	2.7		80	
Water (gm/100gm)	61.1			65.3			7

Table 3. This table illustrates the significant decline in essential minerals between 1940 and 2002. Closer inspection reveals K, P, Ca and Fe all decline significantly between 1940 and 1991. There is little change in Na and Ca contents. Between 1991 and 2002 trace elements either increase or are stable. No analyses were made for Cu and Zn in 1940 so these are not compared.

TABLE 4

Roast Turkey: trace elements in mg per 100gm 1940 to 2002

	1940	1978	1991	2002	1940 to 1991 % change	1991 to 2002 % change	1940 to 2002 % change
Sodium	130		57	90	–56	58	–31
Potassium	367		310	350	–16	13	–5
Phosphorous	320		220	260	–31	18	–19
Magnesium	28.2		27	27	–4	0	–4
Calcium	38.3		9	11	–76	22	–71
Iron	3.8		0.9	0.8	–76	–11	–79
Copper			0.15	0.09		–40	
Zinc			2.4	2.5		4	
Water (gm/100gm)	59			64.6			1

Table 4. This table illustrates the significant decline in essential minerals between 1940 and 2002. Closer inspection reveals there is a marked decline in all elements (Cu and Zn excluded) from 1940 to 1991. Interestingly, as in the beef analyses above, this trend is reversed thereafter with the exception of Cu and Fe which both decline significantly up to 2002

TABLE 5

Back Bacon – fried: trace elements in mg per 100gm 1940 to 2002

	1940	1978	1991	2002	1940 to 1991 % change	1991 to 2002 % change	1940 to 2002 % change
Sodium							
Potassium	517	300		360	–42	20	–30
Phosphorous	229	170		180	–26	6	–21
Magnesium	25.7	20		21	–22	5	–18
Calcium	11.5	13		6	13	–54	–48
Iron	2.8	1.3		0.6	–54	–54	–79
Copper		0.12	0.12	0.06	0	–50	
Zinc		2.6		1.9		–27	
Water (gm/100gm)	12.7			49.7			291

Table 5. This table illustrates the significant decline in essential minerals between 1940 and 2002. Closer inspection reveals similar changes as the previous tables. With the exception of Ca, essential mineral contents in back bacon decline significantly until 1978. Thereafter, there is a significant increase in K whilst and P an Mg stabilise. Ca, Fe, Cu and Zn continue a marked decline. Another significant historical change is the increase in water content by nearly 300% between 1940 and 2002.

TABLE 6

Cheddar Cheese: trace elements in mg per 100gm 1940 to 2002

	1940	1978	1991	2002	1940 to 1991 % change	1991 to 2002 % change	1940 to 2002 % change
Sodium	612	610	670	723	9	8	18
Potassium	116	120	77	75	–34	–3	–35
Phosphorous	545	520	490	505	–10	3	–18
Magnesium	46.9	25	25	29	–47	16	–38
Calcium	810	800	720	739	–11	3	–10
Iron	0.57	0.4	0.3	0.3	–47	0	–47
Copper	0.04	0.03	0.03	0.03	–33	0	–33
Zinc		4	2.3	4.1		78	
Water (gm/100gm)	37		36	36.6	3	2	1

Table 6. This table illustrates the significant decline in all essential minerals except Na between 1940 and 2002. Closer inspection reveals very significant decreases in K, Mg, Fe and Cu from 1940 to 1991. This trend reverses sometime between 1991 and 2002 with the content of the majority of essential minerals stabalising or increasing (Zn).

TABLE 7

Parmesan cheese: trace elements in mg per 100gm 1940 to 2002

	1940	1991	2002	1940 to 1991 % change	1991 to 2002 % change	1940 to 2002 % change
Sodium	755	1090	756	44	–31	0
Potassium	153	110	51	–28	–54	–68
Phosphorous	772	810	267	5	–67	–65
Magnesium	49.6	45	15	–9	–67	–70
Calcium	1220	1200	362	–2	–70	–70
Iron	0.37	0.11	0	–70	all gone	all gone
Copper	0.38	0.33	0	–13	all gone	all gone
Zinc		5.3	2.7		–49	
Water (gm/100gm)	28	18.4	27.6	–34	33	0

Table 7. This table illustrates the significant decline in all essential minerals except Na between 1940 and 2002. Closer inspection reveals very significant decreases in Fe between 1940 and 1991. Unlike Cheddar this trend continues between 1991 and 2002 with the content of Na, K, P, Mg, Ca significantly decreasing and all the Fe and Cu disappearing.

