Chapter

Pellagra: Down Not out If Down and out (and South): Part 2

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Abstract

North-South variation in the supply of meat has always been present Sharing of meat was the rule but in the multi-centric Neolithic revolution when domestication of animals and plants co-evolved class differences became pronounced aristocrats and inferior proletariats and "lesser breeds and lower orders" started to form. The distribution of natural domesticates was uneven with the near-east and a temperate band across Europe well off compared with Africa and the Americas. The Columbian exchange changed this as meat became abundant in the New World who then exported to Europe. Wars, expropriations and genocides were over the meat supply and acquiring pastureland or water. Colonial plantation profits paid for meat imports from "settler colonies" indigenous or poor peoples on low meat pro-pellagrous diets were considered inferior whatever their colour and had poorer health and life expectancy. Attempts to correct hunger in the resultant ramshackle "Third world" concentrated on calories fuelling population booms and busts and delaying demographic, epidemiological and economic transitions. High meat variances are narrowing in China and Asia but need help elsewhere in the South. Dangers of not developing with a safe and sufficient meat supply include the emergence of zoonoses and mass migration. Reparations, rehabilitation and rejuvenation should concentrate on reconstituting a meat commons giving us a shot at redemption and survival.

Keywords: NAD, meat transitions, demographic transitions, epidemiological transitions, TB, poverty traps, metabolic syndromes, genocide

1. Introduction

Almost from time immemorial luminaries such as Cato, Cicero, de Quesney, Turbot, and Smith up until the present day have debated whether agriculture or industry or new energy sources or free trade created wealth and progress. Concepts on the "Biopower and Biopolitical" uses of diet can be dated back to Aristotle and Plato and elaborated on by Foucault and followers. Omnivorous diets for all as a prerequisite tailwind for firing on all body and brain cylinders neverthelessis rarely heralded (even by neurologists or psychiatrists) and even then the links between the "Grand Transitions" involving demographics, economics and epidemiology and the "Mega-threats" of pandemics and climate change are rarely made at a diet- metabolic level [1–7].

In Part 1 we discussed the consequences of being "down and out" or on "skid row" from meat and milk and therefore nicotinamide deprivation and mitochondrial energy within countries since the neolithic agricultural revolution and the domestication of crops and animals—here we shall discuss meat privilege on a broader canvas across time and space and the implications for human and planetary health. All agree that it's "inequality that kills" but how does this actually work? Sub-clinical pellagra stunts and slows individuals and fails to develop prosperity and a bourgeoisie creating bradykinetic macroeconomics and poverty from the pathology of ill health [8–10]. First, however, lets recap on some basic building blocks of civilisations starting with water but then majoring on meat and nicotinamide.

Splitting water by photosynthesis supplies oxygen and combined with CO_2 carbohydrates (CHO) and subsequently NADH to mitochondrial oxidative phosphorylation to produce energy as ATP. Water and water vapour, as a green-house gas, with a supply of photons makes the world habitable. Riparian "river cultures" such as by the Euphrates, Tigris, Nile, Indus and Yellow River with their floodplains and alluvial soils comprised the majority of early civilisations. "Hydraulic" empires, such as Rome, China or the desert kingdoms can be compared with those, some in Europe, with easier rainfall patterns or those with monsoon seasons, for their necessary adaptations for crops and the prodigious amounts of water needed to raise cattle and for their responses to climate changes-often inadequate causing collapses ("the Curse of Akkad"). Water is important for hydropower and trade routes (and Sea power states such as Athens, Carthage, Venice, Netherlands or Britain) and affects the politics of dams and canals and landscapes, such as terracing, and social structures, sanitation programmes, and wars when mutual interest fails [11–17]. A Gordian knot and nexus exists between water, air and diet and (for the last century) oil.

The role of diet, particularly grain in the rise, often with " ecological windfalls" or "ecological imperialism" and fall of empires or other collapses, often with "ecocides" from exploitation of the earth's resources (from Sumeria to Egypt to the Mayan and Roman empires and Easter Island) has been discussed: some enlarge on a role for meat and steppe nomads and, here we emphasise the importance of a sustainable balance between cereals and meat and, innovatively, discuss a metabolic mechanism suggested by the narrative of pellagra and NAD deficiency for both class and country effects [18–26]. Although air is free, unlike meat, but like water often not clean, asphyxiation has been a metaphor (and not always a metaphor thinking of lynching, Covid or George Floyd) for how to subjugate people—and their collective struggle for resources or to breathe as Franz Fanon (1959) said it is *"oxygen that invents a new humanity"*—but NAD deficiency (considered a "pseudo-hypoxia") is a more plausible mechanism [27–29].

2. Hypothesis: Short Story

Geographical gradients of meat intake have always existed but in the last few centuries they diverged and more recently have converged except in parts of the South where some billion people live on below $1.90 a day—the World Bank's definition of extreme poverty and so become enforced and often monophagic vegetarians with effects on health and longevity (**Figure 1**). Initially a more plant-based diet in the Neolithic may have increased fertility and a population growth that allowed for division of labour and high collective intelligence as the " Human Swarm" even as health and height deteriorated; but this may now be a developmental over-run producing "underclasses/countries" [30, 31]. Here we attempt to describe how and why all this happened, hoping to illuminate a universal from the specific of pellagra, and that high meat intake is both

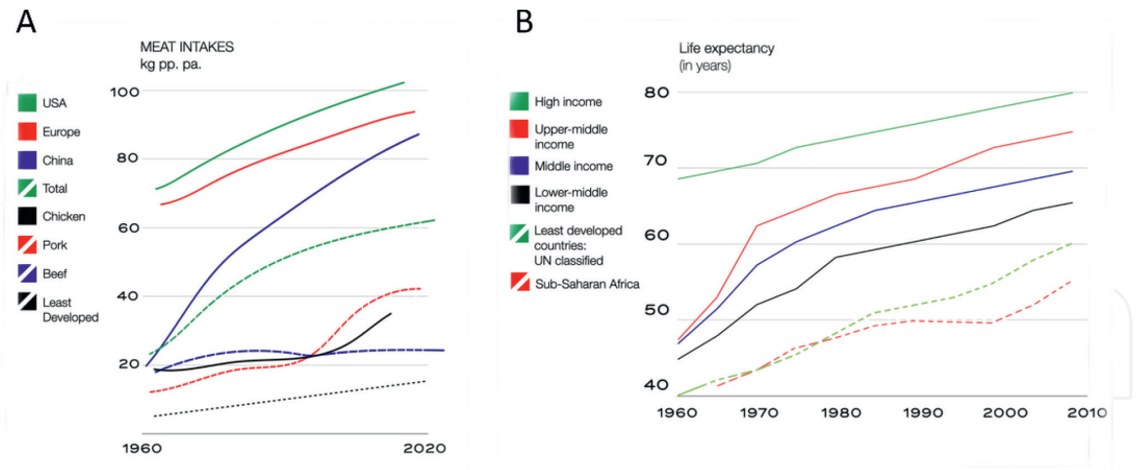

Figure 1.
(A) Meat by type & intakes by continent 1960-now. China shows a remarkable increase as have other "Asian Tigers". Europe and the USA long term leaders on intake are beginning to drop. India is in the middle on intake (better in the south), but Sub-Saharan and some other African countries are stalling as are their epidemiological and demographic transitions. Beef and ruminant intake worldwide have stabilised with pork (omnivorous scavengers) and industrially farmed chicken showing remarkable increases. (B) International Life expectancy by income. Remarkable increases shown here from 1960 but starting much earlier before medicine would have had much impact implying that public health measures such as clean water and a better diet were more important. Nicotinamide metabolism is important to most models of longevity in all species suggesting that high meat/milk intake could be causative.

the cause and the effect of economic progress (generally considered an unresolved "wicked problem"). Countries and continents have different epidemiological and demographic trajectories that may link to timing of safe meat transitions. If inequality is to be overcome its root cause and the source of biopower relationships, whether by class or by nation, needs to be understood and may lie with quality diets and quality populations. Sorting this may be the moral and safe way forward—and intersects with solutions for climate change and reducing civil unrest and pandemics [32–39].

3. More background and current relevance

Plows and petroleum have largely fuelled the food systems but despite successes has not served the poor or the planet that well [40–42] (**Figures 2** and **3**). Food insecurity underlies widespread micro- and macro-nutrient malnutrition, emigration and pandemics in this "nomadic" and "pandemic era" spread by commerce from zoonotic microbial cauldrons [43–46]. Such mega-challenges to feed with "sustainable intensification" increasing populations in the South rarely discuss a relationship between diet and fertility and the interactions with climate change [47–49]. There is a need for a mega-Marshall plan that as Bruntland's classic commission of 1987 said "*meets the needs of the present poor without compromising the needs of future generations*", that may include novel foods and fermented or cultured meat or exceeding "planetary boundaries" will cause a "ecological shock" with loss of biodiversity and further climate change [50–53]. Poor meat food-chains facilitate "bushcraft" and species-jumping zoonoses and decreases resistance to infectious pathology. Wars, including civil wars, and land enclosures and confiscations and land-grabs can be related to "lebenstraum" and the appropriation of well-watered and fertilised pastureland or the oil to support high intensity farming and a better diet-traditionally at others, usually in the global south's, expense. Geopolitical tensions and the follies of war include "slash and burn" tactics, unplanted or unharvested

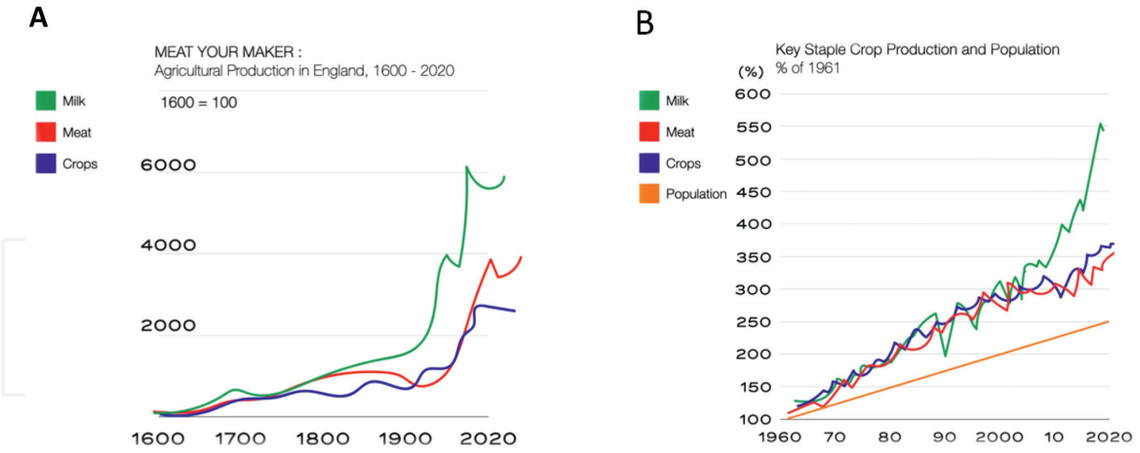

Figure 2.
(A) Meat production England 1600–2020. Meat production increased but barely kept up with population growth. Imports paid for by the profits from the cotton and sugar trade caused the real improvements helped by the repeal of the corn laws and better transportation and refrigeration allowing imports from the "settler" colonies and states. (B) Crop production yields have increased significantly over the last 50 years. Some GM crops contain vitamin A such as golden rice and recently vitamin D in tomatoes otherwise sourced from animal produce (or sunlight). Breads and cereals are often supplemented with vitamins, including nicotinamide, but less often in poor countries and are expensive. Oatmilk is now popular but does not contain as much nicotinamide-riboside as dairy milk.

