

Beyond the Golden Era of Public Health: Charting a Path from Sanitarianism to Ecological Public Health

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Abstract

The paper considers the long-term trajectory of public health and whether a ‘Golden Era’ in Public Health might be coming to an end. While successful elements of the 20th century policy approach need still to be applied in the developing world, two significant flaws are now apparent within its core thinking. It assumes that continuing economic growth will generate sufficient wealth to pay for the public health infrastructure and improvement needed in the 21st century when, in reality, externalised costs are spiralling. Secondly, there is growing mismatch between ecosystems and human progress. While 20th century development has undeniably improved public health, it has also undermined the capacity to maintain life on a sustainable basis and has generated other more negative health consequences. For these and other reasons a rethink about the role, purpose and direction of public health is needed. While health has to be at the heart of any viable notion of progress the dominant policy path offers new versions of the ‘health follows wealth’ position. The paper posits ecological public health as a radical project to reshape the conditions of existence. Both of these broad paths require different functions and purposes from their institutions, professions and politicians. The paper suggests that eco-systems pressures, including climate change, are already adding to pressure for a change of course. (217 words)

The Path to the Golden Era

Public health thinking and action incorporates a theory of progress, rarely discussed and not always evident in practice. At its core is JS Mill's utilitarian notion that the purpose of public policy, and indeed of the state, is the advancement of the conditions of the many, including the most vulnerable. Utilitarian ethics, it has been claimed, remains even today the lynchpin for good public health policies.¹ Realistically, not all political systems or political elites have regarded progress in such terms, although the British model is presented as an ideal case of a society shifting inexorably from non-democracy to democracy.² As Friedrich Engels caustically observed in 1892, sanitary measures applied by British ruling élite may have indeed mitigated disease risks for the general populace, they were certainly intended as a means protect their own social group and their families.³ Similarly, while modern political scientists have acknowledged that such reform notions helped "coax the machinery of government to serve the public purpose", such actions were politically palatable because economic growth made them affordable, without redistribution from the rich.⁴ Like many of the ideas proposed by Jeremy Bentham's protégé, Edwin Chadwick, public health measures incorporated cost-benefit analysis; not only were they intended to pay for themselves, but also to reduce financial burdens on the state.⁵

Such assumptions, linking progress, economics and health, are now brought into question. Economic growth, upon which advances in public health have in a significant degree been predicated, has been shown to be damaging the Earth's climatic systems, planetary biodiversity and ecosystem services, while the more recently implanted, but now firmly embedded, neoliberal encouragement of the free market, is associated with growing economic inequality.^{6,7} Similarly cost-benefit analysis, which assumes the need to trade-off policy options – good or bad - to optimise social outcomes, is now faced by perplexing and possibly insurmountable questions over how Nature itself might be priced. What value, we ask here, is placed upon the damage due to urbanisation, overfishing or intensive farming? Is the demand for cheap energy, driven by mining innovations like hydraulic fracturing ('fracking'), worth the risk of polluted water tables? These questions, and other consequences of growth forced upon health and the environment, form the central theme of this paper.

It is a commonplace to observe that public health today operates in more complex times. From the perspective of the present the health threats of past must surely have focused minds; after all, there was far less scope for individual self protection; market failure was endemic; and it was self evident that the harms then encountered were only remediable through large scale public works. In other words the Sanitary Movement, 'Sanitarianism', was blessed by a fair wind of public opinion and evidence. But was this true? This is a common perspective on Britain's public health past. Indeed, it was a view enunciated by Tony Blair, during in his time as UK Prime Minister. By contrast, he said, health trends today operate in a different context, mostly set by freely-chosen behaviours and not environmentally-sourced harms; indeed, for Blair, matters like obesity or drug use were not *public* health issues at all, at least not in the classical sense.⁸ Although Blair emphasised that something such be done, the underlying premise was that the determinants of health had shifted from the environmental and the collective to that of the level of the individual.

Blair's understanding does seem to accord with the modern general society view. We live in a post-deference culture; people today, it said, now make their own decisions, free of the paternalism of the past. The new government-endorsed approach towards behaviour, instigated in the Blair period, and accorded the seal of approval of behavioural science, was that governments might 'nudge' behaviour, but not much more.^{9 10} This new account of human behaviour, based the modernising logic of individualism and market choice, accorded with the largest story of neoliberalism, in the terms critically described by the late French sociologist, Pierre Bourdieu.¹¹ It was a definite project, he argued, having the explicit aim of replacing older statist, collective or institutionalised traditions of social management and coordination by market or quasi-market processes. Expressed in public health terms, and certainly in Mr Blair's presentation, it represented shift of perspective away from population-based and collective influences, as in the thinking of the late epidemiologist Geoffrey Rose,¹² towards a more atomistic, equally market-framed view of human conduct. The unifying language, tying together both markets and human behaviour, became that of 'choice'.

In some essential respects, neoliberalism represents a return to individualism of earlier times, then the contexting ideology confronting public health reform. Given the parallel between market liberalism then and neoliberalism today, was it true public health movements encountered an easier process of reform? On the contrary, in political terms, opposition to Sanitarianism was of a similar ilk to opposition to public health today, such as criticism of 'nanny statism' or the appeal to voluntary self-reliance. Change, when it did occur, was driven as much by drama – the lived experience of sanitary threat - as by either science or reasoned argument. In Westminster, London, in 1858, what became popularly known as the 'Great Stink' brought the monumental problems of failed sanitation literally to the door of policy makers, focusing their minds, eyes and nostrils, on the need for action.¹³ Then, little was understood about the microbial environment. The scientific backing for measures then, though thoroughly erroneous today (and in dispute then), was 'just enough right', as the public health theorist, C-E Winslow once observed.¹⁴ Even with years of campaigning and public agitation the cause of clean water and elimination of filth required decades before the full benefits were felt.

This is a more sober and realistic model of social change. It identifies the importance of unpredictability, messiness, power, and social-psychological factors having at least equal impact to science, evidence or ideological belief. Successful public health advocates have long understood this; it informed the bruising, decades-long campaigns against 'Big Tobacco', for example. As with the Victorians modern public health advocates receive well-practiced denunciations of their views ('alarmist'), their intentions ('nannyism'), or the impracticality of their measures ('self-defeating'). It is a constant refrain which unifies a portion of the media ranging from the celebrity-obsessed (eg the UK's Daily Mail) to formerly Marxist (eg Spiked Online). It is a narrative which says that public health is illiberal, obsessive, moralistic and even dangerous.

It is perhaps this noisy and contested background, as much as requirement to be seen as neutral and science-based, which explains the official change methodology of public health. The so-called evidence-based approach is gradualist, rationalist and linear: problems are identified, subject to scientific review, formulated into policy options, and finally, when

presented to policy makers, come under the banner of ideologically-free, value-neutral truths which 'speak for themselves'. The outcome is that minds, prejudices and outdated policies are set aside. This may indeed occur; as was the case of Norman Fowler, the British minister charged with addressing HIV/AIDS during the Thatcher era. Fowler made the transition from a Conservative politician to a public health advocate and HIV campaigner.¹⁵ Even if the means of transmission of disease is clear cut, the means of resolution may not be. On many matters, the science is not at all clear, as ecological complexity increasingly substitutes for single cause theories of disease.¹⁶ Equally, those policies which have been evaluated, and are thus 'evidence-based', may not be of sufficient scale and scope and in any case the circumstance of their application may differ wildly. The language of 'delivery', so often applied in public health, often assumes a decontextualised, decultured world, where a measure successful in one setting can be applied to another.

In fact, a great many public health measures have been disruptive, controversial, potentially ruinous (to political or scientific careers), or have continually uncertain consequences.¹⁷ Sanitary reform too had this potential and only with the hindsight of history do the multiple risks of conception and execution it faced disappear. And while modern public health activists may fondly recall the policy successes from Victorian era on - water, sewerage, local government, housing - all of which were the infrastructural essentials through which the later Golden Era emerged, less attention has been given to fact that policy successes won through only by the narrowest of margins, that many measures fell flat, or that powerful economic élites, who felt challenged by their operation, successfully opposed them.¹⁷ The 1858 Big Stink changed London's parliamentarians' minds whereas the 'Big Smoke' of coal-caused smog (smoke+fog) did not. Health-damaging smog met a century of delay before clean air measures addressed it.¹⁸ In sum, while society may indeed be far more complex today, and behavioural factors more prominent than in the past, advocacy for public health continues, almost uniformly (except for disrupted moments in time) as a contested and difficult terrain.

To refer to the 20th century as being Golden Era, therefore, is to speak of a patchy process of improvement, accumulative in impact, and shaped by changes in the standard of living, better food, better housing, technological changes which caused less physical stress to bodies, better education, protection from occupational risks, and a visibly cleaner living environment. This combination of economic and social advance allied with scientific knowledge enabled humanity to believe that the health of populations on a massive scale could be improved. For many it has, according to place, social class and social group. The Golden Era emerged gradually, often spasmodically, through a process of interlinked transitions we have described elsewhere.¹⁹ It also occurred despite the parallel growth of serious issues that trouble thinkers about health, from Malthus to the present.²⁰ These include large-scale global trends such as urbanisation,^{21, 22} unsustainable resource use,^{23, 24} and economic inequalities.²⁵⁻²⁷ The full global health impact of climate change may still be a matter of speculation, but many points are clearer 'knowns'. The rise of sea levels, by an estimated 1 metre by 2100, will result in the drowning of many coastal cities or island communities.^{28, 29}

A paradox has emerged in which the Golden Era has increased risks and benefits. For example as clean air legislation resolved the more visible features of pollution such as smog,

invisible particulate air pollution has risen as consequence of fuel-saving improvements in motor vehicle engine technology.³⁰ We see not dissimilar paradoxes in many sectors such as food, farming, antibiotic use, persistent organic pollutants, waste, indeed almost the entire gamut of everyday products and practices of the consumer era upon which the ‘good life’ has been increasingly based.

