

NOTES AND REFERENCES

These notes will be continuously corrected and expanded on the website www.rationaloptimist.com.

Prologue

- p. 1 'In other classes of animals, the individual advances from infancy to age or maturity'. Ferguson, A. 1767. *An Essay on the History of Civil Society*.
- pp. 1–2 'On my desk as I write sit two artefacts of roughly the same size'. Photographs of the hand axe and computer mouse reproduced by permission of John Watson.
- p. 3 'from perhaps 3 million to nearly 7 billion people'. Kremer, M. 1993. Population growth and technical change, one million B.C. to 1990. *Quarterly Journal of Economics* 108:681–716.
- p. 4 'The human being is the only animal that ...' Gilbert, D. 2007. *Stumbling on Happiness*. Harper Press.
- p. 4 'with the possible exception of language'. Pagel, M. 2008. Rise of the digital machine. *Nature* 452:699.
- p. 4 'compared with even chimpanzees humans are almost obsessively interested in faithful imitation'. Horner, V. and Whiten, A. 2005. Causal knowledge and imitation/emulation switching in chimpanzees (*Pan troglodytes*) and children (*Homo sapiens*). *Animal Cognition* 8:164–81.
- p. 5 'We may call it social evolution when an invention quietly spreads through imitation.' Tarde, G. 1969/1888. *On Communication and Social Influence*. Chicago University Press.
- p. 5 'selection by imitation of successful institutions and habits'. Hayek, F.A. 1960. *The Constitution of Liberty*. Chicago University Press.
- p. 5 'Richard Dawkins in 1976 coined the term "meme" for a unit of cultural imitation'. Dawkins, R. 1976. *The Selfish Gene*. Oxford University Press.
- p. 5 'Richard Nelson in the 1980s proposed that whole economies evolve by natural selection'. Nelson, R.R. and Winter, S.G. 1982. *An Evolutionary Theory of Economic Change*. Harvard University Press.

- p. 6 'a culture or a camera'. Richerson, P. and Boyd, R. 2005. *Not by Genes Alone*. Chicago University Press: 'adding one innovation after another to a tradition until the results resemble organs of extreme perfection'.
- p. 7 "To create is to recombine" said the molecular biologist François Jacob'. Jacob, F. 1977. Evolution and tinkering. *Science* 196:1163.
- p. 8 'what Adam Smith said in 1776'. Smith, A. 1776. *The Wealth of Nations*.
- p. 9 'sluiced artificially cheap money towards bad risks'. For a good account of this see Norberg, J. 2009. *Financial Fiasco*. Cato Institute.
- p. 9 'The crisis has at least as much political as economic causation'. Friedman, J. 2009. A crisis of politics, not economics: complexity, ignorance and policy failure. *Critical Review* 23 (introduction to special issue).

Chapter 1

- p. 11 'On what principle is it, that when we see nothing but improvement behind us, we are to expect nothing but deterioration before us?' Macaulay, T.B. 1830. Review of Southey's *Colloquies on Society*. *Edinburgh Review*, January 1830.
- p. 11 World GDP graph. Maddison, A. 2006. *The World Economy*. OECD Publishing.
- p. 12 'But the vast majority of people are much better fed, much better sheltered, much better entertained, much better protected against disease and much more likely to live to old age than their ancestors have ever been'. Kremer, M. 1993. Population growth and technical change, one million BC to 1990. *Quarterly Journal of Economics* 108:681–716. See Brad De Long's estimates at http://econ161.berkeley.edu/TCEH/1998_Draft/World_GDP/Estimating_World_GDP.html.
- p. 12 'the number of different products that you can buy in New York or London tops ten billion'. Beinhocker, E. 2006. *The Origin of Wealth*. Harvard Business School Press.
- p. 13 'As for the bird outside the window, tomorrow it will be trapped and eaten by the boy'. See McCloskey, D. 2006. *The Bourgeois Virtues*. Chicago University Press: 'Let us then be rich. Remember smoky crofters' cabins. Remember being tied in Japan by law and cost to one locale. Remember American outhouses and iced-over rain barrels and cold and wet and dirt. Remember in Denmark ten people living in one room, the cows and chickens in the other room. Remember in Nebraska sod houses and isolation.'
- p. 14 'income has risen more than nine times'. Maddison, A. 2006. *The World Economy*. OECD Publishing.
- p. 15 'The proportion of Vietnamese living on less than \$2 a day'. Norberg, J. 2006. *When Man Created the World*. Published in Swedish as *När människan skapade världen*. Timbro.
- p. 15 'The poor in the developing world grew their consumption twice as fast as the world as a whole between 1980 and 2000'. Lal, D. 2006.

Notes and references

- Reviving the Invisible Hand*. Princeton University Press. See also Bhalla, S. 2002. *Imagine There's No Country*. Institute of International Economics.
- p. 15 'The percentage living in such absolute poverty has dropped by more than half – to less than 18 per cent'. Chen, S. and Ravallion, M. 2007. Absolute poverty measures for the developing world, 1981–2004. *Proceedings of the National Academy of Sciences USA (PNAS)*. 104: 16757–62.
- p. 15 'The United Nations estimates that poverty was reduced more in the last fifty years than in the previous 500.' Lomborg, B. 2001. *The Sceptical Environmentalist*. Cambridge University Press.
- p. 16 'In 1958 J.K. Galbraith declared'. Galbraith, J.K. 1958. *The Affluent Society*. Houghton Mifflin.
- p. 16 'This would have been unthinkable at mid-century'. Statistics from Lindsey, B. 2007. *The Age of Abundance: How Prosperity Transformed America's Politics and Culture*. Collins.
- p. 17 'Today, a car emits less pollution travelling at full speed than a parked car did in 1970 from leaks.' Pollution facts from Norberg, J. 2006. *When Man Created the World*. Published in Swedish as *När människan skapade världen*. Timbro.
- p. 17 'Within just five years both predictions were proved wrong in at least one country.' Oeppen, J. and Vaupel, J.W. 2002. Demography. Broken limits to life expectancy. *Science* 296:1029–31.
- p. 18 'People are not only spending a longer time living, but a shorter time dying.' Tallis, R. 2006. 'Sense about Science' annual lecture. <http://www.senseaboutscience.org.uk/pdf/Lecture2007Transcript.pdf>.
- p. 18 'The same is true of cancer, heart disease and respiratory disease: they all still increase with age, but they do so later and later, by about ten years since the 1950s.' Fogel, R.W. 2003. *Changes in the Process of Aging during the Twentieth Century: Findings and Procedures of the Early Indicators Project*. NBER Working Papers 9941, National Bureau of Economic Research.
- p. 19 'Yet the global effect of the growth of China and India has been to reduce the difference between rich and poor worldwide.' This is especially clear in Hans Rosling's animated graphs of global income distribution at www.gapminder.com. Incidentally, the individualisation of life that brought personal freedom after the 1960s also brought less loyalty towards the group, a process that surely reached crisis point in the bonus rows of 2009: see Lindsey, B. 2009. *Paul Krugman's Nostalgianomics: Economic Policy, Social Norms and Income Inequality*. Cato Institute.
- p. 19 'As Hayek put it'. Hayek, F.A. 1960. *The Constitution of Liberty*. Chicago University Press.
- p. 19 'Known as the Flynn effect, after James Flynn who first drew attention to it'. Flynn, J.R. 2007. *What Is Intelligence? Beyond the Flynn Effect*. Cambridge University Press.

