OPTIMUM POPULATION TRUST

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Page

> The atrocities of 11th September against the World Trade Center and the Pentagon — symbols of corporate capitalism and military dominance — raised a question mark over the West's breathtaking project to bring all cultures throughout the world into a single economic and trade empire in which people, everywhere, are defined not by their culture but as consumers, customers and competitors. Society's essential services are being wrested from governments and handed to corporations whose motivation is profit. The global economy is precarious and growth, though impossible on a finite planet, is offered as the only prescription.
>
> James Bruges *The Little Earth Book* (2004, p. 7).

The Optimum Population Trust (UK): Manchester

<www.members.aol.com/optjournal> & <www.optimumpopulation.org>

INTRODUCTION

In the introduction to the October 2005 issue, I stressed the importance that we, in OPT, attach to Clive Ponting's *A Green History of the World*. With Part 2, Martin Desvaux provides an additional ten pages of his incisive synopsis. *Green History* is so good that I would feel the OPT Journal to be somewhat redundant, except that there is a battle with 'energy fantasists' still to be fought. There are many who believe that there will be a smooth transition to renewable energy — all it will take is for 'those clever scientists' to put their minds to solving the problem!

Choosing three score years and ten as an appropriate period of time for the human mind to grasp, I provide, in *Human Prospects over the Next 70 Years* (pp. 13-15), an overview of the human situation looking backwards that far, and trying to peer that far ahead into a dim future — dim both because the future is always uncertain, and because the human race has already greatly overshot the Earth's carrying capacity.

With a perspective somewhat similar to Clive Ponting's, that is looking at the vast canvas of history, Professor Bill Russell, in a booklet written in conjunction with his late wife Claire — *Population Crises and Population Cycles* — shows how populations have, for various reasons, been savagely cut back a number of times in various parts of the world. He has no doubt that the same will happen to the whole human population before long.

On pages 18-22, I take a look at Thom Hartmann's book *The Last Hours of Ancient Sunlight*, and find that it has more to commend it than a memorable title, even though its optimism about the future belongs to fantasy land.

The next two pages, 23-24, enshrine further comments on the same book by the well known author and editor Lindsey Grant, and also from two OPT members.

Pages 25-28 are devoted to a conference paper delivered by Professor Tim Dyson last year. He puts neatly many of the points about the dangers of global warming that have been spread across various issues of the OPT Journal, for example *Ice Age, Glacial and Interglacial* in OPTJ 2/1, and *Climate Change and Sea Level in Relation to Population* in OPTJ 4/2.

Sixteen pages were devoted to wind power in the last issue. As I often reiterate, the subject is important, because wind is one of the few forms of *renewable* energy that has a relatively high power density, and we already know enough about it to calculate rather than speculate. However, the subject gets a bit of a rest in this issue, with only two pages devoted to *An Expanded Glossary of Wind Terms* (pp. 29-30). That will provide a springboard for returning to the subject in future issues. The piece is preceded by a couple of introductory paragraphs from Jim Duguid, who has helpfully worked his way through many of my wind paper drafts, making useful comments.

The last two pages continue the *Paths to Wisdom* series, with a contribution from our co-chair, Val Stevens. She lays stress on a recurrent theme of the OPT Journal, namely that much harm is done by those who believe themselves to be doing good, yet are deluding themselves into believing — against all the evidence — what they feel comfortable believing.

I am indebted to the authors of the pieces herein, for their co-operation in getting them into shape for the OPT Journal, and also to Edmund Davey and Martin Desvaux for helping to get the *Glossary of Wind Terms* as simple as the subject allows. As usual I am grateful to David Pimentel for wise counsel, and to Yvette Willey for finding time to peruse the text with her eagle eye.

CLIVE PONTING'S *A GREEN HISTORY OF THE WORLD*. Part 2

A synopsis by Martin Desvaux PhD CPhys MInstP
Email: martindesvaux@aol.com

What experience and history teach is this – that nations and governments have never learnt anything from history, or acted upon any of the lessons they might have drawn from it.

G W F Hegel 1770-1831

Introduction to the Second Instalment

The first instalment appeared in the October 2005 issue. Those first three chapters took a brief look at the history of Easter Island, then moved back tens of thousands years to summarise much of what we now know about the origins of earth's ecosystems and the dawn of mankind. During this period, the evolving human race sustained itself solely by hunting, gathering, and spreading out to populate large parts of the earth. Chapter 3 finished at around 8000 BC, when humanity stood at the point of inventing agriculture.

In this instalment, then, we examine in Chapter 4 the gradual transition of mankind into an agricultural society. Such a change, coupled with growing populations, inevitably had an impact on the environment. Chapter 5 describes this by contrasting the dire consequences for some societies with the longer term stability of Egypt. In Chapter 6, we progress into the last millennium and see how the innate human urge to grow its population was continually being curbed by nature's inability to sustain our ancestors' demands. Hegel's words (above) have a resounding ring to them as we read about the destruction wreaked in ignorance by humans throughout history (Chapter 5). They are all the more sobering in the light of the inability of the majority of today's nations and governments to recognise the need or urgency to balance populations to the ability of the Earth to sustain it - despite our knowledge of the consequences.

I am grateful to Clive Ponting for his permission to quote text and reproduce tables and diagrams. Passages from his book are quoted in italics. The usual uses of ellipsis … indicate where parts of a passage have been skipped. My personal comments have been almost entirely confined to the end notes or are made using the first person singular. Clive Ponting is currently working on a revised and updated edition to be published in paperback by Pimlico in late 2006/early 2007.

Chapter 4: The First Great Transition

Around 8000 BC, the world human population had grown to around four million. Many humans then started gradually to move out of the nomadic life and develop the means to form sustainable settled societies during what is termed the *Neolithic Revolution*. As Ponting correctly comments, this was not a revolution, but an evolution. Revolutions require foresight and drive towards a vision of the future. Ten thousand years ago, humans had no idea where they were going with the changes they were causing to happen. However, once it had occurred, this '*ratchet of evolution*' ensured there was no going back.[1] The transition occurred in three regions – South West Asia, China, and Mesoamerica over five millennia from 8000 to 3000 BC. The evidence to support this gradual progression has come primarily from detailed study of archaeological remains. Tracking progress of plant types from wild to domestic is extremely difficult, but many digs have revealed the types of animals, seeds, tools and weapons used by these early settlers.

The transformation from a nomadic to a settled society took a long time precisely because no one knew into what or how society was developing. There was no conscious 'road map' of development. It was pure trial, error and serendipitous accident, and in this sense shares the characteristic of evolution, in that the only groups to survive were those which made wise decisions based on good ideas. The drive to settlement depended on the ability to cultivate crops and to herd animals, especially those animals which did not compete with humans for food.

As humans hunted and foraged, they had become familiar with the plants and animals around them. They could study and pass on information about the benefits, dangers and habits of things animal and vegetable. However, *"Agriculture is definitely not an easier option than gathering and hunting. It requires far more effort in clearing land, sowing, tending and harvesting crops and in looking after domesticated animals."* Compare, for example, the work involved in picking wild blackberries with that of actually growing a standing crop of fruit or wheat. However, the benefit of agriculture *"is that in return for a greater degree of effort it can provide more food from a smaller area of land."* Wild plants rarely grow in conveniently concentrated patches, but are spread extensively throughout large areas. Several theories have been propounded to explain the transition, but the one that appears to be the best fit is that of population pressure. Hunter-gatherers had ways of containing their population, helped by nature, illness and accidents. But this will not always have worked. As populations grew, they will have split up and gone their separate ways. Because cohesive social bonding is generally tighter in small groups, there will have been a sub-conscious critical size at which groups will have felt comfortable,[2] and beyond which rivalries and/or disagreements in strategy will have made groups prone to division. The splintered groups would have looked for unpopulated habitats. Eventually, as all the best habitats were used up, some groups had to accept less fruitful places to seek food, and were consequently forced to develop other methods of feeding themselves.[3] The first area to develop agriculture was south-west Asia – now Anatolia, Palestine, Syria and Iran. Wheat, barley, lentils and chickpeas were all 'domesticated' from wild '*progenitors*'. Also, *"In parallel with domestication of wild plants the relationship of humans with animals was becoming more intensive."* The wild dog was the first animal to form an alliance, possibly for protection and/or companionship.[4] Around 8000 BC, sheep, followed by goats, became the first animals to be domesticated and exploited. They did not compete with humans for food, but conveniently turned grass into milk which humans could drink, and provided hides as well as meat for a useful dietary supplement. Pigs, which do compete with humans for food, were not domesticated until around 6500 BC.

Ponting outlines the process: *"By 6000 BC the first stage of the transformation of human society in south-west Asia was complete and settled life was becoming the norm… The great transition that had occurred in south-west Asia was transferred to other regions, spreading by a combination of new groups adopting agriculture and settlers who already practised it moving into other areas … between 6000-5000 BC Greece and the southern Balkans shifted their subsistence to agriculture. Cattle were probably domesticated here at this time and spread back into south-west Asia (although they were not milked for another 3000 years)."*

China was the second area in which agriculture became established. Early settlements have been found on terraces along the tributaries of the Yellow river. Although the process would have been the same, the outcomes were different. Agriculture was based on millet (first domesticated around 6500BC) and rice which was grown as a dry land crop. Rice was also domesticated independently by people in settlements along the southern Himalayan foothills, upper Burma through northern Thailand and Vietnam to the far south of China. Native soybeans were only domesticated around 1100 BC "*and then spread* *rapidly, but until then Chinese agriculture was dominated by seed crop production. Pigs and poultry were…domesticated, followed much later by sheep and goats.*"

The third and last main region to develop agriculture was Mesoamerica, what we now know as Mexico, Belize, parts of Guatemala and San Salvador. This region was late in developing settled communities, and maize became the staple diet around 5000 BC with the high-yield varieties taking 3000 years longer to emerge; early varieties were no larger than the human thumb. Small villages first appeared around 2000 BC (coinciding with the appearance of the higher-yielding maize) – much later than the other regions. Cities and ceremonial centres (mainly Mayan and Aztec) did not appear until relatively recently, in about 1000 BC.

Wherever it occurred, the change from hunter gathering to farming had the same overall effect on human society. For hunter-gatherers, ownership of the land they lived off had no meaning. They could not defend it when they had moved away and, as long as they all got enough to eat, nobody was interested in ownership. Agriculture, on the other hand, required settlement in one place for many years. Seeds had to be sown, watered and harvested, requiring a stationary population. The benefit was the production of more food from a smaller area of land; an individual could produce more than his own needs. This increased security of supply, enabling population growth. An important side effect of this was the evolution of 'ownership'. As an individual invested his family's time in cultivating crops, a sense of 'ownership of the soil and crop' developed. This will have led to disputes, requiring a strong leader to resolve them. Thus a primitive legislative function would have come into being. Surplus production of food was used to feed others who did not need to be involved in farming. *"The first non-farmers were probably craftsmen who made pottery.* [*Later on*] *ruling groups, probably religious at first and then political, rapidly took over the distribution functions. Societies emerged with large administrative, religious and military elites, able to enforce collection of food from peasant farmers and organise its distribution to other parts of society. In parallel, unequal ownership of land and therefore of food rapidly emerged …* [also] *the size of surplus available to a particular society has determined the size and extent of other functions – religious, military, industrial and cultural – that the society can support."* As more effective ways of producing surplus food were found, the pressure of population did not abate. It intensified and put more pressure on finding even better ways to produce a surplus.[5] A concurrent and important development occurred around that time, namely the development of hierarchy and authority in settlements.

The development of the south west Asia region serves as a model for the evolution of society. Initially (7000 – 6000 BC), settlements were confined to rain-dependent 'dry farming' in upland areas. As population pressure increased, all suitable sites became occupied and people migrated to the dryer areas of Mesopotamia, which necessitated the development of irrigation techniques. Archaeological remains indicate that most settlements comprised small villages as well as towns, the earliest of which *" … revealed a considerable degree of social organisation from the beginning …nearly all had temples as the focus of urban life and played a fundamental part in the redistribution of resources …by controlling food production and distributing rations to all members of the community."* By 4500 BC, large temples had been built in Uruk and 500 years later its population had grown to 50,000. By 3000 BC, eight large cites had developed in Sumer. Such dominant buildings confirm the role and power of religious elites in controlling large early societies through ceremonies and administrative organisation. One temple at Shuruppak owned 9660 donkeys and organised ploughing through labour gangs. The system created larger surpluses which supported more non-farmers and enabled the gradual emergence of social classes holding wealth and power. Such groups would have organised production, storage and distribution of food and importantly, as the cities became more prosperous, the military resources for defence against covetous neighbours. It was around 3100 BC that in Sumer the need for keeping records and accounts of food and other commodities brought about the invention of writing, the first evidence for which is inscriptions found on over 4000 baked-clay tablets in Uruk.