TABLE 8

Whole Milk: trace elements in mg per 100gm 1940 to 2002

	1940	1991	2002	1940 to 1991 % change	1991 to 2002 % change	1940 to 2002 % change
Sodium	50	55	43	10	–15	–14
Potassium	160	140	155	–12	11	–3
Phosphorous	95	92	93	3	1	–2
Magnesium	14	11	11	–21	0	–21
Calcium	120	115	118	–4	3	–2
Iron	0.08	0.05	0.03	–38	–40	–63
Copper	0.02	0	0	all gone	0	all gone
Zinc		0.4	0.4		0	

Table 8. This table illustrates a decline in all essential minerals between 1940 and 2002. Closer inspection reveals very significant decreases in Fe between 1940 and 1991. A trend which continues to 2002.

TABLE 9 Summary of results

Historical essential mineral depletion – changes in 5 categories of food products

	1940 to 1991 Vegetables (n = 28)	1940 to 1991 Fruit (n = 17)	1940 to 2002 Meat (n = 14)	1940 to 2002 Cheeses (n = 9)	1940 to 2002 Dairy (n = 4)	Weighted Average (n = 72)
Sodium	–49%	–29%	–24%	–9%	–47%	–34%
Potassium	–16%	–19%	–9%	–19%	–7%	–15%
Phosphorous	9%	2%	–21%	–8%	34%	1%
Magnesium	–24%	–16%	–15%	–26%	–1%	–19%
Calcium	–46%	–16%	–29%	–15%	4%	–29%
Iron	–27%	–24%	–50%	–53%	–83%	–37%
Copper	–76%	–20%	–55%	–91%	–97%	–62%

Table 9 illustrates the weighted average changes that have taken place between 1940 and 1991 for fruit and vegetables and between 1940/1960 and 2002 for meat and meat products, cheeses and dairy products. These represent the average changes in 72 food products. The results are stark. They speak for themselves. There has been a 19% loss in Magnesium, a 29% loss in Calcium, a 37% loss in Iron and a really alarming 62% loss in Copper.

There were no changes in the analytical data for fruit and vegetables presented in the 6th edition (2002) from the 5th Edition (1991) but for completeness sake, and to further illustrate the decline in the essential mineral content of all our foodstuffs over time, the data are included in an overall summary presented in Table 9. In 'appreciating' the declines that have taken place it is worthwhile being reminded of the reason why the 'only' trace elements that were analysed for in 1940 were iron and copper. This was because at that time they were the only ones known to be essential (iron in 17th Century and copper in 1928). Since then, of course, the physiological and psychological significance of many others – including Zn, Cr, Co, Se, Mo, Mn – has been proven and others such as B, V, Si, etc have been recognised.

DISCUSSION

1. Issues from the previous paper

Before discussing the significance of the data reviewed above I would like to respond to a number of criticisms leveled at my previous paper.

It has been suggested that my conclusions were invalid as analytical methods have altered over the period reviewed. Advances in analytical methods have undoubtedly occurred but I can do no better than directly quote McCance & Widdowson in their foreword to the 5th and 6th editions: **"Those methods (of 62 years ago) were no less accurate than the modern automated ones, but they took a much longer time"**.

A second criticism is that over the period reviewed, crop and animal varieties have changed to such a degree that ready comparisons are meaningless. There is no doubt that very real changes have occurred and will continue to occur particularly if GM crop varieties are introduced. Furthermore, reduced times for fruit and vegetable 'on the plant ripening' and transit are likely to have affected nutrient contents. Similarly in the meat sector two significant changes have taken place. Crawford[10] demonstrates that not only has the lean to fat ratio decreased but perhaps more significantly the saturated fat to unsaturated fat ratio has also decreased. McCance and Widdowson in their introduction to the 6th Edition to the meat and meat products section state 'The major source of variation in meat composition is the proportion of lean to fat, as a result of husbandry techniques and trimming practices, both at a retail level and in the home. This affects levels of most other nutrients, which are distributed differently in the two fractions'.

Which brings me to the central purpose of my analysis: I did not set out to establish the nutrient content of vegetables or meat in 1940 in comparison to their content now as a simple quantitative analysis but rather as a measure of the changing nutritive value of the British diet. Thereby helping to determine whether, by getting less micronutrients today from essentially the same food types that were eaten 70 yrs ago this circumstance could be undermining the health of our nation in a significant way.

Consequently it is my view that the criticism mentioned previously is irrelevant as it is the intrinsic micronutrient content of food products which have the same 'name' that need to be compared; the consumer in 1940 ate an apple or an orange or a rump steak and so does the consumer in 2006. To misquote Gertrude Stein – a carrot is a carrot is a carrot and a portion of broccoli is a portion of broccoli is a portion of broccoli.