Recognising these contradictions and paradoxes does not mean the Golden Era should be dismissed as false or an epiphenomenon. Located at a point between the horrendous health impact of early industrialisation and urbanisation and a future of mounting uncertainty, the US Centers for Disease Control (CDC) rightly celebrated the 20th century for its (US) successes.³¹ Yet each of the CDC’s 20th century successes must now be tempered by more evidence and warnings (see Table 1). The debate today is whether, a decade into the 21st century and despite real gains in capacity, the accomplishments of the Golden Era with its high points is now under threat.³²⁻³⁴

Table 1. 20th century public health successes tempered by 21st century global problems and warnings

	<i>20th century US public health successes...</i>	<i>...yet related 21st century global problems and warnings</i>
1.	Immunisation	Inapplicability to NCD prevention; evidence of cultural or religious rejection
2.	Motor-Vehicle Safety	Rise in motor car use reducing physical activity
3.	Workplace Safety	Export of cheap, dangerous labour conditions to far-off countries via supply chain globalisation
4.	Control of Infectious Diseases	Rising antimicrobial resistance through over-use and inappropriate use
5.	Declines in Deaths from Heart Disease and Stroke	Rise in obesity and diet-related diseases in low and middle income developing countries
6.	Safer and Healthier Foods	Rapid global nutrition transition and over-consumption of meat and dairy alongside under-consumption of fruit and vegetables
7.	Healthier Mothers and Babies	Global health inequalities; continuing high child mortality
8.	Family Planning	Rapidly rising global population accompanied by ideological or religious attacks on contraception
9.	Fluoridation of Drinking Water	Rising soft drink consumption
10.	Tobacco as a Health Hazard	Spread of global tobacco brands to developing countries

Source: CDC 1999³¹ and authors

Is the Golden Era of Public Health coming to end or just under strain?

The WHO has identified the top ten current causes of death worldwide, with ischaemic heart disease at the top.³⁵ The WHO, however, does not venture into futurology or identify long-term risks. Yet there is increasingly strong evidence of major threats ahead. Rockström and colleagues, for example, have presented a much cited overview from an eco-systems perspective,³⁶ echoing the findings of the UN’s 2005 Millennium Ecosystem Assessment.³⁷ At the same time, social analysts of health point to wide inequalities.^{7, 38} Such lists betray one’s own disciplinary predilections, of course, but surely such summations are precisely

what the public health professions now need to compile to convey the ‘big picture’ it sees for the 21st century to policy-makers and the public alike.³⁹ In line with our own ecological public health perspective,¹⁹ we here identify a list of contenders for high-level risks and threats to public health ahead; these are a mix of the biological, material, societal and cultural (see Table 2).

Table 2. Some major 21st century risks and threats to public health

	<i>Risk and threat</i>	<i>Comment</i>
1.	Eco-systems	Stresses on biodiversity and land use have direct and indirect health impacts and undermine planetary and localised resilience. ^{37, 40}
2.	Water stress	Pressures on ‘blue’, ‘green’ and ‘grey’ water threaten potable water sustainability. ⁴¹
3.	Greenhouse Gas Effects	Temperature change alters viability of current terrestrial and oceanic vitality, affecting humans. ^{42, 43} Sea level rise threatens human habitation. ²⁹
4.	Infectious diseases	Rising antimicrobial resistance threatens medical intervention ⁴⁴ ; increasing risk of zoonotic diseases spreading to humans. ^{45, 46}
5.	Mental ill-health	Societies may be richer but exhibit greater mental stresses. ^{47, 48}
6.	Urbanisation	The sheer number of people poses pressure on habitat, ecosystem services and resource-use. ²²
7.	Healthcare costs	These are immense (but variable) in rich economies and rising in lower income economies. ^{48, 49}
8.	Economic inequalities	Inequalities, over and above absolute low income, are drivers of health, ³² and are wide within and between societies, ^{27, 50} with impact on growth. ⁵¹
9.	Lifestyle	Modern or westernising behaviour patterns expose populations to new combinations of dietary, physical activity, consumption and energy norms and habits. ⁵²
10.	Food supply	Shifting dietary patterns stretches world food supply, not least in relation to meat and dairy production’s resource use. ^{53, 54}
11.	Religious intolerance	The spread of evidence-based public health programmes and infrastructure is rejected by intolerant religious codes which see them as modes of control. ⁵⁵
12.	Socio-political instability	The global political order since the Soviet Union collapse is itself under strain; this is both weakening and exposing international health institutions. ^{56 57}

Source: authors

Arguably, one catalyst for a shift in public health thinking came with the 2007-08 financial crisis in which banks and the financial sector as a whole were exposed as a debt bubble on a massive scale.⁵⁸ This upheaval highlighted the dominance of the growth economy as the under-writer for health improvement, highlighting the existence of a long-term unwritten ‘compact’ or policy package that rising wealth could and would pay for rising healthcare expenditure. The key arguments were over how to pay for it (socialised or private arrangement) and the levels of supposedly affordable consumer debt. The tacit policy package was already shaky in the USA before the financial crisis; it was clear that private, but government supported, healthcare arrangements was a drag on the wider economy, accounting for \$2.8 trillion in 2012, approaching a fifth of GDP, and spawning messy, partisan politics of healthcare reform from President Clinton to so-called Obamacare (but having origins much longer into the past⁵⁹).⁶⁰ The costs of ill-health vary even within the

OECD, but when totals are computed for health and the environment, the full costs to society are immense.⁶¹

Nor do environmental costs convert easily into monetary terms. The concept of positional goods is used to describe amenity losses due to urbanisation and construction, such as the loss of view of a park or a field,⁶² but what value does society place on the elimination of an entire species? Our case here is that some costs are already so huge that they are ignored as generating implications almost too big to consider; hence they become immeasurable and are sidelined. Let us now consider just two such bodies of costs, on environment and health. Table 3 provides some current environmental costs and projections for 2050, drawn from The Economics of Ecosystems and Biodiversity (TEEB) project of the UN.⁶³ This suggests that, based on existing computations, total environmental costs look set to rise from an already significant \$6,596bn in 2008, equivalent to 10.97% of global GDP that year, to \$28,615 bn by 2050 (equivalent to 17.78% of global GDP in 2050.)

Table 3. Annual environmental costs of the global economy in 2008 and projections for 2050

<i>Environmental impact</i>	<i>External costs in 2008 (US\$ bn)</i>	<i>External cost relative to global GDP in 2008</i>	<i>Projected external costs in 2050 (US \$ bn)</i>	<i>Projected external cost relative to global GDP in 2050</i>
Greenhouse gas (GHG) emissions	4,530	7.54%	20,809	12.93%
Water abstraction	1,226	2.04%	4,702	2.92%
Pollution (SOx, NOx, PM, VOCs, mercury)	546	0.91%	1,926	1.20%
General waste	197	0.33%	635	0.39%
Natural resources				
<i>Fish</i>	54	0.09%	287	0.18%
<i>Timber</i>	42	0.07%	256	0.16%
Other ecosystem services, pollutants and waste	n/a	n/a	n/a	n/a
TOTAL	6,596	10.97%	28,615	17.78%

Source: Trucost plc / UNEP & PRI 2010

With regard to health, the figures are similarly huge. One calculation is that in 2010-30, non-communicable diseases (NCDs) will cost a cumulative total of US \$30 trillion, equivalent to 48% of global GDP in 2010.⁶⁴ The same study estimated that mental health problems will add an additional loss of US\$ 16.1 trillion in 2010-30. Within these costs, cardiovascular disease is set to rise by 22% to US\$ 20,032 bn over the 20 year period. Diabetes is set to rise from \$500 bn in 2010 to \$745 bn by 2030. The greatest impact is expected to be in lower and middle income countries, such is the effect of the nutrition transition. Business

optimists see this as a growth opportunity for expensive medical technology even in poor societies,⁶⁵ but can even affluent countries afford mounting healthcare costs, let alone low and middle income ones? In vastly expensive and wasteful private systems, such as the USA's, costs unaffordable to employers are being increasingly transferred to the public purse.⁶⁶ In the UK, sheltered from economic and social costs by the National Health Service, such is the recent acceptance of neoliberal orthodoxy applied to health that Alan Milburn, a former UK Labour health minister, could call for more "competition", while attaching cost-reducing faith to technologically speculative remedies like vaccines for "diabetes, obesity and cardiovascular disease", as if chronic diseases were solely a matter of biological causation.⁶⁷ Such costs are brakes on the improvement in living standards and public goods. Their scale perhaps explains why, in developed economies, many gains in the 'social wage' – pensions, healthcare, housing, infrastructure – are being renegotiated and are the subject to macro-economic debate, and are being privatised and reined back, presented as 'unaffordable'.