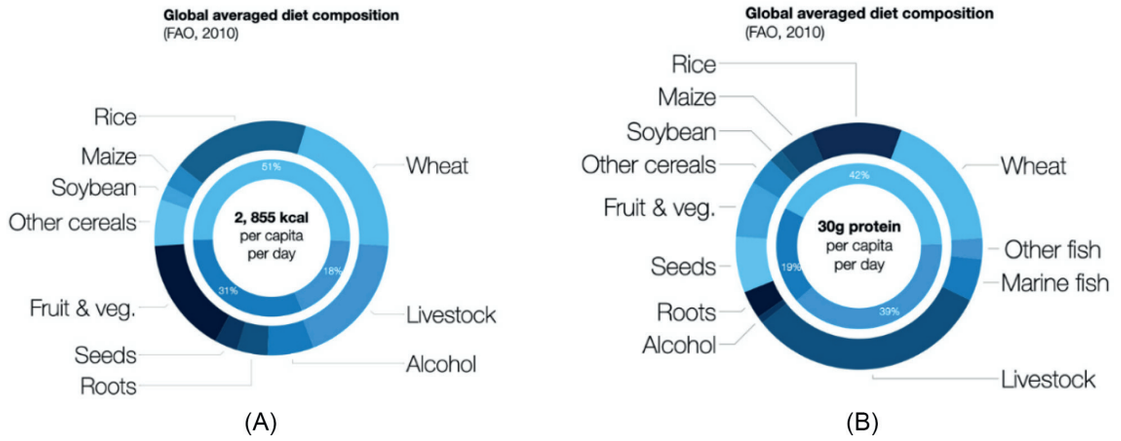

Figure 3.
(A) Global averaged diet composition. However, it is the extremes not the averages that are the problem with the danger of undiagnosed and untreated "pellagra sine pellagra" on the one hand and a possible hypervitaminosis B3 on the other. Switching from one extreme to the other within lifetimes can risk metabolic syndromes. Switching over generations to more meat and milk can lead to demographic, economic and epidemiological transitions. (B) Global sources of protein. All sources are not equal as far as Tryptophan is concerned as an alternative precursor to NAD where animal sources are better, as they are for nicotinamide. Other sources exist such as insects and larval forms—mealworms—that may play an increasing role in the future as may algae and macroalgae seaweeds such as kelps—and artificial laboratory grown meats from stem-cells.

crops, pillaging, stock-piling, blocked ports and sea channels, and sieges and often genocidal "hunger-plans" that along with price rises or tariff arrangements create a vicious cycle and more deprivation, again worst felt by the poor and in the South.

Existential threats such as climat change are both caused by and effect food systems (an initial boost to plant growth by high CO_2 is rapidly cancelled out by drought, floods and fires and locusts). Shorter-lived but potent methane as a greenhouse gas ($80xCO_2$) is largely derived from microbial synthesis in expanding wetlands and thawing permafrost "thermocrast" lakes as well as ruminants (and has increased markedly from 2007 in a vicious cycle that could form a "methane bomb"). Alongside

the effect on CO_2 and nitrous oxide emissions this raises major concerns on meat intake and linked agricultural methods that increase emissions, such as transportation and excess use of fertilisers or tillage that destroy carbon sinks on land and acidified seas. Well maintained pastureland (of no use for crops) and perennial and tree silvacultures can however, like the sea, be massive carbon sinks [54].

High meat intake in the affluent west needs to drop but we will argue that for those on a low income, usually in the south in Asia or Africa it needs to increase (or its synthetic cell-based or safer non-ruminant/insect or plant/fungi and algae substitutes or at least with fortification of vitamins) to allow healthy demographic and epidemiological transitions. "Farmerian" structural violence has been attributed to poor food distribution networks and unfair property laws and metabolic and behavioural dysfunction in ghettoes as well as the incidence of infectious disease and early death [55–57]. A thought experiment imagining a "Dog-land" within the USA showed dogs to be at a high average global meat intake for humans [58].

High meat intake is not so much the problem, although the Delphic ΜΗΔΕΝ ΑΤΑΝ (Nothing in Excess) applies, as high global variances and lowering these drastically is the solution as a wholesale move to a plant-based diet often with ultra-processed high calorific but cheap foods is problematic [59–63]. The Lancet EAT commission suggested as much but was criticised for not explaining how the under-developed world was going to afford to eat a more varied vegetarian diet or for not fully recognising the need for some animal-sourced produce [64–66]. Despite living in a "Superabundant" world with a "breakfast bounty" whereby the price of meat and eggs has fallen for blue-collar workers by over 90% in real terms as measured by how long it takes to work to pay for them many of the poor within countries have not benefited and many countries in the south are no richer than the UK was in 1800 with per capita GDP still not exceeding 10$ a day [67, 68]. English breakfasts indeed became popular largely at the time when the international meat trade really took off with chilled American beef and deep frozen Argentinian and Australasian meat carried by refrigerated ships (such as the Circassia) in the 1880s such that by the eve of WW1 40% of the meat consumed by Britons came from abroad, a trade that shaped the world [69]. But let us start again toward the beginning as this all relates to how the high meat variances and quality of diets between nations as well as classes developed during our history, that were not part of our initial evolutionary trajectory. Not addressing this may de-rail our " slouch toward Utopia" instead directing us toward apocalyptic dystopias, if we do not develop climate smart food supplies and an "ethical omnivory" sensitive to animal rights and refrain from "milking" the poor [70–78].

4. Continental NAD divides

At the time of the Neolithic agricultural revolution all was not equal when it came to available animal domesticates and therefore the meat and milk supply even if sharing meat in our social leap was the early norm hierarchy, exploitations, enslavement and inequality rapidly developed [79, 80]. The middle east and then Europe and the Asian steppes were well off for amenable hoofed ruminants such as goats, sheep and cattle [24]. Africa the "cradle of mankind" having been a meat cornucopia with abundant wild herbivores in the savanna had few natural domesticates and more than their fair share of animal diseases (such as trypanosomiasis (sleeping sickness) in the wide tsetse belt and in the nineteenth century rinderpest introduced from Europe) and competing large carnivores. Nomads and pastoralists and relationships with other animals were important components of our history and culture [81, 82].

Cattle, Chattels and Capital all derive from the same etymology and in practices such as bride-wealth. More damaging was cattle rustling and the concept of "terra nullius" that allows for pastureland not obviously farmed by indigenous people to be appropriated and territorial gains through war or land-grabs and were all meat related as was cannibalism [83]. The New world after the original animal population was decimated by hunters had few natural domesticates other than turkeys and guinea pigs; China had foraging pigs, chickens and many ducks so was reasonably well supplied at times, but still largely cereal based and famine prone [84, 85].

5. Columbian exchange of NAD suppliers and attitudes to other peoples

The Columbian exchange changed the New World dramatically by developing settler states that improved their own and then others supply of meat (**Figure 4**). Cattle, sheep, goats and horses rapidly bred in this new ecology and on ranches [86–88]. This was usually to the detriment of indigenous peoples and the slaves, as illustrated by the manmade deplorable "Trail of Tears" and "Middle Passage", even although Africans had helped by smuggling (Black) rice across the Atlantic and contributed their considerable agricultural and even medicinal skills [89–93]. Some appreciation that native Americans were not, after all, monsters or savages having their own civilisations was there as a philosophy of "All Mankind is One" was supported by the Spanish monk Las Casas and even had royal support but did not unfortunately translate for long. As Montesquieu (1748) said (sarcastically) in his Spirit of the Laws

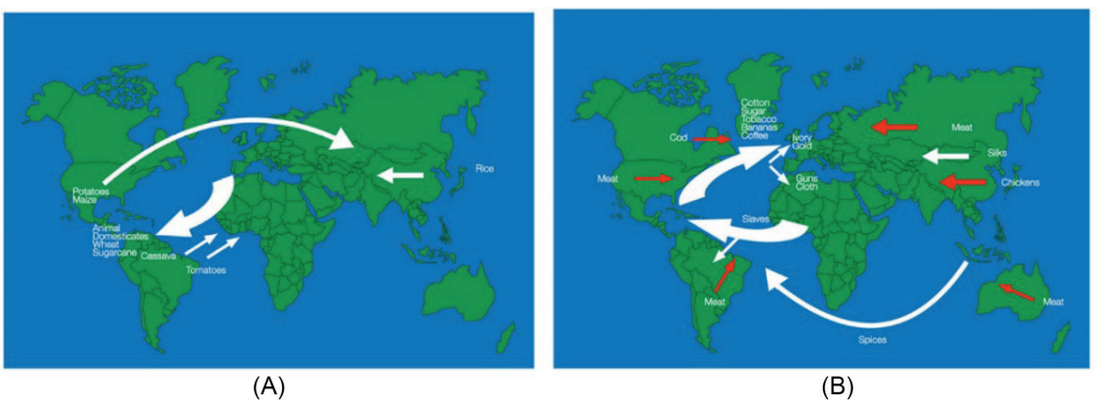

Figure 4.
(A) Columbian exchange. Animal Domesticates, such as sheep and cattle, were introduced to the New World that otherwise had very few such as turkeys and guinea pigs. Earlier megafauna had, as elsewhere, been killed off by hunters and climate change, and later bison were killed by (white)hunters to the detriment of indigenous tribes. Imported ungulates rapidly expanded swarming in the lush new pastures "ghost acres" tripling the pastureland for England and other European powers further aided by cowboys, barbed wire and ranching with the import of new breeds. Later feeds replaced grassland and the "livestock complex" was born. Maize and potatoes went East fuelling population booms and busts. (B) The slave trade by supporting sugar, tobacco and cotton indirectly supported the meat trade as the profits held by Europe paid for the meat imports as had silver and gold. Settler colonies exported meat, now frozen and easily transported, and usually had enough for their own benefit. Others with or without plantations had their farming systems damaged and their peasants taxed (salt and tea taxes provoked rebellions in India and America). Diets deteriorated (such as the Bengal famines). Indigenous peoples contributed much on farming technique and introduced crops such as rice in the West and medicinal "secret cures of slaves" (such as quinine) and commercial plants (such as rubber) of great value that like the silver, gold and (blood)diamonds were basically stolen as "primitive accumulation" to fund capitalist ventures and more profit for the centre. In the Irish famine and even quite recently examples of exporting meat whilst the supply to the local population declined markedly include Guatemala and Costa Rica in the 1960s [26].

"having extirpated the natives Europeans had no choice but to make slaves of Africans besides which sugar would be too dear" may provide the explanation along with other expropriations of useful materials and free or cheap labour from indentured servants.

Previously many racial differences had been attributed to "environmentalism" and climate or diet but the mood changed as Europeans, except when they inter-married (miscegenation may have even saved us from a speciation event) did not change their phenotype and so genetics became a more favoured explanation with whites genes being superior. The underclass and "cultures of poverty" were invented (with planters pitting working class whites and "hillbillies" against people of colour)—a self-fulfilling prophesy when the indigenous natural diets were destroyed in favour of producing cereals and sugar/molasses, and a pellagrogenic diet allowing for "class cluelessness and callousness" [94, 95]. Furthermore "divide and rule" policies by elites and "dog whistle" racial politics were encouraged on the plantations and thereafter stalled many worker class rebellions. More subtly on Haiti in 2008 food price increases were bailed out with strings attached that are damaging longer term for the nutritionally weakened poor—(even though they were the base of agriculture and capitalism in general)— all old and new methods that create superficial frictions that include pitching disadvantaged racial and tribal groups against each other [96–99]. This is now known as the "Southern Strategy" though moved North with the mass great migrations of African Americans after the Civil War (Underground Railroad) and is a "Pluto Populism" and "Racecraft" and often evangelical and nationalistic policy with vote gerrymandering and other suppressions much copied (including ironically by the party of Abraham Lincoln) to this day.

Some original abolitionists retaliated with criticism of eating slave-foods (such as sugar), and other forms of plant robbery such as rubber and cinchona (quinine anti-malarial) sentiments that continue with fair trade movements (but the connection with the meat trade was not realised) [100–103]. Gold and silver and later profits from the slave-based sugar and cotton industry paid for massive levels of meat and fish imports to Europe particularly after the invention of steam engines for ships and the railways, and refrigeration. Colonised settler states after the Americas included Australasia exporting meat; other colonies contributed indirectly such as India and Africa (inspired by Cecil Rhodes) were taxed or used to boost income from mining and "cash mono-crops" using cheap labour advantaging the European core at the expense of the "periphery." Outbreaks of pellagra, in the poor southern "cotton states" of the USA and later in "banana republics" were the tip of a malnutrition iceberg. Advances in farming beyond "hoe-culture" were discouraged as was the manufacture of goods, even traditional cotton clothing—all helped to create a now dependant "Third World" [104, 105].