In a recent paper Davies[11] refers to the need to compare the dry ash contents of foods rather than fresh content. The consumer does not eat dry ash. What we are concerned with here is the continued trend towards quantity and bulk (usually more water content) over quality and taste, and the micronutrient content of fresh produce presented to the consumer.

2. The impact of nutrition on health

The impact of poor nutrition on health is common knowledge. As long ago as the early 17th century it was known that scurvy was caused by a lack of fresh fruit and vegetables. For more than a hundred years we have known about vitamin deficiency diseases and the effects of poor nutrition on populations historically in Europe and the US and to this day in the developing world. In addition to micronutrient and mineral deficiency we now suffer from indiscriminate chemical exposure from our environment. The combination of these factors is leading to outbreaks of various diseases of epidemic proportions which are now beginning to be widely recognised as the primary cause of so called degenerative diseases.

In March 2006, the UN acknowledged a new kind of malnutrition. Catherine Bertini[12] Chairperson of the UN Standing Committee on Nutrition said: "The overweight are just as malnourished as the starving, and nutritional programs in poor countries need to target rising obesity alongside hunger". She also suggested that we need a new definition of malnutrition because food availability is not really the issue. It is the quality of the food that is the problem. This new type of malnutrition, which can be categorised as multiple micronutrient depletion, has been termed 'Type B malnutrition'.

What is implicit in this diagram taken from Davies' paper[14] is that nutrition is fundamental to good health. To be fit and to maintain that quality we call health we need four basic components – good quality sunlight, air, water and food. The significance of these four components cannot be underestimated – too many independent researchers have demonstrated that foods low in micronutrients undermine our physical, mental and emotional well being. This is amply demonstrated in the Appendices 1 and 2 to my first paper detailing research on micronutrients and physical and mental ill health[15,16.]

TABLE 10.

Summary of peer-reviewed research papers which correlate various mental illnesses with mineral and trace elements deficiencies or imbalances.

	Cr	Cu	Fe	I	K	Mg	Mo	P	Se	V	Zn
ADHD		X				X		X			X
Anxiety					X	X		X	X		
Aggression			X		X						X
Bipolar disorder			X	X	X	X	X			X	
Depression	X	X	X	X	X	X			X	X	X
PMS		X	X			X					X
Schizophrenia		X	X	X		X			X		

A large number of peer-reviewed research papers written between 1941 and 2003 correlate various mental illnesses with mineral and trace element deficiencies or imbalances. Table 10 summarises these relationships, the data being extracted from 225 papers published in various respected scientific and medical journals such as the American Journal of Psychiatry, The Lancet, Canadian Journal of Psychiatry, Journal of Affective Disorders, Journal of the American College of Nutrition, British Journal of Psychiatry, Journal of Learning Disabilities etc. (a full list of references is supplied in Appendix 4)

3. Overall nutritional trends in the UK and the US

Over the past 70 years many esteemed men and women working in the fields of nutrition and health have warned us about the impact of poor nutrition on health. Among them are Sir Robert McCarrison[17,18] Surgeon Captain TL Cleave RN[19], Weston Price[20], Linus Pauling[21], and Trowell and Burkitt[22]. It appears that their warnings have been ignored. The most damning evidence is illustrated by our children being offered with deep fried rendered meat, chips and cola and no fruit or vegetables at school meal times.

To have reached this position after the billions of taxpayers pounds spent by various government bodies (MAFF, DEFRA, FSA, various government quangos and many research establishments) on agriculture and nutritional science seems extraordinary. It has taken an obesity crisis and the indignation and passion for good food of a television celebrity chef, Jamie Oliver, to cause government policy makers to act. Oliver seems to have intuitively reached the blindingly obvious conclusion that good food is good for you. In all probability this is too late given that what used to be called adult onset diabetes is now being found in paediatric clinics. There is also a rising prevalence of childhood leukemia, childhood obesity, cardio-vascular disorders, infertility, osteo and rheumatoid arthritis, mental illnesses,