- pp. 19–20 ‘To date 234 innocent Americans have been freed’. <http://www.innocenceproject.org/know>.
- p. 20 ‘the average family house probably costs slightly less today than it did in 1900 or even 1700’. Comparing house prices over long periods of time is fraught with difficulty, because houses vary so much, but Piet Eichholtz has tried to index house prices by comparing the same area of Amsterdam, the Herengracht, over nearly 400 years: Eichholtz, P.M.A. 2003. A long run house price index: The Herengracht Index, 1628–1973. *Real Estate Economics* 25:175–92.
- p. 20 ‘the same amount of artificial lighting’. Pearson, P.J.G. 2003. *Energy History, Energy Services, Innovation and Sustainability*. Report and Proceedings of the International Conference on Science and Technology for Sustainability 2003: Energy and Sustainability Science, Science Council of Japan, Tokyo.
- pp. 20–1 ‘an hour of work in 1800 earned you ten minutes of reading light’. Nordhaus, W. 1997. *Do Real-Output and Real Wage Measures Capture Reality? The History of Lighting Suggests Not*. Cowles Foundation Paper no. 957, Yale. A modern check using British figures of £479 average weekly income and £0.09 per kilowatt-hour electricity cost produces a similar result: ¼ second of work for 18 watt-hours, plus a little more for the cost of the bulb.
- p. 21 ‘using the currency that counts, your time’. Nordhaus, W. 1997. *Do Real-Output and Real Wage Measures Capture Reality? The History of Lighting Suggests Not*. Cowles Foundation Paper no. 957, Yale.
- p. 21 ‘The economist Don Boudreaux’. http://cafehaye.typepad.com/hayek/2006/08/were_much_wealt.html.
- p. 22 ‘The average Briton today consumes roughly 40,000 times as much artificial light as he did in 1750.’ Fouquet, R., Pearson, P.J.G., Long run trends in energy services 1300–2000. Environmental and Resource Economists 3rd World Congress, via web, Kyoto.
- p. 23 ‘Healthcare and education are among the few things that cost more in terms of hours worked now than they did in the 1950s.’ Cox, W.M. and Alm, R. 1999. *Myths of Rich and Poor – Why We Are Better Off Than We Think*. Basic Books. See also Easterbrook, G. 2003. *The Progress Paradox*. Random House.
- p. 23 ‘observe what *Harper’s Weekly* had to say’. Gordon, J.S. 2004. *An Empire of Wealth: the Epic History of American Power*. Harper Collins.
- p. 23 ‘They were enricher-barons, too’. McCloskey, D. 2006. *The Bourgeois Virtues*. Chicago University Press.
- p. 24 ‘Henry Ford got rich by making cars cheap’. Moore, S. and Simon, J. 2000. *It’s Getting Better All the Time*. Cato Institute.
- p. 24 ‘The price of aluminium fell from \$545 a pound in the 1880s to twenty cents a pound in the 1930s’. Shermer, M. 2007. *The Mind of the Market*. Times Books.
- p. 24 ‘When Juan Trippe sold cheap tourist class seats on his Pan Am airline

Notes and references

- in 1945'. Norberg, J. 2006. *When Man Created the World*. Published in Swedish as *När människan skapade världen*. Timbro.
- p. 25 'Where it took sixteen weeks to earn the price of 100 square feet of housing in 1956, now it takes fourteen weeks and the housing is of better quality.' Cox, W.M. and Alm, R. 1999. *Myths of Rich and Poor – Why We Are Better Off Than We Think*. Basic Books.
- p. 25 'To remedy this, governments then have to enforce the building of more affordable housing, or subsidise mortgage lending to the poor'. Woods, T.E. 2009. *Meltdown*. Regnery Press.
- p. 25 'according to Richard Layard'. Layard, R. 2005. *Happiness: Lessons from a New Science*. Penguin.
- p. 26 'The hippies were right all along'. Oswald, Andrew. 2006. The hippies were right all along about happiness. *Financial Times*, 19 January 2006.
- p. 26 'a study by Richard Easterlin in 1974'. Easterlin, R.A. 1974. Does economic growth improve the human lot? in Paul A. David and Melvin W. Reder (eds). *Nations and Households in Economic Growth: Essays in Honor of Moses Abramovitz*. Academic Press.
- p. 26 'the Easterlin paradox does not exist'. Stevenson, B. and Wolfers, J. 2008. *Economic Growth and Subjective Well-Being: Reassessing the Easterlin Paradox*. NBER Working Papers 14282, National Bureau of Economic Research; Ingleheart, R., Foa, R., Peterson, C. and Welzel, C. 2008. Development, freedom and rising happiness: a global perspective, 1981–2007. *Perspectives on Psychological Science* 3:264–86.
- p. 26 'In the words of one of the studies'. Stevenson, B. and Justin Wolfers, J. 2008. *Economic Growth and Subjective Well-Being: Reassessing the Easterlin Paradox*. NBER Working Papers 14282, National Bureau of Economic Research.
- p. 27 'a tax on consumption to encourage saving for investment instead'. Frank, R.H. 1999. *Luxury Fever: Why Money Fails to Satisfy in an Era of Excess*. The Free Press.
- p. 27 'to be well off and unhappy is surely better than to be poor and unhappy.' The journalist Greg Easterbrook's prayer goes: 'thank you that I and five hundred million others are well-housed, well-supplied, overfed, free, and not content; because we might be starving, wretched, locked under tyranny and still not content.' Easterbrook, G. 2003. *The Progress Paradox*. Basic Books.
- p. 27 'psychologists find people to have fairly constant levels of happiness'. Gilbert, D. 2007. *Stumbling on Happiness*. Harper Press.
- p. 27 'political scientist Ronald Ingleheart'. Ingleheart, R., Foa, R., Peterson, C. and Welzel, C. 2008. Development, freedom and rising happiness: a global perspective, 1981–2007. *Perspectives on Psychological Science* 3:264–86.
- p. 28 'Ruut Veenhoven finds'. Veenhoven, R. 1999. Quality-of-life in individualistic society: A comparison of 43 nations in the early 1990's. *Social Indicators Research* 48:157–86.