Cash crops such as from peanuts, cacoa or tea took precedence over staples such as rice or yams often in the name of comparative advantage (that then had to be imported with no control over price) and destroyed mixed farming and the meat supply for all except surviving pastoralists. Ironically the Masai were even admired by their colonial masters for their height and health. As Daniel Defoe author and pamphleteer, said at the time *"No African trade, no negroes, no sugar, indicoes, cotton; no islands, no continent no (meat) trade"* and change or even insight has come slowly. This all allowed the "great subsistence crisis" in the north-western world triggered by war, volcanic eruption (Tambora 1815) and the "year without summer" and effects from El Nino to be the last crisis in the North but came at the expense of the South [106–108]. Modern equivalent practices include the export of Palm Oil and soybean (used as animal fodder in industrial farms) causing much local ecological damage—swaths of the Brazilian Cerrado region turned in to cropland and rainforests cleared

for grazing cattle contributing to both local and global climate change and destroying much biodiversity in order to supply the west with more meat or biofuels [109, 110].

6. The West then the rest: meat as propellant. More circumstantial evidence

Ink (and blood) has been spilled over the issue of the reason for the rise of the west and we have added meat centrality to previous arguments relevant to all empire building and as advice to their builders [111–122]. Poor cooperation between agricultural empires, such as the Roman and the Ming empires (who decried milk and its products in an anti-Mongol gesture except in Zhangua province that fared better), and their "barbarian" pastoralist neighbours has been implicated in their falls (perhaps answering Needham's puzzle in the case of China as to why they were overtaken) [123, 124]. Similar issues have emerged for the Ottoman and Mughal empires with lack of animal fodder or exhausted irrigation systems and ecocides leading to "high equilibrium traps and inadvertent selection for quantity rather than quality population growth in low meat economies [125–127].

Julius Caesar noted of British tribes in 54BC "lacte et carne vivant" but most observers date Britain's success to the response to the 14th C Black Death that itself followed on from a great famine (and is thought to have originated in the East and spread along the Silk Road by Mongols as a zoonosis involving the fur trade in marmots and grain supplies eaten by both man and rats with their fleas all in close proximity with gruesome stories of early biological warfare catapulting the dead into a city (Caffa) under siege [128]). Here, the argument goes, the high death rate led to a shortage of peasants and yeomen so, despite early aristocratic resistance, wages rose and agrarian fields turned to pastureland innovations such as turnips for winter fodder avoiding autumnal culls and spring seasonal hardship (when pellagra often emerged). Meat intake increased markedly for several centuries—all reflected in increasing height and perhaps, IQ [129–134]. The need for labour saving devices became the "mother of inventions" for agriculture then industry. Studies have used estimates of affordable "baskets" at various times with international variations and fluctuations in the incidence of the more pellagra-genic basket support these claims [135–137] (**Figure 5**).

Elsewhere populations exploded on more cereal (and now maize) based diets and agricultural reforms lagged with many other obstacles in the East and South that involved ecological and unresolved water and irrigation issues that were not so difficult in rainy Europe [138]. The rise of the northern white protestants on a high dairy diet in the reformation compares with the poorer but more fertile Catholics which may have been another divergence in the making [139, 140]. In England population grew slowly for centuries but then populations boomed, at the time of Malthus, as there were dietary setbacks so by the 1800s many of the poor were enforced vegetarians culminating in the "hungry forties" before another meat transition took place.

Reforms of corn laws and deflation of food prices along with cotton and other profits allowing importation of meat on a grand scale meant that for once the poorest gained and could afford a better diet. This allowed for an expansion of the middle classes and the rise of "hawkers" of street meat and "fishwives", taverns and restaurants helped. The Chartist movement and the rise of trade's unions avoided the concurrent hunger inspired revolutions in Europe at least until the 1930's hunger

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	Basket	2-3000 calories
	Respectable: quantity pp, per year	Bare bones subsistence: pp, per year: Pellagrongenic
Beans / Peas	34 kg	20 kg
Beer	182 litres	
Bread	182 kg	
Oatmeal / grain		170 kg
Meat	26 kg	5 kg
Butter	5.2 kg	3 kg
Cheese	5.2 kg	
Eggs	5.2 kg	
Fuel	5.0 MDBT	2.0 MDBT
Linen / Cotton	5 metres	3 metres

Figure 5.
Subsistence baskets. Food baskets have been estimated for many countries over many centuries. Such baskets can be tracked—In England they deteriorated before the Black Death but then improved as income (after opposition) increased for centuries. The birth of the lead in agriculture and the industrial revolution has been attributed to this high meat intake and enough money for consumers to spend on luxuries developing commerce (once sumptuary laws were abandoned). Poor harvests and wars had led to economic failures widespread vegetarianism culminating in the "hungry" 1840s. Many then escaped from bare bones pellagrogenic diets and continued the lead in Europe but then were overtaken by the USA with China catching up more recently. These dietary divergences and convergences can be linked to the rise and fall of empires and civilisations.

marches. In England (and later America) and in Amsterdam and Antwerp's "glory years" butchers and their guilds prospered in the *luilrkkerland* (delicious-land) with stories depicting houses made of pancakes and bacon with pre-roasted pigs walking—butchers could not keep up with the nouveaux riche [141, 142].

Many observers have touched upon diet being important for talent, "industriousness" and progress: "Rosbifs" and "Roast Beef of Old England" were immortalised in paintings and song and Shakespeare's plays, such as Henry Vth [143]. Other dietary explanations have included a spice or "sugar rush" (although the dangers of sugar were pointed out by Thomas Willis around 1670 as diabetes "mellitus"). Importation of tea (that became part of the British identity despite no tea plantations in the UK) and coffee displaced beer, a safer source of liquid than water at the time, and distilled spirit addiction "drunk for a penny, dead drunk for tuppence" even feeding infants

as depicted by Hogarth's Gin Alley, as preferable stimulants rather than depressants (whilst at the same time driving the opium trade depressing China may all have led to some international advantage). But back to meat important trades spices (curry becoming emblematic of the UK) relates to the preservation and taste of meat, or by camouflaging the added salt, along with other forms of charcuterie [144–148].

7. Nicotinamide not sugar rush: intellectual "savants and tinkerers"

We propose a meat and nicotinamide "rush" as a more likely explanation for moving the dial with non-dietary correlations such as coal and steam enabling improvements in the supply as would profits from sugar and cotton plantations [116, 149–152] (**Figure 6**). Long rotating global waves of prosperity allowing more (patentable) innovation noted by Kondratieff may have a basis in agricultural success and lower prices or higher wages and could relate to meat transitions that in turn are related to

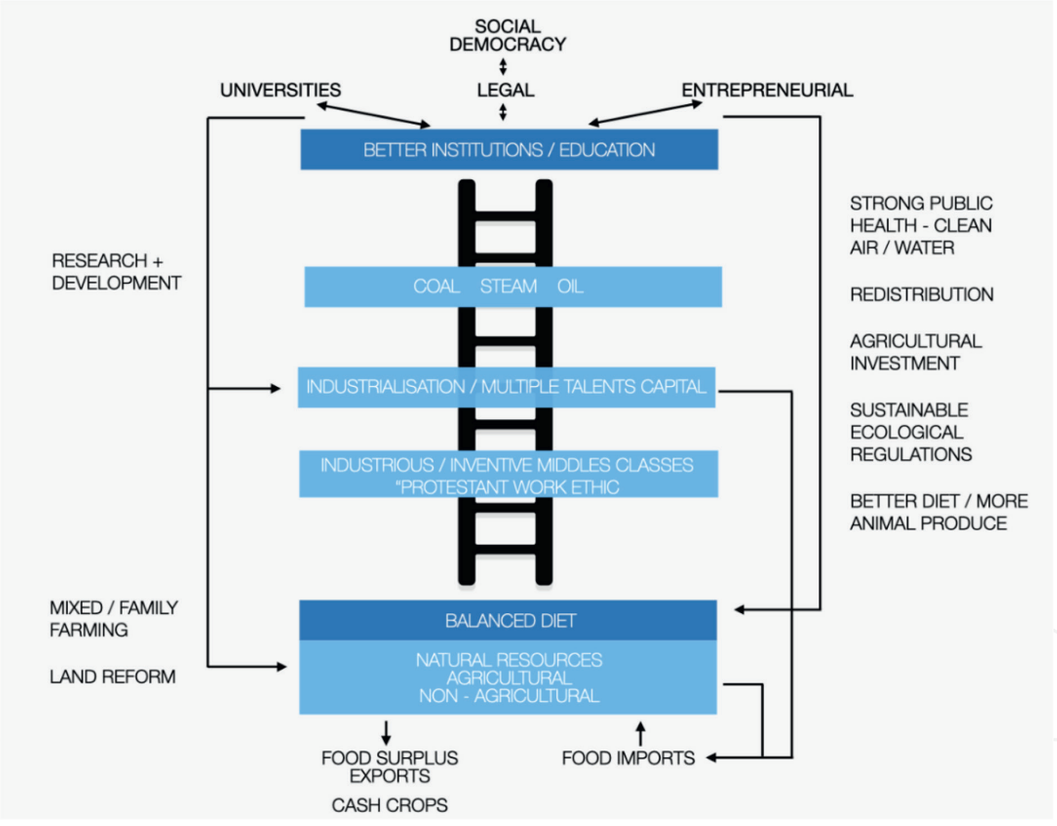

Figure 6.
Ladder of development. Better institutions and governance are the conventional wisdom and thought, after Weber, to be the major drivers of progress and may prove proximate causes. However, it is our contention that this develops only after a critical mass of the population have high human capital from an adequate and balanced diet. This became a positive feed-back loop in the nineteenth C helped by the rise of restaurants (and chefs no longer needed by the (French)aristocracy) further improving diet that gives the illusion that better diet is a consequence, but we would claim reverse causation. History does suggest this was learnt the hard way obscured with friction and peasant rebellions (such as Jack Kade's in 1450 over enclosures and privatisation of land usually for wool rather than meat that then became too expensive for the poor unless they worked)—and indeed has still not been learnt. Weber's example of protestants in northern Europe had high meat and dairy/butter intake and were lactose tolerant compared with southern Europe with less mixed farming and olive oil rather than butter that has a higher nicotinamide content. Southern Europe was the site of the first recorded pellagra outbreaks, by Casal, in the 18th century. Perhaps subconscious cultural lessons were learnt as Italy now has the most democratic of diets and this "Mediterranean" diet leads to relatively good health outcomes [153].

local agricultural and import opportunities all favouring good dinners for some; but let us look again at the example of nineteenth century Britain [153, 154].

8. Tectonic plates: meat, epidemiological and demographic transitions meet early in the UK

Agriculture evolved in Europe with fallows enriched by grasses and legumes "Ley farming" improving the soil and nitrogen content, and the rise and fall of tillage improving the soil microbiome, with alternation of crops and livestock with integrated systems demonstrated by Jethro Tull (1751) and "Turnip" Townsend for winter forage [155, 156]. Stock breeding and "High farming" were introduced by pioneers such as Robert Bakewell and John Webster as the UK became the world's "Stud Farm" and proponent of feedlots. England compared with many other countries including France had a high ratio of pasture to arable land supporting high meat intakes and horsepower along with ample manure for crops and was an important pre-requisite for the industrial revolution [157]. The fishing industry particularly for (dried and salted) herring, cod and whale took off supplying much meat as the "Northern Hunt Trades" and fourteenth C carp fish farming, helped by being allowed to eat fish on the many religious fasting/meat-free days, but soon was in trouble from over-fishing and later farms such as those for shrimp damaged the ecology of mangrove swamps as important carbon sinks even though done properly fish-farms may re-emerge as important sources of nicotinamide [158–160].