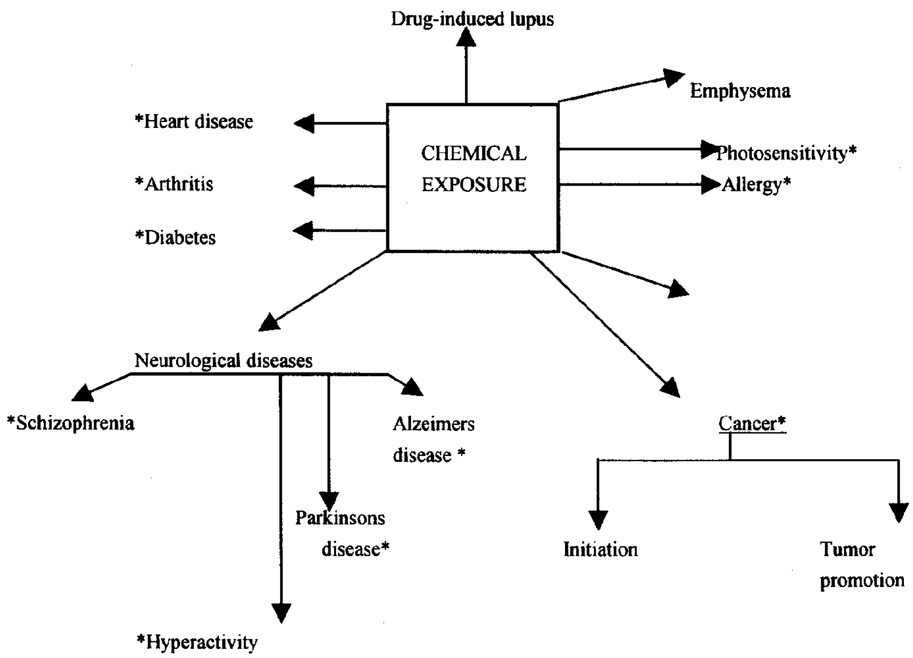

Figure 1. Diseases associated with exposure to environmental chemicals (after Forrester & Wolf[13]). The dashed lines indicate that there is circumstantial evidence to suggest that chemical exposure may play a role in the aetiology of these diseases, but this has not been proven directly. *Conditions where diet or micro-nutritional status are known to play a role.

hyperactivity, etc. All these have been shown to have some direct relationship to diet and specifically micronutrient deficiency.

However the agricultural, medical and nutritional 'establishment' appears to continue to ignore the obvious relationship between food and health while other sectors of the government are beginning to recognise it. For example, in a Reply by Broadley, Mead and White[23] based on their own paper 'Historical variation in the mineral composition of edible horticultural products' to a commentary by Davies on their paper, they recognise the decline in essential minerals over time – but contest the validity of the statistical methodology used – then dismiss these losses with the comment "Since horticultural products in general and fruit and nuts in particular are small contributors of minerals to the average diet … changes in mineral composition are unlikely to be significant in overall dietary terms." This is a comment made by 'experts' in their field who are educating our future 'experts' in the field of horticulture. Their comment directly contradicts the governments' guidelines of the '5 a day' campaign.

Government, academic institutions and the medical establishment continue to claim there is the need for further 'scientific' research when common sense tells that bad diets cause bad health and that the fast food industry continues to be permitted to peddle junk food to children. Recently, 30 years after the confectionary and fast food establishments started it, Hastings *et al*.[24] proved the blindingly obvious fact that advertising to children works. Even so, according to Caraher and Lang[25] government agencies have all but ignored these findings. More recently Brant *et al*.[26] found that rats fed on organic food were slimmer, slept better and had stronger immune systems than rats fed on conventionally grown produce. To me, given the enormous knowledge base on nutrition and health available, these findings are common sense. Is it really necessary to continue to prove the obvious?

An example of a far more valid contribution to the ongoing research – which is necessary in this field – is that currently being promoted by GREEN – Gardens for Research Experimental Education and Nutrition[27]. In this project GREEN are attempting to track the flow of nutrients from soil to plant and learn how this may be affected depending on the method of cultivation employed, to grow the same vegetables. Central to their working hypothesis is the importance of understanding and working with the soils natural micro-ecology. When plants are encouraged to work in symbiosis with soil microbes it appears to increase the transfer of essential nutrients from soil to plant. To date their research has produced potatoes and leeks with substantial increases in Ca, Mg, Fe and excellent ratios and content of Zn and Cu that far exceed any of the 1940 data. For example the calcium content of potatoes is 50 times more than that present in 1940 and for leeks the calcium content is 4 times more than that present in 1940.

In addition to measuring chemical nutrients they are also considering vitality (or freshness), visual appearance and taste of their vegetable crops. This research project should be applauded – and publicly funded.

