Critical nutrition events in human history

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Decisions we make and implement about how people should be fed or feed themselves can have far-reaching effects on population, health and ecosystems and not simply those of an individual's health or even that of a community. Nutritionists and food policy makers are usually preoccupied by the need to optimize health, well-being and life expectancy in the light of a contemporary analysis of food–health relationships.

Past pressures to feed human populations in Europe were temporarily resolved by the import from the Americas of maize and potatoes or sugar production with slave labour in various parts of the world. In China, the advent of rice production allowed population growth. In turn, the progressive increase in size of these populations has had long-term consequences for indigenous food cultures and people across the globe, often with their destruction and the reduction of food cultural diversity.

Innovations in agricultural practice and food technology have also had unintended consequences. The development of dairying and dairy technology has contributed to the desertification of Africa and the increased fat consumption of Western peoples and their changing health patterns.

The present rapid changes in the production, transport, processing and storage of food may solve some immediate health and population problems, but a more sophisticated and long-range analysis is required if we are to minimize any adverse effects and encourage a favourable impact on the human species and its habitat.

Introduction

One of the most significant influences on my own views about nutrition and health, and in turn human history has been a consideration of the work of Linnaeus (1707–78), later Carl von Linné (when he had been elevated to the nobility). Linnaeus graduated in Medicine at Uppsala University. He began his academic life as a botanist, and he practised medicine in Stockholm. These two disciplines, the study of plants and their potential or appropriateness for use as human food, and the analysis of factors contributing to human health and disease, have been exciting fields of enquiry for me.

Again, the cities of Uppsala and Stockholm have played an important part in the development of my own academic and medical career. On the morning of the defence of my MD thesis at Uppsala University, I found to my delight a wonderful constellation of potted plants and flowers on my Uppsala doorstep, with good wishes from Professor Arvid Wretlind, arguably the father of parenteral nutrition and then Professor of Nutrition at the Karolinska Institute and Hospital in Stockholm. That morning Scandinavian nutritionists, physiologists and metabolic physicians gathered for the defence of my thesis, under the watchful eye of my extended Swedish family.

The thesis had to do with nutritional and endocrine determinants of human cardiac metabolism in health and disease. This was in 1972 and Uppsala University was nearly 500 years old, having been founded in 1477. The evening required that speeches would be made in Latin and Swedish and my Swedish relatives were interested in how much I reflected the standards and interests of my Swedish great grandfather, Sven Magnus Wahlqvist, the first in my paternal ancestry to shift from the patronymic to the regularized family surname tradition. He had been a school principal, a naturalist, a musician, and a librarian. One of his principal interests was the documentation of factors which contributed to mortality in his community. He had been certified to deliver certain areas of health care, like vaccination, blood letting and the use of the Spanish 'fly' for various ailments, while not actually being a medical graduate. By the time he died at the age of 83 there were mixed feelings in the community about his interest in the documentation of factors contributory to mortality, especially those deriving from his interest in nature. Questions of how sacrosanct such information was, were later set aside in a nation given to systematic observation of the health of entire populations.

One of the most interesting letters Sven Magnus ever wrote to my grandfather was where he considered the adverse social and health consequences of potatoes on his community. At the end of the 19th century, he had witnessed people turning potatoes into Schnapps, rather than use this food for regular nutritional sustenance. In the 18th century, his countryman Linnaeus, had counselled against the introduction of the potato into Swe-

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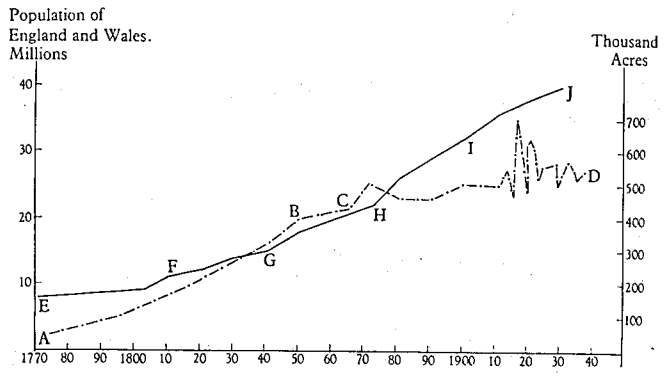

Figure 1. Curve *ABCD* represents the acreage under potatoes in England and Wales, in hundred-thousand acres. That between *A* and *C* is based on deductions from contemporary estimates. That between *C* and *D* is based on official estimates. Curve *EFGHIJ*, represents the population of England and Wales. That between *F* and *J* is based on census returns. That between *E* and *F*, on estimates from Ernie's *English farming, past and present*, 1936. Source: The history and social influence of the potato. Redcliffe Salaman (Cambridge University Press, 1987).