The astonishing rise of the chicken and egg market began to contribute [161]. However, with population increases numbers could not keep pace with demand. The well documented [60, 162–164] meat transition occurred early in the UK (1850–1900) with intake almost doubling for the general population although the idea that people and slaves need any more than subsistence died hard "scarcity promotes industry and less drunkenness" being a common view as was starvation as being a natural Malthusian population correction (as expressed by government in the Irish and Bengal famines). Better wages later became popularised by Henry Ford, as did conveyor belt manufacturing after observing the meat packing industry and is the basis of consumer society and luxury markets with all relating to Engel's curves.

The pattern of disease changed dramatically with far less infections and early deaths most notably for TB [165–169]. Sanitation or at least better housing and fresh air and clean water have been considered important in this pre-antibiotic era, but evidence is surprisingly unsupportive for TB perhaps because rents rose squeezing family budgets. There are many other correlations, such as increased sugar intake, but the only one, to our eyes, with a convincing biological explanation is more meat as meat is a source of nicotinamide. Nicotinamide has antibiotic activity against TB (and other organisms including Mycobacterium leprae that also "disappeared" in the western world in the earlier sixteenth century meat transition) and many TB antibiotics developed are nicotinamide analogues. Furthermore, TB excretes nicotinamide (used as a test for pathogenic strains) suggesting that it may be a nutritional symbiont that turns dysbiotic if relied upon too heavily [170]. As TB disappeared diseases of modernity particularly allergic and auto-immune diseases appeared [168, 171].

Biological explanations are to hand as the Tryptophan-NAD intrinsic pathway would not be activated on a NAD-precursor rich diet and is well known to be the immune tolerance pathway so over-reaction to otherwise harmless antigens might be expected (that might include the foetus); and absence of "Old Friends" could lead to loss of immune education again leading to immune over-reactions [171]. Relative

infertility indeed rose once death rates had fallen as part of the demographic transitions that causes temporary population explosions and then stability—and then population declines as fertility falls below that needed for replacement. Such demographic patterns happen with modernity but the element of modernity responsible has never been identified (many happened before effective birth control was available or education improved.) Rather than talking of "African exceptionalism", for instance, diet should be reconsidered as there is a longer history of meat being held responsible for low fertility and cereal dependency or poor diet short of starvation for high fertility amongst the proletariat causing much alarm about "replacement" by "inferior" peoples, but little action. Higher quality of population rather than higher numbers should be the aim ("K" v. "r" selection) and that can be done starting with better diet [172].

9. Nineteenth-twentieth century meat exchanges: rural and third worlds

Observers ,such as de Sant Pierre (1769) noted that "*coffee and sugar were not essential to Europe but brought wretchedness and misery upon America and Africa*" including becoming reliant on local "bushmeat" eating their own, now rare, wild animals from elephants to monkeys and losing some indigenous cereals, that often have lower calories and more micronutrients let alone being a source of cultural and biodiversity that may become important with climate change. During the later colonial period meat and tropical goods flowed from the periphery in to the European core aided by refrigeration and canning and "Free Trade" using cotton and sugar profits to pay for the imports and essentially living well at others expense creating "Victorian Holocausts" in the tropics often exacerbated or even capitalising on climate change [106, 173–177] (**Figure 7**). Current telling examples can be seen in Madagascar currently and occasionally in the centre as in the 1930s Dust Bowl on the American prairies that are worrying signs for a future of climate change in coastal and natural deserts, even California [178].

Figure 7.
Sugar in Europe and the settler colonies was balanced by higher meat intake. This was not true for poor people particularly those in the Caribbean and "cotton" (and pellagra) southern states of the USA fed with high quantities of molasses (and rum) and little meat. This was a recipe for pellagra and poor nutrition throughout life and transgenerational epigenetic effects including metabolic syndromes. Reparations might be well directed to preventing this happening in the future. The same argument is true for poor peoples in rich economies where cheap calories with 2 for 1 deals and junk food do not help people ascend Engel's curves.

Within the core there were extraordinary concentrations of cattle and meat flowing from rural areas to magnets large towns and cities that majored in animal husbandry and use of pigs as well as horses, hens and cows contributing to "metabolic rifts". As Jenner rhymed (1772) *"Fat droves of sheep and oxen, consigned from Lincoln fens, that swearing drovers beat to Smithfield pens."* This need spread and the Scottish clearances and the "colonisation" of Ireland caused much hardship and emigration in order to supply meat centrally at the expense of the "crofters". Smithfield market is an exemplar in its Georgian day of a dominant 800-year-old industry of live animals "meat on the hoof" driven into the city for food and transport (and dung not easily re-cycled) dwarfing other better-known industries, such as sugar and coffee, and helped by advances in stockbreeding for meat and dairy. Abattoirs then moved out of town and out of view of the consumers with new tensions for animal rights by making the "cognitive dissonance" over killing animals easier.

10. Pellagra: plus Kwashiorkor

Pellagra epidemics re-emerged in the periphery, namely South Africa, where it had been unknown until 1914, as did poverty, racism and disease—chiefly infectious or nutritional such as Kwashiorkor, well- illustrated by Oxfam, and felt by many to be infantile pellagra particularly after the protein hypothesis was discarded [179–182]. Post WW2 local initiatives and cereal exports and some meat from the developed world supported some feed-lot cattle in the underdeveloped world allowing for their own meat transitions that drove demographic and epidemiological transitions [105, 183–188]. However, this was highly heterogeneous (often aid was linked with political and anti-communist motives or a way of exporting subsidised surpluses that did nothing for local

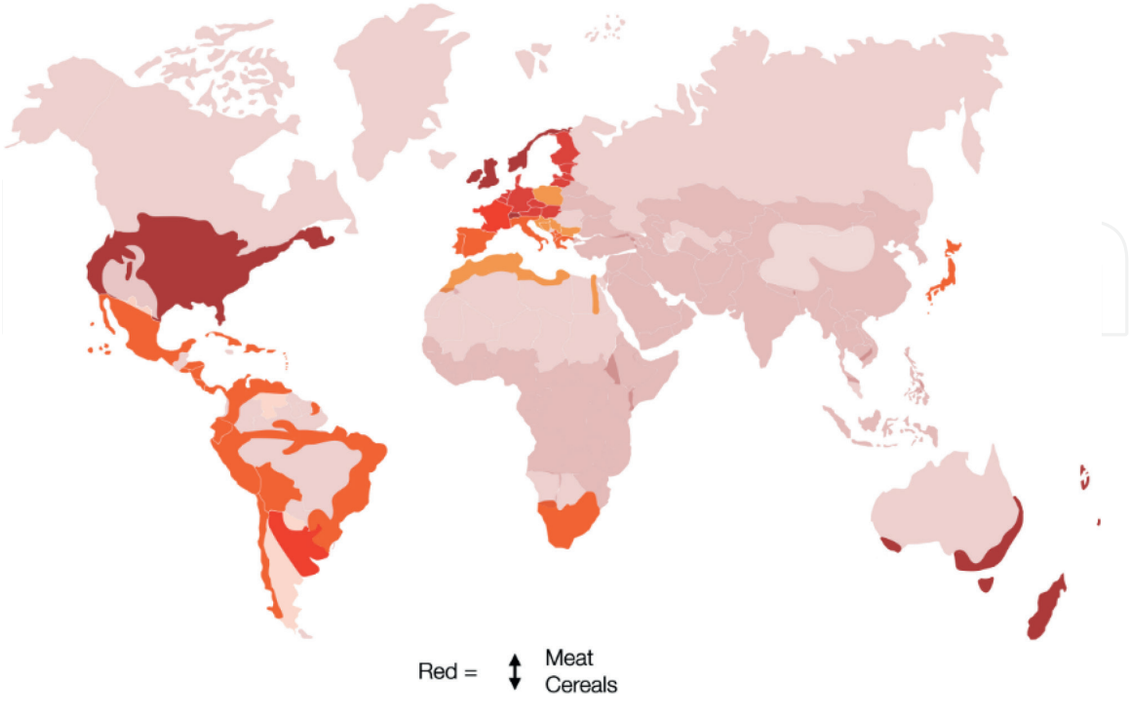

Figure 8.
Countries in shades of red whose cereal consumption fell as meat consumption rose correlate with high or very high (darker red) economic activity. This is Engel's/Bennett's law at an international level. Poor countries are trapped by high food and energy prices where they also make up a larger share of the national inflation basket.

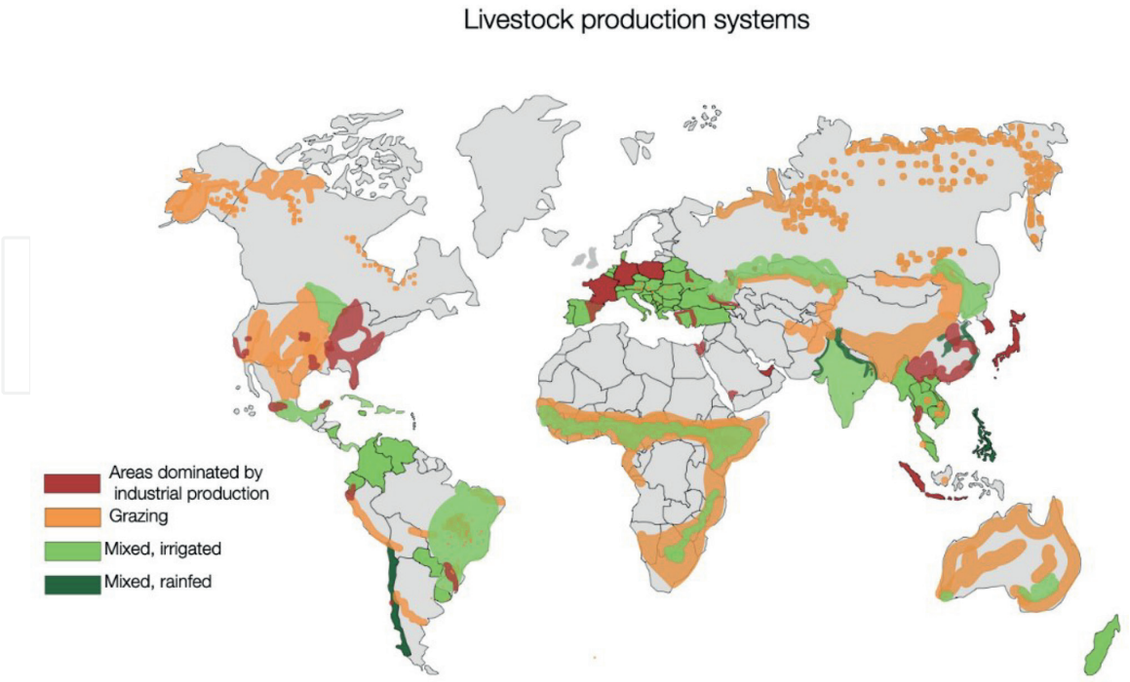

Figure 9.
Meat and wheat international trades are high as is maize and soyabean with much used to support meat industrialisation (and biofuels). Sources and industrialisation of meat is geographically very heterogeneous. More local production with mixed farming or pastoralism would help reduce variances across the globe and reduce the need for artificial fertilisers.

farmers) and more commonly being cereal based may have given rise to population explosions as much as alleviating hunger. Transitions are still incomplete in southern Asia and most of Africa where poverty, stunting and chronic infectious disease with population explosions remain common and, we suspect subclinical pellagra is common.

Such countries may be the victims of excessive cerealization then calorificization with "empty calories" and "junk foods" and other temptations by-passing the normal function of Engel's law [189, 190]. The so called "resource curse" may be when states get lucky with natural underground resources whether oil or minerals, or cash crops they do not spend it on improving diet where it is poor—by chance or design Europe did not do that with their wool and cotton trades and may have narrowly escaped this trap—probably "a damm close run thing" as Wellington said of Waterloo (**Figures 8** and **9**).