One could ask how we ever got ourselves to this sorry position. I list below some of the reasons why the mineral content of food has diminished over time:

i. favoring varieties of crops and animal breeds for their presentation rather than nutritional quality
ii. increased use of trace element free NPK fertilizers
iii. the inevitable soil depletion of essential minerals through continuous crop growing and contributed to by the overuse of NPK fertiliser with its consequent damage to endomycorrhizal fungi that help liberate essential minerals from the soil[28]
iv. inherent soil deficiencies of essential minerals due to parent bedrock material, the amount of organic matter present, the ionic potential of differing trace elements, the degree of soil oxidization and soil pH[29]
v. increased transport distances, storage times and storage methods for ‘fresh’ produce

and some of the other factors contributing to the population’s growing ill health:

i. increased lifestyle stresses – mental, physical and emotional
ii. increased use of stimulants – coffee, tea, tobacco, alcohol etc.
iii. increased use of medication
iv. dietary trends towards cheaper, more refined, quicker convenience food and drinks – high in proteins, saturated fats and refined carbohydrates but very low in micronutrients
v. polluted air and water supplies
vi. sunlight deprivation and quality (due to ozone depletion)

The problem is that the quality of the food and drink we consume does make a difference to our health as has been indicated above. The impact of the decline in micronutrients in modern foods compared to those foods available seventy years ago is exacerbated by two further problems – a substantial proportion of the population consume little or no fresh vegetables at all and 'modern' foods contain various other components that come as 'part of the package', namely residual herbicides, pesticides, fungicides and the ubiquitous additives of processed, convenience foods e.g. colourings, flavourings, preservatives etc. And whilst some of these have been individually tested for short term safety, no one knows what their interactions might be or their cumulative effects on the body over a lifetime.

The question arises of what is to be done about this potentially catastrophic state of affairs. During the Second World War the UK government required that, due to rationing, diets might be inadequate and all children were to receive cod liver oil and orange juice. Sixty years on we find that we are in a situation where the nation, as a whole, is overfed but malnourished and the government is again considering mandatory dietary supplementation. This would undoubtedly be a constructive short to medium term solution but only if at the same time we actively encourage, from an early age, the growing trend towards healthier eating and drinking, paying specific attention to advertising and the availability and presentation of junk foods in schools, hospitals, penal institutions and public places. There is a desperate need for the food and drinks industries to become more aware and realise they have an ever growing responsibility to their customers to provide good quality, nourishing, non-toxic products. More 'holistic' and local projects such as that being developed by GREEN should be encouraged. And let's educate our children from an early age about the value and significance of our soil; how its health is directly relevant to our own, and to the health of the environment.

Assuming that the two basic premises presented here are correct – namely that the micronutrient content of our food has declined and that nutrition impacts health – there is a need for pan-European policy making bodies to encourage the growing, rearing, presentation and eating of good quality food. If we are really going to improve things, a concerted effort is needed from a variety of sources requiring the direct and integrated involvement of concerned government departments and agencies and the agriculture and food and drink industries.

CONCLUSIONS

What a dilemma we have found ourselves in. Research from all over the world has demonstrated the reality of the loss of micronutrients from our foods and provides evidence that micronutrient deficiencies significantly undermine our health, contributing towards chronic physiological and psychological illnesses in people of all ages.

Yet we continue to see the relentless pursuit of farming and marketing practices that emphasize cheapness and durability over quality to the point where the past few generations have become conditioned to accept this as the norm – with palates that have been conditioned to prefer foods containing excessive amounts of saturated fats, refined proteins, salt, sugar and other refined carbohydrates.

So what is the way forward into the 21st Century? One component to the resolution of this dilemma would be for all parties concerned to recognize the current gravity of the problem (without apportioning blame) and resolve to rectify the situation by implementing appropriate policy changes in both government and industry.

Another interesting, relatively recent, positive development is the significant and growing trend wherein individuals are beginning to make their own health choices. This trend towards nutritional awareness, with the buying of locally-grown and organic produce and a greater interest in food preparation, world cuisine and animal husbandry is a powerful force and one that is likely to bring about significant changes within the food industry.

Already this consumer-driven change has resulted in food labelling alterations as well as greater availability of organically-grown foods. We have also recently experienced within the foods and drinks industry a resistant but gradual decline in the addition of additives to food, especially artificial colours and preservatives, sugar, salt and trans-fats.

There is clearly still a long way to go and the next step will be to insist on the proper nourishment of the soils on which our food is grown and reared, preferably through organic, bio-dynamic and other sustainable farming methods, so that it will necessarily provide the minerals and trace elements that are essential for our future health and wellbeing.