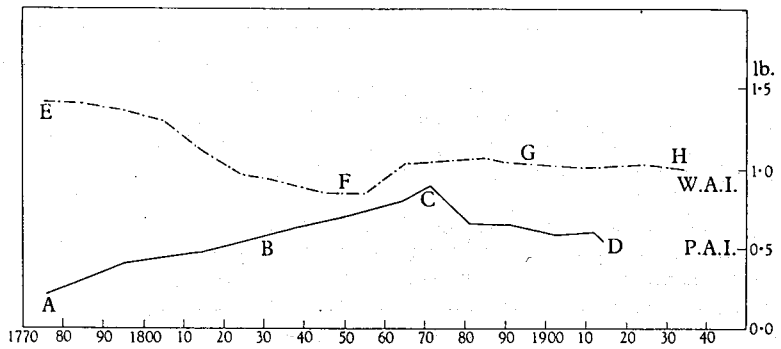

Figure 2. Curve *ABCD* represents the daily quantity in pounds of potatoes available per head of the population in England and Wales. Curve *EFGH* represents the daily quantity in pounds, of wheat available per head of the population in England and Wales. Source: The history and social influence of the potato. Redcliffe Salaman (Cambridge University Press, 1987).

den as food, because of its potential toxicity, later confirmed when the neurotoxicity of solanene in green potatoes was appreciated. Linnaeus's concern proved correct in another way as with the introduction of the potato, the Swedish population exploded. Farms were able to produce many more calories of food per hectare than had previously been the case and so larger families could initially be accomodated on the same farm. But balance between population and food production was not achieved and, during the latter part of the 19th century, one quarter of the Swedish population, one million out of four million emigrated, principally to North America. This accounts for relatives that we have today in New England. Various factors, this amongst them, also accounted for our family's arrival in Australia.

The hunter–gatherer period

A most useful analysis of the hunter–gatherer diet has been provided by Eaton and Konner[1]. They refer particularly to the late paleolithic period from 35 000 to 20 000 BC. As they say, this was the last time period during which human physiology and biochemistry interacted with extrinsic influences typical for which they were originally selected. The diet consisted principally of uncultivated vegetables and wild game. Considerable variety of foods would have been obtained, however, amongst the vegetables and sources of game, as well as from nuts, berries and other fruits, insects and more. The contribution to energy intake from fat was modest at about 21%, the protein high at 34% and the carbohydrate modest at 45%, although the type of carbohydrate was, of course, unrefined and the total contribution to dietary fibre intake high at about 46 grams per day. The cholesterol intake was actually significant at about 600 mg per day, but, of course, with little associated saturated fat intake. Population was relatively stable other than what was allowed by movement to new hunting or gathering areas.

Advent of subsistence agriculture and of herds-people

About 11 000 years ago people began to keep sheep and cattle and the domestication of cattle was further in evidence about 8500 years ago. There was evidence of dairying in the Saharan region about 4000 BC and of cheese production in Egypt in about 2300 BC. Subsistence agriculture began to develop through this period as well with the progressive use of wheat and barley in the Tigris and Euphrates, as well as Nile river regions about 8000 BC. In China, rice was developed as a grain for cultivation, in Henudu in about 5500 BC. And maize was developed in the Tehuacan Valley in Mexico in about 4000 BC. The human diet was now destined to change radically, to provide a progressive stimulus to population growth and the further requirement for food production, an ever spiralling trend. With crop, dairy and meat production came the stimulus to technologies and the industry of food. Intermediaries on the food chain, like millers, became increasingly powerful individuals, and the stimulus to trade in food grew and grew.

Food preservation

Human settlements required food to be available locally, in and out of season, and this provided a stimulus to food preservation. Even though there was a risk attached to certain preservation techniques like curing and salting, it was a worse prospect not to have food at all. It is only in recent times that it has been possible to replace these early food technologies with ones which are apparently safer, like freezing, bottling and canning. Now, in an effort to maintain food supply for an ever increasing population, there is a new preparedness to accept unknowns with preservation techniques, such as food irradiation, where the production of novel chemical compounds is considerable. Not that traditional cooking methods do not generate a range of chemical products, but they are ones with which the human species has been familiar for many generations.

Fermentation and alcohol

The use of alcohol amongst hunter–gathers seems to have been negligible.There is some evidence for use of the sweet slightly intoxicating sap of a Tasmanian cider eucalypt by Aboriginal Australians. Herdspeople began to use fermented milks (Koumisi and Kefir) or, at the very least, various cultured milks and their products. The fermentation of foods was progressively developed in China and the Far East; the Scandinavians fermented fish as a way of preserving it. The first wine was probably produced about 10 000 ago. The advent of alcoholic beverages, made possible through subsistence agriculture and the production of grains, fruits and tuberous vegetables was forever to change the course of human development and history.