11. Poverty pathogenesis converges on NAD mechanisms

Stephen J Gould's comment channels as "*I am, somehow, less interested in the weight and convolutions of Einstein's brain than in the near certainty that people of equal talent have lived and died in cotton fields and sweat shops*"—much talent and brain power is indeed being wasted for lack of NAD as William Blake said (in 1793) "Reason is the bound circumference of Energy". The poor (and particularly women as men commonly got the "Lion's share" of meat) have a NAD deficient headwind to contend with and an NAD-related degenerative pathology and functional neuropsychiatric effects ("feebleminded" and ripe at times for enforced sterilization or extirpation) from both low dietary intake and increased consumption as they are exposed to more than their fair share of environmental genotoxic and other toxins and infections [191, 192]. Chemical revolutions have shaped our world from chlorine (releasing bleaching fields for pastureland) (1785) to soap and

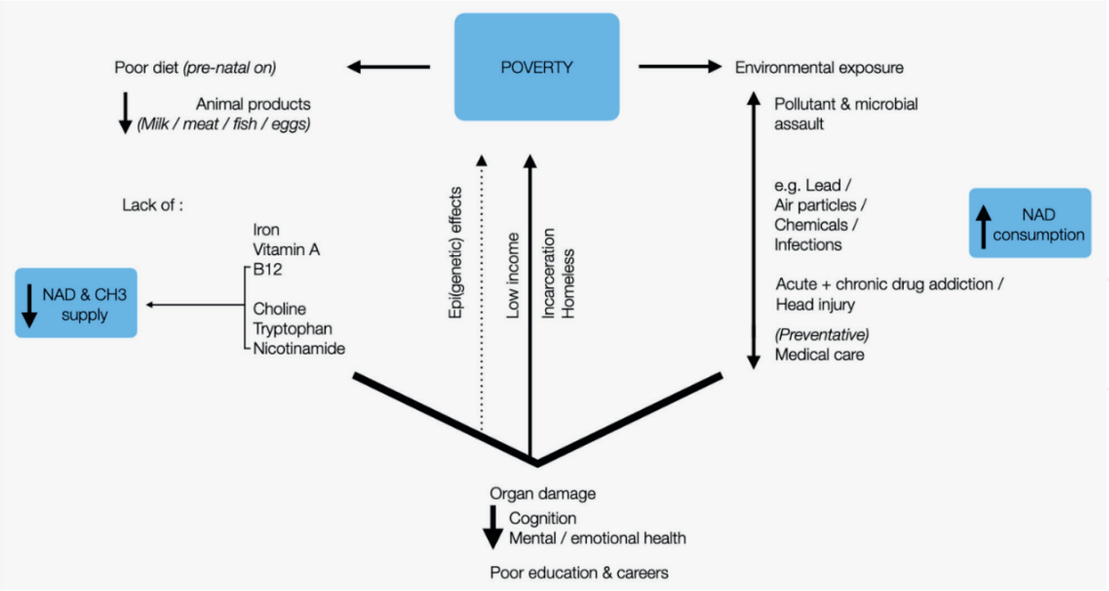

Figure 10.
A balanced diet has to include adequate nicotinamide supply along with other micronutrients that, until supplementation was introduced, had to come from animal produce. Supplementation and "nutritionism" may be an emergency procedure of value but is a technological fix (as is Golden Rice) to try to fix an economic problem and ignores broader cultural and health issues that rarely work and in the case of nicotinamide can drain the methylome [196]. Poor diet and poverty are interlinked in cycles of despair and increased environmental hazards adding insult to injury that are trans-generational.

cleaning water (1850) to refining sugar to artificial fertilizers to DDT and organophosphates and neonicotinoids to leaded gasoline and poison gases and safe refrigeration, (that enabled the meat trade) but all have come at a (neurotoxic)price and unforeseen consequences particularly in poor neighbourhoods [193–195] (**Figure 10**). Incentives for "credit invisible" disadvantaged people to set up business in the USA (as part of Nixon's "black capitalism" even concentrated on fast food outlets and franchises "force feeding junk" (although admittedly hamburgers, kebabs and "cod fish sandwiches" like fish and chips in Britain increase meat intake)rather than grocery stores as did targeted advertising and "Foodopolies" and all not helped by traditions of "soul/slave" food [197, 198]. Poor neurobiology has previously been blamed on genetics, but this plays a secondary role perpetuating the problem through epigenetic means well after the environmental assault [199]. Epigenesis may have direct effects through chromatin marks or in a wider sense of the term lead to poorer education both within and outside the family or access to (preventive) medical care or exercise. A large volume of evidence supports the idea that animal products such as milk and meat are important in child development in good studies in many countries over many years: given the evidence that increased income is spent on ascending Engel's curves this explains the beneficial effects of universal income and services being cost effective with improved labour outcomes and productivity and the failure of austerity programmes [129, 133, 200, 201].

12. Living high: letting die

The moral position on this *"thou shalt not kill"* is clear as many ethicists and philosophers from Aristotle on have pointed out that all should be allowed to flourish [202–205] (**Figure 11**). Many diseases of poverty can be related to meat deprivation and the "western diet" linked with allergy and auto-immune disease and (food) allergies often attributed

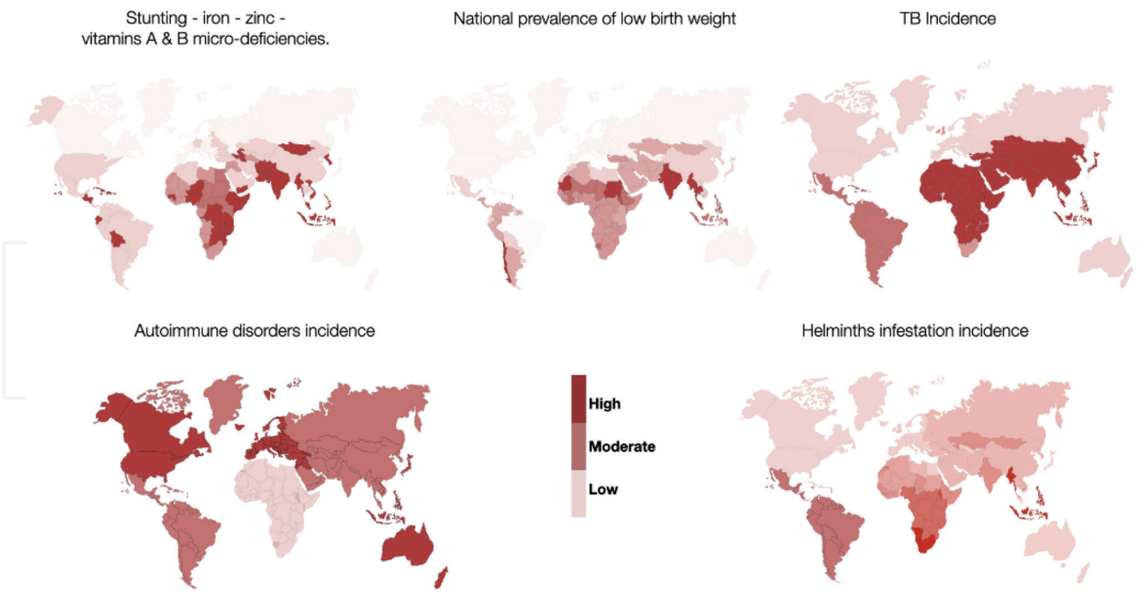

Figure 11.
Stunting whether measured by height or IQ tests is very geographic and correlates with poor diets. So do low birth weights that then even if diet improves runs the risk of metabolic syndromes. TB decreases over time if meat intake increases as it did in Victorian England but is still common in countries where meat intake is low. Nicotinamide has antibiotic actions against TB and many helminths. As TB and Helminth incidence decrease allergic and auto-immune disease quickly and consistently rise in incidence as does longevity and some age- related inflammatory, degenerative and cancerous conditions.

to lack of fibre and ultra-processed foods could be a direct effect of higher nicotinamide doses and that the theories merge as less fibre with changes in the gut microbiome and less butyrate and other short-chain fatty acids (SCFAs) affects the niacin receptors such as GPR43 and GPR109A and both T cell function and NAD metabolism [206–209].

We did not emerge from Hobbesian state of "solitary, poor, nasty, brutish and short" but from a (meat)affluent society. As Rousseau, Locke, Paine, John Stuart Mill and many since have pointed out the essence of the social contract and property rights with enclosures is that there is then an obligation to feed those whose land, pasture and hunting rights have been expropriated. Indeed that has often been taken as the hallmark of civilisation even if codes are regularly broken [210]. Many revolts, revolutions and even world wars have been based on the right to subsistence, or used food as a weapon such as the Nazi Hungerplan (see "The taste of war"-Collingham 2012 – for many relevant examples emphasising the need for meat). Some nearly succeeded such as the French revolution's "le droit a la subsistence" supervised by the "Comite de Mendicite" of 1790 that after long years of malnutrition under the Ancien Regime was working well until adverse finances due to the Napoleonic wars intervened [211–215].

The basis of a good diet is well known even if detail changes with fashions rather than evidence: Hippocratic and Aristotle's biopower recommendations for individuals and states on dietary and exercise regiments are not that different to modern recommendations or as observed in healthy "Blue Zones" [64, 216]. The problem is that for millions within even wealthy countries and billions globally this advice is not affordable or even available—and not because the poor cannot manage their domestic budget or cook properly but because high calorific foods are cheap and there is less waste and they keep you alive even if "starving on a full stomach" [66]. Cost of thriving indices (Coti) suggest that even the (crucial) middle classes in rich countries are over the last 50 years struggling for the basics including the nutritious food baskets – at lease on one income. Statesman like actions to alleviate intergenerational friction from "baby boomer"

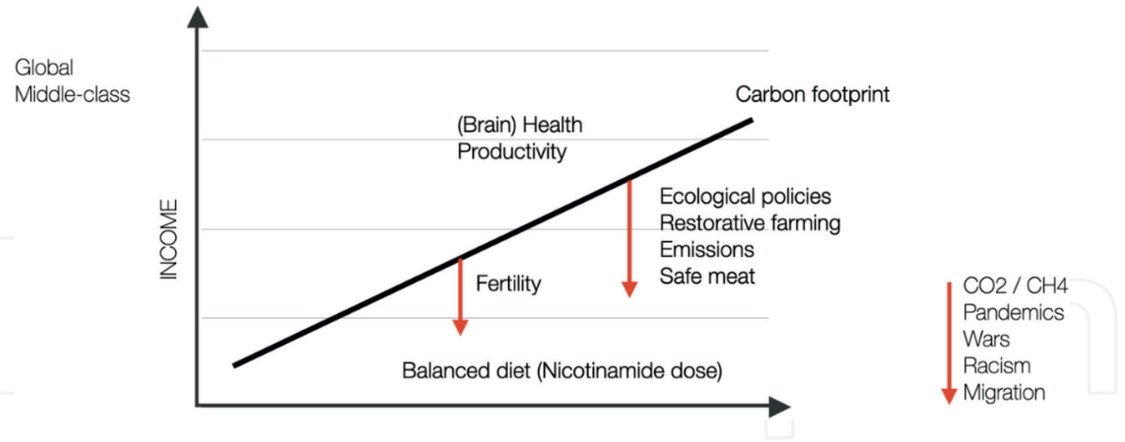

Figure 12.
A balanced diet leads to better demographics with high quality but lower numbers of offspring that raise productivity and inventiveness and eventually lowers emissions after an initial sharp rise at least in the past. This is different to the cereal related boom-bust demographics of the neolithic and recent green revolutions with their emphasis on calories that become demographic and health "time bombs".

pinches on subsequent generations prosperity and diet need accepting as breaks in the contract between generations (after Edmund Burke). A move back to "kitchen table" issues rather than the distraction of post-materialist cultural concerns treating lower status non-elites better may counteract populism and waves of migration along a metabolic gradient unstoppable by "Canute-like" border controls and walls [217].