Egypt and the Indus Valley developed roughly in parallel with south west Asia but other regions of the world developed over markedly different time frames. China developed irrigation much later and, in the Americas, the difficulty and slowness in developing high-yielding maize varieties held back population growth and therefore the development of large cites. After describing in detail the development of human societies around the world, Ponting comments in the closing paragraph that: *"Despite the variations in cultural achievements, none of these empires and states altered the way in which humans obtained their subsistence once settled agriculture had been adopted. Nevertheless their impact on their immediate environment was far-reaching. They provide the first examples of intensive human alteration of the environment … of their major destructive impact …[and] of societies that so damaged the environment as to bring about their own collapse."*

Chapter 5: Destruction and Survival.

Once settled communities took hold, destruction of the environment slowly began to increase. The early settlements were clearly successful in providing sufficient food for all. The consequence will have been a rising population since starvation and attack from aggressors will have diminished. Survival rates increased as child – and adult – mortality decreased, tipping the balance in favour of a growing population which then exerted further pressure to deliver even more food. Wherever this occurred, it resulted in deforestation to produce arable land as well as additional timber to build and heat homes as well as to cook food. The long-term consequence of this activity was the degradation and erosion of the soil. Ponting cites the evidence thus: *"Recent evidence from Jordan suggests that as early as 6000 BC, within about a thousand years of the emergence of settled communities, villages were being abandoned as soil erosion caused by deforestation resulted in badly damaged landscape, declining crop yields …"*

Unlike hunter-gatherer communities, settled societies developed overheads in the form of:

a) rulers;
b) priests for ceremonial and spiritual needs;
c) bureaucrats for administrative purposes now that 'ownership' had evolved;
d) a resident military force for defence and maintenance of law and order;
e) craftsmen to make artefacts, utensils and weapons to serve a society with its ever-growing needs.

Communities depended on larger and larger food surpluses to maintain these functions and, when yields fell as a result of over-cultivation, societies collapsed. In Mesopotamia around the banks of the Tigris and Euphrates, the Sumerians sowed the seeds of their own destruction by overworking the land and forests. A combination of 40ºC summer temperatures (generating high evaporation rates) combined with irrigation (causing the water table to rise) led to increased salinity of arable land. This happened very slowly, but once the salinity had exceeded the tolerance level of crops (0.5% for wheat and 1% for barley), there would have been a rapid collapse of food production and, inevitably, of the population and the settlements. Desalinisation is a slow process that involves letting the land lie fallow for many years. This was probably not known at that time, or if it was people could not afford to wait and would have moved on to exploit other areas – or eventually died of starvation. In the Sumer region *"…crop yields fell 42% between 2400 and 2100BC … 65% by 1700BC…Dating from 2000 BC there were contemporary reports of 'the earth turned white…' The later history of the region reinforces the point that all human interventions tend to degrade ecosystems and shows how easy it is to tip the balance towards destruction when the agricultural system is highly artificial, natural conditions are very difficult and the pressures for increased output are relentless. It also suggests that it is very difficult to redress the balance or reverse the process once it has started."* [6]

In the area around Baghdad, some 3000 years later, digging channels from the Tigris and Euphrates for irrigation led a burgeoning civilisation to a similar fate, followed by Mongol conquest in the 13th century. The result was a massive collapse of the population from 1.5 million to about 150,000 by 1500 AD.

The history of Indus Valley followed a similar pattern to Mesopotamia. A once richly-forested region, well stocked with wildlife, it was laid waste by a society which emerged around 2300 BC and only survived for 500 years. Some forest was cleared for arable land, but the practice of oven-drying mud bricks (rather than leaving them out in the sun) led to rapid deforestation, followed by soil erosion and then degradation of the soil itself. In many cases, as food decreased, the weakened society was open to conquest. Large-scale deforestation had become an accepted way of building up settlements, cities and civilisations. The scars are everywhere to be seen on the earth's surface. Nowhere is it more obvious than in North Africa and the Middle East where human groups developed earliest and left behind a desertified and uninhabitable area. The Mediterranean region also bears witness to the march of Man. What was a natural habitat of deciduous forest is now covered by vines, olive trees, herb bushes, sheep on overgrazed land and silt in large deltas and river mouths. Plato, wrote in his *Critias*: "*What now remains is like the skeleton of a sick man… there are some mountains which have nothing but food for bees, but they had trees not very long ago … many lofty trees …boundless pasturage for flocks. Moreover, it was enriched by the yearly rains which were not lost to it, as now by flowing from the bare land into the sea*…"

In China, nearly all forests had disappeared by 1800 due to its need to cultivate millet. This inevitably caused severe soil erosion. The loss of trees from the uplands of China now leads to the regular flooding of the Yellow River. As a result, this river now changes course and regularly causes a heavy loss of life.[7] In the 1600s, the same trend in Japan led to strict government controls on tree felling.

By contrast, medieval Ethiopia originally had its centre of state in the north. However, following extensive deforestation and soil degradation, it moved south in 1000 AD. This process then repeated itself. Eventually, when Addis Ababa became capital in 1883, a 100-mile-radius zone became treeless by 1903, mainly through provision of charcoal for the capital. This happened in only 20 years! [8]

In Mesoamerica, the Maya died out in the 9th century AD. Originally thought to be a peaceful race, recent research shows that, at their peak, they were in fact a warmongering people with cities often only 10 miles apart. The need to support priests for ceremonial activities and to maintain armies to defend against neighbouring cities put unsustainable pressure on the surrounding land which was nothing better than cleared jungle. As already mentioned, deforested hillside and tropical soils can erode easily, and crops quickly decline once intensive arable farming begins. This was all the more rapid as there were few domesticated animals to produce manure. Rapid decline of soil fertility will only have served to increase competition between cities for the remaining land resources, leading to further warfare, exacerbating population decline through malnutrition.

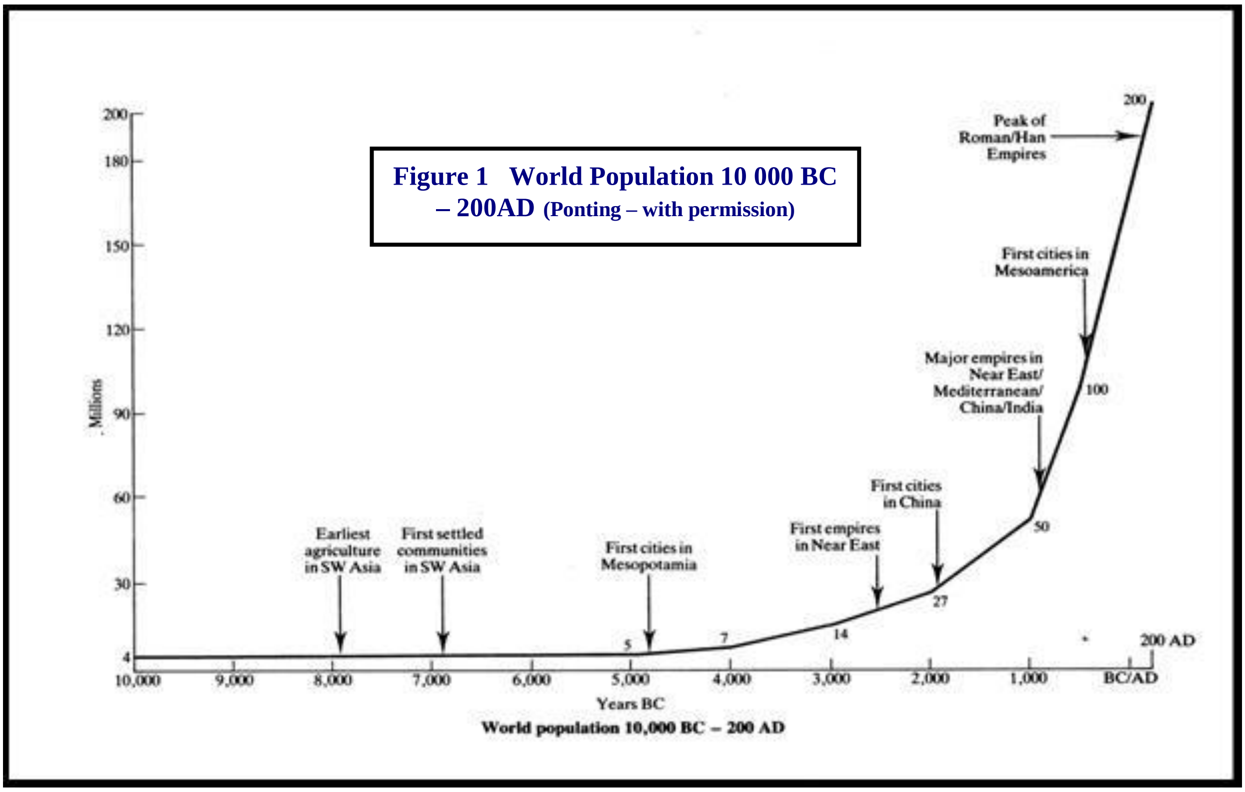


Figure 1 World Population 10 000 BC – 200AD **(Ponting – with permission)**

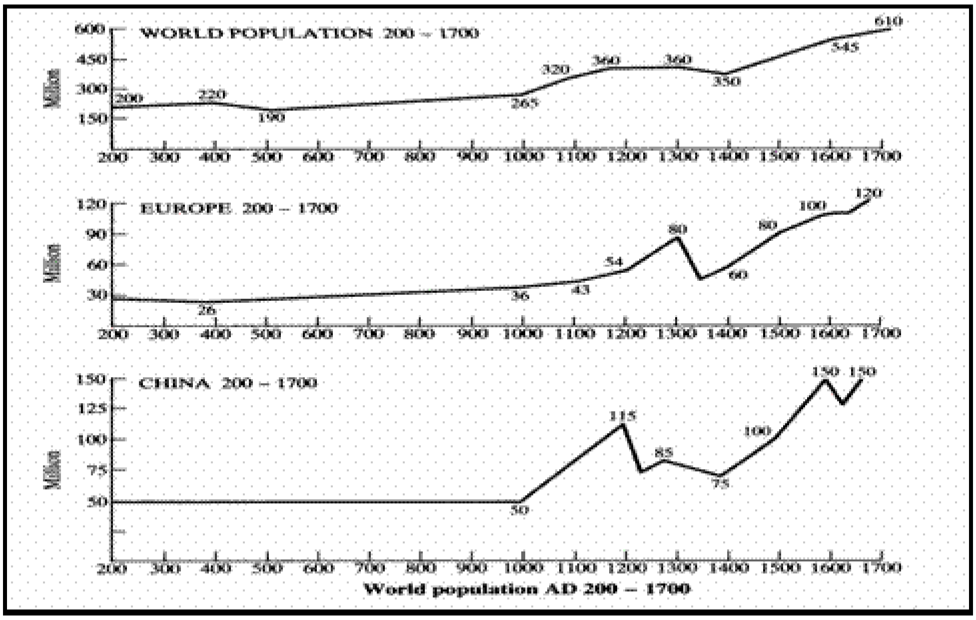


Figure 2 **(Ponting – with permission)**

In contrast to the Mayans, Egypt provides a classic example of a society living in sustainable balance with the environment and ecology. For 7,000 years, Egyptians used the annual flooding of the lower valley of the Nile to provide the food necessary to sustain their society. The flood brought with it nutrient-rich silt which meant that there was no need for irrigation because the water table fell to 10 feet below the surface within a month at the end of November – exactly the right time to sow. Thus no salination of the soil occurred, as was evidenced by their regular wheat harvests (seen earlier as a salinity indicator). Their success was to exploit the natural process with minimal interference with the natural ecology. As testimony to the success of the Egyptian system, the 18th century Nile crop yields were double those of France. That is not to say that conditions were always so benign. Nature is intrinsically chaotic and there were periods when the floods became abnormally high or low. As a result, settlements were sometimes inundated and destroyed or crops were reduced. For example, between 2250 – 1950 BC low floods led to meagre crops and mass starvation. The resulting social unrest led to the demise of the Old Kingdom. A thousand years later, during the Middle Kingdom, another period of low flooding led to the collapse of the Ramessid dynasty. It was only when, in the 1840s, modern man installed irrigation systems to increase crop production that, by 1882, the "*British agricultural expert Mackenzie Wallace described the 'white nitrous salts covering the soil and glistening in sun like untrodden snow*". Later, between 1892 -1902, the British built the Aswan Dam on the upper Nile to try to control the water supply to the lower Valley. The final nail was put in the coffin of the Egyptian agricultural system in 1971 when the High Dam was completed in a joint Egyptian-Russian venture to provide hydroelectric power, water storage and irrigation control. This caused retention of silt in the dam, which robbed the Nile farmers of their annual delivery of soil nutrients from Mother Nature. As a result, farmers had to use expensive artificial chemical fertilizers in its place, and many went bankrupt as a result.