According to Francis Fukuyama and Seth Colby, the former being one of the originators of the (US) neo-conservative (or neoliberal) outlook, the 1980s Reagan-Thatcher revolution legitimated a shift away from state-centric economic policies toward ones favourable to free markets. Over the period labour markets were liberalised as trade unions progressively lost their power to set wages; global trade increased; the rights of property owners were strengthened and taxes lowered; state-owned industries were privatised; and levels of regulation, particularly over the financial system, were diminished. Together with a broader shift towards a more integrated global economy these changes stimulated a thirty-year period of growth.⁶⁸ The 2007-08 commodity / banking crisis which generated a new Great Recession with its abrupt slowdown of production – at least in the West - ought to have been a signal to debate what sort of growth the world wants, and where public health sits in conceptions of progress. Across the world, food prices jumped, and in over 60 countries rapid controls and responses put in place to cushion populations added to the sense of uncertainty. The Arab Spring, a sequence of governmental ruptures, is also traced to the financial crisis, which exposed, beneath the surface, a combination of environmental, energy and economic crises.⁶⁹

Instead, the dominant governmental, business and economist response was to work all-out to return to 'business-as-usual'. The public health community, like other welfare interest groups mostly based in, or reliant upon, the public sector, was largely side-lined, emphasising its status as recipient of the largesse of the wider economy. Some voices raised important questions,⁷⁰⁻⁷² but the general conclusion that there has to be a wider reconfiguration of the political economy, with health at its core, barely featured. Indeed the consultation set up by the WHO in the aftermath of the financial crisis was designed to see how the "economic downturn may affect health spending, health services, health-seeking behaviour and health outcomes" and "to make the case for sustaining investments in health" rather than to reconfigure the economy around ill-health prevention.^{19, 73} The dominant response was to accept the need to rescue them and then shore up the debt-fuelled finance markets,³³ leading to on-going public sector 'reform', the reassertion of the case for de-regulation, privatisation, and wage restraint or cuts in service or provision or funding.

The role of public health in the pursuit of progress became confused in the late 20th century with economic prosperity and its consumption indicators, especially in terms of energy use and commercially-nudged products and lifestyles. This approach is almost certainly unsustainable.⁷⁴ Whether one looks at climate change, eco-systems, food systems, social inequalities, or health itself, the dominant model of consumerist economics contains inherent risks. It also departs from public health's early progress theory, which in JS Mill's utilitarian formulation entailed not only moral and aesthetic development, achieved through education, but also what Mill referred to as a 'steady-state' economy where harm to Nature was presented as 'off-limits' to economic activity.⁷⁵⁻⁷⁷ What we describe as Ecological Public Health contains these philosophical and economic progress dimensions, among others. Why is this older and more radical tradition not now in the ascendancy?

In fact, while the neoliberal growth model remains dominant, interesting divergences in what that means have emerged even in the developed world. In the case of energy use, Germany, through its recent energy policy (the *Energiewende*, or energy transition) has made a long-term commitment to renewables and the withdrawal from nuclear power, while the UK and USA, while mildly increasing their commitments to renewables, have encouraged investment in pollutant hydraulic fracturing ('fracking').^{78,79,80} These are different models of how to build economic growth and thus to fund public health, one restraining from and the other intent on pumping fossil fuel-derived carbon into the atmosphere.^{43,81} Such concerns may seem recent, and to some sceptics or objectors, overblown, but the first warnings on the impact of the burning of fossil fuels on the Earth's carbon cycle were made as early as 1924, by the public health statistician and biophysicist, Alfred Lotka.⁸² As with tobacco, challenges to the science of human and environment risk come from many sources, some self-interested (the fossil fuel industries in the case of fossil energy-related risk), others which represent an ideological aversion to limitations on free markets.⁸³ It is appropriate that, after a period of research gestation, public health actors are now formulating analysis and policy measures to define the new direction for a new energy transition.⁸⁴

The food system is another example of a fundamental economy-health mismatch. That said, the 20th century was in some respects a period of remarkable food progress. Unprecedented quantity was produced, harnessing revolutionary techniques in production, distribution and processing.⁸⁵ A production-focussed policy approach was put in place from the 1940s, focussed on raising output to make more food available, lower prices and enable improved access. This approach facilitated late 20th century consumer sovereignty and expanded food choice, with ordinary consumers offered unprecedented variety and ranges of foods at low costs.^{85,86} The supermarket mode of retailing of 30,000 items in one store has been normalised and spread into the developing world.⁸⁷ Agriculture accounts for c16% of greenhouse gas emissions. An outpouring of food products – many 'ultra-processed' to use Monteiro and colleagues' classification⁸⁸ – has contributed to a nutrition transition from simple foods to high-calorie foods, with resulting epidemic shifts,⁸⁶ as well as environmental damage.³⁶ Intensification of farming has caused eco-systems destruction, pollution and unsustainable water and energy use.⁸⁹ And an over-production of food has enabled processors, retailers and caterers to become sometimes unwitting vectors of bad diet and ill-health. While Europeans consume as though there are 2 planets, the USA does so as though there are 3-4.⁹⁰

The consumption patterns of the West are admired, emulated, hard-wired into culture, driven by retail chains and product marketing. Personal success imagery is linked to branded consumption behaviour thereby destabilising the positive element of traditional diets: simplicity, seasonality, eating according to need, sharing. Such is the impact of the nutrition transition that there are now 1.5 bn people obese or overweight and just 0.9 bn hungry,⁹¹ and 65% of the world's population live in countries where overweight and obesity kills more people than underweight.⁹² For a decade, the UK has been collecting data on obesity as a prime cause of hospital admissions. Old certainties about ever-reducing food prices have been replaced by the recognition of new uncertainties about food prices and import dependency. The new market normality is no longer the steady rise in production but volatility of supply,⁹³ and long supply chains controlled by logistics technology.⁹⁴

Analyses such as these can generate evidence-based but gloomy prognoses. The UK Astronomer Royal, for example, a past President of the Royal Society, one of the world's oldest scientific bodies, has stated that the 21st century has a 50:50 chance of humanity exterminating itself.⁹⁵ The counter-narrative to the Golden Era can easily almost 'out-Malthus' Malthus, and suggests a winding road to collapse. Between these two polar opposites – Golden Era and Collapse – the latter the title of a popular book⁹⁶ - the public health world and practitioners exist and must chart an optimistic reconfiguration of political economy. Without necessarily subscribing to collapse thinking, there are good grounds for reviewing the now dominant neoliberal growth model, the context in which much recent public health and healthcare practice has been based. Happily, many economists, too, share these doubts.⁹⁷⁻¹⁰¹ If the formula defined by one perceptive critic in the 1970s as 'health = medicine' needs extensive reworking,¹⁰² so too does the belief that economic growth or simply 'wealth' is the necessary precondition for health progress.¹⁰³

The crisis of public health thinking: where are the certainties?

All of the above points to the need for a fundamental rethink in public health. It is often taken for granted that the bio-medical model of public health has primacy but in recent decades it has become a truism that an increasing proportion of health problems are found in behavioural patterns with causation linked to culture and about which bio-medicine has little to say; parallel to this is the shocking impact of persistent religious intolerance along with geo-political instabilities, both sober reminders that public health is also, and must be, a moral movement. Alongside such cultural positioning is the hard evidence of pressure on eco-systems, and looming threats such as climate change and biodiversity loss. For these reasons – cultural, economic, moral and environmental - we support the argument that the public health movement and its analysts should re-engage openly with the larger picture. We see five models, or traditions, of what is meant by public health on offer: the sanitary-environmental, the biomedical, the social-behavioural, the techno-economic, and ecological public health itself (see *Editorial*).¹⁰⁴ These are useful touchstones for any big scale thinking, structures through which the public health movement has engaged with change and argued its case.

The *sanitary-environmental model* has perhaps been one of the greatest achievements of the developing world since the late 19th century. Major investment in health infrastructure – drains, water, houses, etc. - helped civilise and make safe rapidly urbanising societies in the West. Today, that kind of big change is urgently needed in the burgeoning megacities of the poor world, too often devoid of planning or drains. Here the key, unsung profession for public health has been the planners.^{105, 106} Another vital group are the engineers. More such investment is certainly needed and the cost is repaid many times in illness prevented.¹⁰⁷ The cost-benefit of these utilitarian measures remains unimpeachable.

Although the sanitary-environmental model was arguably the first representative form of public health in the modern period it was the *bio-medical model* which first legitimated the importance of the medical professions and has to a large extent been the health world's public image. While the technical advances in medical practice have been remarkable, the limits to what medical intervention can effect are also all too evident. As noted above medical actions, particularly expressed in terms of personalised care, can be a major economic burden on families, employers and the state. But many genuine advances can be cost-reducing, such as effectively-used antibiotics or immunisation or more rapid forms of personal treatment. It is thus not necessarily the case that the more advanced the medicine, the higher the costs; in fact it should be the reverse. What medicine cannot do, however, is address the enormous distortions caused by social inequalities within and between societies. These tend to be matters resolvable only through political action. Nor can it address the wider ecological constraints on modern versions of progress: the need to invest in water conservation and safety, public education, the case for 'low impact' housing or adequate food supplies, and so on. As fast as medicine creates miracle cures – such as antibiotics –some are rendered less effective.¹⁰⁸ Medicine may be able to invent bariatric 'cures' for obesity but still not address the minds which want to over-eat or rein in the cultural influences which set and spread habits and aspirations to do so.¹⁰⁹ The medical professions now recognise that resolution of this type of health problem lies outside

medicine.¹¹⁰ That said, modern medicine is enormously beneficial, with the proviso that it is used cautiously not carelessly.