- p. 28 'some pressure groups may have exacerbated real hunger in Zambia'. Paarlberg, R. 2008. *Starved for Science*. Harvard University Press.
- p. 28 'The precautionary principle'. Ron Bailey points out that most renditions of the precautionary principle boil down to the injunction: 'Never do anything for the first time.' <http://reason.com/archives/2003/07/02/making-the-future-safe>.
- p. 29 'By the same age, human hunter-gatherers have consumed about 20 per cent of their lifetime calories, but produced just 4 per cent.' Kaplan, H.E. and Robson, A.J. 2002. The emergence of humans: the co-evolution of intelligence and longevity with intergenerational transfers. *PNAS* 99:10221-6; see also Kaplan, H. and Gurven, M. 2005. The natural history of human food sharing and cooperation: a review and a new multi-individual approach to the negotiation of norms. In *Moral Sentiments and Material Interests* (eds H. Gintis, S. Bowles, R. Boyd and E.Fehr). MIT Press.
- p. 31 'curse of resources'. Ferguson, N. 2008. *The Ascent of Money*. Allen Lane.
- p. 31 'the Great Depression of the 1930s is just a dip in the slope'. Findlay, R. and O'Rourke, K.H. 2007. *Power and Plenty: Trade, War and the World Economy*. Princeton University Press.
- p. 31 'All sorts of new products and industries were born during the Depression'. Nicholas, T. 2008. Innovation lessons from the 1930s. *McKinsey Quarterly*, December 2008.
- p. 31 'Arcadia Biosciences in northern California'. http://www.arcadiabio.com/pr_0032.php.
- p. 33 'Henry David Thoreau asked'. Thoreau, H.D. 1854. *Walden: Or Life in the Woods*. Ticknor and Fields.
- p. 34 'In 1900, the average American spent \$76 of every \$100 on food, clothing and shelter. Today he spends \$37'. Cox, W.M. and Alm, R. 1999. *Myths of Rich and Poor – Why We Are Better Off Than We Think*. Basic Books.
- p. 34 'To produce implies that the producer desires to consume' said John Stuart Mill; 'why else should he give himself useless labour?'. Mill, J.S. 1848. *Principles of Political Economy*.
- p. 34 'Thomas Thwaites set out to make his own toaster'. <http://www.the-toasterproject.org>. 'Kelly Cobb of Drexel University set out to make a man's suit'. <http://www.wired.com/print/culture/design/news/2007/03/100milesuit0330>. See also <http://www.thebigquestions.com/2009/10/30/the-10000-suit>.
- p. 37 'In civilized society,' wrote Adam Smith'. Smith, A. 1776. *The Wealth of Nations*.
- p. 38 'Leonard Read's classic 1958 essay "I, Pencil"'. Read, L.E. 1958. I, Pencil. *The Freeman*, December 1958. For a fine modern rerun of the same subject see the novel by Roberts, R. 2008. *The Price of Everything*. Princeton University Press.
- p. 38 'As Friedrich Hayek first clearly saw'. Hayek, F.A. 1945. The use of

Notes and references

- knowledge in society. *American Economic Review* 35:519–30.
- p. 39 ‘a smaller quantity of labour produce a greater quantity of work’. Smith, A. 1776. *The Wealth of Nations*.
- p. 39 ‘you would have spent your after-tax income in roughly the following way’. Data from the Bureau of Labour Statistics: www.bls.org.
- p. 40 ‘An English farm labourer in the 1790s spent his wages roughly as follows’. Clark, G. 2007. *A Farewell to Alms*. Princeton University Press.
- p. 40 ‘A rural peasant woman in modern Malawi spends her time roughly as follows’. Blackden, C.M. and Wodon, Q. 2006. *Gender, Time Use and Poverty in SubSaharan Africa*. World Bank.
- p. 40 ‘the Shire River in Machinga province’. <http://allafrica.com/stories/200712260420.html>.
- p. 41 ‘not just the services you need but also those you crave.’ The distinction between needs and wants, as expressed by Abraham Maslow’s hierarchy of needs, is a mischievous one: people evolved to be ambitious, to start exaggerating their social status or sexual worth, long before they have satisfied their basic needs. See Miller, G. 2009. *Spent*. Heinemann.
- p. 41 ‘the entire concept of food miles is “a profoundly flawed sustainability indicator”’. Bailey, R. 2008. The food miles mistake. *Reason*, 4 November 2008. <http://www.reason.com/news/show/129855.html>.
- p. 41 ‘Ten times as much carbon’. See <https://statistics.defra.gov.uk/esg/reports/foodmiles/final.pdf>.
- p. 42 ‘six times the carbon footprint of a Kenyan rose’. Specter, M. 2008. Big foot. *The New Yorker*, 25 February 2008. http://www.newyorker.com/reporting/2008/02/25/080225fa_fact_specter. See also <http://grownunderthesun.com>.
- p. 42 ‘just as it did in Europe in 1315–18’. Jordan, W.C. 1996. *The Great Famine: Northern Europe in the Early Fourteenth Century*. Princeton University Press.
- p. 43 ‘Today, 1 per cent works in agriculture and 24 per cent in industry’. Statistics in this paragraph from Angus Maddison (*Phases of Capitalist Development*), cited in Kealey, T. 2008. *Sex, Science and Profits*. Heinemann.
- p. 43 ‘the original affluent society’. Sahlins, M. 1968. Notes on the original affluent society. In *Man the Hunter* (eds R.B. Lee and I. DeVore). Aldine. Pages 85–9.
- p. 43 ‘They lived into old age far more frequently than their ancestors had done.’ Caspari, R. and Lee, S.-H. 2006. Is human longevity a consequence of cultural change or modern biology? *American Journal of Physical Anthropology* 129:512–17.
- p. 43 ‘they had largely wiped out the lions and hyenas’. Ofek, H. 2001. *Second Nature: Economic Origins of Human Evolution*. Cambridge University Press.
- p. 44 ‘Geoffrey Miller, for example, in his excellent book *Spent*’. Miller, G. 2009. *Spent*. Heinemann.

- p. 44 'The warfare death rate of 0.5'. Keeley, L. 1996. *War Before Civilization*. Oxford University Press.
- p. 44 'a cemetery uncovered at Jebel Sahaba'. Otterbein, K.F. 2004. *How War Began*. Texas A & M Press.
- p. 45 'asks Geoffrey Miller'. Miller, G. 2009. *Spent*. Heinemann.