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APPENDIX 1 – Changes in the Mineral content of 14 samples of Meat between 1940 and 2002

Year of Analysis	Mineral	Beef/Topside - roast	Beef/Rump Steak - fried	Corned beef	Bacon/Back - fried	Bacon/Streaky - fried	Chicken Meat - roast	Duck - roast	Goose - roast	Ox kidney - stewed	Pheasant - roast	Pork Leg - roast	Rabbit - stewed	Turkey - roast	Venison - roast	Totals	Change
1940	Sodium (Na)	76	80		-	-	80	195	145	164	104	66	32	130	86	1158	
1972		48														48	
1991			54				81	96	150			79		57	86	603	
2002		62	71		-	-	100	96	80	150	66	69	48	90	52	884	less 24%
1940	Potassium (K)	370	371	117	517	462	355	319	406	164	411	308	210	367	364	4741	
1972		350			300	290										940	
1991			360	140	*	*	310	270	410			350		310	360	2510	
2002		410	360	140	360	350	300	270	320	210	360	400	200	350	290	4320	less 9%
1940	Phosphorous (P)	286	257	119	229	238	271	231	267	392	308	363	199	320	286	3766	
1972		200			170	160										530	
1991			220	120	*	*	210	200	270			200		220	290	1730	
2002		230	220	130	180	200	200	200	220	290	220	250	150	260	240	2990	less 21%
1940	Magnesium (Mg)	28.1	24.8	29	25.7	25.1	23	23.9	30.8	22.4	35	22.6	21.6	28.2	33.4	373.6	
1972		23			20	19										62	
1991			24	15	*	*	24	20	31		3	22		27	33	199	
2002		27	23	15	21	21	23	20	23	19	26	27	18	27	27	317	less 15%
1940	Calcium (Ca)	6.2	5.2	12.8	11.5	52.3	14.5	19	10.4	20.8	49.3	5.2	11.3	38.3	29	285.8	
1972		6			13	12										31	
1991			7	14	*	*	9	13	10			10		9	29	101	
2002		8	5	27	6	7	17	13	10	17	28	10	39	11	6	204	less 29%
1940	Iron (Fe)	4.7	6	9.8	2.8	3.2	2.6	5.8	4.6	7.1	8.4	1.7	1.9	3.8	7.8	70.2	
1972		2.6			1.3	1.2										5.1	

1991			3.2	2.9			0.8	2.7	4.6			1.3		0.9	7.8	24.2	
2002		2.9	2.7	2.4	0.6	0.7	0.8	2.7	3.3	9	2.2	1.1	1.1	0.8	5.1	35.4	less 50%
1940	Copper (Cu)	0.25	-		-	-	-	-	-			-	0.2	-	-	0.45	
1972		0.13			0.12	0.12										0.37	
1991		0.14	0.15	0.24	0.12	0.12	0.12	0.31	0.15			0.29		0.15	0.36	1.33	
2002		0.04	0.02	0.18	0.06	0.07	0.08	0.31	0.15	0.63	0.1	0.06	0.06	0.09	0.36	0.6	less 55%
1972	Zinc (Zn)	4.9			2.6	2.4											
1991		5.5	5.3	5.6			1.5	2.6	2.6			3.5		2.4	3.9		
2002			6.5	4.7	5.5	1.9	2.1	2.7	2.6	2.6	3	1.3	3.2	1.7	2.5	3.9	less 1%

Copper – comparisons between the two figures given in 1940 with those in 2002 show a 78% decrease in Copper content

Copper – comparisons between those 1991 figures which are different from those given in 2002 – for the same cuts of meat – show a 55% decrease in Copper content

Zinc – comparisons between those 1991 figures which are different from those given in 2002 – for the same cuts of meat – show a 1% increase in Zinc content

Each individual figure represents mg per 100 gm

These statistics have been calculated by comparing and contrasting data first published in 1940 by McCance and Widdowson in 'The Chemical Composition of Foods', which was commissioned by the Medical Research Council - with that data published by the same authors in 1991 entitled 'The Composition of Foods'

This later - 5th edition - was commissioned by the Royal Society of Chemistry and the Ministry of Agriculture Fisheries and Food. The latest - 6th edition - in this series was published in 2002 by the Royal Society of Chemistry and the Foods Standards Agency.

APPENDIX 2 – Summary of changes in the mineral content of 9 Cheeses between 1940 and 2002