The role of bio-medicine in combating rising NCDs is limited, as noted. Hence the increasing policy focus on the *social-behavioural model* which, in overtaking the old health education approach, enlists the modern images and practices of marketing to urge or cajole or subvert consumers to change behaviour.^{9, 111} But what social marketing campaign to address ill-health can possibly counteract the vast spending power of the food industry or the motor vehicle industry or the screen-based culture industry?¹¹² The first warps consumption, the second constrains physical activity, and the third distorts minds and expectations.

The final conventional approach to public health, the *techno-economic model*, admittedly a blurred concept for many working in the public health field, has triumphed in recent years, almost in spite of many public health criticisms of its ambitious claims. This is the model already considered earlier which proposes that health improves by getting wealthier and through technology, or in more subtle versions, technology allied to useful knowledge,¹¹³ which is then applied to the determinants of health which can only be afforded by economic growth. In effect the policy formula is: economic growth + technology = improved human physiological development and capacity.¹¹⁴

While these conventional models of public health intervention have each offered and still offer much, they miss the fundamental misalignment of bodies, environments and health. This is what the *ecological public health model* seeks to do, drawing in the strengths of the other models perhaps, but also through rethinking the conventions of public health inquiry and action.^{100, 108} It has emerged most forcefully on the issues of NCDs and obesity, where intractable multi-level problems require system change.^{109, 115} Ecological public health questions whether the 20th century global economy can be modified easily, and instead it strives to re-emphasise the mismatch between business-as-usual economic growth and healthy populations in healthy environments. Problems cannot be externalised because they 'bite back'; human existence cannot be cut loose from planetary or biological dynamics. Ecological relationships need to be assumed, not just causal ones. In recent public health reports on obesity and other pandemics and on the state of public health institutions, there are signs that something akin to ecological public health thinking is being proposed as necessary both to drive practice and resolve problems.^{112, 116, 110, 117, 118}

The crisis of institutions and powers: what drives change?

Although achieving social progress requires some model of social change, it has been the simple practicality of public health measures in the past, rather than quality of their theorisation, which in large part explains their success. On the other hand public health proponents are also Enlightenment dreamers, seeking a more rational, more just and more responsible world, one achieved through better information and evidence, scientific rationality, public involvement and open debate and the advancement and advocacy of social reform. While the practical and more pragmatic approach is rooted in utilitarianism, broader progress thinking has many roots. One can detect the legacy of Georg Hegel (on a rational State), Immanuel Kant (on individual duty and education), Edwin Chadwick (on administration and functionality), Annie Besant (on sexual health rights and women's

labour), Elizabeth Blackwell and Elizabeth Garrett Anderson (on medical education for women), John Stuart Mill (on economic and social progress) or John Dewey (on substantive democracy), Florence Nightingale and Mary Seacole (on hospital care), Hermann Biggs (on public health laboratories), Eleanor Rathbone (on household incomes) and John Snow (for a combination of imagination and data), to name just some. Over the years such lists of 'pioneers' have been compiled.¹¹⁹ Among these European and US figures – and countless others from the worldwide public health movement – it is perhaps John Snow who carries a particular affection in conventional public health iconography, epitomising public health intervention as almost superman, a tough and resilient seeker of epidemiological truth.¹²⁰

Today, are such health heroes and heroines possible or even desirable? Perhaps Microsoft billionaires Bill and Melinda Gates are equivalent figures. Certainly, their vastly wealthy Foundation, free of state trappings, acts as a honeypot for a dominant version of modern activism, attacking malaria, poverty, vaccination, genetic engineering, and more, with equal gusto and strategic clarity.¹²¹ These are mainly technological pursuits for immediate results, however. Their critics have argued that technical solutions might fix symptoms but do not necessarily resolve causes. Such partnerships are in danger of repeating oil-giant Rockefeller in the era of the League of Nations in the 1930s, another time of weak States.¹²² Do we really want another Big Corporate period to coincide with a continuing and deliberate weakening of the state, the process political scientists memorably call the 'hollowing out' of the state?^{123, 124}

While politicians might prefer, and certainly lionise the Gates approach, most public health personnel might be more comfortable with another, lower profile approach: slow evidence building, collective action, some opportunism, focussed attack, and capacity building. Perhaps the best illustration of this route to success is the spate of national tobacco bans at the end of the 20th century, culminating in the global Framework Convention; these stem from a combination of hard interventions, facts, tight arguments and well organised pro-health alliances.¹²⁵ These represent half a century of collective effort, often against huge odds and with little profile accorded, much opprobrium and accusation of unwarranted intrusiveness.¹²⁶

If there is no super-rich funder or well established campaign to champion ecological public health, this is partly due to the ubiquity of another approach subscribed to by governments and analysts: Public Private Partnerships (PPPs). These are frequently proposed as the answer to modern problems. They offer multi-actor, multi-level stakeholder-influenced effort. More importantly, they are favoured by 'hollowed out' states with tight public health budgets.¹²⁷ PPPs seem to answer the difficulty: optimise leverage by inviting opponents to 'partner'; together 'we will be more effective'. This approach, however, assumes that interests are aligned and that the capacities, supply chains and marketing systems of private business and finance are essential to achieve requisite leverage over all health. But is this true? And where does this power and analysis come from? Partly it stems from the argument from within public health itself that modern diseases are so complex in their aetiology that there are no simple measures for tackling them. Even tobacco smoking is not reducible to a chemical addiction; its eradication requires actions across cultural, legal, environmental, economic, educational and mass psychological planes, and more. Hence the need for partnerships is the argument. In reality, however, PPPs are neither neutral nor

benign.¹²⁸⁻¹³¹ They muzzle potential intervention and modes of confronting the forces which shape ill-health.

Nor are PPPs new. The success of the late 19th century hygiene movement depended on supplies and the marketing of the soap, disinfectants, and detergents industries, for example.¹¹³ Their growth made vast fortunes for families some of whose commercial empires remain today (Johnson & Johnson, Unilever, Procter & Gamble). These past PPPs also contained conflicts of interest, but today the tensions are of a different order. PPPs are presented as the dominant institutional response for almost everything not just in public health but healthcare itself, education, societal infrastructure such as transport, water, food supplies and knowledge. The genome and genetic information became issues shrouded by patents and intellectual property exploration.¹³² Had it not been for the Wellcome Trust's intervention and leadership, the human genome could easily have been patented for private profit.¹³³ Bits of genome have been, and huge investment is currently expended in personalised medicine, financed by hedge funds and others.

To the question of what drives change therefore, comes several answers: not just idealism, not just well-intentioned philanthropy and not just the serendipitous alignment between health goals and the search for profit. These existing avenues leave open a vast terrain of possibility. If the first public health movements were indeed social movements, usually led by professional groups, members of social élites, technical and scientific specialists, and in some cases radicals and free thinkers, such a collective effort constituted an entirely unpredictable blend of talents, beliefs and attitudes. Since we cannot predict in advance the mixture of social forces into the future, we therefore cannot rule any out either. It is a situation calling for openness and plurality. In the new conditions of the 21st century, new social movements must be embraced, and not side-lined or patronised as unqualified, non-scientific or unprofessional. The public health movement should acknowledge few boundaries.

Is the public health movement addressing the right vectors?

The question of the place of public health goes much further than a purely ideological or intellectual debate. The models vary in how they conceive of progress and how they fit this new economic, social and cultural landscape. In our view, public health practice and its associated movements have been corralled into too narrow a policy terrain, forced to employ models and institutions inherited from the 20th century, or earlier, which are not fully appropriate today. Indeed, what powers and foci are actually needed today?

In 1963, Aldous Huxley, the writer, brother to the biologist Julian Huxley, who established the United National Educational, Scientific and Cultural Organisation (UNESCO), voiced the hope that the World Health Organisation, alongside the other bodies of the United Nations in the wake of post World War 2 reconstruction, would form the “beginnings of a new ecological politics.”¹³⁴ The WHO had drawn directly from the earlier and now forgotten League of Nations' Health Organisation.¹³⁵ That, in turn, drew on experience in tackling contagions and the health consequences of trade and the movement of people spreading diseases in the age of Empire.^{136, 137} Those functions are needed – as witnessed by the 2014-

15 Ebola outbreak in Africa¹³⁸ – and many public health advances have been spawned out of a mixture of self-interest, trade and efficiency arguments.

So why are not modern institutions not addressing the equivalent vectors of ill-health, when the case for doing so is so powerful?¹³⁹ In some part, in the case of the attempts to weaken UNESCO, for example, the answer is to be found in power politics.¹⁴⁰ International agencies are easy to attack, often defined as wayward (ie, independently minded) by the dominant powers, and in any case difficult to fund. A 2015 independent review, commissioned to inquire into the WHO's handling of Ebola, argued that WHO must re-establish its pre-eminence as "the guardian of global public health" and that UN should ensure that the organisation put global health issues "at the centre of the global security agenda." In order to do so, the organisation required both a cultural shift from within as well as far greater political and financial support from without, noting that no core funds were available for a emergency response such as presented by Ebola.¹⁴¹ In other words, in terms of health security or population health, interventions at the international level rank very poorly, if at all, and especially in comparison with military spending.

Another argument is the sheer complexity of multilevel, multifactorial, multi-agency governance, and that expectations of perfect, quick solutions which are nigh impossible to meet. Another reason given by social scientists is perceptions of urgency or focus have radically changed. Late 20th century economies have provided real comforts in living: warm houses, clean food, mains water, safe, reliable transport. These have softened life's harder edges and have shifted perceptions of the locus of threat. Risks have declined while the perception, awareness and distortions of risk have risen.¹⁴² Cutting across these is the realisation that consumerism is undermining itself and ourselves, not just through drivers of change such as climate change or resource access linked inequalities but also through a 'lock-in' between culturally-set modes of living and health consequences. Problems are normalised but bemoaned. Cynicism sets in - 'what can we do?' or 'the public won't like it' – a diminution of past ambition which must now be exposed, confronted and re-channelled.