Chapter 2

- p. 47 'He steps under the shower, a forceful cascade pumped down from the third floor.' McEwan, I 2005. *Saturday*. Jonathan Cape. The person taking the shower is Perowne, the surgeon at the centre of the plot.
- p. 47 Life expectancy graph. World Bank Development Indicators.
- p. 48 'One day a little less than 500,000 years ago, near what is now the village of Boxgrove'. Potts, M. and Roberts, M. 1998. *Fairweather Eden*. Arrow Books.
- p. 49 'a single twitch of progress in biface hand-axe history'. Klein R.G. and Edgar B. 2002. *The Dawn of Human Culture*. Wiley.
- p. 49 'Its brain was almost as big as a modern person's'. Rightmire, G.P. 2003. Brain size and encephalization in early to Mid-Pleistocene *Homo*. *American Journal of Physical Anthropology* 124: 109–23.
- p. 51 'the erectus hominid species'. For simplicity, I am going to call all the species of hominid that lived between about 1.5 million and 300,000 years ago 'erectus hominid' after the longest-established and most comprehensive name used for hominids of this period. The current fashion is to include four species within this group: *H. ergaster* earliest in Africa, *H. erectus* a little later in Asia, *H. heidelbergensis* coming out of Africa later into Europe and its descendant, *H. neanderthalensis*. See Foley, R.A. and Lahr, M.M. 2003. On stony ground: Lithic technology, human evolution, and the emergence of culture. *Evolutionary Anthropology* 12:109–22.
- p. 51 'it was a natural expression of human development'. See Richerson, P. and Boyd, R. 2005. *Not by Genes Alone*. Chicago University Press: 'Perhaps we need to entertain the hypothesis that Acheulean bifaces were innately constrained rather than wholly cultural and that their temporal stability stemmed from some component of genetically transmitted psychology.'
- p. 51 'Meat enabled them to cut down on the huge gut'. Aiello, L.C. and Wheeler, P. 1995. The expensive tissue hypothesis: the brain and the digestive system in human and primate evolution. *Current Anthropology* 36:199–221.
- p. 52 'the toolkit was showing signs of change as early as 285,000 years ago'. McBrearty, S. and Brooks, A. 2000. The revolution that wasn't: a new interpretation of the origin of modern human behavior. *Journal of Human Evolution* 39:453–563. Morgan, L.E. and Renne, P.R. 2008. Diachronous dawn of Africa's Middle Stone Age: New 40Ar/39Ar ages from the Ethiopian Rift. *Geology* 36:967–70.

Notes and references

- p. 52 'by at least 160,000 years ago'. White T.D. et al. 2003. Pleistocene Homo sapiens from Middle Awash, Ethiopia. *Nature* 423:742–7; Willoughby, P. R. 2007. *The Evolution of Modern Humans in Africa: a Comprehensive Guide*. Rowman AltaMira.
- p. 52 'Pinnacle Point in South Africa'. Marean, C.W. et al. 2007. Early human use of marine resources and pigment in South Africa during the Middle Pleistocene. *Nature* 449:905–8.
- p. 53 'a few slender-headed Africans did begin to colonise the Middle East'. Stringer, C. and McKie, R. 1996. *African Exodus*. Jonathan Cape.
- p. 53 'at Grottes des Pigeons near Tatoralt in Morocco'. Bouzouggar, A. et al. 2007. 82,000-year-old shell beads from North Africa and implications for the origins of modern human behavior. *PNAS* 2007 104:9964–9; Barton R.N.E., et al. 2009. OSL dating of the Aterian levels at Dar es-Soltan I (Rabat, Morocco) and implications for the dispersal of modern Homo sapiens. *Quaternary Science Reviews*. doi:10.1016/j.quascirev.2009.03.010.
- p. 53 'obsidian may have begun to move over long distances'. Negash, A., Shackley, M.S. and Alene, M. 2006. Source provenance of obsidian artefacts from the Early Stone Age (ESA) site of Melka Konture, Ethiopia. *Journal of Archeological Science* 33:1647–50; and Negash, A. and Shackley, M.S. 2006. Geochemical provenance of obsidian artefacts from the MSA site of Porc Epic, Ethiopia. *Archaeometry* 48:1–12.
- p. 54 'Lake Malawi, whose level dropped 600 metres'. Cohen, A.S. et al. 2007. Ecological consequences of early Late Pleistocene megadroughts in tropical Africa. *PNAS* 104:16422–7.
- p. 54 'Their genes, marked by the L3 mitochondrial type, suddenly expanded and displaced most others in Africa'. Atkinson, Q.D., Gray, R.D. and Drummond, A.J. 2009. Bayesian coalescent inference of major human mitochondrial DNA haplogroup expansions in Africa. *Proceedings of the Royal Society B* 276:367–73.
- p. 55 'living in large social groups on a plentiful diet both encourages and allows brain growth'. Dunbar, R. 2004. *The Human Story*. Faber and Faber.
- p. 55 'a fortuitous genetic mutation triggered a change in human behaviour'. Klein, R.G. and Edgar, B. 2002. *The Dawn of Human Culture*. John Wiley.
- p. 55 'FOXP2, which is essential to speech and language in both people and songbirds'. Fisher, S.E. and Scharff, C. 2009. FOXP2 as a molecular window into speech and language. *Trends in Genetics* 25:166–77. doi: 10.1016/j.tig.2009.03.002 A.
- p. 55 'the mutations even change the way mice pups squeak'. Enard, W. et al. 2009. A humanized version of FOXP2 affects cortico-basal ganglia circuits in mice. *Cell* 137:961–71.
- p. 55 'Neanderthals share the very same two mutations'. Krause, J. et al. 2007. The derived FOXP2 variant of modern humans was shared with Neandertals. *Current Biology* 17:1908–12.

- p. 57 'as Leda Cosmides and John Tooby put it'. Cosmides, L. and Tooby, J. 1992. Cognitive adaptations for social exchange. In *The Adapted Mind* (eds J.H. Barkow, L. Cosmides and J. Tooby). Oxford University Press.
- p. 57 'In Adam Smith's words'. Both Adam Smith quotes are from book 1, part 2, of *The Wealth of Nations* (1776).
- p. 57 'In the grasslands of Cameroon'. Rowland and Warnier, quoted in Shennan, S. 2002. *Genes, Memes and Human History*. Thames & Hudson.
- p. 59 'The primatologist Sarah Brosnan tried to teach two different groups of chimpanzees about barter'. Brosnan, S.F., Grady, M.F., Lambeth, S.P., Schapiro, S.J. and Beran, M.J. 2008. Chimpanzee autarky. *PLOS ONE* 3(1):e1518. doi:10.1371/journal.pone.0001518.
- p. 59 'Chimpanzees and monkeys can be taught to exchange tokens for food'. Chen, M.K. and Hauser, M. 2006. How basic are behavioral biases? Evidence from capuchin monkey trading behavior. *Journal of Political Economy* 114:517–37.
- p. 59 'not even a hint of this complementarity is found among nonhuman primates.' Wrangham, R. 2009. *Catching Fire: How Cooking Made Us Human*. Perseus Books.
- p. 60 'Birute Galdikas reared a young orang utan'. Galdikas, B. 1995. *Reflections of Eden*. Little, Brown.
- p. 60 'fire itself is hard to start, but easy to share'. Ofek, H. 2001. *Second Nature: Economic Origins of Human Evolution*. Cambridge University Press.
- p. 61 'males and females specialise and then share food'. Low, B. 2000. *Why Sex Matters: a Darwinian Look at Human Behavior*. Princeton University Press.
- p. 61 'men hunt, women and children gather'. Kuhn, S.L. and Stiner, M.C. 2006. What's a mother to do? A hypothesis about the division of labour and modern human origins. *Current Anthropology* 47:953–80.
- p. 61 'making strikingly different decisions about how to obtain resources within that habitat'. Kaplan, H. and Gurven, M. 2005. The natural history of human food sharing and cooperation: a review and a new multi-individual approach to the negotiation of norms. In *Moral Sentiments and Material Interests* (eds H. Gintis, S. Bowles, R. Boyd and E. Fehr). MIT Press.
- p. 62 'Martu women in western Australia hunt goanna lizards'. Bliege Bird, R. 1999. Cooperation and conflict: the behavioural ecology of the sexual division of labour. *Evolutionary Anthropology* 8:65–75.
- p. 62 'Women demand meat as their social right, and they get it – otherwise they leave their husbands, marry elsewhere or make love to other men'. Biesele, M. 1993. *Women Like Meat*. Indiana University Press.
- p. 62 'In the Mersey estuary near Liverpool'. Stringer, C. 2006. *Homo Britannicus*. Penguin.
- p. 63 'In the Alyawarre aborigines of Australia'. Bliege Bird, R. and Bird, D.