Year of analysis	Mineral	camembert	chedder	cream	danish blue	edam	gouda	parmesan	processed	stilton	Totals	Change
To enable an historical comparison to be made I have amalgamated the 1940 and 1960 figures together to provide a total												
1940 and 1960	Water	47.5	37	10	40.5	43.7	42.4	28	43	28.2	320.3	Plus 19%
1978												
1991		50.7	36	45.5	45.3	43.8	40.1	18.4	45.7	38.6		
2002		54.4	36.6	45.5	46.3	43.8	40.4	27.6	47.4	38	380	
1940 and 1960	Sodium (Na)	1408	612	110	1417	983	1054	755	918	1150	8407	Na Less 9%
1978		1410	610	300	*	*		*	1360	*	3680	
1991		650	670	300	1260	1020	910	1090	1320	930	8150	
2002		605	723	300	1220	996	925	756	1351	788	7664	
1940 and 1960	Potassium (K)	111	116	47	186	159	124	153	86	161	1143	K less 19%
1978		110	120	160					82			
1991		100	77	160	89	97	91	110	130	130		
2002		104	75	160	88	89	82	51	178	96	923	
1940 and 1960	Phosphorous (P)	285	545	44	425	523	469	772	480	304	3847	P less 8%
1978		290	520	100					490			
1991		310	490	100	370	530	490	810	800	310		
2002		241	505	100	344	508	498	267	768	314	3545	
1940 and 1960	Magnesium (Mg)	17.4	46.9	5.2	20.4	27.7	24.5	49.6	47.6	27.2	266.5	Mg less 26%
1978		17	25	10					24			
1991		21	25	10	27	39	38	45	22	20		
2002		14	29	10	20	34	32	15	27	15	196	
1940 and 1960	Calcium (Ca)	152	810	30	578	739	622	1220	724	362	5237	Ca less 15%
1978		380	800	98					700			
1991		350	720	98	500	770	740	1200	600	320		
2002		235	739	98	488	795	773	362	610	326	4426	

1940 and 1960	Iron (Fe)	0.76	0.57	0.14	0.17	0.21	0.34	0.37	0.57	0.46	3.59	Fe less 53%
	1978		0.76	0.4	0.12					0.5		1.38
1991		0.2	0.3	0.1	0.2	0.4	0.1	1.1	0.5	0.3	3.2	
2002		0	0.3	0.1	0	0.3	0.3	0	0.5	0.2	1.7	
1940 and 1960	Copper (Cu)	0.08	0.03	0.04	0.09	0.03	0.06	0.38	0.03	0.03	0.77	Cu less 91%
1978		0.08	0.03						0.5		0.61	
1991			0.03				0	0.33	0.17	0.18	0.68	
2002		0	0.03	0	0	0	0	0	0	0.04	0.07	
1978 (1st analysed)	Zinc (Zn)	3	4	0.48		4		4	3.2	4	22.68	Zn less 18%
1991			2.3				1.8	5.3	3.2	2.5	12.8	
2002		2.1	4.1	0.5	3	3.8	3.9	2.7	2.6	2.9	18.7	

Each individual figure represents mg per 100gm.

These statistics have been calculated by comparing and contrasting data first published in 1940 by McCance and Widdowson in ‘The Chemical Composition of Foods’, which was commissioned by the Medical Research Council – with that data published by the same authors in 1991 entitled 'The Composition of Foods'

This later – 5th edition - was commissioned by the Royal Society of Chemistry and the Ministry of Agriculture Fisheries and Food. The latest – 6th edition – in this series was published in 2002 by the Royal Society of Chemistry and the Foods Standards Agency.

APPENDIX 3 – Summary of changes in the mineral content of 4 Dairy products between 1940 and 2002

Year of analysis	Mineral	Whole Milk	Butter	Cream – Single	Cream – Double	Totals	Percentage Change
To enable an historial comparison to be made I have amalgamated the 1940 and 1960 figures together to provide a total							
1940 and 1960	Sodium (Na)	50		42.2	46.2	138.4	Na – Less 47%
1991		55		49	37	141	
2002		43		29	22	94	
1940 and 1960	Potassium (K)	160	15	124	79	378	K – Less 7%
1991		140	15	120	65	340	
2002		155	27	104	65	351	
1940 and 1960	Phosphorous (P)	95	24	44	21	184	P – Pluss 34%
1991		92	24	76	50	242	
2002		93	23	79	52	247	
1940 and 1960	Magnesium (Mg)	14	2.4	6	3.8	26.2	Mg – Less 1%
1991		11	2	9	6	28	
2002		11	2	8	5	26	
1940 and 1960	Calcium (Ca)	120	14.8	79	50	263.8	Ca – Plus 4%
1991		115	15	91	50	271	
2002		118	18	89	49	274	
1940 and 1960	Iron (Fe)	0.08	0.16	0.31	0.2	0.75	Fe – Less 83%
1991		0.05	0.2	0.1	0.2	0.55	
2002		0.03	0	0	0.1	0.13	
1940 and 1960	Copper (Cu)	0.02	0.03	0.2	0.13	0.38	Cu – Less 97%
1991		0	0.03	0	0	0.03	
2002		0	0.01	0	0	0.01	

1978 (1st analysed	Zinc (Zn)	0.35					Zn – Less 17%
1991		0.4	0.1	0.5	0.2	1.2	
2002		0.4	0.1	0.3	0.2	1	