In summary: "*Many of the earliest settled societies were unable to strike a balance between their need for food for the populace as well as for rulers, bureaucrats, priests and soldiers and the ability of the environment to sustain agriculture over a long period ... The struggle to provide enough food was to be one of the central features of nearly all of the rest of human history. It remains acute for the majority of the people in the world.*"

Chapter 6: The Long Struggle

Until about the start of the 19th century, most of the world's population lived close to starvation. This is because humans always push the envelope without realising it. No sooner does a more plentiful source of food appear – through discovery of a new supply or an advance in agriculture – than the local populace grows to absorb it, thus placing itself again close to starvation level. Then, when crops fail, the weakest and poorest people die until there is just enough food for those remaining.[9] Primitively-slow communications and transport meant that famine in one area could rarely be alleviated by a surplus from another. About ninety-five percent of the population were peasants with low life expectancy, high infant mortality and vulnerability to disease.

Priests, soldiers, rulers, etc., were a limited but privileged 'upper class'. As gradual advances in farming techniques slowly increased the food supply, populations grew until the five million inhabitants in 5000 BC (when the cities first appeared in Mesopotamia) had become 50 million in 1000 BC. This was when major empires had become established in the Mediterranean, the Near East, India and China. The world population in 1000 BC was less than that of the UK today (Figure 1). By 200 AD, there were 200 million people, but widespread social instability and warfare ensured that the world population only grew to 265 million over the next 800 years (Figure 2); it then more than doubled to 610 million by about 1700. In China, the population remained stable for about 800 years after the collapse of the Han dynasty (220 AD). *"The Chinese developed the most sophisticated agricultural system in the world (based on ... crop rotation…still largely unused in Europe) ... By 1200 China was the largest, most literate and most advanced country in the world."* One of the most significant advances was the transition from dry to wet rice cultivation which increased the yields. But structural problems prevented the balance between population and food supply from improving so the *per capita* consumption remained low. Furthermore, the Mongol invasions caused 35 million deaths and two epidemics in 1586-89 and 1639-44 each caused a 20% reduction in population. However, as food production was proportionate to the peasant population, the society remained close to the brink of starvation.

In Medieval Europe agriculture fared no better than in China. The population was smaller and so was food output since soil fertility was reduced due to overuse. Poor grazing fields limited animal stocks as manure was removed to fertilise arable land. Many animals were slaughtered in the autumn because there was not enough feed for them during winter. Eventually, in about 800, France adopted a new three-field rotation system and increased crop yields. That this system only spread to England by 1250, shows how slowly innovations took to diffuse even relatively short distances. The use of improved ploughs enabled larger areas to be tilled. Growing legumes to fix nitrogen in the soil helped improved yields around 1300, but this practice was mainly limited to Flanders.

There is some evidence of population control in Europe at that time, as there is a loose correlation between population level and the number of marriages as well as with the lateness of marriages.[10]

By 1000 AD, Europe's population was 36 million and rose in the following 300 years to 80 million (Figure 2). In the next 200 years, periods of over-population were controlled by famines (1316-17) and the bubonic plague of 1348; by 1500 the population had recovered to 80 million since the heavily-reduced population entering the 15th century had become relatively prosperous. Due to labour shortages following the plague of 1348, wages rose as peasants found themselves in a sellers' market. By 1600, it was back to over 80 million and the signs of overpopulation reappeared. Famines, and the plague of 1666, held numbers in check till 1700, when the European population rose to 120 million.

The most important influence on the fate of populations in Europe during this period was the weather. As Figure 3 shows, the temperature varied by +/- 2ºC between 900 and 1900. The Medieval warm period from 900 – 1300 enabled the Vikings to settle in Iceland and Greenland and brought an extended period of good weather to Europe, improving harvests and enabling vines to grow in England as far north as the river Severn. As a result, the population more than doubled as shown in Figure 2. When that period ended and average temperatures fell, the Viking population in Greenland declined and was finally destroyed in 1350. Vines could no longer be grown profitably in England after 1400 AD. Then, from about 1550 to 1850, Europe fell into the grip of the 'Little Ice Age'. This caused several rivers including the Thames, Rhone and Guadalquivir to freeze over during several winters; the sea even froze in Marseilles in 1595 and 1684! Effects varied throughout Europe. They were particularly severe in Scandinavia leading to terrible starvation. In many areas of England, the timing of sowings changed and the duration of the growing seasons shortened; crops changed to adjust to the wetter conditions. Since the effect was worse in winter than summer, the effect on population was therefore not as adverse as might have been expected. Nevertheless, infant mortality and early death were rife from disease and starvation. Famines were never far away, particularly for the poor. In China, the two thousand years after 108 BC had 1828 years of famine in at least one province. In France, there were sixty years of famine between 970 and 1100. Europe experienced its worst food shortages in 1315-17, when the population had grown through the end of the medieval warm period of relatively bountiful and regular harvests. In 1315, four wet seasons in a row led to catastrophic crop failures. Ploughing was often impossible, seeds rotted and hay was too wet to store. What crops survived were of poor quality. The same happened again in 1316.

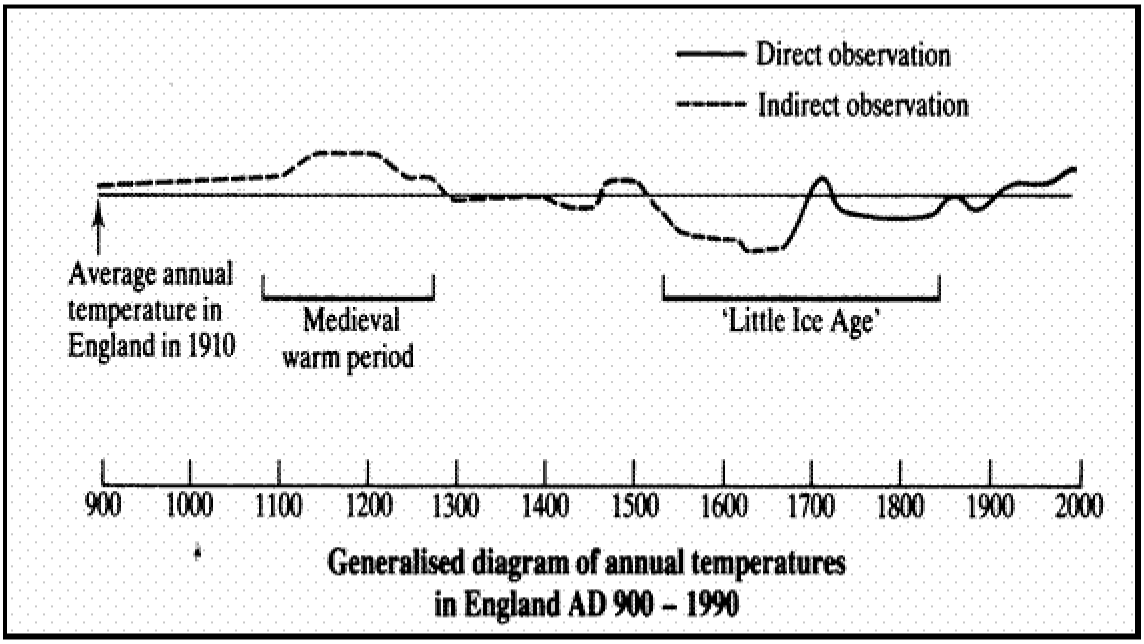


Figure 3 . (Ponting –with permission)

Crop failures in a wet year usually lasted three to four years as, in desperation, farmers ate too much of their stock of seed corn. This reduced the sowings for the succeeding year. Inevitably, as prices rose, the poor starved to death. On that inescapable slide towards death, they were driven, at best, to theft and, *in extremis*, to cannibalism.

A narrow crop base was a major part of the problem, since narrow diversity led to widespread crop failures when disease struck. The most infamous crop failure was the cause of the Irish Potato Famine of 1845-46. Ireland had 8 million people at the time (twice today's population). The majority were peasant farmers with small half acre holdings and most of them grew potatoes and little else. When blight arrived from America in 1845, part of the crop was destroyed. But when it recurred in 1846, the crop failed totally and 1 million of the poorest died. Despite the repeal of the Corn Laws, to allow import of grain, the Irish peasantry died in their tens of thousands because they could not afford to buy the grain. As always, the well-off element were least affected.

The threat of famine in Europe was very slow to subside. In 1200-1800, Europe and its colonies gradually brought famine under control. This was due to: the use of more legumes and more widespread manuring to increase soil fertility; an increased range of fodder crops; better crop diversity and rotation; increased protein output by improved breeding and cross-breeding of animals which could also be kept over winter.

Gradually, all these innovations, coupled with the introduction during the late 19th century of new types of food from around the world, rendered food production more resistant to widespread crop failures. *"The real revolution in the European food situation came about after 1850 with large scale importation of food from the rest of the world and the use of imported resources such as guano from South America and other fertilizers from colonial territories to improve domestic productivity. … One of the main reasons for Europe's success in breaking free from the long struggle to survive ... lay in its changing relationship with the rest of the world and, in particular, its ability to control an increasing share of the world's resources".*

The history continues in the next issue with the Expansion of European Settlement.

Endnotes

1. The ratchet of evolution (or perhaps more precisely, *progress*) implies a major irreversible transition during the evolution of humankind's society. It could be thought that there can never be a reversal of development. But this ratchet could be questioned if we consider (as just one example) the regression of Britain's culture during the dark ages. Many of the advances, discovered and brought over by the Romans, were 'unlearnt' after 400 AD, when they abandoned our island because of trouble elsewhere in the empire. Our technology regressed. While the 'ratchet' may apply to humanity as a whole, I consider that it is reversible in 'local' areas where conditions remove the means to keep up the advanced state of society. Such regressions have been temporary up till now, but with the forthcoming depletion of fossil fuels, it should perhaps never be taken for granted. Vide: 'The Lord of the Flies'.

2. There is a critical size above which it becomes inefficient for a group to gather and hunt in a given area. The larger the group, the further it must range in its quest for food. Above the critical size, the group must continually roam and have less and less time to gather and hunt. By splitting up, one half of the group moves away to a new area and each group's subsistence is more manageable.

3. Interestingly, Stone Age market forces came into play. Where less wild food was incapable of supporting a population, the extra work involved in cultivation began to look more attractive. That is, the return on labour increased. Thus early seed sowers reaped better crops than nature could supply in the wild. True to Darwinism, groups that did not start to produce their own food or could only produce an inadequate amount, died out and those who could produce enough survived.

4. The dog is a gregarious animal with a strong territorial instinct. As one example of how its domestication might have occurred, young abandoned or orphaned pups would have been found by humans and become quickly dependent on them. Any canine descendants with nasty traits would quickly have provided extra protein for the human diet; the more amenable canines would have survived, bred and domesticated.

5. We see here that population pressure coupled with the innate human instinct for preservation and propagation of its genes is the sole driving force of innovation and technology – particularly in farming.

6. We have plenty of evidence of "*how easy it is to tip the balance towards destruction when the agricultural system is highly artificial"* today – on a massive scale. The use of pesticides (leading to the decline of bird life), sewage or artificial fertilisers (severely polluting rivers), acid rain, and the destruction of the Amazon forest, are but a few examples.