13. Poverty traps

Previous worries about alleviating poverty and encouraging laziness or high fertility can now be shown, and the pellagra example helps, to be wrong—better diet cures laziness and poor or even criminal behaviour patterns and may decrease fertility (to the point it becomes a concern as the demographic dividend from more young people dissipates and immigration can become a necessity) [218] (**Figure 12**). The original Neolithic move to a more cereal based diet may have been a "Faustian" bargain increasing fertility and populations that could develop divisions of labour but at the expense of poorer health and human capital for some—a bargain we should recognise and take active steps to avoid.

"Tragedy of the commons" [219] claims that peasant cooperatives overgraze pastureland are rare whilst capitalist corporations frequently have short term non-sustainable profit orientated approaches that damage the soil and use artificial fertilisers and pesticides to such an extent that they damage ecosystems and diminish biodiversity. Mixed farming cooperatives usually do the more sustainable reverse unless driven out of the market when if close to starvation "seed corn" may get eaten or corn sold cheaply that has to be bought back early in the next season at greater expense or, not eating (or even destroying) cattle as it is the only source of wealth—classic poverty double traps that happen [220].

14. Politics and economics

No political or economic ideology has had unalloyed success in feeding their own populations (or of consistently helping others)—a key measure of the legitimacy of

any government. Neoliberal policies emphasise industrial agribusiness' efficiency with monopolies and profits to shareholders, compared with earlier "Fordist" capitalist systems that encouraged higher pay leading to better diets and consumerism for workers and gains for subordinate classes, have not served meat equality well [221, 222]. Neither has the Ricardian economics of "comparative advantage" that makes some sense when exporting tropical goods (or wine from Portugal versus cloth from England) and free trade but taken too far can destroy local mixed farming and even staples that then have to be "offshored" to unreliable or expensive sources leading to food insecurity [223].

State involvement as socialist and collectivist experiments also often fail such as in China or in the Soviet Union as witnessed by the Ukrainian Holdamor with starvation even in the "breadbasket" of Russia [224]. Other widespread famines and Stalin's Russia "Terror-Famine" in the 1930s and China's and Mao's "Secret Famine" in the 1960s—neither put nutrition first but industrialisation. Meat issues and differentially successful agrarian policies may have been behind both the rise and fall of the Iron Curtain—McDonald's in Moscow was reduced to ersatz meat and meat queues were deeply unpopular in east Germany and Poland [225]. The need for square meals was re-discovered in the 1930s great depression in the capitalist USA and in Britain stimulated by hunger and job marches and both had to take a more socialist stance as in Roosevelt's "New Deal" [226, 227]. This deal incorporated anti-monopolist laws that dissolved the "Beef Trust" (alongside the more remembered Standard Oil) and supported the earlier populist movement of farmer cooperatives and the "Granger" movement notably and unusually from all "races" in the 1870s although "Big Ag" later has regained power [228–231].

The more capitalist and scientific focus (as with the "green" scientific hybrid and GM approaches) have been mainly on yields and calories rather than on nutrition and improving human capital—paradoxically reducing overt starvation but perhaps fuelling population booms on a "Sisyphean task" as far as keeping everyone well fed is concerned [26, 232–235]. There have been attempts to prioritise economies to basic human needs [236–240]. These sometimes put diet and meat via either jobs or direct cash ahead of other human or political or even international legal values (that often favour the rich) and could "unshackle" some economies (such as in India relative to China's undemocratic policies) as a (hopefully) temporary trade-off [241–243].

15. Big food—small holders

A basic challenge is to decouple growth from its reliance on fossil fuels and fertilisers (from bones to guano to potash, phosphorus and artificial oil fuelled nitrogen fixation) in a way that does not make things worse for the planet or its inhabitants: compound "green growth" is likely to require a combination of some reversion to traditional crop-pastureland recycling practices and technological innovation from vertical farming to artificial meat to methane-eating bacteria in dairy farms and measuring progress using Human Development indices not GDP [244–247].

Agribusiness has been guilty of short-term emission heavy and other "Silent Spring" approaches that contribute to climate change and will eventually lead to less suitable agricultural land being available. Somehow a way forward with "local for local" (as was true for almost the whole of our evolution) "10 mile diets" insourcing more sustainable farming and ranching needs to be found [248–251]. Loss of biodiversity includes loss of the rarer foods that might be needed later and include some sources of meat [252]. Goldschmidt's 1978 "As you Sow" research showed profound effects on

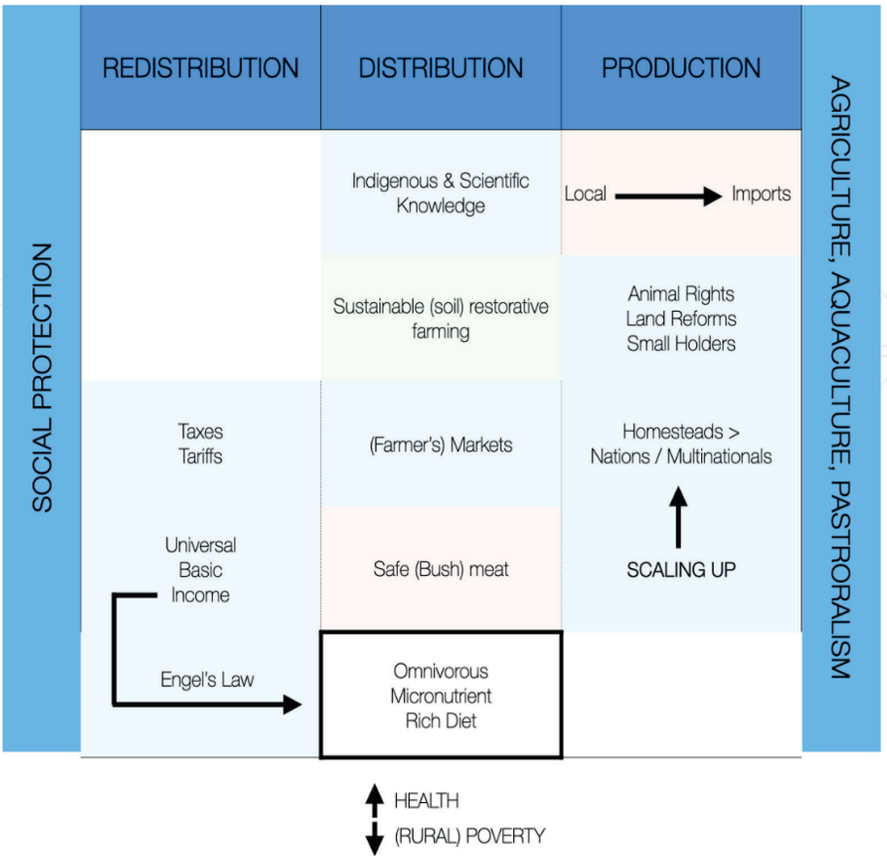

Figure 13.
Answers are likely to come from a combination of social protection of income ideally through well-paid jobs and better educational infrastructure in deprived areas as "pre-distribution" or, redistribution with universal lifelines for meat (and energy) consumption up to a certain point with food subsidies or cash payments. Local production of foods and the best of the scientific and indigenous knowledge approaches with restorative farming and better and safer distribution networks will help.

the community affecting poverty and health of industrial agriculture adversely versus family owned farms [253].

There are many suggestions and experiments ongoing that could solve these problems that integrate crop—livestock systems—if these decentralised systems can satisfy be scaled up creating a world system rather than globalisation with its high food miles and waste [254–267]. Local economies with food sovereignty going beyond food security with international peasant, slow food, cooperative solidarity movements like *La Via Campesina and Gruppi di Acquisto Solidale* with the many versions of food hubs may cut out middle-men and monopolies or speculators making produce cheaper, safer and closer products suitable to diverse dietary needs [244, 268]. Regenerative farming and agroecology, sometimes less strict than organic farming that does not allow weed-killers, with less tillage or chemicals and "soil doctors" may heal poor soil health and make them both more productive and more resilient to climate change (whether temperature, drought or floods) as well as habitat for a rich ecosystem for micro-organisms and a storage sink for carbon - but this is often only solvable by local measures as there is no "one size fits all" solution [269–272] (**Figure 13**). Care needs to be taken as radical overhauls such as banning all fertilisers and pesticides can cause a low yield crisis, as suggested by the experience of Sri Lanka. Laboratory grown meat has come a long way since the first burger (2013 and

$330,000) as have shifts from beef and lamb toward chicken and tofu but may remain too expensive for the poor and unacceptable "Frankenfoods" to the rich [273].

16. Is more data needed?

Cartesian logic says that when we have enough knowledge of a balanced diet, we do not need the "logic" of the marketplace to help us valorise or price meat. Neither do we need more data to act. The long overdue measurement and screening of NAD pathways in populations should still be done and would act as a lever to target deficient individuals and to adjust dosage at times of stress.

A simple goal reclaiming a meat and diet commons should be set that would quite possibly pay for itself several-fold in productivity, resilience and safety [274–277].

17. Pro-pandemic meat variances: poor plagues can plague the rich world

If altruistic and moral arguments do not suffice, then fear of pandemics and climate change might tip the balance toward further action. The meat supply has long been a source for concern from nineteenth century meat packers in Americas "Red meat Republic" and Chicago's "Porkopolis" as depicted by Cronon and Sinclair in "the Jungle" with dangers to the packers and the consumers triggering legal constraints on labour and consumer safety (the birth of the FDA). This did not stop the variant

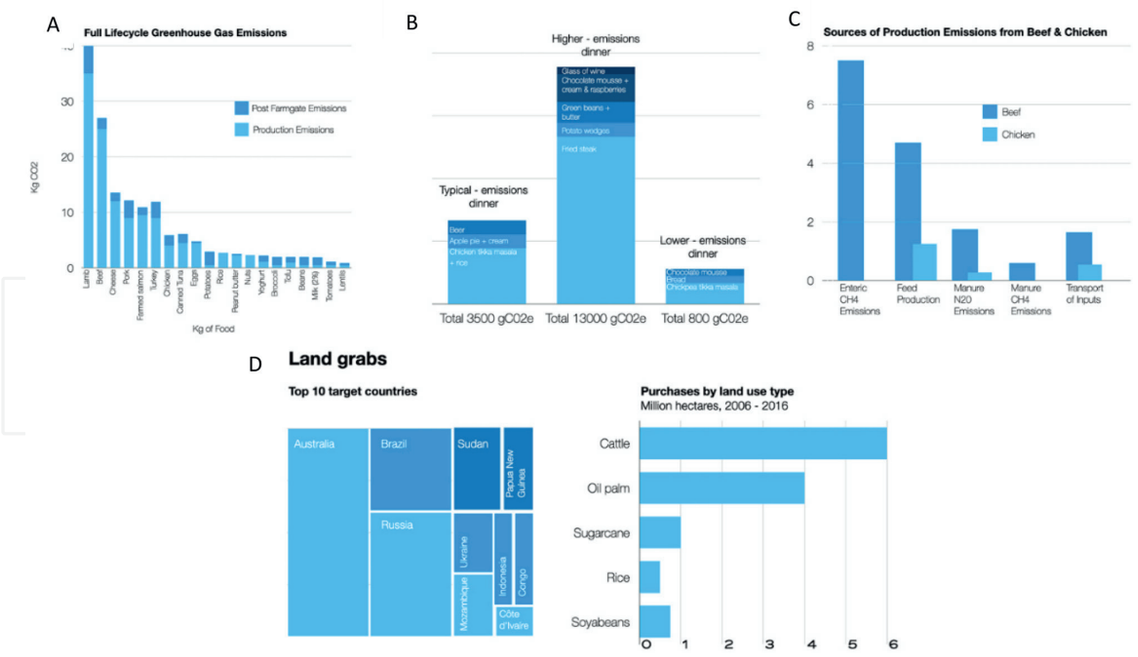

Figure 14.
(A) Greenhouse emissions by food type. (B) Emissions from beef and chicken. (C) High to low emission meals. (D) Land grabs and their main uses. Ruthless pastureland and cropland appropriations and exploitations have been important drivers of our history. Territorial gains (Ukraine excepted) are now rare but the goal of most deals remains to feed the western centre or create profits from cash crops, oil or mining increasingly of rare metals. All benefitting from information technology and "offshoring" with cheaper labour rather than improving the farms or the diet of the local inhabitants [294–296]. When local governments are astute to avoid "resource curse" or the "Dutch disease" they use profit to farm and feed their population properly and do not become too dependent on others for aid or their food surpluses or manufactured goods.