What might be identified as a list of vector candidates that the public health movement ought to be confronting today is lengthening. Alongside traditional enemies, like dirt and disease, might be otherwise defined as desirable or aspirational modes of living. They includes automobiles (reducing activity and symbolising carbon emissions), the internet and social media (shaping ideas and lifestyles), the media and cultural industries (developing consumer expectations), tourism (for the fantasy of escape), the food industries (for calorie over-production and moulding tastes) and e-commerce (to bring the whole world to our homes), for example.¹⁴³⁻¹⁴⁷ Even to identify such normal and accepted features of the modern economy as 'vectors' risks the accusation of being anti-progress - or more accurately, anti-prosperity or anti-technology. Yet to do so is not a call to return to 'simpler times' but only to acknowledge that modern public health actors are being left in the slow lane as other, usually commercial forces, determine the conditions under which people live and shape the cultural parameters of everyday life. Some of these forces, of course, constitute contributors to PPPs, provide commercial and branded face to public events, such the Olympics or football tournaments. The default position underlying all is 'choice culture' whereby corporate brands become both ally and counterpart to neoliberal economics.

Such a sober assessment of unequal power and the shaping of context is not new, rather it provides a more realistic insight into the herculean tasks undertaken by the public health movements of the past; members of this movement dared to think the unthinkable and imagine better modes of living, and to confront the emergent forms of modernity of their day.¹⁴⁸ One lesson is that the heroes and heroines were not working in isolation but with others, organised in campaigns. Nor, as we noted, were they endlessly successful but faced continual setbacks. They were opportunistic, just like those of recent years, to cite two examples, who took the chance to ban smoking on public transport in the wake of a London Underground fire,¹⁴⁹ or to create food safety agencies at national and European levels out of the ashes of BSE ('mad cow disease').^{150, 151} Similarly, on a far larger scale, the experience of World War 2 gave a major opportunity to create institutions to champion public health and intervene in its shaping conditions. A generation of health professionals won public support to change structures and to prevent rather than patch up problems.¹⁵² The point is that nothing then was inevitable and what we view today as practical, uncontroversial measures had to be fought for. History may look like a narrative of unfolding progress, but at each point outcomes might have been otherwise, and in some cases actually were. And of course, the same is true of the future. The future cannot easily be predicted, but it can be made.

It is surely time for the modern public health movement similarly to take stock of what we are against or what we are for, and on that basis to review existing goals, institutions and powers. Table 4 takes a long historical perspective, suggesting that there have been five key phases in the creation of modern international public health institutions and proposes a sixth is unfolding. The table illuminates the question of what institutions are required to address the vectors of ill-health and to pursue ecological public health today. Some dilemmas are well established, but unavoidable, such as the seemingly inexorable demands of healthcare, which, by virtue of its mounting costliness, undermines investment in prevention. Others, as was noted in Table 2, are more uncertain. Health improvement in an era requiring ecological public health cannot rely on finance and trade to provide capital and wealth generation, lest these be the preserve only of the rich countries. The starting premise must be that all societies need ecological public health at their core. Today, as this paper has argued, the public health project faces major choices. In Table 4, for schematic purposes we highlight two significant path options, among the many possible, in the sixth and emerging phase of public health..

Table 4. Phases in the creation of modern Public Health Institutions

<i>Phase</i>	<i>Period (in rich economies)</i>	<i>Actions</i>	<i>Institutions created</i>	<i>Comment</i>
Phase 1	Mid 19 th century	Experimentation with engineering	Sanitary inspectors; town planners	Local or national in focus and impact
Phase 2	Late 19 th century	First global agreements	Infection controls	First acknowledgement of global implications
Phase 3	early C20 th	Membership of international institutions via League of Nations	International Health Organisation; International Labour Organisation.	Formalisation of governance procedures

Phase 4	post WW2	Separation of United Nations from finance & economic organisations	UN alongside Bretton Woods (World Bank, IMF), plus ancillary bodies, like OECD	Separation between public health and 'economy' enshrines economics in prime role
Phase 5	Late 20 th century	Creation of ad-hoc public bodies and conventions	UN : UNEP, UNCTAD, etc., Finance: G8, G20, World Trade Organisation, etc.	These add to policy scope and reach but also to fragmentation
Phase 6	Early to mid 21 st century?	PATH A: Incremental modification of business-as-usual	Continued dominance of finance institutions over health. Emphasis on bilateral trade deals to maintain economic growth	Aims to keep using natural resources for growth and to fund public health as 'optional extra'
		PATH B: Reconfiguration for Ecological Public Health	Merger of UNEP, WHO, ILO, UN-Habitat?	Goal to create a new powerful ecological public health body

Source: authors

Path A is the pursuit of business-as-usual but modified by incremental change, negotiation and vulnerability to disruptive events. In Path A externalised costs mount, and PPPs are offered as mechanisms of ameliorative action. Path B, the pursuit of political economy in line with ecological public health, is characterised by different economic drivers and new patterns of work and wealth conservation, such as fossil fuel energy reduction and conservation, sustainable land use, full cost accounting (to internalise environmental, dietary and health costs), and lower impact lifestyles incorporating 'new' features such as physical activity in daily life. We have argued elsewhere that if society was serious about tackling obesity, as one example only, then the entire social system would need significant re-direction.¹⁵³ Table 2 earlier set out some of the enormous issues to be confronted.

Critics might dismiss Path B as idealistic and appropriate, if at all, only for Western over-consuming, high-impact economies, and as not appropriate for under-consuming, poorer economies. 'Don't raise the drawbridge on advances, which you have and others want' is one criticism. This has been answered by the UK's Royal Society in its report on policy options for global development.¹⁵⁴ This proposed a 'Contract and Converge' (C&C) approach, under which rich societies would reduce their high impact existences, emission rates and waste while poorer economies are permitted initially to raise theirs to higher standards of living, but then the obligation under C&C is for all to reduce them. C&C has the advantage of aiming for an equitable world but where sustainability is 'built in'. In reality, such transitions – a mode of analysis we champion elsewhere¹⁹ – are rarely so orderly or consensual. More likely is a mix of pragmatism, crisis response, drift and expediency. Our point is that when faced by troubling indicators across such a wide range of issues, as is found today, the public health movement ought to begin the serious modelling of changes which are proportionate to the fundamental problems this article seeks to emphasise: the mismatch of bodies, environment, economy and political processes.

At the UN, such big thinking certainly exists but is frustratingly hesitant and slow. In 1999, the UN's Millennium Development Goals (MDGs) set targets for key indicators for public health.^{155, 156} In 2012, at the Rio+20 conference, new Sustainable Development Goals (SDGs) were proposed and are finalised by the end of 2015.¹⁵⁷ These are closer to ecological

public health thinking but are vague in relation to the dominant economic growth model. Perhaps that is inevitable, but it indicates that UN processes have not been, up to now, under serious pressure for a radical rethink. The Great Recession has been weathered, with only modifications rather than a reorientation of political economy. The SDGs will be significant, however, and the public health movement should ensure that global targets are not lost at the national and local level, by holding governments, public and commercial actors to account. One should remember how the original 1992 UN Conference on Environment and Development (Rio) inspired action at the local level. All over the world, teams of local agencies, inspired by Rio's Local Agenda 21, produced a new kind of ecological public health thinking, practice and campaigns for change.

Experience teaches that there is always room for public health manoeuvre. Allies are essential. As noted one profession, planners, have been side-lined for too long often but have significant capacity to lead such processes. The pursuit of ecological public health requires new consortia, not just of local planners, but environmental health and public health practitioners, community development bodies, arts and cultural organisations and others to come together to start planning what a better infrastructure for health would look like, and to help build examples of positive examples to drive local economies. Movements for Healthy Cities, Sustainable Food Cities, Transition Towns and counterparts across the planet are scouting this territory already, building the case for a positive model of what more sustainable communities could be.^{158, 159} A stationary state, no-growth or circular economy, or even the promotion of what development economist Joseph Stiglitz calls "growth of the right kind"¹⁶⁰ implies neither an inactive citizenry nor technological stasis. Investments become directed towards technologies, economic sectors or employment enhancing opportunities which promote mutualism between social goals and sustainable development. One of the many keys to change is the establishment of new incentives for economic institutions to become more resource-light and employment rich. Ultimately economic success is reliant upon the status of natural ecosystems and human health upon which economic processes ultimately rely.

Conclusions

This paper has suggested that what has been described as a Golden Era of public health might not have been so golden after all, as it depended upon mounting inequalities of wealth, between as well as within societies, unsustainable use of resources, and willingness to disregard the external costs or collateral effects which a version of economic growth produced and indeed was dependent upon. That said, the era saw substantial improvements across many fields and improvements in general levels of population and personal health. What the qualified success of the era portends for the future is less clear, however. Many indicators - obesity, inequalities, ecosystem threats - are rising and the potential for some societies to 'grow' their way forward are compromised by many factors, in which resource limits, resource use feedback, and failures of democratic governance are merely the most prominent.