Notes and references

2008. Why women hunt: risk and contemporary foraging in a Western Desert Aboriginal community. *Current Anthropology* 49:655–93.
- p. 63 'A sexual division of labour would exist even without childcare constraints.' It is reasonable to wonder if a hundred thousand years of doing different things have not left their mark on at least some of the modern leisure pursuits of the two sexes. Shopping for shoes is a bit like gathering – picking out the perfect item in a crowd of possibilities. Playing golf is a bit like hunting – aiming a ballistic projectile at a target in the great outdoors. It is also noticeable how much more carnivorous most men are than most women. In the West, female vegetarians outnumber male ones by more than two to one, but even among non-vegetarians it is common to find men who take only a token nibble at the vegetables on their plate, and women who do the same with meat. Of course, it is part of my case that in the Stone Age men supplied gathering women with meat and women supplied hunting men with veg, so both sexes were omnivores, but perhaps when it came to 'stopping for lunch', the women would eat the nuts they had gathered while elsewhere the men cooked up a tortoise or cut a steak off their first kill. Such speculation is not, I admit, very scientific.
- p. 63 'It is as if the species now has two brains'. Joe Henrich first made this point to me late at night in a bar in Indiana.
- p. 63 'men seem to strive to catch big game to feed the whole band'. Bliege Bird, R. and Bird, D. 2008. Why women hunt: risk and contemporary foraging in a Western Desert Aboriginal community. *Current Anthropology* 49:655–93.
- p. 63 'Hadza men spend weeks trying to catch a huge eland antelope'. Hawkes, K. 1996. Foraging differences between men and women. In *The Archaeology of Human Ancestry* (eds James Steele and Stephen Shennan). Routledge.
- p. 63 'men on the island of Mer in the Torres Strait'. Bliege Bird, R. 1999. Cooperation and conflict: the behavioural ecology of the sexual division of labour. *Evolutionary Anthropology* 8:65–75.
- p. 64 'Steven Kuhn and Mary Stiner think that modern, African-origin *Homo sapiens* had a sexual division of labour and Neanderthals did not'. Kuhn, S.L. and Stiner, M.C. 2006. What's a mother to do? A hypothesis about the division of labour and modern human origins. *Current Anthropology* 47:953–80.
- p. 64 'first advocated by Glyn Isaac in 1978'. Isaac, G.L. and Isaac, B. 1989. *The Archaeology of Human Origins: Papers by Glyn Isaac*. Cambridge University Press.
- p. 65 'To paraphrase H.G. Wells'. Wells, H.G. 1902. 'The Discovery of the Future'. Lecture at the Royal Institution, 24 January 1902, published in *Nature* 65:326–31. Reproduced with the permission of AP Watt Ltd on behalf of the Literary Executors of the Estate of H.G. Wells.
- p. 66 'to land, probably around 45,000 years ago, on the continent of Sahul'.

- O'Connell, J.F. and Allen, J. 2007. Pre-LGM Sahul (Pleistocene Australia-New Guinea) and the archaeology of Early Modern Humans. In Mellars, P., Boyle, K., Bar-Yosef, O. et al., *Rethinking the Human Revolution*, Cambridge: McDonald Institute for Archaeological Research, pp. 395–410.
- p. 66 'genetics tell an unambiguous story of almost complete isolation since the first migration'. Thangaraj, K. et al. 2005. Reconstructing the origin of Andaman Islanders. *Science* 308: 996; Macaulay, V. et al. 2005. Single, rapid coastal settlement of Asia revealed by analysis of complete mitochondrial genomes. *Science* 308:1034–6; Hudjashov et al. 2007. Revealing the prehistoric settlement of Australia by Y chromosome and mtDNA analysis. *PNAS*. 104: 8726–30.
- p. 67 'Jonathan Kingdon first suggested'. Kingdon, J. 1996. *Self-Made Man: Human Evolution from Eden to Extinction*. John Wiley.
- p. 67 'All along the coast of Asia, the beachcombers would have found fresh water'. Faure, H., Walter, R.C. and Grant, D.E. 2002. The coastal oasis: Ice Age springs on emerged continental shelves. *Global and Planetary Change* 33:47–56.
- p. 68 'so louse genes suggest'. Pennisi, E. 2004. Louse DNA suggests close contact between Early Humans. *Science* 306:210.
- p. 68 'conceivably even close enough to acquire a smattering of their cousins' genes'. Svante Paabo, personal communication. See also Evans, P.D. et al. 2006. Evidence that the adaptive allele of the brain size gene microcephalin introgressed into Homo sapiens from an archaic Homo lineage. *PNAS* 103:18178–83.
- p. 69 'driven to the brink of extinction by human predation'. Stiner, M. C. and Kuhn, S. L. 2006. Changes in the 'connectedness' and resilience of palaeolithic societies in Mediterranean ecosystems. *Human Ecology* 34:693–712.
- p. 69 'in the Mojave desert of California, ravens occasionally kill tortoises for food'. <http://www.scienceblog.com/community/older/archives/E/usgs398.html>.
- p. 70 'shells, fossil coral, steatite, jet, lignite, hematite, and pyrite were used to make ornaments and objects'. Stringer, C. and McKie, R. 1996. *African Exodus*. Jonathan Cape.
- p. 70 'A flute made from the bone of a vulture'. Conard, N.J., Maline, M. and Munzel, S.C. 2009. New flutes document the earliest musical tradition in southwestern Germany. *Nature* 46:737–740.
- p. 71 'jewellery made of shells from the Black Sea and amber from the Baltic'. Ofek, H. 2001. *Second Nature: Economic Origins of Human Evolution*. Cambridge University Press.
- p. 71 'This is in striking contrast to the Neanderthals, whose stone tools were virtually always made from raw material available within an hour's walk of where the tool was used'. Stringer, C. 2006. *Homo Britannicus*. Penguin: 'Whereas virtually all Neanderthal stone tools were made