7. What had up till recently been considered a 'natural' disaster was in fact 'man-made'. This is a classic example of the type of planetary reaction propounded in Lovelock's Gaia theory – mentioned in the endnote 3 of the first instalment.

8. Sadly, Ethiopia is now a destitute country barely living at subsistence level, and this is a stark demonstration of what happens when we do not learn from past experience. National and political greed inevitably leads to the downfall of all societies and empires, of which Rome is a classic example. Even today, despite our knowledge of the shortcomings of our ancestors, we are still guilty of reckless deforestation in the Amazon and Asia to feed insatiable commercial interests. The outcome will be no different to that of earlier societies – just very much more dramatic.

9. Prior to the oil age, about 95% of people were involved in farming. Food production was therefore *dependent* on people power. The production per capita being fairly constant over many centuries ensured that populations grew and declined in phase with the variation of agricultural conditions and output at any particular time.

10. Interestingly, this trend exists today in Europe, where marriages are later and many do not marry at all, preferring to live alone. That, coupled with birth control and a falling fertility rate in men, has led to a negative growth rate in the birth rate of the UK and several other European countries – a welcome trend which is more than eliminated by increased immigration levels.

HUMAN PROSPECTS OVER THE NEXT 70 YEARS

by Andrew R.B. Ferguson

In considering the destiny of the human race over the next three score years and ten, it is useful to start by looking backwards seventy years (to 1935), at which time world population was about 2100 million. It might be said that it was then that the population started its slow motion explosion, wreaking inevitable damage on the environment as the rapid growth continued. With a population of 2100 million, every person might have been allowed a modest emission of 4 tonnes of carbon dioxide per year (one fifth of current US rates), without overloading the Earth's carbon sinks. However, despite Svante Arrhenius's warning, in 1896, of the danger of overloading the Earth's carbon sinks, population continued growing rapidly — doubling every 43 years — reaching 6500 million by 2005, by which time carbon emissions were about three times the Earth's absorption capacity.

During this seventy year period, the burgeoning human population exceeded many other of the Earth's ecological limits, as is shown by the following shortlist, taken from a 1999 paper by Pimentel et al.[1]

a) "3 billion humans malnourished worldwide;"
b) "40,000 children die each day due to malnutrition and other diseases;"
c) "Globally, the annual loss of land to urbanization and highways ranges from 10 to 35 million hectares per year, with half of this lost land coming from cropland;"
d) "Worldwide, more than 10 million hectares of productive arable land are severely degraded and abandoned each year" (about 7% of the total per decade);
e) "Water demands already far exceed supplies in nearly 80 nations of the world;"
f) Since 1960, "nearly one-third of the world's arable land has been lost due to urbanization, highways, soil erosion, salinization, and water logging of the soil;"
g) "grain production per capita started declining in 1984 and continues to decline;"
h) "irrigation per capita started declining in 1978 and continues;"
i) "food production per capita started declining in 1980 and continues;"
j) "fertilizer supplies essential for food production started declining in 1989 and continues to do so."

In part, the recent slowing of the annual growth rate of population is a result of these strains on ecological capacity. During the 70 years prior to 2005, the mean exponential growth rate was 1.6% a year (peaking in the 1960s at 2.1% a year). By 2005 the rate had dropped to 1.2% a year. That is an impressive rate of reduction. China's draconian controls on procreation must take a substantial part of the credit. Further reduction will be more difficult, so a guesstimate for growth rate over the next 70 years might be half the 2005 rate of growth. That means a growth rate of 0.6% a year, which would result in population growth as shown on the lower line of Figure 1, leading to a population of just under 10,000 million in 70 years time. That line is only realistic in its *endpoint*. What is likely to happen in reality is that the present growth rate will decline to zero in a fairly steady way. The top line shows a steady decline from 1.2% to zero. Both projections are simplifications, and will not happen in that precise way. We now need to consider some of the factors that are likely to lead to a somewhat different prospect for the human race.

This explosion in human population has been facilitated by access to fossil fuels. Fossil fuels have allowed populations to flourish in salubrious areas far from where the food and fibres are produced. Crop yields have been enhanced by artificial fertilizers, herbicides, pesticides, and timely sowing and harvesting. Losses have been reduced by effective storage. With fossil fuels available, we have not had to rely on biomass for energy. As the sources of cheap energy start to decline, we must expect a drop in human population commensurate with the declining ability to provide food and fibres to sustain humans.

While the precise time that oil and gas supply will peak is uncertain, almost no one would dispute that before 70 years have passed, oil and gas supply will be seriously in decline, thus exacerbating the problems listed above. The whole globalization project will be unravelling, if that has not occurred earlier. From this we must conclude that the growth in population during the end of the 70 year period is likely to be less than that shown in Figure 1, especially because we are steadily undermining the Earth's ecological capacity, through such things as soil erosion, destruction of forests, destruction of other species, over-fishing, and probably also through causing erratic weather due to climate change.

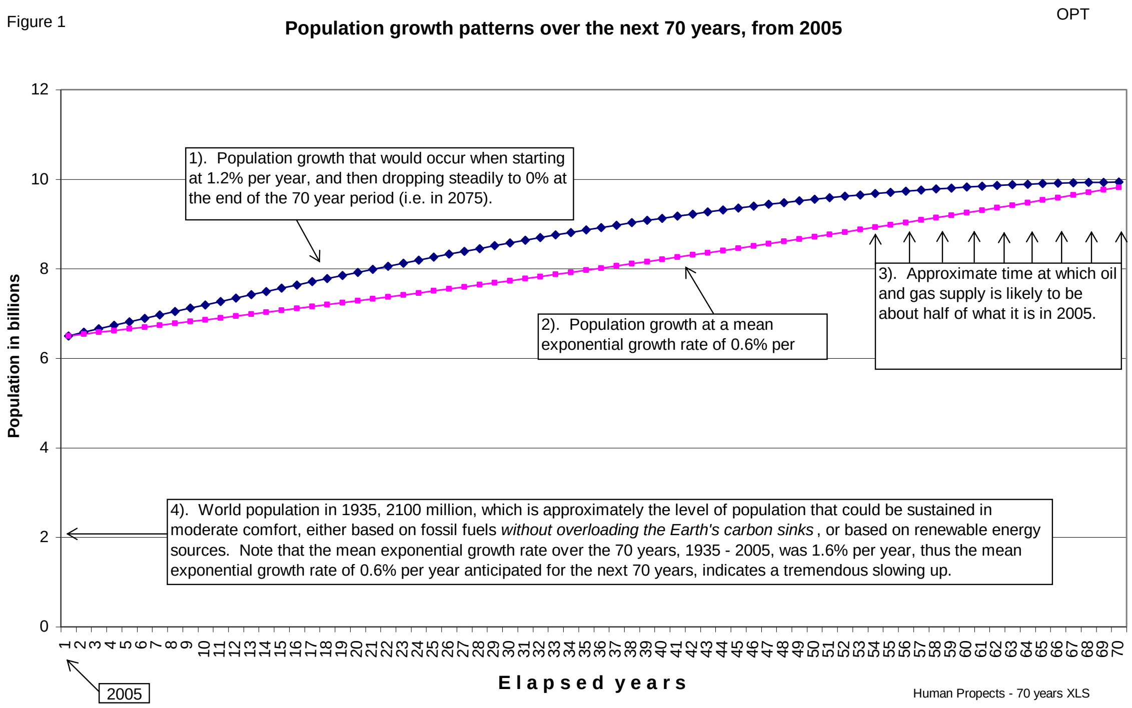
If the only conclusion that could be drawn was that there is a desperate need to reduce population, that would not be either very new or useful. More important is to consider what individual nations can do to preserve something of human civilization —assuming that to be a worthwhile goal. Where appropriate action might be successful is best brought out by one aspect of eco-footprinting, namely that which measures the biocapacity available to each nation. Table 1 shows the biocapacities available to a few selected nations, drawn from the *Living Planet Report 2004*.[2] Of those shown, the only nations likely to be able to support their present populations *on renewable energy* — that is sustainably — are Norway, Sweden, Finland, New Zealand and Australia. The table also highlights a weakness in eco-footprinting, namely its failure to account fully for unsustainable practices. Australia has tremendous problems of sustainability stemming from the way in which water flows inwards, leading to a tendency for land to be lost to salination. Also Australian agriculture may prove to be particularly at risk due to climate change. So Australia is a good example of the need for biocapacities (the space available for ecological footprints) to be subject to individual scrutiny. Indeed, the general conclusion of this study is that nations need to examine their own individual prospects over the next 70 years, and take action appropriate to a fossil-free future.

	Biocapacity in global ha/cap		Biocapacity in global ha/cap
Jordan	0.2	Western Europe	2.1
Bangladesh	0.3	USA	4.9
India	0.4	Norway	6.9
Pakistan	0.4	Sweden	9.8
Tajikistan	0.4	Finland	12.4
Rwanda	0.5	New Zealand	14.5
China	0.8	Australia	19.2

1. The paper is by D. Pimentel, O. Bailey, P. Kim, E. Mullaney, J. Calabrese, L. Walman, F. Nelson, and X. Yao, 1999. Will Limits of the Earth's Resources Control Human Numbers? *Environment, Development and Sustainability* 1: 19-39, 1999. It argues for a global population of 2 billion, on the basis of the amount of ecologically productive land needed to support humans in a fairly good lifestyle from renewable resources.
2. WWF, 2004; World-Wide Fund for Nature International, UNEP World Conservation Monitoring Centre, Global Footprint Network. *Living Planet Report 2004*. Eds. Jonathan Loh, Mathis Wackernagel. (42 pp.).

[Zoom go 150% or as needed to read figures on graph]

Figure 1



POPULATION CRISES AND POPULATION CYCLES by Claire and WMS Russell

A commentary by Andrew RB Ferguson

In a 1997 forum, that was conducted in *Politics and the Life Sciences*, of the 17 contributors to the forum, there were only six of them, Virginia Abernethy, Lindsey Grant, Jack Parsons, David and Marcia Pimentel, and David Willey, who gave an unequivocal yes to these three stated assertions:

1) For everyone to *sustain* an adequate comfortable (i.e. modest European) standard of living, world population would need to be about 2 billion.

2) History, anthropology, and politics tell us that nations will never agree how to share out the pain involved in making the dramatic changes required by Proposition (1).

3) Only nations can exercise some control over the two key variables — consumption and population. Therefore nations must assume responsibility for living within their biocapacity.

From this, we can deduce that while it may be fair to blame politicians and economists for their failure to face up to reality, academics have been far from helpful, for they have failed to reach a consensus view that reflects reality. To such a great an extent is this the case, that every academic able to join the above elite is a cause for celebration!

Clive Ponting provides a cause for such celebration, as does the sociologist William Catton, with his book *Overshoot: The Ecological Basis of Revolutionary Change* (1982). To them we may add the late Claire Russell, and William Russell. The latter is Emeritus Professor of sociology at Reading University. He approved of an essay of mine, *Intractable Limits to a Sustainable Human Population*, that was published in the journal Medicine Conflict and Survival (Vol 21/2, April-June 2005), so kindly sent me a copy of a book that he and his wife published in 1999, *Population Crises and Population Cycles*. In it, the authors bring home — with amplification— what Ponting records, namely that throughout history population has cyclically pressed against the limits of natural resources.

Some of Russells's graphs are particularly instructive. There is one that shows the region of Mexico with a population estimated at 25 million at the time of the Spanish conquest, 1519, dropping to 1 million by 1609. That is a mean exponential rate of decline of 3.5% per year. A substantial cause was the introduction of diseases against which the indigenous population had no immunity. This was amplified by the importation of sheep and cattle resulting in overgrazing, causing widespread erosion and valley floods.

That combination of circumstances is not likely to recur, so of more interest is the longer-term decline in population in Egypt. Russell's diagram, on page 17, shows an Egyptian population of about 20 million, in 800, dropping to 2 million by 1750. The mean exponential rate of decline over that 950 year period works out at 0.24% per year. The fall was not steady. Instead there were six clearly defined plateaus, during which the population remained constant for a while, before continuing on a downward path. The book does not mention why this huge change, from 20 million to 2 million, occurred. In a personal communication, Russell said the main reason was disease, but this time without the added power of diseases to which the inhabitants had no immunity.