In these messy circumstance the public health professions cannot and should not hide behind what has been conditioned intellectual reflex of calling for 'more research, more

evidence'; that is always true but not a reason for delay. On the contrary, we should be more collectively noisy in championing ecological public health as the core of the new 21st century political economy, and not just separate out the indicators of human health, outside of consideration of the conditions which shape health, and seeing it as a consequence of a trickle down from unsustainable growth. In arguing the cause of ecological public health no claim of novelty is made here. Many of the key arguments, and in remarkably similar terms, have been made before, more than a half a century ago.¹⁶¹ The call for UN agencies to be the developmental agencies for ecological public health measures, as noted, has been made before. What differs today? At that time such analyses or prescriptions may have been judged discretionary or optional, with growth being seen the prime motor of public health success. Today, we argue, ecological public health is no longer discretionary or optional is being forced upon society by growing evidence of eco-systems stress and by societal dislocation. We see the coming period as one where proponents must argue for ecological public health not only as the pathway which best avoids, or mitigates against, predictions of collapse, but as one which also addresses the rising levels of NCDs, which in other respects may be the most redolent of the health afflictions of our current age.

This is an argument as much about values as about threats, evidence as well as narrative, choices as well as limits. Indeed, it is not so markedly dissimilar from that deployed more than a century and a half ago by Edwin Chadwick in order to marshal his case for change (and whether later critics agreed with him or not.)¹⁶² The public health movement always needs better integration of datasets and thinking, and must argue not just for their maintenance but expansion. Interdisciplinary knowledge such as is required for ecological public health action is essential. New kinds of meta-analyses are needed - serious, systematic summations of evidence about threats to 21st century health. While much of this data will be national, regional or global, we see immediate opportunity for such cross-sectoral, cross-institutional data pooling and action at the local level. It is here that tackling some of the enormity of the global challenges becomes feasible and practicable. Ecological public health, like all other models, can only emerge if its champions tackle the scale, power and influence of anti-health forces over the modern world. One can only admire the courageous work of some researchers and small NGOs tackling the anti-health dynamics of marketing and 'spin', for instance.¹⁶³ This task cannot be underestimated, nor the emerging imbalance between private data and public: advertisers, marketing companies, technology firms, even supermarket giants, know vast amounts about human behaviour. Public – private tensions over the nature of and access to Big Data, for example, is an issue emerging in this area.¹⁶⁴ We see the need for reconfiguration of academic centres studying and supporting ecological public health with more cross-institution working. The 2014-15 Lancet UCL Commission on climate change and health points a way for such public and policy messages.⁸⁴ Ecological public health is more than an argument based on financial costs or the capacity to manipulate behaviour; it is a matter of values, long-term perspective, and the pursuit of a practical vision of human progress. In this manner, the path from Sanitarianism to Ecological Public Health is not as tortuous or as frustrating as it first appears.

REFERENCES

1. Dawson A. Resetting the Parameters: public health as the foundation for public health ethics. In: Dawson A, editor. *Public Health Ethics: Key Concepts and Issues in Policy and Practice*. Cambridge: Cambridge University Press; 2011.
2. Acemoglu D, Robinson JA. *Economic Origins of Dictatorship and Democracy*. New York: Cambridge University Press; 2006.
3. Engels F. *The Condition of the Working Class in England in 1844*. London: Penguin Classics; 1987 (1845/1892).
4. Lizzeri A, Persico N. Why Did the Elites Extend the Suffrage? Democracy and the Scope of Government, with an Application to Britain's 'Age of Reform'. *Quarterly Journal of Economics*. 2004; 119:707 - 65.
5. Chadwick E. *Report on the Sanitary Conditions of the Labouring Population and on the Means of its Improvement*. London: published by Edwin Chadwick privately 1842 May.
6. Piketty T. *Capital in the Twenty-First Century*. Cambridge MA: Belknap Press of Harvard University Press; 2014.
7. Piketty T, Saez E. *Top Incomes and the Great Recession: Recent Evolutions and Policy Implications* Washington, DC: International Monetary Fund 2012.
8. Blair T. *Our Nation's Future: Public Health*. Speech by the Prime Minister on healthy living. Nottingham. July 26. <http://www.number-10.gov.uk/output/Page9921.asp>, accessed 7 May 2009: Prime Minister's Office, London; 2006.
9. Thaler R, Sunstein C. *Nudge: Improving Decisions about Health, Wealth, and Happiness*. New Haven CT: Yale University Press; 2008.
10. Rayner G, Lang T. Is nudge an effective public health strategy to tackle obesity? *No. British Medical Journal*. 2011; 342:d2168-d.
11. Bourdieu P. The Essence of Neoliberalism. *Le Monde Diplomatique*. 1998: <http://mondediplo.com/1998/12/08bourdieu>
12. Rose G. *The Strategy of Preventive Medicine*. Oxford: Oxford University Press; 1992
13. Halliday S. *The great stink of London : Sir Joseph Bazalgette and the cleansing of the Victorian capital*. Stroud: Sutton; 1999.
14. Winslow C-EA. *The conquest of epidemic disease: a chapter in the history of ideas*. Princeton, NJ: Princeton University Press; 1943.
15. Fowler N. *AIDS: Don't Die of Prejudice*. London: Biteback Books; 2014.
16. McMichael AJ. Prisoners of the Proximate: Loosening the Constraints on Epidemiology in an Age of Change. *American Journal of Epidemiology*. 1999; 149:887-97.
17. Luckin B. Pollution in the city. In: Daunt MJ, editor. *The Cambridge Urban History of Britain: 1840-1950*. Cambridge 2000. p. 207-28.
18. Greater London Authority. *50 Years On: The struggle for air quality in London since the great smog of December 1952*. London: Greater London Authority 2002.
19. Rayner G, Lang T. *Ecological Public Health: reshaping the conditions for good health*. Abingdon: Routledge / Earthscan; 2012.
20. Malthus TR. *An essay on the principle of population, as it affects the future improvement of society with remarks on the speculations of Mr. Godwin, M. Condorcet and other writers*. London: Printed for J. Johnson; 1798.
21. Leon DA. Cities, urbanization and health. *Int J Epidemiol*. 2008; 37:4-8.
22. UN Habitat. *State of the World's Cities 2010/2011 - Cities for All: Bridging the Urban Divide*. London: Earthscan; 2010.

23. Ayres RU, Ayres EH. Crossing the Energy Divide: Moving from Fossil Fuel Dependence to a Clean-Energy Future. Upper Saddle River, New Jersey: Pearson Education; 2009.
24. Hoekstra AY, Mekonnen MM. The water footprint of humanity. Proceedings of the National Academy of Sciences. 2012; 109:3232-7.
25. OECD. Divided we stand: why inequality keeps rising. . Paris: Organisation for Economic Co-operation and Development. 2011 December.
26. UN Habitat. State of African Cities 2010: Governance, Inequalities and Urban Land Market. Nairobi: UN Habitat; 2010.
27. Ortiz I, Cummins M. Global Inequality: Beyond the Bottom Billion - A Rapid Review of Income Distribution in 141 Countries. New York: Unicef2011 April 2011.
28. Bamber JL, Aspinall WP. An expert judgement assessment of future sea level rise from the ice sheets. Nature Clim Change. 2013; 3:424-7.
29. Rohling EJ, Haigh ID, Foster GL, Roberts AP, Grant KM. A geological perspective on potential future sea-level rise. Scientific Reports. 2013; 3.
30. Gertler AW, Gillies JA, Pierson WR, Rogers CF, Sagebiel JC, Abu-Allaban M, et al. Real-world particulate matter and gaseous emissions from motor vehicles in a highway tunnel. Res Rep Health Eff Inst. 2002:5-56; discussion 79-92.
31. Centers for Disease Control and Prevention. Ten Great Public Health Achievements--United States, 1900-1999. Journal of the American Medical Association. 1999; 281:1481-83.
32. Commission on Social Determinants of Health. Closing the Gap in a Generation: Health equity through action on the social determinants of health. Final Report of the Commission on Social Determinants of Health.
http://www.who.int/social_determinants/final_report/en/index.html. Geneva: World Health Organisation2008 August.
33. Stuckler D, Basu S. The Body Economic: why austerity kills: London; 2013.
34. Lancet. The Global Burden of Disease Study 2010. The Lancet. 2012; 380:2053-260.
35. WHO. Top 10 causes of death. Factsheet 310
<http://www.who.int/mediacentre/factsheets/fs310/en/>. Geneva: World Health Organisation2013 July 2013 Contract No.: Factsheet 310
36. Rockström J, Steffen W, Noone K, Persson Å, Chapin FS, Lambin E, et al. Planetary boundaries:exploring the safe operating space for humanity. Ecology and Society. 2009; 14:32 online <http://www.ecologyandsociety.org/vol14/iss2/art32/>.
37. Millennium Ecosystem Assessment (Program). Ecosystems and human well-being : synthesis. Washington, DC: Island Press; 2005.
38. Giles C. IMF warns on threat of income inequality. Financial Times. 2014.
39. Rees SM. Our Final Hour: A Scientist's Warning. London: Basic Books; 2009.
40. Khoury CK, Bjorkman AD, Dempewolf H, Ramirez-Villegasa J, Guarinof L, Jarvisa A, et al. Increasing homogeneity in global food supplies and the implications for food security. Proceedings of the National Academies of Science. 2014;
www.pnas.org/cgi/doi/10.1073/pnas.1313490111.
41. UNEP. World Water Assessment Programme, Water – A shared responsibility. The United Nations World Water Development Report No 2. Geneva: United Nations Environment Programme2006.
42. McMichael A, Woodruff R, Hales S. Climate change and human health: present and future risks. The Lancet. 2006; 367:859-69.
43. WHO, WMO. Atlas of health and climate. Geneva: World Health Organisation and World Meteorological Organisation2012.