The development of staples

Perhaps one of the major influences of food on history was the transfer of the potato and of maize to Europe from central America. Evidence points to these crop introductions to Europe having led to a major population explosion and ultimately to the colonization of the Americas, Australia and New Zealand by Europeans.

Earliest evidence for the use of the potato comes from central and southern America, where it was represented in pottery as early as 200 AD. It appears to have become a strong part of food belief and culture, although not to have led to the same degree of population growth as it did in Europe. What checks and balances operated in the Americas and not in Europe are unclear[2].

We know well enough what a profound social effect the potato had on Europe. On account of the monoculture and susceptibility to plant disease, famine became a problem, most notably the Irish potato famine. The most universal failure of the potato crop in Ireland was in 1845 and 1846. I have referred already to the way in which the potato was misused as a source of alcoholic beverage when the food supply was short.

During the years of the Second Word War, Britain still saw the potato as a preferred crop as it could be produced locally with less dependence on grains.

One of the remarkable aspects of the potato is that it can grow at almost any altitude and almost any location. There is an ongoing pressure to meet human food requirements, especially locally, by more and more successful potato production, despite, it may be argued the lessons of history. Very recently the Australian Foreign Affairs and Trade journal reported the development by Australian scientists of a "hairy potato" to alleviate food problems through greater disease resistance[3].

The use of sweeteners by humans is of particular interest[4]. These have included honey, manna, sugar, grapes, dates, maple, coconut, carrots, sorghum and maize. Sugar cane, according to Kretchmer, had its origin in Papua New Guinea at the time of a neolithic agricultural revolution. The domestication of cane occurred simultaneously in several parts of the world. Demand for sugar cane was a major factor in the development of the international slave trade and, therefore, this aspect of human food history is one of its saddest. It underscores, however, the interplay between food production, economics, politics and ethics which became inevitable once subsistence agriculture had arisen.

Lime juice and extended travel

Not only did increased food production stimulate migration as a consequence of population growth, but the ability to travel long distances was itself dependent on the resolution of problems of human nutrition. The most classical example of this was the recognition that scurvy was a human food, if not nutrient, deficiency disease, amongst seafarers. Scurvy had been recognized by the Egyptians and reference to it appears in the Papyrus Ebers about 50 BC. Hippocrates, about 600 BC described what was probably scurvy amongst the Greeks, and Pliny described the condition amongst the Romans in 63 AD. An account of scurvy is given in the first edition of *Encyclopaedia Britannica* in 1771. A report published in Leiden in 1734 by J. F. Bachstrom maintained that the cause of scurvy was a lack of fresh vegetables or greens in the diet. The prevention of scurvy amongst the crew of Captain James Cook aided his discovery of Australia for the British, yet the first European settlement at Sydney Cove was bedevilled by scurvy. When planted crops and trees failed, the use of Australian bush food helped to reduce the problem. Although James Lind had discovered the effects of citrus fruit in preventing scurvy on the ship Salisbury in 1747, his treatise was not published until 1764 and the British Admiralty did not adopt his recommendations until 1795. Thereafter, British sailors were nicknamed "Limeys"[5].

The major food problem that arose from relocated populations was that they then required foods from a distance as well as those grown locally. The value of local food production in terms of overall cost-effectiveness and in sense of control over one's food supply was progressively lost.

Dairy technology and increased availability of dairy fat

Milk provided a readily accessible energy-dense food in its own right or by way of its products, provided the fat content was high. Much attention was paid to the avoidance of watered down milk and the maintenance of fat content. In due course, this was to contribute to an excessive intake of saturated fat in the human diet. Whole culinary traditions depended on the use of dairy fat, as butter, cheese or cream, most notably the French. There may have been offsets in the French diet to accommodate the higher fat consumption, such as a plentiful vegetable intake, and maybe the wine intake; this was not necessarily the case in other food cultures in Europe.

Although the early development of dairying was by herds-people on the African continent, the use of dairy products came to characterize European civilization. Europeans were tolerant of lactose into adulthood. Other ethnic groups who continued to use dairy products did so where the lactose was largely broken down to its component sugars of glucose and galactose. Whilst reference has been made to the contribution of crops initially from the Middle East and then from the Americas into Europe as far as population growth was concerned, it is interesting to consider the impact of dairy products on European populations as well. One line of reasoning is that, if not contributory to population growth, it and the fairly nutrient-dense grain wheat, may have enabled stature to be greater amongst Europeans with the pas-

sage of time. However, if one reviews skeletal remains from early Scandinavian settlements, these appear to have had fairly tall people and then height decreased later to increase again. Some of the most interesting work on the history of stature in Europe has been done by researchers at the Stockholm Museum.