Notes and references

- from raw materials sourced within an hour's walk from their sites, Cro-Magnons were either much more mobile or had exchange networks for their resources covering hundreds of miles'.
- p. 73 'say the evolutionary biologists Mark Pagel and Ruth Mace'. Pagel, M. and Mace, R. 2004. The cultural wealth of nations. *Nature* 428:275–8.
- p. 73 'Ian Tattersall remarks'. Tattersall, I. 1997. *Becoming Human*. Harcourt.
- p. 73 'It is such a human a thing to do, and so obvious an explanation of the thing that needs explaining: the capacity for innovation'. See for example Horan, R.D., Bulte, E.H. and Shogren, J.F. 2005. How trade saved humanity from biological exclusion: the Neanderthal enigma revisited and revised. *Journal of Economic Behavior and Organization* 58:1–29.
- p. 75 'defined by the stockbroker David Ricardo in 1817'. Ricardo, D. 1817. *The Principles of Political Economy and Taxation*. John Murray.
- p. 75 'It is such an elegant idea that it is hard to believe that Palaeolithic people took so long to stumble upon it (or economists to define it)'. It is also surprising how hard it is for many intellectuals to grasp its essentials. For a catalogue of its misrepresentations, see Paul Krugman's essay 'Ricardo's Difficult Idea': <http://web.mit.edu/krugman/www/ricardo.htm>.
- pp. 75–6 'Insect social life is built not on increases in the complexity of individual behaviour, "but instead on specialization among individuals"'. Holldobler, B. and Wilson, E.O. 2008. *The Superorganism*. Norton.
- p. 77 'Even Charles Darwin reckoned'. Darwin, C. R. 1871. *The Descent of Man*. Quoted in Ofek, H. 2001. *Second Nature: Economic Origins of Human Evolution*. Cambridge University Press.
- p. 77 'According to the anthropologist Joe Heinrich'. Heinrich, J. 2004. Demography and cultural evolution: how adaptive cultural processes can produce maladaptive losses – the Tasmanian case. *American Antiquity* 69:197–214.
- p. 78 'The most striking case of technological regress is Tasmania'. Heinrich, J. 2004. Demography and cultural evolution: how adaptive cultural processes can produce maladaptive losses – the Tasmanian case. *American Antiquity* 69:197–214.
- p. 79 'it was not that there was no innovation; it was that regress overwhelmed progress'. Diamond, J. 1993. Ten thousand years of solitude. *Discover*, March 1993.
- p. 80 'The Tasmanian market was too small to sustain many specialised skills'. Heinrich, J. 2004. Demography and cultural evolution: how adaptive cultural processes can produce maladaptive losses – the Tasmanian case. *American Antiquity* 69:197–214.
- p. 81 'On Kangaroo Island and Flinders Island, human occupation petered out, probably by extinction, a few thousand years after isolation'. Bowdler, S. 1995. Offshore island and maritime explorations in Australian prehistory. *Antiquity* 69:945–58.
- p. 81 'causing the anthropologist W.H.R. Rivers to puzzle'. Shennan, S. 2002.

- Genes, Memes and Human History*. Thames & Hudson.
- p. 81 'Shell beads had been moving long distances across Australia since at least 30,000 years ago.' Balme, J. and Morse, K. 2006. Shell beads and social behaviour in Pleistocene Australia. *Antiquity* 80: 799–811.
- p. 81 'The best stone axes travelled up to 500 miles from where they were mined.' Flood, J. 2006. *The Original Australians: the Story of the Aboriginal People*. Allen & Unwin.
- p. 81 'In contrast to Tasmania, Tierra del Fuego'. Heinrich, J. 2004. Demography and cultural evolution: how adaptive cultural processes can produce maladaptive losses – the Tasmanian case. *American Antiquity* 69:197–214.
- p. 82 'The success of human beings depends crucially, but precariously, on numbers and connections.' Incidentally, the story of the Greenland Norse, or of the inhabitants of Easter Island, told so eloquently as tales of ecological exhaustion in Jared Diamond's book *Collapse*, probably say as much about isolation as ecology. Isolated from Scandinavia by a combination of the Black Death and the worsening climate, the Greenland Norse could not sustain their lifestyles; like the Tasmanians, they forgot how to fish. Easter Island Diamond may have partly misread: some argue that its society was possibly still flourishing, despite deforestation, when a holocaust of slave traders arrived in the 1860s – see Peiser, B. 2005. From genocide to ecocide: the rape of Rapa Nui. *Energy & Environment* 16:513–39.
- p. 82 'This may explain why Australian aboriginal technology, although it developed and elaborated steadily over the ensuing millennia, was lacking in so many features of the Old World'. O'Connell, J.F. and Allen, J. 2007. Pre-LGM Sahul (Pleistocene Australia-New Guinea) and the archaeology of Early Modern Humans. In Mellars, P., Boyle, K., Bar-Yosef, O. et al. *Rethinking the Human Revolution*. Cambridge: McDonald Institute for Archaeological Research, pp. 395–410.
- pp.82–3 'The "Tasmanian effect" may also explain why technological progress had been so slow and erratic in Africa after 160,000 years ago'. Richerson, P.J., Boyd, R. and Bettinger, R.L. 2009. Cultural innovations and demographic change. *Human Biology* 81:211–35; Powell, A., Shennan, S. and Thomas, M.G. 2009. Late Pleistocene demography and the appearance of modern human behaviour. *Science* 324:1298–1301.
- p. 83 'As the economist Julian Simon put it'. Simon, J. 1996. *The Ultimate Resource 2*. Princeton University Press.
- p. 84 'Tasmanians sold women to the sealers as concubines'. Flood, J. 2006. *The Original Australians: the Story of the Aboriginal People*. Allen & Unwin.