44. WHO. The evolving threat of antimicrobial resistance - Options for action. Geneva: World Health Organisation 2012.
45. European Academies Science Advisory Council. Combating the threat of zoonotic infections London: EASAC / Royal Society 2008.
46. Ostfeld RS. Biodiversity loss and the rise of zoonotic pathogens. *Clinical Microbiology and Infection*. 2009; 15:40-3.
47. WHO. The World Health Report 2001 - Mental Health: New Understanding, New Hope. Geneva: World Health Organisation 2001.
48. Abegunde DO, Stanciole AE. An estimation of the economic impact of chronic noncommunicable diseases in selected countries. Geneva: World Health Organization, Department of Chronic Diseases and Health Promotion 2006.
49. OECD. OECD Health Statistics 2013. Paris: Organisation for Economic Co-operation & Development 2013 27 June 2013.
50. Keating G, O'Sullivan M, Shorrocks A, Davies JB, Lluberias R, Koutsouk A. Global Wealth Report 2013. Zurich: Credit Suisse AG; 2013.
51. Ostry JD, Berg A, Tsangarides CG. Redistribution, Inequality, and Growth. Washington DC: International Monetary Fund 2014 February 27 2014.
52. British Medical Association. Behaviour change, public health and the role of the state – BMA Position Statement. <http://bma.org.uk/working-for-change/improving-and-protecting-health/behaviour-change> London: British Medical Association 2012 December 2012.
53. Foresight. The Future of Food and Farming: Challenges and choices for global sustainability. Final Report. London: Government Office for Science 2011 January 24 2011.
54. Gerber PJ, Steinfeld H, Henderson B, Mottet A, Opio C, Dijkman J, et al. Tackling climate change through livestock – A global assessment of emissions and mitigation opportunities. . Rome: Food and Agriculture Organization of the United Nations 2013.
55. Nussbaum MC. The New Religious Intolerance: Overcoming the Politics of Fear in an Anxious Age. Boston MA: Belknap Press/Harvard University Press; 2012.
56. Clift C. What's the World Health Organization For? Final Report from the Centre on Global Health Security Working Group on Health Governance. London: Royal Institute of International Affairs 2014.
57. McKeon N. The United Nations and Civil Society: Legitimizing Global Governance - Whose Voice? London: Zed Books; 2009.
58. Tett G. Fool's Gold: how unrestrained greed corrupted a dream, shattered global markets and unleashed a catastrophe. London: Little Brown; 2009.
59. Starr P. Professionalization and Public Health: Historical Legacies, Continuing Dilemmas. *Journal of Public Health Management and Practice*. 2009; 15:S26-S30.
60. Cuckler GA, Sisko AM, Keehan SP, Smith SD, Madison AJ, Poisal JA, et al. National Health Expenditure Projections, 2012–22: Slow Growth Until Coverage Expands And Economy Improves. *Health Affairs*. 2013; 32:1820-31.
61. UNEP Finance Initiative, PRI. Universal Ownership: Why environmental externalities matter to institutional investors. Geneva: United Nations Environment Programme (UNEP) Finance Initiative and The Principles for Responsible Investment (PRI) 2010 October 2010.
62. Hirsch F. Social Limits to Growth. Cambridge, Mass: Harvard University Press.; 1976.
63. TEEB. The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A synthesis of the approach, conclusions and recommendations of TEEB: UN Environment Programme 2010.

64. Bloom DE, Cafiero ET, Jané-Llopis E, Abrahams-Gessel S, Bloom LR, Fathima S, et al. The Global Economic Burden of Noncommunicable Diseases. . Geneva: World Economic Forum & Harvard School of Public Health 2011.
65. Manson K. Ethiopia's middle class rises, with western diseases in tow. Financial Times. 2014 February 27 2014.
66. Wilson R. Health care spending still rising for states and cities. The Washington Post. 2014.
67. Milburn A. The NHS is an opportunity as well as a challenge. Financial Times. 2014.
68. Fukuyama F, Colby S. What Were They Thinking? The Role of Economists in the Financial Debacle. American Interest. 2009; Sept/Oct.
69. Lagi M, Bertrand KZ, Bar-Yam Y. The Food Crises and Political Instability in North Africa and the Middle East. Cambridge, MA: New England Complex Systems Institute; 2011.
70. Stuckler D, Meissner CM, King LP. Can a bank crisis break your heart? Globalization and Health 2008; 4.
71. Stuckler D, Basu S, Wang SW, McKee M. Does recession reduce global health aid? Evidence from 15 high-income countries, 1975-2007. Bulletin of the World Health Organisation. 2011; 89:252-7.
72. Horton R. The global financial crisis: an acute threat to health. Lancet. 2009; 373 355-6.
73. Organization WH. The Financial Crisis and Global Health: Report of a High-Level Consultation. Geneva: World Health Organization 2009 19 January 2009.
74. Jackson T. Prosperity without Growth: Economics for a Finite Planet. London: Earthscan; 2009.
75. Mill JS. On Liberty. Kitchener, Ontario: Batoche Books Limited; 2001 (1859).
76. Mill JS. Principles of Political Economy. London 1848.
77. Mill JS. Utilitarianism. London: Parker, Son, and Bourn; 1863.
78. International Energy Agency. Energy Policies of IEA Countries 2013. Paris: International Energy Agency / Organisation for Economic Co-operation and Development 2013.
79. Freyman M, Salmon R. Hydraulic Fracturing & Water Stress: Growing Competitive Pressures for Water. Boston, MA: Ceres; 2013.
80. Howarth RW, Ingraffea A, Engelder T. Natural gas: Should fracking stop? Nature. 2011; 477:271-5.
81. National Academy of Sciences, Royal Society. Climate Change: Evidence and Causes. Washington, DC & London: The National Academies Press & Royal Society of London 2014.
82. Lotka AJ. Elements of Physical Biology. Baltimore: Williams and Wilkins Co.; 1925.
83. Dunlap RE, Jacques PJ. Climate Change Denial Books and Conservative Think Tanks: Exploring the Connection. American Behavioral Scientist. 2013; 57:699-731.
84. Watts N, Adger WN, Agnoletti P, Blackstock J, Byass P, Cai W, et al. Health and climate change: policy responses to protect public health. The Lancet. 2015.
85. Lang T. Crisis? What Crisis? The Normality of the Current Food Crisis. Journal of Agrarian Change. 2010; 10:92-102.
86. Lang T, Heasman M. Food Wars: the global battle for mouths, minds and markets. London: Earthscan; 2004.
87. Reardon T, Timmer PC, Berdegue JA. Supermarket Expansion in Latin America and Asia

Implications for Food Marketing Systems. In: Regmi A, Gehlhar M, editors. *New Directions in Global Food Markets*. Washington, DC: Economic Research Service/USDA; 2005.

88. Monteiro CA, Levy RB, Claro RM, de Castro I, Cannon G. Increasing consumption of ultra-processed foods and likely impact on human health: evidence from Brazil. *Public Health Nutrition*. 2011 14:5-13.

89. UNEP, Nellemann C, MacDevette M, Manders T, Eickhout B, Svihus B, et al. *The Environmental Food Crisis: The Environment's role in averting future food crises. A UNEP rapid response assessment*. Arendal, Norway: United Nations Environment Programme / GRID-Arendal www.grida.no;2009.

90. Global Footprint Network. *Living Planet Report 2010: biodiversity, biocapacity and development*. Gland, London and Oakland: WWF, Institute of Zoology, Global Footprint Network 2010.

91. FAO. *Hunger statistics and Hunger map*: <http://www.fao.org/hunger/en/> Rome: Food and Agriculture Organisation 2014.

92. WHO. *Obesity and Overweight: factsheet 311*. Geneva: World Health Organisation 2011 March 2011.

93. OECD, FAO. *Agricultural Outlook 2011-20*. Paris and Rome: Organisation for Economic Co-operation and Development and Food and Agriculture Organisation. 2011 June 17 2011.

94. Lang T, Heasman M. *Food Wars: the global battle for mouths, minds and markets*. 2nd ed. Abingdon: Routledge Earthscan; 2015.

95. Rees MJ. *Our final century: a scientist's warning : how terror, error, and environmental disaster threaten humankind's future in this century - on Earth and beyond*. London: Heinemann; 2003.

96. Diamond J. *Collapse: how societies choose to fail or survive*. London: Penguin Books; 2005.

97. Martínez-Alier J, Pascual U, Vivien F-D, Zaccai E. Sustainable de-growth: Mapping the context, criticisms and future prospects of an emergent paradigm. *Ecological Economics*. 2010; 69:1741-7.

98. Muradian R, Martinez-Alier J. *Globalization and Poverty: An Ecological Perspective*. Berlin: Heinrich Böll Foundation; 2001.

99. Sorrell S. Energy, Economic Growth and Environmental Sustainability: Five Propositions. *Sustainability*. 2010; 2:1784-809.

100. Victor PA. Ecological economics and economic growth. *Ann N Y Acad Sci*. 2010; 1185:237-45.

101. Wam HK. Economists, time to team up with the ecologists! *Ecological Economics*. 2010; 69:675-9.

102. Wildavsky A. *Doing Better and Feeling Worse: The Political Pathology of Health Policy*. *Deadalus*. 1976; 106:105-23.