CJD outbreak in the UK from unnatural farming and feeding practices associated with "industrial meat regimes" or in China "dragonhead enterprises"—COVID-19 highlights the need for better and safer meat supplies as did other earlier emergent zoonoses; pathogen spillover is more likely when there are rapid changes in bat ecology including climate change and deforestation and when they are hungry and nomadic themselves bringing them closer to intermediate viral hosts and the human food-chain [62, 278–284].

The quest for meat is strong enough that risks get taken both by the poor in desperation, such as widespread poaching endangering species, and equally by the bored uber-rich desiring exotic foods usually meat. Bush meat and other wildlife hunting or farming particularly in deforested areas can bring species together so closely that it allows for microbial/viral species-jumping an important source of new (and old) zoonoses and food poisoning. Animal culls from emergent veterinary infection or known pathogens that could have been avoided by better vaccination programmes can impair the meat supply and cause price spikes. Regulating the market with a visible hand banning illegal wildlife, improving livestock densities and revamping with less cruelty to animals and fish, tidier slaughterhouse conditions combined with early warning systems are urgent to correct this "biological experiment" as are fresh looks at conservation in zoos and parks with public health in mind [285–288]. Restricting the rich in a "meat retreat" but supplying the poor is the crucial point that must be kept central to policies and not compatible with calls to abolish livestock farming and replace with veganism and microbial ferments (reminiscent of the dystopian 1973 film Soylent Green) [45, 289–293] (**Figure 14**).

NAD depleted populations are prone to infections and more likely to infect others with the infections further depleting NAD from tissue damage and perhaps impaired uptake of tryptophan in a metabolic trap. Indeed some manifestations of COVID and other infections (and long lasting side-effects such as chronic fatigue) may be new versions of pellagra with its documented disturbances of nicotinamide metabolism [297].

18. Answers: nutritional repairs as reparation and route to prosperity

Well-meaning attempts, and utopian ideals, have been made to alleviate nutritional poverty from feasts and potlatches in feudal times to poor laws and charity including from churches and monasteries and later foundling hospitals, school meals and food banks—and the far less well-meaning depictions of the "undeserving poor" and establishment of workhouses [298]. The usual reason for support was to provide enough basic subsistence to socially "produce and reproduce" a surplus workforce in case needed for industry or for "cannon-fodder". More enlightened policies exist but often rush to education or electricity or fertility control or good institutions without much mention of diet the gift that underpins these worthy goals [299–303] (**Figure 15**). In other words a meat and fish ("Blue") Commons and a "Glocalisation" foodscape needs to be recreated counteracting the "Lauderdale paradox" (as the "Charter of the Forest" a part of the Magna Carta had attempted in 1217 as later did the 17th C Leveller and Digger upheavals in the English Civil War, with "warning tears of the oppressed", and later the Quakers and Chartists). However, the rich still enriched themselves "contrived scarcity" of what had been abundant and was to become super-abundant. The worries of "Grim reaper" Malthusians such as Paul Ehrlich (as in his 1980 bet with the cornucopian Julian Simon) are perhaps resolvable by high "K" quality populations on good diets not "r" "population bombs" [304]. On the whole up to now the optimists have been right with Human

Figure 15.
Food spend as % of income remains high in many countries and will be a lot worse for the poorest families. Engel's/Bennett's law is clear cheap empty calories will be the first priority and meat/milk and vegetables will be squeezed out. By contrast rich people in rich countries spend a negligible proportion of their income on food that is in effect free as it barely affects their disposable income. Overindulgence can however be exacerbated by excessive fortification in foods and drinks running the risk of hypervitaminoses B3 for the affluent.

Development reports showing reductions from 60% to 10% of peoples in extreme poverty (less than 2$ a day) since 1950 with increases in schooling, life expectancy and happiness but this has been unequally spread; the pandemic has reversed progress in a detour that may last given an "uncertainty complex" in a "polycrisis" or ticking "cluster bombs" best avoided by returning to basics such as wholesome diets.

Global problems, we have illustrated can be dated to unlucky geographies exacerbated by colonialism and post-colonial self-determination and the long shadow of slavery or neo-slavery, such as indentured servants and child labour, frequently resulting in pro-pellagrous diets [305–311]. Indeed, some good data is on catch-up growth after the stunting of American slave children that gives hope, as do many other studies across the world on migrants that diet with more animal products and protein can improve height cognition and behaviour and life chances within and across generations. Massive reparations were made to the slave owners not the slaves and reconstruction deals such as " Forty acres and a mule" that would have helped were soon reneged on [28]. If we set our minds we could disallow a range of black-white disparities in the prevalence of chronic disease including (Caribbean) "amputation capitals" caused by metabolic and "blood sugar" syndromes as well as excessive deaths from infection. Targeting the vulnerable may be more effective, more workable and more affordable than other proposals or repatriating looted cultural artefacts and could be off-set by other stolen assets from corrupt dictators laundered in the West as more recent "sins of the fathers" [57, 312–319].

Reparations, it will be remembered were poorly managed in Versailles in 1919 with fatal consequences (paving the way to WW2), despite help from the American Red Cross and "Save the Children" (who against opposition also helped starving Russians).

By common assent the German famines led to fascism, further *lebenstraum (that was a factor initiating WW1 seeking "a place in the sun" for both Germany and Japan)* and WW2: The "Hungerplan" to starve Soviets and Jews mixed up such nutritional policies, racism and later genocide and "Holocausts" (whilst the world watched "*a grotesque dream is forming*"—Joseph Roth 1924) [212, 320, 321]. Half-starving people on a low meat diet turns them into versions of pellagrins, underlined by Primo Levi's description of the "Musselman" who close to death "*with head dropped and shoulders curved whose face and eyes not a trace of thought was to be seen*"—that then "proves" them inferior.

In the WW2 case this chain of events was defined (by Lemkin and Lauterpacht -1945/6) as "genocide" and "crimes against humanity" and their "Final Solution" of euthanized death [302–304, 322–324]. Many genocides can also be seen in the light of dividing pastoralist and farmer groups and deciding they are ethnically different as evidenced in the history of the San (hunted as bushmen) or frictions over dairy farming in Kenya (the Mau Mau uprising in 1952) or in Rwanda or Darfur or inventing national borders that encourage ethnolinguistic diversity and friction as in Africa and India/Pakistan with similar colonial-settler like frictions and "indiginocides" in Gaza, Sri Lanka and Myanmar [323].

In these self-fulfilling policies half-starving people on a low meat diet turns them into versions of pellagrins 'legitimising' denationalisation followed by dehumanization and should be incorporated into Stanton's "10 stages of genocide" under ecological and economic headings. We should re-think development emphasising the opposite outcome from a better diet turning the investment of reducing famine and malnutrition and circumvent various vested interests to avoid future criticisms and our own "autogenocide" [245, 325–331]. This is particularly important for Africa and some parts of Asia allowing them to complete their demographic and epidemiological transitions to everyone's advantage [274, 332–336]. The remarkable success of countries such as South Korea, a war-torn "basket case" in the 1950s concentrating on agriculture, land reform, exportable goods and culture shows that "Shrimp to Whale" progress can be done [337].

19. Better policies: nutrition front and centre "to each according to their needs"

Food stamps and maternal support and attempts to maximise employment or provide universal basic incomes have had some luck [338]. Multiple studies over nearly a century in many countries have shown the benefits of animal sourced foods the tall Masai relate to pastoralism and the tall Dutch to high milk intake in the Netherlands—international IQ comparisons may similarly relate to diet [339–353]. Universal basic income first suggested in Thomas More's old Utopian dream and enacted in Speenhamland (1795) almost became American policy in 1969 as part of the "War on Poverty" and many recent studies have shown large cost-effective gains in many measures across the board—this may well reflect Engel's curves in improving the amount of milk and meat in diet [354]. Universal basic services is a closely related idea that would have similar results if it included diet as a priority rather than jump to welfare objectives such as free education and health by-passing diet [355, 356]. A reinvention of "gas and water" municipal socialism (as instigated by Chamberlain in Birmingham) and "New Jerusalem's" with communes driven then by labour unions and strikes to include diet and international subsistence revolts often led by women ("Rebecca food riots") andhelp to local farmers and their markets may be a the exemplar narrative and pre-requisite for success [357–362].

Policies that encourage rather than marginalise pastoralism (as a protected local industry as important as other forms of security such as energy, computer, ships or military technology) and invest in "precision" mixed farming and sustainable regenerative agriculture and aquaponics combining local indigenous knowledge with the best of the scientific approaches—and learning from well—constructed trials sensitive to local opportunities and cultural needs have to make sense [53, 76, 256, 266, 363–370]. Pastoralists are particularly at risk of climate change and its effects on forestation such as the advance of Boreal forests and reindeer populations or, their loss from fires, and is in the Sahal a flashpoint for outbreaks of violence [371].

Furthermore, agriculture and silviculture improve biodiversity reflecting the co-evolution between man, birds, bees and other insects, and symbiotic microbes in our gut and in the soil [372–374]. Neonicotinoids and other pesticides have damaged insect populations and the use of antibiotics to encourage growth in animals contributes to changes in our microbiome with antibiotic resistance and the emergence of "superbugs" now a major health hazard [375].

20. Humanitarianism: re-igniting a concern for distant others

Humanitarianism and its institutions have a history that some date from the consequences of decisions in Paris (1919) and Biafra (1970), where pellagra was well described, was another historical stimulus—that is still relevant to poor nutrition and population explosions in Nigeria [364, 376–379]. Charity organisations, such as Medicins Sans Frontières and the NGO Oxfam [380] with local development is the way forward including supporting pastoralists. The need for migration should then be manageable with less friction—after all behaviourally modern *Homo Sapiens* has been on a transcontinental global quest for meat or fish along eastern and western coastal "kelp and salmon highways" (and remember the Polynesians and Thule Inuit and the more commercial Basques) for 200,000 years or so and only migrates away from family when it is forced to [381, 382].

Calls for internationalisation of the meat, milk and egg supply pointing out the related failures of water privatisation and to the overall success of national meat rationing in time of war may be in order [11, 383, 384]. Such combined national and international approaches with a broader view of "A Duty of Care" [385–387] should lessen the loaded dice of being born in the wrong place with little chance up upward mobility (on the Gatsby curve) and may even be helped by technology and increased ability to virtually see the world from other perspectives, although runs the risk of flaming inequality, with gamers even playing farming games (originally "Harvest Moon") rather than shooting "baddies" and rewards for being kind not vengeful [388, 389].

21. NAD ups and downs over time and place—"Only one Earth"

Pellagra, often familial, is an outstanding example, alongside eco-genetic opposite side of the genetic coin examples, such as phenylketonuria also cured by dietary intervention, of good nature via good nurture [390]. Cotton market failures led to pellagra outbreaks just as loss of ship building led to a dietary and health collapse in Glasgow [391, 392]. Although the rest of "Bad Food Britain" or the USA is far from ideal (with many food-banks necessary) hope comes from Mediterranean countries where the class food divide is not so marked, and neither are health inequalities. Perhaps as

they were in the eye of the original pellagra storm lessons were learnt Elsewhere the "fallacy of composition" states that because many have access to luxuries one must not presume that necessities are catered for as heavy marketing of new technologies distort Engel's law even in slums and "shanty towns"[393].

Politics should lower its sights and deal with Masferrer's (1929) "El minimum vital" regardless of the hand dealt by fate and as Berthold Brecht said in his Three Penny Opera "*You may proclaim, good sirs, your fine philosophy but till you feed us right and wrong can wait*" or Scott Fitzgerald (1925 -Jazz age) in the Great Gatsby "*No human difference is so profound as between the sick and the well*" and this failure to allow ascension up the food chain is the real source of (brain)health inequality[382, 394–397]. A "Constitution of knowledge" or "Adaptive intelligence" or "Metacognition" depend upon diet and if these do not function well neither science or the arts or political and democratic institutions can emerge capable of solving the major problems facing the planet and our own survival [263, 296, 380, 398–404].