Each individual figure represents mg per 100gm.
These statistics have been calculated by comparing and contrasting data first published in 1940 by McCance and Widdowson in 'The Chemical Composition of
Foods', which was commissioned by the Medical Research Council - with that data published by the same authors in 1991 entitled 'The Composition of Foods'
This later - 5th edition - was commissioned by the Royal Society of Chemistry and the Ministry of Agriculture Fisheries and Food series
The latest - 6th edition - in this was published in 2002 by the Royal Society of Chemistry and. the Foods Standards Agency

APPENDIX 4

Some references relating to the intrinsic role of mineral and trace element deficiency or imbalance in psychiatric disorders.

Boron

Boron deficiency or imbalance may play a role in the symptoms of mood disorders. Observational and experimental studies have shown an association between boron and brain function 1,2,3,4,5.

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Chromium

Chromium deficiency or imbalance plays a role in the symptoms of mood disorders. Observational and experimental studies have shown an association between chromium and depression 1,2,3,4.

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Copper

Copper deficiency or imbalance plays a role in the symptoms of mood disorders. Observational and experimental studies have shown an association between copper and ADHD 1,2,3, **depression 4,5,6, premenstrual syndrome 7, and schizophrenia** 8,9,10,11,12,13.14, 15,16,17,18,19.

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Iodine

Iodine deficiency or imbalance plays a role in the symptoms of mood disorders 1,2. **Observational and experimental studies have shown an association between iodine and aggression** 3, **anxiety** 4, **bipolar disorder** 5,6,7, **depression** 8,9, **and schizophrenia** 10.

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Iron

Iron deficiency or imbalance plays a role in the symptoms of mood disorders. Observational and experimental studies have shown an association between iron and aggression 1,2,3,4, **ADHD** 5,6,7,8,9, **bipolar disorder** 10, **depression** 11,12,13,14, **premenstrual syndrome** 15, **and schizophrenia** 16,17,18.

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Magnesium

Magnesium deficiency or imbalance plays a role in the symptoms of mood disorders. Observational and experimental studies have shown an association between magnesium and aggression 1,2,3,4,5,6,7,8,9,10, **anxiety** 11,12,13,14,15, **ADHD** 16,17,18, **bipolar disorder** 19,20,21, **depression** 22,23,24,25,26,27,28,29,30,31,32,33, 34, **premenstrual syndrome** 35,36,37,38,39,40,41,42,43,44,45,46,47, 48,49,50,51, **and schizophrenia** 52,53,54,55,56,57,58,59,60,61,62,63, 64.

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Manganese

Manganese deficiency or imbalance plays a role in the symptoms of mood disorders. Observational and experimental studies have shown an association between manganese and aggression 1,2,3,4,5, **ADHD** 6,7,8,9, **and schizophrenia** 10,11,12,1,14.

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Molybdenum

Molybdenum deficiency or imbalance plays a role in the symptoms of mood disorders. Observational and experimental studies have shown an association between molybdenum and bipolar disorder 1. **There is also strong evidence for the neuro-protective role of molybdenum** 2,3,4.

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Nickel

Nickel deficiency or imbalance may play a role in the symptoms of mood disorders. Observational and experimental studies have shown nickel to be associated with critical brain function 1,2,3,4,5,6,7,8,9,10.

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Phosphorus

Phosphorus deficiency or imbalance plays a role in the symptoms of mood disorders. Observational and experimental studies have shown an association between phosphorus and anxiety 1,2,3 **and ADHD** 4.

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Potassium

Potassium deficiency or imbalance plays a role in the symptoms of mood disorders 1**. Observational and experimental studies have shown an association between potassium and aggression** 2,3,4, **anxiety** 5**, bipolar disorder** 6,7,8,9, **and depression** 10,11.

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Selenium

Selenium deficiency or imbalance plays a role in the symptoms of mood disorders. Observational and experimental studies have shown an association between selenium and anxiety 1, **depression** 2,3, **and schizophrenia** 4,5,6,7,8,9,10.

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Vanadium

Vanadium deficiency or imbalance may play a role in the symptoms of mood disorders. Observational and experimental studies have shown an association between vanadium and bipolar disorder 1,2,3,4,5.6.7,8,9,10, 11,12,13,14,15,**and depression** 16,17.

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Zinc deficiency or imbalance plays a role in the symptoms of mood disorders. Observational and experimental studies have shown an association between zinc and aggression 1,2,3,4,5,6, **ADHD** 7,8,9,10, 11,12,13, **depression** 14,15,16,17,18,19, **and premenstrual syndrome** 20,21,22,23,24.

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