Colonization of the Americas, Australia and New Zealand

As discussed earlier, this was principally a consequence of changing food supply in Europe and the associated population explosion. As a consequence, the countries to which Europeans migrated lost a good deal of their indigenous food culture and knowledge. The immigrants had little insight into the potential value of local food culture for their own survival or preferred health, let alone the ultimate value of the survival of the human species through drawing on the heterogeneity of plants usable for human food, the food cultures themselves and the knowledge that went with them.

A major consequence of this colonization was the proud conquering of the new lands with deforestation and the turning of more and more land to grazing for meat production and to land for grain production.

By the beginning of the 20th century, Australians had the highest per capita consumption of meat in the world, some 264 lbs (120 kg) per head per year, followed by the USA 150 lbs (68 kg), England 100 lbs (45 kg), France 34 kgs and Germany 29 kgs[6]. With time, Australia has dropped down the international league of meat consumption, the lead now being taken by Argentinians and Australia ranking about 4th or 5th. The fattiness of our meat supply is also undergoing a revolution at the present time towards leanness and there appear to be significant associated changes in the rates of disease, like coronary disease that are likely to be dependent on fat intake.

Progressive urbanization

Development of urban society has been subject to a precarious food supply, with increased need of transport to the city, and a dependence on food storage and preservation, distribution and ultimate preparation. The economic well-being of communities has fluctuated with time and their exposure to conflict and war has also put them at risk in relation to their food supplies.

The new "functional foods"

If, with increasing urbanziation, we cannot deliver food as we know it, food technology will find ways of producing food analogues, so that we may eat food that looks like fish when it is not, or looks like egg when it is not. The question will be whether we have allowed sufficiently for the biological importance of the human species of the non-nutrient components of food and of the importance of physicochemistry of food for physiology. We are likely to be engaged in an obligatory major human experiment with a rapidly changing food supply.

Additionally, there is increasing interest in fine-tuning of the food supply in relation to particular health problems, with the development or so-called "functional foods". There is a greying of the demarcation between food and medicine in European cultures, a demarcation which has not existed in oriental or indigenous cultures. The advent of the functional food approach in Western society will be encouraged by the rise of sophisticated food technology in the Far East.

Matters of ethics and ecology

The progress of suburbia has often meant the loss of good market-growing lands on which the city once depended. Some relief has been provided by urban gardens themselves and this is likely to be of increasing importance as cities become larger and larger and the food distribution lines longer. It is worth reflecting on the nature of food supply in cities like Mexico city now with a population of 20 million. The problems of protein energy malnutrition are rampant and it is difficult to see how these will be easily solved. More effective planning of urban food supply will be required in the future and there is growing interest in these matters in the World Health Organization (WHO).

With progressive urbanization the determinants of eating behaviour are also changing. We are more and more distant from the origin of our food beliefs[7]. What we eat and how much choice we have depends on availability, price and convenience. We are encouraged to eat or not to eat on the basis of advertising, the media, educational programmes and the advice of health care professionals. Taste, texture, colour, smell and presentation all remain important.

For the developed world, most people now have access to an abundant and increasing food supply. The extent of variety, rather than a dependence on staple, appears to be a particularly important contributor to the health and longevity of peoples in developed countries. There is an increasing trend for people to have two or three meals of fish a week, the level of intake that many nutrition scientists would now advocate. In Japan, seafood is commonly eaten 6 days out of 7. The question is, whatever the desirability of seafood consumption, will most of the world's population be able to afford it and will the environment tolerate this demand for food? In some respects, the recognition of food variety is attentive to ecological questions, since it requires a diversification, rather than a dependence on monocultures.

Of increasingly overiding importance for the worlds' food supply and human health must be the integrity of the earth's ecosystems.

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〝人類史中的營養點故危險期〞

一般人應如何給予膳食或如何來取食的決策以及其實施就整個人類群體，健康及生態來講具有相當可觀的影響，而且這個影響不只限於個人或社區群體的健康狀況。由於新模式的分析方法顯示出食品與健康之關係，營養學家們和食品政策規劃者通常偏重於健康的最終需求，生活的安寧和生命的延長。過去，歐州曾在短期之內依靠奴隸勞工進口玉米和馬鈴薯或蔗糖制品來供給人們食品以解決食荒問題。中國曾利用米糧來增進人口的成長。結果，這些地區不只人口急速增加帶給土著膳食之文明及全體人類長期的影響，甚至破壞和縮小膳食文明的變異性。農業操作及食品技術的革新也同時帶來非意指的後果。乳業及乳品技術的發展造成了非洲荒地遍然以及西方人民油脂進食的增加和其對健康狀況的改變。目前，生產，運輸，製造和儲存食品上的迅速改變也許可以解決眼前健康和人口的一些問題，但是我們仍需要一個更爲週詳及久經世故的解折，假如我們設想減輕任何逆境來鼓勵一個對人類及其棲其地的順向衝擊。