Chapter 3

- p. 85 'Money is not metal. It is trust inscribed'. Ferguson, N. 2008. *The Ascent of Money*. Allen Lane.
- p. 85 Homicide rate graph. Spierenburg, P. 2008. *A History of Murder*. Polity

Notes and references

- Press. See also Eisner, M. 2001. Modernization, Self-Control and Lethal Violence. The Long-term Dynamics of European Homicide Rates in Theoretical Perspective *The British Journal of Criminology* 41:618-638.
- p. 85 'Greenstreet whispers to Bogart'. Siegfried, T. 2006. *A Beautiful Math: John Nash, Game Theory and the Modern Quest for a Code of Nature*. Joseph Henry Press.
- p. 86 'As the economist Herb Gintis puts it'. <http://www.reason.com/news/show/34772.html>.
- p. 86 'people in fifteen mostly small-scale tribal societies were enticed to play the Ultimatum Game'. Henrich, J. et al. 2005. 'Economic man' in cross-cultural perspective: Behavioral experiments in 15 small-scale societies. *Behavioral and Brain Sciences* 28:795-815.
- p. 87 'costly punishment of selfishness may be necessary'. Fehr, E. and Gächter, S. 2000. Cooperation and punishment in public goods experiments. *American Economic Review*, Journal of the American Economic Association 90: 980-94; Henrich, J. et al. 2006. Costly punishment across human societies. *Science* 312:1767-70.
- p. 88 'in other group-living species, such as ants or chimpanzees, the interactions between members of different groups are almost always violent'. Brosnan, S. 2008. Fairness and other-regarding preferences in nonhuman primates. In Zak, P. (ed.) 2008. *Moral Markets*. Princeton University Press.
- p. 88 'human beings can treat strangers as honorary friends'. Seabright, P. 2004. *The Company of Strangers*. Princeton University Press.
- p. 88 'primatologists such as Sarah Hrdy and Frans de Waal'. Hrdy, S. 2009. *Mothers and Others*. Belknap. De Waal, F. 2006. *Our Inner Ape*. Granta Books.
- p. 89 'The traders of Malaysia, Indonesia and the Philippines were often women, who were taught to calculate and to account from an early age.' Pomeranz, K. and Topik, S. 2006. *The World That Trade Created*. M.E. Sharpe.
- p. 89 'the British government trusted a Jewish lender named Nathan Rothschild'. Ferguson, N. 2008. *The Ascent of Money*. Allen Lane.
- p. 90 'the experiment, run by Bart Wilson, Vernon Smith and their colleagues'. Crockett, S., Wilson, B. and Smith, V. 2009. Exchange and specialization as a discovery process. *Economic Journal* 119: 1162-88.
- p. 90 'the Yir Yoront aborigines, in northern Australia'. Sharp, L. 1974. Steel axes for stone age Australians. In Cohen, Y. (ed.) 1974. *Man in Adaptation*. Aldine de Gruyter.
- pp. 91-2 'a young naturalist named Charles Darwin came face to face with some hunter-gatherers'. Darwin, C.R. 1839. *The Voyage of the Beagle*. John Murray.
- p. 92 'New Guinea highlanders, when first contacted by Michael Leahy and his fellow prospectors in 1933'. Connolly, R. and Anderson, R. 1987. *First Contact*. Viking.

- p. 92 'The people of the Pacific coast of North America were sending seashells hundreds of miles inland, and importing obsidian from even farther afield.' Baugh, T.E. and Ericson, J.E. 1994. *Prehistoric Exchange Systems in North America*. Springer.
- pp. 92-3 'The Chumash of the Californian channel islands'. Arnold, J.E. 2001. *The Origins of a Pacific Coast Chiefdom: The Chumash of the Channel Islands*. University of Utah Press.
- p. 93 'Das Adam Smith Problem'. Coase, R. H. 1995. Adam Smith's view of man. In *Essays on Economics and Economists*. University of Chicago Press.
- p. 93 'How selfish soever man may be supposed'. Smith, A. 1759. *The Theory of Moral Sentiments*.
- p. 93 'Man has almost constant occasion for the help of his brethren'. Smith, A. 1776. *The Wealth of Nations*.
- p. 93 'honorary friends'. Seabright, P. 2004. *The Company of Strangers*. Princeton University Press.
- p. 94 'As the philosopher Robert Solomon put it'. Solomon, R.C. 2008. Free enterprise, sympathy and virtue. In Zak, P. (ed.). 2008. *Moral Markets*. Princeton University Press.
- p. 94 'a baby smiling causes particular circuits in its mother's brain to fire'. Noriuchi, M., Kikuchi, Y. and Senoo, A. 2008. The functional neuroanatomy of maternal love: mother's response to infant's attachment behaviors. *Biological Psychiatry* 63:415-23.
- p. 94 'the neuro-economist Paul Zak'. Zak, P. 2008. Values and value. In Zak, P. (ed.). 2008. *Moral Markets*. Princeton University Press.
- p. 94 'Zak, together with Ernst Fehr and other colleagues, conducted one of the most revealing experiments in the history of economics'. Kosfeld, M., Henrichs, M., Zak, P.J., Fischbacher, U. and Fehr, E. 2005. Oxytocin increases trust in humans. *Nature* 435: 673-6.
- p. 95 'by suppressing the activity of the amygdala, the organ that expresses fear'. Rilling, J.K., et al. 2007. Neural correlates of social cooperation and non-cooperation as a function of psychopathy. *Biological Psychiatry* 61:1260-71.
- p. 96 'says the economist Robert Frank'. Frank, R. 2008. The status of moral emotions in consequentialist moral reasoning. In Zak, P. (ed.) 2008. *Moral Markets*. Princeton University Press.
- p. 96 'people acutely remember the faces of those who cheat them'. Mealey, L., Daood, C. and Krage, M. 1996. Enhanced memory for faces of cheaters. *Ethology and Sociobiology* 17:119-28.
- pp. 96-7 'Capuchin monkeys and chimpanzees are just as resentful of unfair treatment'. Brosnan, S. 2008. Fairness and other-regarding preferences in nonhuman primates. In Zak, P. (ed.) 2008. *Moral Markets*. Princeton University Press.
- p. 97 'the more people trust each other in a society, the more prosperous that society is'. Zak, P. and Knack, S. 2001. Trust and growth. *Economic Journal* 111:295-321.