The PRB data sheet shows a mid-2003 population for Egypt of 72.1 million. Thus the mean exponential growth rate for the prior 253 years, that is starting from 1750, is 1.4% per year. But the reader hardly needs this illustration that a rapid rate of sustained expansion of population is easier than a rapid rate of sustained contraction!

Another graph shows that for 1600 years, starting around 200, the population of North-Western Europe fluctuated between about 20 and 50 million. Then, in the next 200 years, that is from 1800, it increased to 300 million. That is a mean exponential growth rate of 0.90% per year. Throughout history, population explosions lead to damage to the environment, with a consequent decrease in carrying capacity. That is less obvious in North-Western Europe than elsewhere. Moreover at the present time it is largely masked by substantial supplies of cheap energy.

Russell realizes that the whole world is already in a situation of overshoot. He sums up the sobering facts (which appear with almost monotonous regularity in the OPT Journal) in a paragraph in the book's concluding pages:

> As on Easter Island, the world crisis response has not averted harm to the environment. Besides rapid depletion of minerals and fossil fuels, and pollution of land, air, fresh water and oceans, there is direct damage to the land environment — deforestation, overgrazing, overcropping, over-irrigation, and the resulting erosion, silting, laterisation, waterlogging, salinisation and desertification. As we have seen, these effects have been produced by earlier crises in climatically vulnerable regions. By 1864, when the American diplomat George Perkins Marsh published the first general book on the subject, the whole Earth was beginning to be affected, and by now world environmental damage has attained frightening proportions. In India there is serious wind or water erosion on 1.5 million square kilometres of land, and about the same area in China. According to a United Nations report, "one-third of the world land surface is threatened by desertification" (Caldwell and Caldwell, 1994). …
>
> The remedy for all these horrors was succinctly stated in 1830 by Robert Malthus (1766–1834). …
>
> It would therefore [because of superior contraceptives] be extremely easy to mount a massive world programme of voluntary birth control, and how welcome this would be is shown by the fact that desperately poor women in Calcutta have been known to spend 10% of their miniscule income on contraceptives. We may thus hope to reduce the world population of nearly six billions to the billion or so who could probably live a good life even in our already depleted Earth environment.

It tends to be obligatory for authors to finish on an optimistic note, so perhaps one should not censure Russell's optimism too strongly, but in reality, although voluntary birth control combined with excellent contraception facilities may produce a falling population in a few places, such as Europe today, it is highly improbable that it will produce that result in all countries of the world, and certainly not at a rate of 1% a year, which is about *the mean exponential rate of decline that would need to be sustained over 150 years* in order to reduce a population of 9 billion to a sustainable (with a scarcity of fossil fuels) 2 billion.

The book *Population Crises and Population Cycles* does not address the assertions listed as items 2 and 3 at the start of this piece, but I have ascertained, by personal communication, that Russell's answer to both is in the affirmative, so the Russells — one posthumously — can be elected to join the elite who are able to face reality unflinchingly!

References

Caldwell, J C, Caldwell, P. 1994. Rapid Population Growth and Fragile Environments: the Sub-Saharan African and South Asian Experience. In: K L Campbell and J W Wood (eds.), Human Reproductive Ecology: Interactions of Environment, Fertility and Behaviour. New York: New York Academy of Sciences.

Catton, W. 1982. *Overshoot: The Ecological Basis of Revolutionary Change*. USA: University of Illinois.

Russell, C, Russell W M S. 1999. Population Crises and Population Cycles. London: the Galton Institute.

A MONOGRAPH ON "THE LAST HOURS OF ANCIENT SUNLIGHT"

by Andrew R.B. Ferguson

The constant theme of OPT Journal papers is that at sometime during the twenty-first century, oil, natural gas and easily accessible coal will become so scarce that for most people fossil fuel will be unavailable. This will mean that a much smaller population can be supported. In the meantime, there is an equally pressing need to lower population so as to reduce the risk of excessive carbon dioxide in the atmosphere leading to runaway global warming. It is of interest to look at what others have to say on this subject. This monograph on Thom Hartmann book, *The Last Hours of Ancient Sunlight*,[1] will take within its scope some other efforts to look realistically at the human situation, at the present turning point in human history.

Hartmann sets out, in Part I of his book, the basic facts about the discovery and exploitation of this concentrated energy, which is to be found in the Earth, and is the product of 70 million years of sunlight (captured about 410 to 340 million years ago). He also sets out, with brilliant clarity, the consequences of our exploitation of that resource. Over a few centuries, but most particularly in the last seventy years, it has produced an explosive growth of human population (from 2 to 6 billion), *with concomitant ecological devastation*.

This story has been set out before, most especially in Clive Ponting's 1991 book, *A Green History of the Earth*; and in David and Marcia Pimentel's 1996 (revised edition) book, *Food, Energy, and Society*. The essential essence was contained in a 1999 scientific paper by Pimentel et al., *Will Limits of the Earth's Resources Control Human Numbers?*[2] Hartmann provides, in the commendable compass of 88 pages, a more easily accessible account than that of Ponting's promethean 430 page book, or in Pimentel's excellent but academic presentations.

There are a few minor factual errors in Hartmann's book,[3] but for the most part it is a fine presentation, which makes no bones about the root cause of our problems: an excessive human population, *temporarily* made possible by easily available energy.

Hartmann's analysis is weakest with respect to renewable energy. He correctly points out that when the human race relied only on 'current sunlight', world population was limited to about 1 billion (page 19). However, the crucial question is to what extent new technology will allow us to extract a greater proportion of 'current sunlight' (converting it into suitable forms) than was possible before science opened out new possibilities. Hartmann wisely points out the considerable difficulties, in the absence of oil and natural gas, attendant upon, for example: (a) mining and refining the materials needed to construct and connect up wind turbines; and (b) carrying out all the manufacturing processes associated with the production of solar panels. But while it is easy to point out these problems *in general principle*, the great difficulty is in being *quantitative* about what is likely to be possible.

Hartmann does not, for instance, dwell on the difficulties of producing a substitute for oil, or mention the amount of energy which is needed to produce the 3 litres of liquid hydrogen that has the same 'motive' energy as 1 litre of gasoline when burnt in an internal combustion engine, namely 12 kilowatt hours of electrical energy (OPTJ 3/2, p. 21). However, he is hardly to blame, since the five papers which have appeared in recent OPT Journals would not have been necessary if the matter was fully understood. Those papers are, *Verdict on the Hydrogen Experiment — an Update* (OPTJ 3/2), *Hydrogen and Intermittent Energy Sources* (OPTJ 4/1), *Hydrogen Fantasies* (OPTJ 4/1), *Hydrogen as an Energy Carrier* (OPTJ 4/2), *The Hydrogen Economy: Reality or Fantasy* (OPTJ 5/2).

What is also absent is an analysis of, or even a suggestion for, a reasonable minimum per capita need for energy. As I argued in *Perceiving the Population Bomb*,[4] to maintain even a modest European lifestyle, that is to provide an adequate health service and a moderate standard of education, it is probably necessary for each person to have, *on average*, 2 kW of power, that is 2 x 24 x 365 = 17,000 kilowatt hours of primary (thermal equivalent) energy per year (this 2 kW compares with 5 kW presently used in Europe, and 10 kW in the USA). On average, a hectare of forest will sustainably produce about 3 tonnes of dry wood a year (about 6 cubic metres). Each tonne of dry wood contains about 5550 kilowatt hours of energy; thus it may appear that each person will need just a hectare of 'energy land' to support them, or significantly less if some of the energy can be provided from wind turbines and solar panels. However, there are huge losses in transforming biomass into 'liquid' energy, and also large energy inputs are needed to grow and harvest such diffuse forms of energy. It may well be that Hartmann is right in his *implication* (page 19) that, without oil and gas, the human race will be back to where it was before science and technology provided *temporary* solutions. But in indicating this, Hartmann takes inadequate steps to silence the vociferous 'renewable energy fantasists', such as *Friends of the Earth*, *Greenpeace*, and some Energy Secretaries and Environment Ministers. In short, he does not address the most vital points, and thereby attempt to 'prove' that world population really does need to be reduced to the low figure of 1 billion, as he implies. While pointing out this weakness, we can again have considerable sympathy for him, because data is lacking in the whole field of renewable energy. But it is essential to recognize this weakness, and not gloss over it.

Part II of Hartmann's book is titled, *Younger and Older Cultures: How Did We Get Here*. His speculations on this are generally similar to those of Clive Ponting, namely that there was much to be said in favour of the hunter/gatherer lifestyle, which proved itself sustainable for 100,000 years or more. Ponting puts most of the stress, when explaining the change over to agriculture, on the increasing density of human populations, and suggests that a change was forced on humans when population density became too great to support a hunter/gatherer lifestyle. This is not exactly the basis of Hartmann's analysis, but he would certainly agree with Ponting that the adoption of agriculture, with its production of agricultural surpluses, combined with the development of more lethal weapons, tended to produce cities or states (Younger Cultures, in Hartmann's terms) that were hierarchical, and more interested in conquest and capture than in developing their own lands. Whatever may be the explanation of how we got where we are now, all are agreed that we cannot simply go back to a tribal lifestyle. Thus the most important thoughts *should be* contained in Part III, with its apposite title, *What Can We Do About It?*

Hartmann says (page 200):

> There are specific things that can be done — that you can do — that we can all do . . . All begin with one person understanding how things are, how they got this way, and that there are alternatives. Right now, that person is you, and then you can pass this understanding along to others, and they to others, and so on.

This is a comforting idea, and doubtless contains an element of truth, but the fact is that the process may be far too slow to be effective. David and Marcia Pimentel, of Cornell University, brought out the first edition of their book, *Food, Energy, and Society*, in 1979; since then Pimentel has published a peerless series of scientific papers.[5] Clive Ponting's *A Green History of the Earth* came out as a Penguin book in 1992. Thus a nucleus of people — namely those who have read these books and papers — have understood the situation well enough for many years. But in the short attention-time-span of our culture, books of epochal importance, like *A Green History of the Earth*, soon sink from public attention.

The great problem is getting the message to a sufficient proportion of the population, including politicians, so that the latter come to believe they could take effective action without being voted out of office. The latter is vital: Al Gore, when Vice-president of the USA, clearly did not think that he could safely (in political terms) pursue the policies that his book, *Earth in the Balance*, had indicated to be absolutely vital. We should not limit our praise to Ponting and the Pimentels: there are many illustrious academics who have striven, for many years, with books and lectures, to awaken the public to the overpopulation problem and our precarious reliance on fossil fuels, for example, Paul and Anne Ehrlich, Gretchen Daily, Albert Bartlett, Walter Youngquist, Richard Duncan, Colin Campbell, and the late Donna Meadows.

For a long while, we, in OPT, have believed that the best starting point would be to get Ponting's *A Green History of the Earth* accepted as the basis of education in schools. Politicians might be able to effect this, but it must be doubted that most of them are sufficiently aware of the dangers ahead to try to promote such a drastic change in education. There must also be doubts about whether politicians can ever go against commercial interests, which they would be doing by espousing such an idea.

Does Hartmann come up with any suggestions as to how to break down this apparent impasse? The plain answer is No, although that is not how Hartmann sees it. He says, "Part III shows bright hope for a warm and positive future. You'll learn specific tools and techniques, ways you can change your world and the world around you." It is difficult to express Hartmann's "tools and techniques" in a nutshell, but this, from page 302, gives a flavour of what he believes to be necessary: "to feel the presence of God, the divine intelligence in all living things and even in the supposedly inanimate universe." To my mind, his ideas would work for some people, but it would be hard to find sufficient teachers willing to implant such ideas into young heads. Although historically such beliefs have worked well enough for some tribes, it is better today, I would argue, to stick to the facts of *A Green History of the Earth*, which no teacher should be ashamed of trying to din into the heads of their pupils! When a younger generation has been brought to the level of awareness that the study of this material would impart, then it may be possible to make the drastic alterations to our society which are needed, such as cutting down, and eventually virtually banning, advertising, as a preliminary to largely abandoning our disastrous consumer lifestyles.

It should be admitted that Part III contains some good common sense about the sort of changes that are needed. For instance, Hartmann points out that other societies have avoided the emphasis that our culture has placed on competition; he provides some examples. He says, page 242, "When European missionaries taught Australian Aborigine hunter/gatherers how to play 'football' back in the early 1900s, the Aboriginal children played until both sides had equal scores, that was when the game was over, in their mind." Again, he points at the Iroquois, saying that, "Only women in the tribe could vote on most issues. As a result, decisions regarding relations with other tribes were more often made in the context of 'what will work for our children?' rather than 'who wins?' or considerations of pride, power, or conquest."