103. Pritchett L, Summers LH. Wealthier is Healthier. *Journal of Human Resources*. 1996; 31:842-68.

104. Lang T, Rayner G. Ecological public health: the 21st century's big idea? An essay by Tim Lang and Geof Rayner. *BMJ*. 345:e5466.

105. Boardman P. *The worlds of Patrick Geddes: biologist, town planner, re-educator, peace-warrior*. London: Routledge; 1978.

106. Ndubisi F. *Ecological Planning: A Historical and Comparative Synthesis* Baltimore: Johns Hopkins University Press; 2002.

107. Alirol E, Getaz L, Stoll B, Chappuis F, Loutan L. Urbanisation and infectious diseases in a globalised world. *The Lancet Infectious Diseases*. 2011; 11:131-41.
108. WHO. Antimicrobial resistance: global report on surveillance. Geneva: World Health Organisation 2014 April 30
109. Lang T, Rayner G. Overcoming policy cacophony on obesity: an ecological public health framework for policymakers. *Obesity Reviews*. 2007; 8 165-81.
110. Colleges AoMR, Stephenson Tc. *Measuring Up: the Medical Profession's Prescription for the Nation's Obesity Crisis*. London: Academy of Medical Royal Colleges 2013.
111. Dolan P, Hallsworth M, Halpern D, King D, Vlaev I. *MindSpace*. London: Cabinet Office and Institute for Government 2008.
112. Moodie R, Stuckler D, Monteiro C, Sheron N, Neal B, Thamarangsi T, et al. Profits and pandemics: prevention of harmful effects of tobacco, alcohol, and ultra-processed food and drink industries. *The Lancet*. 2013; 381:670-9.
113. Mokyr J. *The Gifts of Athena: Historical Origins of the Knowledge Economy*. Princeton, New Jersey: Princeton University Press; 2002.
114. Fogel RW. Technophysio evolution and the measurement of economic growth. *Journal of Evolutionary Economics*. 2004; 14:217-21.
115. Lang T, Rayner G. Obesity: a growing issue for European policy? *Journal of European Social Policy*. 2005; 15:301-27.
116. Bloom BR. Public Health in Transition. *Scientific American*. 2005; 293:92-9.
117. Institute of Medicine. *The Future of the Public's Health in the 21st Century*. Washington, DC: National Academy Press 2002.
118. Tait PW, McMichael AJ, Hanna EG. Determinants of health: the contribution of the natural environment. *Australian and New Zealand Journal of Public Health*. 2014; 38:104-7.
119. Smillie WG. The Great Pioneers of Public Health in America 1610-1925. *American Journal of Public Health*. 1953; 43:1077-84.
120. Lancet T. The Catastrophic Failures of Public Health. *The Lancet*. 2006; 363:745.
121. Gates Foundation T. *Gates Foundation: What we do*. <http://www.gatesfoundation.org/What-We-Do>. Seattle: Bill and Melinda Gates Foundation 2014.
122. Brown ER. *Rockefeller Medicine Men: Medicine and Capitalism in America*. Berkeley and London: University of California Press; 1979.
123. Rhodes RAW. The Hollowing out of the State. *Political Quarterly*. 1994; 65:138- 51.
124. Milward HB, Provan KG. Governing the Hollow State. *Journal of Public Administration Research and Theory*. 2000; 10:359-80.
125. WHO. *WHO Framework Convention on Tobacco Control*. Geneva: World Health Organisation 2003.
126. Holmes D. Judith MacKay: self-made scourge of the tobacco industry. *The Lancet*. 2013; 381:1531.
127. Skelcher C. Changing images of the State: overloaded, hollowed-out, congested. *Public Policy and Administration* 2000; 15:3-19
128. Gostin LO, Mok EA. Grand challenges in global health governance. *British Medical Bulletin*. 2009; 90:7-18.
129. Kraak VI, Harrigan PB, Lawrence M, Harrison PJ, Jackson MA, Swinburn B. Balancing the benefits and risks of public-private partnerships to address the global double burden of malnutrition. *Public Health Nutr*. 2011:1-15.

130. Simon PA, Fielding JE. Public health and business: a partnership that makes cents. *Health Aff (Millwood)*. 2006; 25:1029-39.
131. Gilmore AB, Savell E, Collin J. Public health, corporations and the New Responsibility Deal: promoting partnerships with vectors of disease? *Journal of Public Health*. 2010; 33:2-4.
132. Venter JC, Adams MD, Myers EW, Li PW, Mural RJ, Sutton GG, et al. The Sequence of the Human Genome. *Science*. 2001; 291:1304-51.
133. Wellcome Trust Sanger Institute. The Human Genome Project: history. Cambridge: Wellcome Trust 2013 30 January 2013.
134. Huxley A. *The Politics of Ecology: A Question of Survival*. Santa Barbara, CA: Center for the Study of Democratic Institutions; 1963.
135. League of Nations. Health Organization. Geneva: League of Nations Information Section 1931.
136. Blackwell E. *Why hygienic congresses fail: lessons taught by the International Congress of 1891 London*. New York: G. Bell; 1892.
137. Baldwin P. *Contagion and the State in Europe 1830-1930*. Cambridge Cambridge University Press; 1999.
138. WHO Ebola Response Team. Ebola Virus Disease in West Africa — The First 9 Months of the Epidemic and Forward Projections. *New England Journal of Medicine*. 2014; 371:1481-95.
139. Brown TM, Cueto M, Fee E. The World Health Organization and the Transition From "International" to "Global" Public Health. *Am J Public Health*. 2006; 96:62-72.
140. Preston W, Herman ES, Schiller HI, Analysis IM. *Hope & Folly: The United States and UNESCO, 1945-1985*. Minneapolis, MN: University of Minnesota Press; 1989.
141. Panel of independent experts. Report of the Ebola Interim Assessment Panel. Geneva: World Health Organisation 2015.
142. Beck U. *Risk society: towards a new modernity*. London: Sage; 1992.
143. Roberts I, Edwards P. *The Energy Glut: the Politics of Fatness in an Overheating World*. London: Zed Press; 2010.
144. Children's Food Campaign. *A Children's Future Fund - How food duties could provide the money to protect children's health and the world they grow up in*. London: Children's Food Campaign (Sustain) 2013.
145. Hawkes C. *Marketing Food to Children: the Global Regulatory Environment*. Geneva: World Health Organisation 2004.
146. Hastings G, Stead M, Macdermott L, Forsyth A, Mackintosh AM, Rayner M, et al. *Review of Research on the Effects of Food Promotion to Children. Final Report to the Food Standards Agency by the Centre for Social Marketing, University of Strathclyde*. London: Food Standards Agency 2004 November.
147. Proust K, Newell B, Brown H, Capon A, Browne C, Burton A, et al. Human health and climate change: leverage points for adaptation in urban environments. *Int J Environ Res Public Health*. 2012; 9:2134-58.
148. Richardson BW. *Hygeia, a City of Health*. 1876.
149. Fennell D. *Investigation into the King's Cross Underground Fire. Report to the Department of Transport*. London: Her Majesty's Stationery Office 1988 November 1988 Contract No.: Cm 499.
150. James P. *Food Standards Agency: An Interim Proposal*. Aberdeen: Rowett Research Institute 1997 May 2 1997.

151. Commission of the European Communities. White paper on Food Safety. Brussels: Commission of the European Communities 2000 January. Report No.: COM(1999) 719.
152. Boyd Orr SJ. Food and the People. Target for Tomorrow No 3. London: Pilot Press; 1943.
153. Lang T, Rayner G. Overcoming Policy Cacophony on Obesity: an Ecological Public Health Framework for Politicians. *Obesity Reviews*. 2007 8:165-81.
154. Royal Society. People and the Planet. London: Royal Society 2012.
155. United Nations Development Programme. Millennium Development Goals. <http://www.undp.org/mdg/basics.shtml>. New York: United Nations 2000.
156. Waage J, Banerji R, Campbell O, Chirwa E, Collender G, Dieltiens V, et al. The Millennium Development Goals: a cross-sectoral analysis and principles for goal setting after 2015. *The Lancet*. 2010; 376:991-1023.
157. United Nations. Sustainable Development Goals. New York: United Nations Department of Economic and Social Affairs, Division for Sustainable Development 2015.
158. Rydin Y, Bleahu A, Davies M, Davila JD, Friel S, De Grandis G, et al. Shaping cities for health: complexity and the planning of urban environments in the 21st century. *Lancet*. 2012; 379:2079-108.
159. Hopkins R. The transition companion : making your community more resilient in uncertain times. Totnes: Transition Books; 2011.
160. Stiglitz JE. The Ethical Economist: Growth may be everything, but it's not the only thing. *Foreign Affairs*. 2005; 84:128.
161. Hanlon JJ. An Ecologic View of Public Health. *American Journal of Public Health*. 1969; 59:4-11.
162. Hamlin C. Public Health and Social Justice in the Age of Chadwick: Britain, 1800-1854. Cambridge: Cambridge University Press; 1998.
163. Hamerschlag K, Lappé A, Malkan S. Spinning food: how food industry front groups and covert communications are shaping the story of food. Washington DC: Friends of the Earth (US) 2015 June 2015.
164. Ruppert E, Harvey P, Lury C, Mackenzie A, McNally R, Baker SA, et al. Socialising Big Data: From concept to practice. Manchester: CRESC, The University of Manchester and the Open University 2015. Report No.: Working Paper No. 138.