Poor nutrition commonly gets medicalised shifting the blame and responsibility from the state to the individual and then blaming willpower or incarcerating or driving to drug and food addictive behaviour with opioid epidemics and mappable deaths of despair as was even documented three centuries ago in the pellagra epidemics [78, 405]. Failure to progress nutrition and human capital may explain the "Great economic disappointment" of the last 20 years [406]. Poor classes and countries particularly in the South face a NAD headwind that results in a developmental and degenerative pathology of poverty and inferiority, as judged by many in richer habitats who choose to forget the quote from Corinthians "*What do you have that you did not receive? And if you received it, why do you boast as if it were not a gift.*" Or the meritocrats conveniently forget "*Der Mensh was iBt*" (Feuerbach 1850) that can now be shown by stable isotope research, that has tracked our meat: plant dietary history, to be literally true that we are what (and where) we eat [407–409]. Rich gastronomy and exotic diets look decadent at best if the south is included in "Only One Earth" (Ward 1972) and contributes to a dangerous syndemic and as said to the rich after Belshazzars feast in the Book of Daniel "*thou art weighed in the balances, and found wanting".* Meat is not a luxury for billions and should be democratised or as Benjamin Franklin (1758) stated "For want of a nail, the kingdom was lost". Metabolic rifts allow for dangerous metabolic ghettoes with poor brain development crucial for abstract thought, language writing and arithmetic and the many Neuro- prefixed disciplines that "supersize the mind" [312, 316, 410, 411]. A more moral economy should focus on this need as did the "physiocrats" and "levellers" several centuries ago—and was Confucian philosophy long before that [186, 397, 412]. Meat markets are (Pareto) inefficient as it would be possible to make many people better off without making anyone worse off (indeed they may well be better off too; giving money would pay for the meat and would not be wasted as predicted by Engel and has been shown in several randomised trials (see Banerjee and Duflo's Nobel prize winning studies).

22. Postcript 1: current concerns

Much of the heated controversies over the rights and wrongs of meat based or plant-based diets can be resolved if seen in the light of needing homeostasis and NAD(H) based metabolism[284, 413–420] that may yet rhyme with a green hydrogen energy revolution [421]. The writing is on the wall over the ethics and safety of allowing billions to be poorly fed so we need to sort this out or any future generations will obloquy us in the same way as we criticise the diet-mediated slave trade and most genocides [269, 422].

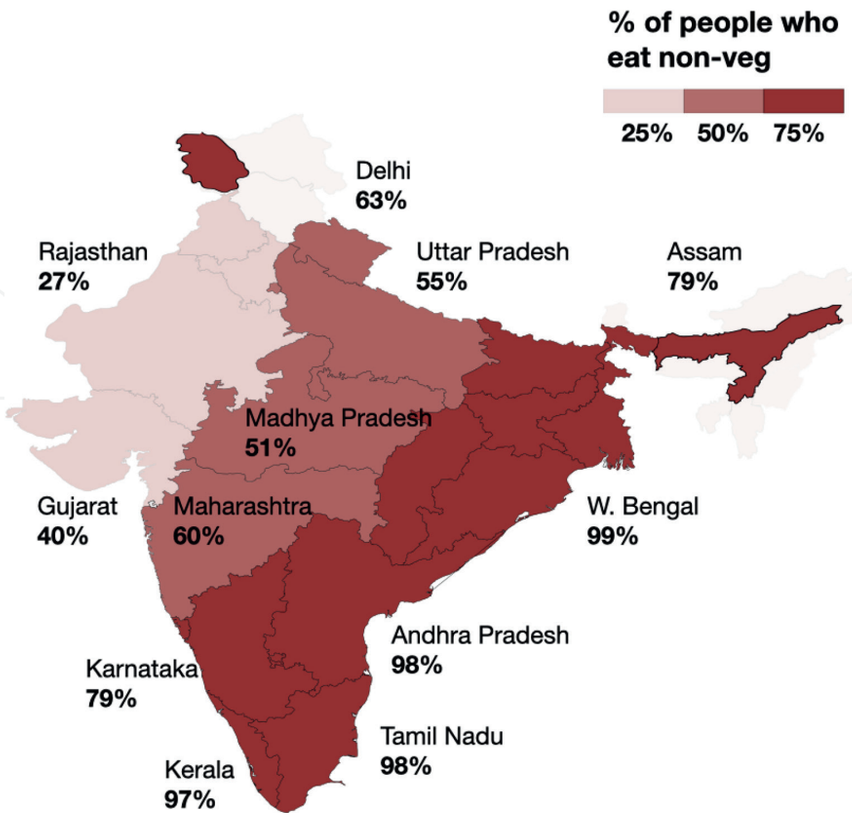

Figure 16.
Southern v, Northern India may be as close to a controlled experiment as it is possible to get compared to the natural experiments we have described. A child born in the South is far less likely to die in their first year of life or lose her mother in childbirth. She will receive better nutrition with free midday meals and go to school and stay in school longer then attend college and secure employment with better pay. She will have fewer children who in turn will be healthier and more educated than her. Southern India, and Kerala in particular, over the last 50 years has developed meat and especially beef as a secular dish cutting across class, caste and religion—the latter of course is complex historically with taboos that remain influential in the North. Initially the extra expense may have been kick-started by Gulf migration and remittance monies sent home but is now self-sustaining due to economic success and high meat production as well as consumption.

Stagflation with increasing prices and no growth was triggered in the 1970s by energy and then food price spikes and may happen again turbocharged by current shocks—for every percentage point increase in food prices another 10mn people are pushed into extreme poverty and developed countries are far from immune to this effect (prices are up 30% this year) with households paying over 50% of income on food. Heavy current subsidies of foods may become unaffordable for some countries and already concentrate on calories encouraging junk food and "buy one get one free" deals. Repeating dated mantras such as the poor needing help with cooking and domestic budgeting or, protectionism with export bans over foods or fertilisers are not an answer.

Recent events in Ukraine bring to a head longstanding problem in the food-chain affecting everyone but particularly those teetering in countries affected by conflict—including Yemen, Ethiopia Sudan and Egypt—risking another "Arab uprising" that began symbolically with the self-immolation of a Tunisian vegetable vendor and were followed by Sudanese and other protests over the price of bread [423].

Individuals may be best served by free money but some states need "Special Drawing Rights" and support via World Food Programmes and combined with investment to improve agricultural yields such as in Africa and incentives to cut down

on scandalous food waste (as in European "butter mountains" and "milk lakes") and overindulgence in the developed world [424–426].

23. Postcript 2: QED?

These are man-made disasters, as was overt pellagra. Hope should come from realising that darkest London of 200 years ago was not that different to the poorest regions of the world now. Strong correlations with progress such as fossil-fuel dependency that may have tempted emerging economies, such as in Africa, to believe that they cannot leap-frog to green economies can be shown that the legacy carbon path, or at least an extreme form of it, is not necessary if a balanced diet is prioritised.

Concrete optimism could spring from an almost randomised series of experiments in India where the southern states have overtaken the Northern states in educational and economic terms with better health (such as infant mortality or TB incidence) with enlightened policies on meat/milk/eggs eating and midday school meals [427] (**Figure 16**).

Improved diet would increase resistance to infection more than the most powerful antibiotics and avoid "superbugs" and improve gene maintenance, expression, regenesis (including of neurones) and alter our inheritance in a way that glitzy gene therapies—for the rare and rich—could only dream of (although it has been suggested that such technology could by using gene-drives reduce the desire for meat and make us more altruistic) [278, 428–431]. At the same time the nightmare of more inequality would be avoided as so much unmet need would be addressed. The fairly high hereditability of traits such as height and IQ and many diseases are much less if poor suggesting that diet is the crucial, cheaper and fairer intervention [432].

24. Discussion

It does not take a paranoid or an anxious mind-set to sense trouble ahead if food-security and nutrition is not taken more seriously—the Maputo declaration of 2003 committed African leaders to devote 10% of budgetary allocations to agriculture; few have come close but placate populations with food imports that they increasingly cannot afford and should rely less on free trade but produce more at home or "friend-shore" rather than deal with international monopolies with few value based rules [433–435]. Commerce and market forces along with some optimism over new technology could, if it prioritised diet, create its long- promised potential for peace, (as first suggested by Montesquieu (1748) and Angell (1910)) and " freedom" and democracy between interdependent classes and countries that currently are made dependant on those with (non-seasonal and varied) affluent dietary and other (decadent) appetites—and could stop us all hurtling toward disaster [436–438].

A post liberal cosmopolitan economics that considers others more, and agrees with Joesph Roth (1938) " People aren't pigments and the world is not a palette!" and is not about the survival of the richest (even planning escapes to Mars (!) or eternal lives) or even a "golden billion" and other "great replacement" conspiracy theories by remembering Benjamin Franklin's 1776 dictum "we must hang together or surely we shall hang separately" is in order [439–441]. Originally race was closely linked to class and poverty (as are immigration and other white laws) exemplified by parochial commentaries such as "the Bethnal Green poor are a caste apart, a race of whom we

know nothing" force-feeding inferiority that then needed to be despised or civilised in hostile environments cloaked in superficial markers such as colour or religion, as noted by WEB. Du Bois when visiting a Warsaw ghetto in 1949 [442].

Better diet for all should speed up our "slouch toward Utopia" rather than "molecular utopianism" for the few. We finally begin to answer Keynes' 1924 criticism that "*we lack a coherent scheme of progress*" as that means meat for metabolic progress, not meat as a sign of progress or for "showing-off". Poverty alongside affluence definable as "stuffed and starved" metabolic diseases with pathologies not due to "status anxiety". A flatter not fatter earth with reduced meat variances is required and need not wreck the world and may save it [188, 443–446]. As (Sir)Bob Geldof, influenced by the history of *An Gorta Mor*—the Irish Great Hunger of the 1850s when governments also stood-by—recently said "*Development is not some feel-good virtue-signalling function, it is a critical necessity of humanity or the spores of poverty find fertile ground in the poisonous fields of ethnicity, populism and nationalism- ask Putin".* Giving in to our altruistic urge with something of a moral revolution may help when combined with a "fear factor" of pandemics and climate change and a concern for our kids and future generations and generational injustice [447–452].

Bernard Kouchner, the originator of Medecins Sans Frontiers, (1993) having observed starvation and pellagra in the Biafran war wrote in his memoir *"Le malheur des autres"*— "A quoi servaient medicins s'ils n'alertaint pas le monde du blocus alimentaire…..silencieux nous etions complices du massacre systematique". Preventative and moral medicine needs to avoid being accomplices amongst the geopolitical chaos and speak and act up over malnutrition and pandemic avoidance with safer meat supplies—and in keeping with Ernest Hemmingway's *"if the story is so simple it can be said in 6 words"* and to avoid the weight of circumstantial but (we hope) percipient material dragging our argument down we say loud and clear Square Meals—Poverty and Pandemics Gone. The lesson of the Black Death or of imports from "settler colonies" is that doubling meat intake for the peasants creates "Golden Ages" with more equality of early developmental outcomes and opportunities but this could be done without more plagues or creating more third worlds in the post-colonial age that could "boomerang" [453, 454]. As a critique of development policies, states: the silence on unequal (metabolic) rights for rich and poor made unequal by dietary not genetic or cultural "tangles of pathology",—and the lack of trust to make their own subsistence and other decisions has to end with less emphasis on blaming the victims and punishing laws and orders [455]. "Races" may correlate with skin colour but this oppressive social construct disconnects from causation as it includes Jews, Gypsies, Romas and many other poor economically disempowered white classes on poor diets (in the past including the Irish and Italians or indeed anyone non-Nordic), subject to (immigration) discrimination and genocide, that profoundly affects plastic phenotypes[456–459].

*His story relevant to child malnutrition was "*Baby shoes for Sale. Never used*"*

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