These are sound points, but when I was at school, where academic success and athletic prowess was held in such high esteem, it appeared to me to be a crazy system of rewards; for surely what needed to be encouraged was kindly co-operation and concern for others. The problem, it seemed to me then, and still does now, is not seeing what needs to be done, but in knowing how to get society to move in that direction. During my lifetime, things have only got worse, with financial success and celebrity status being ever more exalted.

In summary, we can be glad for Hartmann's memorable title, and for his commendable presentation of our global predicament. *Part I of his book should be read by everyone*. The 'solutions' he presents are not so much wrong, as likely to be inadequate to the magnitude of the problem. Here he is not alone. F.E. (Ted) Trainer's book, *Towards a Sustainable Economy*, also provides a wealth of wise advice about how to tread more lightly on the Earth, but even were it possible to get that advice to be heeded, the change would be insufficient to deal with the magnitude of the problem: a human population which has exploded, in the last 70 years, from 2 billion to a totally unsustainable 6 billion. But then it must be admitted that the proposed teaching of '*Green History*' solution to the problem may be impossible to realize in the face of the many ways in which democracy malfunctions, perhaps most memorably and amusingly summarized in Gore Vidal's *Imperial America: Reflections on the United States of Amnesia* (2004).

Concluding thoughts

Hartmann says, in his introduction, "I'm writing in the hope of creating positive and lasting change." Having expressed some doubts regarding Hartmann's hopes, let us dredge up some positive thoughts of our own. The great task of ending the Atlantic slave trade has similarities to, and lessons for, the current struggle to raise human awareness and stimulate appropriate action. Although Wilberforce was supported by some of the finest parliamentarians of all time, William Pitt and Edmund Burke, and although he was backed by zealous popular efforts, especially from the Quakers, it took Wilberforce — the 'nightingale of the Commons' — nearly twenty years of persistent effort to get a law passed, through the House of Commons and House of Lords, to abolish the slave trade. There is little sign of a similar level of interest — either in parliament or among the people — concerning our present precarious predicament, but soon signals will come through, strong and clear, both as to climate change and the scarcity of fossil fuels. Then there might come about that *relatively* rapid overturning of vested interests that for so long defended the slave trade — and vested interests related to the slave trade were nearly as strong as the commercial interests constituting the fossil fuel lobby today. Perhaps only then will the preparatory work, of all those who have tried to raise awareness, prove to have been not entirely in vain.

References

OPTJ 3/2. 2003. *OPT Journal*, Vol 3, No 2 (Oct), Manchester, UK: Optimum Population Trust. 32 pp. Archived at www.members.aol.com/optjournal2/optj32.doc

OPTJ 4/1. 2003. *OPT Journal*, Vol 4, No 1 (Apr), Manchester, UK: Optimum Population Trust. 32 pp. Archived at www.members.aol.com/optjournal2/optj41.doc

OPTJ 4/2. 2003. *OPT Journal*, Vol 4, No 2 (Oct), Manchester, UK: Optimum Population Trust. 32 pp.

Pimentel, D, Pimentel, M. 1996. *Food, Energy, and Society*. Revised edition. Niwot Co., University Press of Colorado. 363 pp. (£30).

OPTJ 5/2. 2005. *Optimum Population Trust Journal*, Vol. 5, No 2, October 2005. Manchester (U.K.): Optimum Population Trust. 32 pp. Archived on the web at www.members.aol.com/optjournal2/optj52.doc

Ponting, C. 1991. *A Green History of the World*. First published in New York, by St Martin's Press, then by Penguin, in 1992, 432 pp.

Trainer, F.E. (Ted) 1996. *Towards a Sustainable Economy*. England: Jon Carpenter Publishing; Australia: Envirobook.

Vidal, Gore. 2004. *Imperial America: Reflections on the United States of Amnesia*. Clairview.

Endnotes

1. First revised edition published in Great Britain in 2001, by Hodder and Stoughton (the first revised edition was published by Harmony Books in 1999).
2. Pimentel, D., Bailey, O., Kim, P., Mullaney, E., Calabrese, J., Walman, L., Nelson, F. and Yao, X. 1999. Will Limits of the Earth's Resources Control Human Numbers? *Environment, Development and Sustainability* 1: 19-39, 1999.
3. On page 14 Hartmann says, "The Triassic and Jurassic Periods came to an end 205 million years ago when, according to the most widely accepted scientific view another meteor or asteroid struck the planet, triggering another great extinction which also extinguished the dinosaurs." It is true that there was a mass extinction event (the 4th) at the end of the Triassic, about 210 million years ago, but it was the end-Cretaceous mass extinction, about 65 million years ago, which is associated with the extinction of the dinosaurs.

   On page 22 Hartmann says, "or alternative sources of energy such as cold fusion or hydrogen cells . . . " It is a mistake to think of hydrogen cells as a *source* of energy: they are a method of *converting* energy; energy is needed to produce hydrogen.

   On page 46 Hartmann says, "Grain and food production in both America and the rest of the world peaked during the 1980s (and declined steadily in the 1990s)." What he should have referred to is grain and food production *per capita*.

   On pages 69-70 Hartmann says, "in just the past twenty years the concentration of CO_2 in the atmosphere has increased from 315 to over 360 parts per million. Within two more decades, it's projected to exceed 500 parts per million." The 315 to 360 ppm figures indicate a rise of (360 - 315) = 45 / 20 = 2.25 ppm per year. This is slightly high. Taking figures from *Vital Signs 2000*, the 1998 figure was 366.6, and the 1978 figure was 335.3, thus the rise was (366.6 - 335.30) = 31.3 / 20 = 1.57 ppm per year. The 500 ppm "within two more decades" is obviously far too high. Taking 370 as a current figure, 370 + 20 x 1.57 = 401. This would be a good estimate for two decades hence, or perhaps slightly higher if there is an increasing trend..

   These are minor slips, which do not effect the thrust of Hartmann's arguments.
4. Ferguson, A.R.B. 2001. Perceiving the Population Bomb. *WorldWatch*, July/August, pp. 36-39.
5. The following short list of Pimentel's most important papers was given in David Willey's 1999 paper in *Medicine, Conflict and Survival*, Vol. 15, 291-294: "A commentary on David Pimentel's Ecology of Increasing Disease: Population Growth and Environmental Degradation":

   1989 Ecological systems, natural resources, and food supplies.

   1989 Low-input sustainable agriculture using ecological management practices.

   1991 Environmental and economic impacts of reducing U. S. agricultural pesticide use.

   1991 Ethanol fuels: energy security, economics and the environment.

   1992 Conserving biological diversity in agricultural/forestry systems.

   1993 Economics and energetics of organic and conventional farming.

   1993 *World soil erosion and conservation* (Ed.). Cambridge (UK): Cambridge University Press..

   1994 Achieving a secure energy future: environmental and economic issues.

   1994 Natural resources and an optimum human population.

   1995 Environmental and economic costs of soil erosion and conservation benefits.

   1997 Economic and environmental benefits of biodiversity.

   1997 Water resources: agriculture, the environment, and society.

   1997 Feasibility of large-scale biofuel production (Giampietro *et al*, see references).

   1998 An optimum population for North and Latin America.

   1998 Ecology of increasing disease: population growth and environmental degradation.

OTHER VIEWS ON "THE LAST HOURS OF ANCIENT SUNLIGHT"

comments by Lindsey Grant, Val Stevens, James P. Duguid

Lindsey Grant, is the author or editor of many books relating to the population problem, his most recent being the admirably compact *The Collapsing Bubble* (2002). In this paragraph, taken from a Negative Population Growth (NPG) paper, Grant wrote an incisive sentence describing Thom Hartmann's book, *The Last Hours of Ancient Sunlight*:

> Several writers have been writing about the world after oil. Howard Hayden's *The Solar Fraud* (Pueblo, CO: Vales Lake Publishing Co., 2001 & 2004) undertook to show just how costly and impractical solar energy would be as a substitute for fossil energy. Thom Hartmann's *The Last Hours of Ancient Sunlight* (New York: Three Rivers Press, 1998) is a poetic condemnation of the damage that human activity has inflicted on the Earth and a mystical essay on the return to an idyllic society that he believes will come with the end of fossil energy. James Howard Kunstler's *The Long Emergency* (New York: Atlantic Monthly Press, 2005) is a thoroughly frightening speculation about the impact of the end of oil and a speculative effort to describe a better world to follow.

Like David Willey, our founder, I find myself agreeing with everything that Grant writes. I circulated my monograph to two OPT members, requesting comments either on it, or the book itself. While generally agreeing with the monograph, Val Stevens commented:

> I wonder if the real purpose of the monograph is to draw together evidence about the difficulties of solving world energy-shortages through alternative technologies . . . I feel I need a wide spread of examples of the high front end inputs of energy needed for all the alternative technologies — on the model of your example of hydrogen fuel.

Val Stevens was correct in thinking that one purpose of the monograph was to bring out these difficulties, and while she is right in calling for detailed analyses of the inputs, the difficulties inherent in that are apparent from the arguments that have been going on for the last twenty years as to whether the amount of energy that goes into producing ethanol from corn (maize) exceeds the energy contained in the ethanol. The OPT Journal is an ongoing effort to struggle with such problems. She wrote her response before publication of the October 2002 edition of the *OPT Journal*, which brought out some of the problems of assessing the net energy-capture (amount of *useful* energy that can be captured per hectare) of renewables. All six issues since then have been dealing with the problem. An article in the April 2003 issue (OPTJ 3/1, *Implications of the USDA 2002 Update on Ethanol from Corn*) somewhat by-passed the difficulty of assessing the inputs needed to produce ethanol from corn, by showing that even by leaning over backwards to make ethanol production seem sensible, for instance by subtracting from the ethanol output only the required *liquid* inputs, it is apparent that the net liquid energy made available is not a very significant proportion of liquid fuel requirements needed to sustain the main elements of our modern lifestyle. It was estimated (p. 12) that, "50 million hectares of cropland would supply about 11% of the liquid fuel used in U.S. transport." To which I added, so as not to forget a primary aspect of the population problem in the United States, the ethanol produced would, "suffice to meet 10 years of U.S. population growth (at the 1.06% per year rate of the three closing decades of the last century)."

To assess the *useful* output of ethanol, the following factors need to be taken into account:

a) The *proportion* of the corn-growing land which will need to be irrigated, and the energy, and the type of energy, that will be needed to pump the irrigation water.

b) The energy required to produce the fertilizers, herbicides and pesticides to be used, and the energy needed to apply them. Note that with regard to energy, it is not only the amount that is important, but also the type (e.g. 'liquid'), and how that type is to be produced renewably.

c) The *annual yield*, per hectare, which can be achieved under the foregoing assumptions *without causing loss of soil or degradation of fertility*.

d) The amount of energy, and type, required to effect the conversion of corn to ethanol.

e) The amount of energy, and type, required to produce the *equipment* needed to sow the seed, tend the crop and harvest it, and effect the conversion to ethanol; also relevant is how long that equipment will last.

f) The energy cost of dealing with effluents of the conversion process,

g) The degree to which useful by-products can be said to offset other energy costs.

In view of this complexity, which is only slightly greater that that pertaining to other types of renewable energy, it is hardly surprising that there is little agreement among academics when they attempt to analyse the *net* energy-capture which can be expected from biomass (and especially when biomass is used to produce ethanol and methanol), hydroelectrics, solar panels, wind power for supply electricity directly, wind power to produce hydrogen, tidal power and wave power. It is no exaggeration to say that most academics who tackle renewable energy soon find themselves getting bogged down on account of the difficult estimations which are required to make progress.

Stevens went on to say that while she felt she ought to read *The Last Hours of Ancient Sunlight*, it was yet more clear that she should read Clive Ponting's book. She felt that, "Hartmann's was not the most important, and might be skipped if one has as little reading time as I have." I wholly concur, but the number of fine thinkers who have seen the extent of the problem is of interest even if their need to be optimistic leads them to stray from reality. Hartmann's book is not only led astray by the need to be optimistic, but also appears to be addressed particularly to those who are 'spiritually minded'. Another book of his is titled, *The Prophet's Way*. This title correctly indicates that he is looking for more than a hard-nosed rational solution to the problem.

Stevens, on the other hand, would like a clearer picture, one that the layman can hang on to regarding what will be possible with renewable energy alone. The truth is that no one knows the answer. So a wise precautionary approach — taking account of the present level of ignorance — is what is suggested by Hartmann. To sum it up briefly, it is this.

Let us not fall for the often-heard, wildly optimistic predictions for renewable energy. When our inheritance of ancient sunshine has been consumed, we *may well* be back where we were about three hundred years ago. Indeed, it seems *most probable* that the whole world of modern technology, which we now inhabit, is dependent on ancient sunshine.

Jim Duguid, on reading *Ancient Sunlight*, neatly summed up my feelings about Hartmann's solutions being weak, saying: "The remedial course he proposes is a thorough change of culture in both the more and the less developed nations. It seems to me impossible that given the competitive and acquisitive force of human nature, that this change could ever be accomplished, and certainly not on a global scale or within the short time available till fossil-fuel depletion and other resource damage brings disaster."

References

Grant, L. 2005. *The Collapsing Bubble; Growth and Fossil Energy*,. Seven Locks Press. 74 pp. $9.95, ISBN #1-931643-58-X. Available from Amazon, most bookstores, or by contacting: Seven Locks Press, PO Box 25689, Santa Ana, CA 92799; 800-354-5348 or 714-545-2526; email: sevenlocks@aol.com

OPTJ 3/1. 2003. *Optimum Population Trust Journal*, Vol. 3, No 1, April 2003. Manchester (U.K.): Optimum Population Trust. 32 pp. Archived on the web at www.members.aol.com/optjournal2/optj31.doc

ON DEVELOPMENT, DEMOGRAPHY AND CLIMATE CHANGE by Tim Dyson

A review essay by Andrew R.B. Ferguson

Abstract. In his 23 page conference paper, Tim Dyson correctly identifies the essence of the overpopulation problem, namely its impact on the environment. However he merely *assumes* that renewable energy can play only a small part in the replacement of fossil fuels. Since two-thirds of the papers published in the OPT Journal aim at demonstrating that point, we have no reason to disagree with the assumption, but as there are copious popular books which attempt to demonstrate the feasibility of an 'eco-economy' or a 'hydrogen economy', and since most academic papers which have a bearing on the subject refer blithely to a "transition" occurring at some time, it does seem cavalier to merely assume that it is unrealistic to believe it is possible to support the present population on the basis of renewable energy.

Another weakness in this generally admirable paper is that, if the subject under discussion is to be of more than academic interest, the reader should be able to say what action is appropriate if the argument is correct. Unfortunately Tim Dyson, like Howard Hayden and Vaclav Smil, fails to set out the logic of the implications of the arguments he presents, namely that because fossil fuels are bound to run out, *without delay* the world needs to start to reduce population to a sustainable 2 billion.

In 1996, Tim Dyson, Professor of Population Studies at the London School of Economics, published a book, *Population and Food: global trends and future prospects*. It was a very thorough study of that subject. The frontispiece said:

> Considering likely future trends in climate, land resources, water availability, trading patterns, farm inputs and technological innovation, the author argues that there should be no insurmountable problems in meeting the world's food demands to the year 2020, and questions the current pessimism voiced about future food prospects.

That is possibly true, but *relatively* trivial. In the conference paper under review (available on the net)[1] Dyson widens his horizons, appreciating that food is but one aspect of the many problems which indicate that humans have overshot carrying capacity.

He argues forcefully — along the lines often presented in the OPT Journal — that there is no need for sophisticated climate models to see that the world is heading into a dangerous situation because of the amount of carbon being released into the atmosphere. In one paragraph, he sums up the essence of that situation:

> The essential argument of this paper has been that there is a significant chance of very major climate change occurring at some time during the present century. Of course, it is quite possible that future change in the world's climate will be modest, manageable, and perhaps even beneficial for many. But the chances of some sort of disastrous change occurring — abrupt or otherwise — appear to be just as great.

One assumption which underlies Dyson's paper is that renewable energy is capable of playing only a small part in replacing fossil fuels. As two-thirds of each issue of the OPT Journal is devoted to arguing this point, it is somewhat surprising to see it simply assumed by Dyson. It is certainly not assumed by the academic community in general. Howard Hayden is the exception rather than the rule in exposing the idea as unrealistic (OPTJ 5/1, pp. 3–8). Vaclav Smil, who has devoted his working life to studying energy, is still unrealistically optimistic about the prospects (OPTJ 5/1, pp. 9–13).

We, in OPT, have no doubt that Dyson is correct in believing that renewable energy cannot support anything like the present population, but if that assumption is made, and if it is also admitted that fossil fuels will eventually run out, then the question of primary importance is what population can be supported on the basis of renewable energy. It is certainly true that *some* population can be supported on the basis of renewable energy, since that is exactly what the world did up until about 1800. So the primary question that a Professor of Population Studies needs to address is what population could be supported on the basis of renewable energy. Does Dyson agree with David Pimentel, Lindsey Grant, the OPT, plus several other people and organizations that have thought deeply about this problem, and decided that the figure is in the region of 2 billion? The reader is left in the dark about that. In other words, Dyson, like Hayden and Smil, fails to draw the logical conclusion from the facts he presents, namely that the primary aim of humans today needs to be to reduce population to a sustainable level, which may not be exactly 2 billion, but is certainly a fraction of the present population.

The paper is being presented at the Conference of the International Union for the Scientific Study of Population, Tours, 18-23 July, 2005. It is a shame that the very people who should be spelling out the most important population lesson of all — the need for population reduction — seem to fight shy of it. The points mentioned so far cover the full extent of what I find to criticize in this paper. In most respects, Dyson penetrates to the roots of the problem. For instance, this is Dyson's wise appraisal of the political reaction to the threat of climate change.

> This brings us to the international political response — because reducing global CO_2 emissions would certainly require international agreement. The United Nations Framework Convention on Climate Change was initiated in 1992 to start the process towards stabilization of GHGs. But the Convention specifically avoided the issue of the level at which CO_2 (and other GHGs) should be stabilized — a matter which remains largely unresolved. Following publication of the IPCC's second report, world leaders met in Kyoto in 1997. But in many respects the ensuing 'Kyoto process' can itself be seen as one chiefly concerned with ways of avoiding making reductions in CO_2 emissions. Examples of this tendency include the discussion of 'carbon sequestration' i.e. the planting of trees and other vegetation to help 'neutralize' CO_2 emissions. It took considerable time for the limitations of this approach to be appreciated fully — in particular, that over the long run the areas of forest required are incredibly great and that there is no feasible way of stopping the 'respiration' of sequestrated carbon back into the atmosphere (Lohmann 1999). Another approach with a strong element of avoidance — one that has occupied armies of negotiators, lawyers, economists, consultants, etc, the very stuff of Weberian bureaucratization (Prins 2003) — is the construction of 'carbon markets'. The theory is that by enabling 'emissions trading' such markets will allow some countries (usually richer ones, with high emissions) to pay others (usually poorer ones, with low emissions) — essentially as a way of reducing the need to make any reductions at all. The fact is that:
>
> > None of Kyoto's market measures … tackle directly the physical root of global warming: the transfer of fossil fuels from underground, where they are effectively isolated from the atmosphere, to the air. (Lohmann 2001:5).

OPT has continually stressed the need for an agreement on a target limit to carbon dioxide concentration, and for agreement on how a global emissions limit is to be spread between nations. On an international basis, these questions have been hardly addressed. After the UK had set itself a target of reducing its carbon dioxide emissions by 60%, the target was reported by government and media alike as being in accordance with IPCC recommendations. Both the government and the media failed to note that for the UK to conform to the IPCC requirement (a *global* reduction of 60) would require the UK to reduce emissions by 87%.[2] Needless to say, the media in the USA is just as reticent in noting this matter of equity when discussing US emissions. It is also pleasing to see Dyson drawing attention to the fact that sequestering carbon in wood is at best a temporary measure. OPT has continually drawn attention to this, noting that it is a weakness of eco-footprinting that it has a tendency to convey the notion — albeit only indistinctly—that the fossil fuels we are burning can be sequestered in trees.

Dyson is again to be applauded for his realistic appreciation of the political realities when he says:

> The prospects for an enforceable international agreement to significantly reduce CO_2 emissions are very poor. While it may be in the interest of the world as a whole to restrict the burning of fossil fuels, it is in the interest of individual countries to avoid making such changes. Moreover, the enormous complexities involved — many of them created and informed by matters of interest — will also hinder agreement. Doubtless there will be gains in energy use efficiency, shifts towards less carbon intensive fuels, and greater use of renewable energy sources (e.g. solar, wind and tidal power). But except for a massive shift towards nuclear — which has many serious problems attached, and would in any case take decades to bring about — there are limits to what such changes could possibly achieve in terms of CO_2 reduction. Other technological ideas — like the development of the so-called 'hydrogen economy', or the extraction of CO_2 from coal and its sequestration underground or at sea — are remote, even fanciful ideas as large scale and significant solutions to the problem. Indeed, such notions can themselves be the basis of avoidance inasmuch as they suggest that something is being done. Understandably, poor countries are unlikely to put great effort into constraining their CO_2 emissions — especially in the face of massive discrepancies between them and the rich.

All that is entirely true, but note that Dyson merely assumes what OPT and Howard Hayden argue at great length, namely that "greater use of renewable energy sources (e.g. solar, wind and tidal power)" will prove to be able to play only a very small part in supplying the energy needed to support a population of over 6 billion.

OPT also agrees with Dyson (John Nunn has made an extensive study of the matter) that doubts surround the ultimate level of carbon dioxide concentration:

> There is great uncertainty about how big the coming rise in global CO_2 emissions will be. And, particularly in relation to oil and natural gas, it seems likely that limits to the available supplies may operate to curb future expansion to some degree.

The greatest uncertainty arises on account of the amount of coal that it will be viable to extract. What is certain is that there is enough carbon contained in oil, gas and coal to bring the world into the regime of dangerous climate change. The correct conclusion therefore—although it is not one that Dyson spells out — is that a much smaller population is needed. This is a pity, as China, Iran, and Europe have already demonstrated that reducing fertility to a level where populations will fall is not impossible. Dyson does take note of various governments' absurd reaction to declining population, namely to worry about the *economic* consequences rather than applaud the *ecological* consequences.

The concluding paragraph of Dyson's paper shows both its strength and it weakness. He surveys the salient points of his essay thus:

> That modern economic growth and the demographic transition both began at around the same time in history is hardly coincidental. Population growth, migration, and

> urbanization all play significant roles in the subject of global warming and climate change. However, the most important part, by far, is that played by fossil energy — coal, oil and natural gas — in fuelling economic development. It is important to remember that what still locks so many people in conditions of material poverty is their reliance upon economies that remain overwhelmingly 'organic' i.e. they have no real access to the energy supplied by fossil fuels. If there are major changes to the world's climate in the coming century then the agricultural, economic, political and wider social repercussions could be so great that they impact on the future growth trajectory of the human population. While our children or grandchildren may not face the end of the world, they could well face the end of the world, at least as we have known it.

All of that is exactly true and to the point. What is omitted is that without fossil fuels it would be possible to support, in modest comfort, a population of only about 2 billion, and that therefore the primary concern of the human race, and individual nations, should be to reduce their populations to levels which could be supported by renewable energy.

References

Lohmann, L. (1999). *The Dyson Effect: Carbon 'Offset' Forestry and the Privatization of the Atmosphere*, Corner House, Briefing 15. Available at <<http://www.thecornerhouse.org.uk/briefing/>>. Access April 2005.

Lohmann, L. (2001). *Democracy or Carbocracy? Intellectual Corruption and the Future of Climate Debate*, Corner House, Briefing 24. Available at <<http://www.thecornerhouse.org.uk/briefing/>>. Access April 2005.

OPTJ 5/1. (2005). *Optimum Population Trust Journal*, Vol. 5, No 1, April 2005. Manchester (U.K.): Optimum Population Trust. 32 pp.

Prins, G. (2003). "Why are we here?" Introduction to the conference on Knowledge, the Environment and Security, Wilton Park, UK.

Endnotes

1. The paper is available at http://iussp2005.princeton.edu/download.aspx?submissionId=50222 (accessed March 2006).
2. If present emissions, of about 6.3 GtC/yr, are to be reduced by 60% that gives a global figure for 'allowable' emissions of 2.5 GtC/yr. If that is divided by a population of say 7 billion, then each person can emit 2.5 / 7 = 0.36 t/yr. UK emissions are about 10 tCO_2/cap/yr = 2.73 tC/cap/yr. Thus the reduction needed to achieve an equitable 'allowable' emission is 1 - (0.36 / 2.73) = 87%.

In the October 2005 OPT Journal, I did not find room to include Jim Duguid's comments on an article therein. I include them here, as a lead into the next two pages.

> I do like your discussion paper on *A Plain Man's Questions Concerning Wind Power*. It explains the importance of 'peak infeed factor', which I had not before appreciated. It is needed to define the 'block' of electricity to which wind power is expected to contribute, and the proportion of it that will have to be supplied inefficiently by flexible backup.
>
> Your figures of UK's base demand of 20 GW and its mean demand of 45 GW emphasizes the other cause of variability of demand, so well shown in your Figure 2. Really, it is hard enough to cope with the normal variations in demand, and lunatic to add to the difficulty by introducing wind power as a variable means of supply. Until the unlikely discovery of economic means of large-scale storage of surplus wind energy for use when needed, the development of wind power should not proceed beyond the experimental stage.

AN EXPANDED GLOSSARY OF WIND TERMS

by Andrew R.B. Ferguson

Rated capacity. A wind turbine design is such that power output increases with wind strength, but only up to a certain point. The reason for a limit is that it would be hard to make use of spikes of wind power that occurred only a few days a year; and then perhaps for just a few hours. Thus at a certain wind speed — around 13 m/sec, the power output from the wind turbine stabilizes (only to be interrupted if exceptionally high winds cause a problem). This stable plateau of power output — the maximum which a wind turbine can feed into the grid — is known as the *rated capacity* (in kW or MW) of that wind turbine.

Peak infeed factor. While a few wind turbines which are in moderate proximity to one another will sometimes feed their full *rated capacity* into the grid, wind turbines spread over a wide area will never produce their collective *rated capacity*, because it is unlikely that the wind will be at optimum levels over the whole area. For instance, in the E.ON Netz area, which spreads 800 km across Germany, the peak infeed from all the wind turbines collectively, during 2004, was 85% of their *rated capacity*. That is to say, in 2004, their *peak infeed factor* was 85%. Incidentally, the ideal would be to spread the wind turbines so widely that the *peak infeed factor* was much lower than this.

Load factor (also called capacity factor and infeed factor). Of course wind does not constantly blow in the optimum speed range. Sometimes, even over a substantial area, it may be calm. In order to assess how much electricity wind turbines are producing as a fraction of their *rated capacity*, we need to know the average amount of power that they feed into the grid over a year (unqualified, *load factor* usually implies a year, although it can also be useful to look at individual months). *Load factor* is calculated from the total energy, in watt-hours, fed in from the wind turbines, divided by the 8760 hours in a year. While there is no widespread agreement about usage, the term *infeed factor* does imply clearly that the measurement is based on the amount of power that is fed into the grid. For example, in Wind Report 2005, E.ON Netz reported the mean power fed into the grid, in 2004, as 1295 MW (i.e. 1295 x 8760 MW hours). The average installed *rated capacity* was 6650 MW. This makes the *infeed factor*, during 2004, 1295 / 6650 = 19%.

With figures given in that way, there is no doubt that what is being counted is the electricity that is fed into the grid, which makes the term *infeed factor* slightly more appropriate. The term *load factor*, although closely similar, is perhaps more appropriate when there is an element of doubt about the statistic. For instance, data given by the DTI for the UK contains this supplementary note: "Actual generation figures are given where available, but otherwise are estimated using a typical *load factor* or the design *load factor*, where known." The term *capacity factor* can generally be taken as synonymous with *load factor*. It appears to be a term introduced by the wind industry as an alternative to *load factor*, perhaps in recognition that the *load factor* of wind turbines is entirely different from the *load factor* of fossil fuel plants. The latter is normally below plant capacity mainly because electricity is only produced when wanted. Wind turbines operate below *rated capacity* because wind does not always blow at optimum speed.

Backup. This word requires a dissertation rather than a precise definition. In their first wind report, Wind Report 2004 (referring to the year 2003), E.ON Netz said,

> Only limited wind power is available. In order to cover electricity demands, traditional power station capacities must be maintained as so-called 'shadow power stations' at a total level of more than 80% of the installed wind energy capacity, so that the electricity consumption is also covered during economically difficult periods.

This has often been taken to mean that 80% of the *rated capacity* of the wind turbines must be additionally provided as '*backup*' to wind power. A better way of looking at it is to say that the referenced 80% (i.e. peak infeed) must be there whether there is wind power in the system or not. Introducing electricity from wind into the system will cause 'intrusions' (i.e. encroachment) into fossil fuel plant equivalent to about 80% of the *rated capacity* of the wind turbines, since with wind producing at *peak infeed factor*, all the '*backup*' fossil fuel plant could be closed down. In practice, it does not work that way, since the varying intrusion of wind into the system is not borne by a specific part of the total fossil fuel and hydro capacity, but rather it is shared out over the whole flexible part of the system.

It is apparent now why the term 'shadow power station' might be misleading. In Wind Report 2005, E.ON Netz dropped the term, and conveyed the same idea in these terms:

> Their dependence on the prevailing wind conditions means that wind power has a limited *load factor* even when technically available. It is not possible to guarantee its use for the continual cover of electricity consumption. Consequently, traditional power stations with capacities equal to 90% of the installed wind power capacity must be permanently online in order to guarantee power supply at all times.

That final sentence, containing the word "online," is a mis-translation. A better translation is: "Consequently, in order to guarantee power supply at all times, there must always be sufficient capacity available from traditional power stations to cover at least 90% of the *rated capacity* of the installed wind turbines." The 90% figure for 2004, rather than the 80% of 2003, is due to slightly stronger winds in 2004, giving a higher *peak infeed factor*.

All that may seem clear, but it has been thought to be in conflict with the Germany Energy Agency (DENA) report which stated that, "The wind related regulation and reserve capacities can be covered by the conventional power station park and its operating method as outlined in this study." In fact there is no conflict. For E.ON Netz is not to be understood as asserting that *more* fossil fuel capacity has to be available to deal with the wind, but rather that the *existing* fossil fuel plant and hydro has to act in concert with the additional wind infeed, with fossil fuel output reducing as the infeed from the wind increases. Thus the term *backup*, as it applies to wind, is rather loose, referring both to plant covering the 80% or 90% of *rated capacity* referred to by E.ON Netz, and plant kept available to deal with sudden unforeseen changes, such as failure of a major nuclear plant. In the latter respect, wind may only requires a small additional reserve to what is available already, which is why DENA said that the 'rapid response reserve' — what it called the "regulation capacity" — that is presently available within the system can cope with the wind infeed up to the 13% *wind penetration* (see next) that it was studying.

Wind penetration. In Wind Report 2005, E.ON Netz say, "In total, German wind farms generated 26 billion kWh of electricity [in 2004], which is around 4.7% of Germany's gross demand." In that statement, 4.7% is the *wind penetration*. E.ON Netz refer specifically to "gross demand." Occasionally an alternative figure is given as the *wind penetration*, namely one referring to the fraction of "final consumption" rather than of "gross demand." Final consumption is a figure *net* of the electricity used within the energy industry and *net* of transmission losses; it is about 85% of gross demand.

In summary, for 2004, with a 4.7% *wind penetration*, and 19% *infeed factor*, we know that the *rated capacity* of the wind turbines must be 4.7 / 0.19 = 25% of Germany's mean demand. Because of the 85% *peak infeed factor*, we know the wind turbines 'intruded' on the rest of the system to the extent of 25 x 0.85 = 21% of mean demand. Low demand is about 60% of mean demand, thus the 'intrusion' was about 21 / 0.60 = 35% of low demand. It is thus understandable that 4.7% *wind penetration* was manageable.

This is the second contribution to this series, which chronicles how a few people, living at the start of the twenty-first century, reached their understanding of the human condition. Val Stevens is a current co-chair of the Optimum Population Trust, alongside John Guillebaud.

PATHS TO WISDOM, NUMBER 2

By Val Stevens, of ECO, the Campaign for Political Ecology.
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Perhaps the most appropriate response to this invitation — to outline a personal 'path to wisdom' — is to recount the milestones that I have passed along the way.

Paul Ehrlich's *Population, Resources, Environment* (1970)[1]

This book put all my Geography studies in a new light. I joined the recently formed Conservation Society in Edinburgh, where I was lucky enough to have Professor Aubrey Manning as my mentor. The twin aims of the Conservation Society were halting population growth and halting economic growth. Jack Parsons' books on population (*Population versus Liberty*, etc.) also had a great influence on me. Through the 70s, we thought the new insights into the human predicament coupled with the power of reason would win vast numbers of converts. Indeed a great many organisations (FoE, Greenpeace, Ecology Party, Oxfam) took up these ideas and promoted them.

Joining Friends of the Earth

Activists swiftly realised that most people could only think in small chunks. Campaigns had to be tightly focussed: returnable bottles, insulating lofts, fighting acid rain, stopping nuclear power, saving the rainforests. Through the 80s FoE was very successful using this strategy. But people — including the activists — rarely put the pieces together into a big picture. When they did, they adopted the left view that it was all the fault of capitalism; this was the era of Red and Green, and the environmental movement attracted many with left wing views. It was intellectually exciting.

The Destruction of Nature in the Soviet Union[2]

This book brought home the fact that Socialism**,** with its drive for production targets whatever ecological havoc they wrought, was just as bad for the Earth as Capitalism. And we woke up to the many social miseries associated with the USSR regime. Gradually, a new doctrine emerged — Capitalism and Socialism bad; Third World good. Environmental destruction and burgeoning population was caused by gross inequalities; only ending poverty could stop the trends. At this point I revolted: because the other popular reason given (by the same organisations) for environmental destruction was affluence! Logic and reason were going out of the window to benefit a woolly ideology.

Meeting and working with David Willey

David set up Optimum Population Trust c.1990. He was active in FoE, and baffled by their stance on population. A brilliant scholar, he taught himself demography and environmental impact theory (such as existed) and single-handedly, to begin with, built up a great body of work on carrying capacity and ecological footprinting, which was respected by academics in this field around the world — he being almost the only one in this field in UK. Now the work is continued and expanded by Andrew Ferguson — editor of this Journal.

Real World magazine

In parallel with OPT's development, *Real World* reflected the birth of radical ecology, eco-centrism, bio-centrism. For me this magazine presented blazing insights. I started writing for it. Steered by the ex-Left, and ex-Green party member Sandy Irvine, it renounced the contradictory, guilt-ridden, muddled thinking of the left-greens, and broke through the constraints of political correctness to attack both Left and Right, criticised the environmental organisations and the Green party, and rated high growth of population as destructive as high per capita consumption. With these ideas at its core, ECO (the Campaign for Political Ecology) was set up and I became an Executive Committee member.

Professor John Gray's Lectures

At meetings hosted by ECO in the early 90s, Gray's 'Post Humanist' views reflected the emerging eco-centred analysis of man's place in nature. It seemed as if a whole new era of thought had dawned. But this new 'enlightenment' has remained utterly marginal. On the world stage (e.g. UN global conferences) through the 90s, social justice lobbies and the women's movement brooked no mention of the growth of human numbers as part of the environmental crisis — it was still all down to capitalist oppression and poverty, with human short-term welfare before protection of ecosystems — as if we didn't utterly depend on them. In the face of such hubris my bafflement gave way to despair. The curious thing is that I acknowledge as worthy of support, each particular issue on which the environmental and justice organisations campaign; they are all part of a decent and sustainable society. But, to go right back to stage one on my path, Ehrlich said "However worthy the cause, it is doomed if we don't halt human population growth."

Endnotes

1. *Population, Resources, Environment* by Paul R. Ehrlich and Anne H. Ehrlich. W.H. Freeman and Co., San Francisco, 1970
2. *The Destruction of Nature in the Soviet Union* by Boris Komarov. Pluto Press, 1978.