Notes and references

- p. 99 'John Clippinger draws an optimistic conclusion'. Clippinger, J.H. 2007. *A Crowd of One*. Public Affairs Books.
- p. 99 'as Robert Wright has argued'. Wright, R. 2000. *Non Zero: the Logic of Human Destiny*. Pantheon.
- p. 101 'Michael Shermer thinks that is because in most of the Stone Age it was true'. Shermer, M. 2007. *The Mind of the Market*. Times Books.
- p. 101 'incredible augmentation of the pots and pans of the country'. Quoted in O'Rourke, P.J. 2007. *On The Wealth of Nations*. Atlantic Monthly Press.
- p. 102 'said the Archbishop of Canterbury in 2008'. *Spectator*, 24 September. 2008.
- p. 102 'As the Australian economist Peter Saunders argues'. Saunders, P. 2007. Why capitalism is good for the soul. *Policy Magazine* 23:3–9.
- p. 102 'Brink Lindsey writes'. Lindsey, B. 2007. *The Age of Abundance: How Prosperity Transformed America's Politics and Culture*. Collins.
- p. 102 'Arnold Toynbee, lecturing working men on the English industrial revolution which had so enriched them'. Quoted in Phillips, A. and Taylor, B. 2009. *On Kindness*. Hamish Hamilton.
- p. 103 'In 2009 Adam Phillips and Barbara Taylor argued'. Phillips, A. and Taylor, B. 2009. *On Kindness*. Hamish Hamilton.
- p. 103 'As the British politician Lord Taverne puts it'. Lord Taverne, personal communication.
- p. 103 'John Padgett at the University of Chicago compiled data on the commercial revolution in fourteenth-century Florence'. Described in Clippinger, J.H. 2007. *A Crowd of One*. Public Affairs Books.
- p. 103 'observed Charles, Baron de Montesquieu'. Quoted in Hirschman, A. 1977. *The Passions and the Interests*. Princeton University Press.
- p. 103 'David Hume thought commerce "rather favourable to liberty"'. McFarlane, A. 2002. David Hume and the political economy of agrarian civilization. *History of European Ideas* 27:79–91.
- p. 104 'The rapid commercialisation of lives since 1800 has coincided with an extraordinary improvement in human sensibility'. Pinker, S. 2007. A history of violence. *The New Republic*, 19 March 2007.
- p. 105 'it was the nouveau-riche merchants, with names like Wedgwood and Wilberforce, who financed and led the anti-slavery movement'. Desmond, A. and Moore, J. 2009. *Darwin's Sacred Cause*. Allen Lane.
- p. 105 'Far from being a vice,' says Eamonn Butler'. Butler, E. 2008. *The Best Book on the Market*. Capstone.
- p. 105 'When shown a photograph of an attractive man'. Miller, G. 2009. *Spent*. Heinemann.
- p. 106 'As Michael Shermer comments'. Shermer, M. 2007. *The Mind of the Market*. Times Books.
- p. 106 'your chances of being murdered have fallen steadily since the seventeenth century in every European country'. Eisner, M. 2001. Modernization, self-control and lethal violence. The long-term dynamics

- of European homicide rates in theoretical perspective. *British Journal of Criminology* 41:618–38.
- p. 106 ‘Murder was ten times as common before the industrial revolution in Europe, per head of population, as it is today.’ See also Spierenburg, P. 2009. *A History of Murder*. Polity Press.
- p. 106 ‘the environmental Kuznets curve’. Yandle, B., Bhattarai, M. and Vijayaraghavan, M. 2004. *Environmental Kuznets Curves*. PERC.
- p. 106 ‘when per capita income reaches about \$4,000, people demand a clean-up of their local streams and air’. Goklany, I. 2008. *The Improving State of the World*. Cato Institute.
- p. 107 ‘because people were enriching themselves and demanding higher standards’. Moore, S. and Simon, J. 2000. *It’s Getting Better All the Time*. Cato Institute.
- p. 107 ‘The “long tail” of the distribution’. Anderson, C. 2006. *The Long Tail: Why the Future of Business Is Selling Less of More*. Hyperion.
- p. 108 ‘now-unfashionable philosopher Herbert Spencer who insisted that freedom would increase along with commerce’. Quotes are from 1842 essay for *The Nonconformist* and 1853 essay for *The Westminster Review*. Both quoted in Nisbet, R. 1980. *History of the Idea of Progress*. Basic Books.
- p. 108 ‘The American civil rights movement drew its strength partly from a great economic migration’. Lindsey, B. 2007. *The Age of Abundance: How Prosperity Transformed America’s Politics and Culture*. Collins.
- p. 109 ‘much argument about whether democracy is necessary for growth’. Friedman, B. 2005. *The Moral Consequences of Economic Growth*. Knopf.
- p. 109 ‘I am happy to cheer, with Deirdre McCloskey’. McCloskey, D. 2006. *The Bourgeois Virtues*. Chicago University Press.
- p. 110 ‘One side denounced capitalism but gobbled up its fruits; the other cursed the fruits while defending the system that bore them.’ Lindsey, B. 2007. *The Age of Abundance: How Prosperity Transformed America’s Politics and Culture*. Collins.
- p. 111 ‘Like Milton Friedman’. Quoted in Norberg, J. 2008. *The Klein Doctrine*. Cato Institute briefing paper no. 102. 14 May 2008.
- p. 111 ‘serfs under feudal brandlords’. Klein, N. 2001. *No Logo*. Flamingo.
- p. 111 ‘Shell may have tried to dump an oil-storage device’. Greenpeace claimed that the *Brent Spar* had 5,500 tonnes of oil in it, then later admitted the true figure was nearer 100 tonnes.
- p. 111 ‘Enron funded climate alarmism’. Ken Lay had ambitions for Enron to ‘become the world’s leading renewable energy company’ and it lobbied hard for renewable energy subsidies and mandates. See <http://masterresource.org/?p=3302#more-3302>.
- p. 111 ‘half of today’s biggest companies did not even exist in 1980’. Micklethwait, J. and Wooldridge, A. 2003. *The Company*. Weidenfeld.
- p. 112 ‘According to Eric Beinhocker of McKinsey’. Beinhocker, E. 2006. *The Origin of Wealth*. Random House.
- p. 113 ‘Like corrugated iron and container shipping’. The development of

Notes and references

- containerisation in the 1950s made the loading and unloading of ships roughly twenty times as fast and thereby dramatically lowered the cost of trade, helping to start the boom in Asian exports. Today, despite the advent of the weightless information age, the world's merchant fleet – at over 550 million gross registered tonnes – is twice the size it was in 1970 and ten times the size it was in 1920. See Edgerton, D. 2006. *The Shock of the Old: Technology and Global History since 1900*. Profile Books.
- p. 113 'A single, routine, minuscule Wal-Mart decision in the 1990s'. Fishman, C. 2006. *The Wal-Mart Effect*. Penguin.
- p. 114 'As Kodak and Fuji slugged it out for dominance in the 35mm film industry'. The remarkable thing about the death of film cameras is how blind the film companies were to it. As late as 2003, they were insisting that digital would only take some of the market and film would endure.
- p. 114 'In America, roughly 15 per cent of jobs are destroyed every year'. Kauffman Foundation estimates: cited in *The Economist* survey of business in America, by Robert Guest, 30 May 2009.
- p. 114 "“This isn't about auctions,” said Meg Whitman, the chief executive of eBay'. 'ebay, inc'. Harvard Business School case study 9-700-007.
- p. 117 'In a sample of 127 countries'. Carden, A. and Hall, J. 2009. Why are some places rich while others are poor? The institutional necessity of economic freedom (29 July 2009). Available at SSRN: <http://ssrn.com/abstract=1440786>.
- p. 117 'the World Bank published a study of “intangible wealth”'. Bailey, R. 2007. The secrets of intangible wealth. *Reason*, 5 October 2007. <http://reason.com/news/show/122854.html>.
- p. 118 '*lex mercatoria*'. I discuss this in more detail in *The Origins of Virtue* (1996).
- p. 118 'When Michael Shermer and three friends started a bicycle race across America'. In Shermer, M. 2007. *The Mind of the Market*. Times Books.

Chapter 4

- p. 121 'Whoever could make two ears of corn'. Swift, J. 1726. *Gulliver's Travels*.
- p. 121 Global cereal harvest graph. See FAOSTAT: <http://faostat.fao.org>.
- p. 122 'Oetzi, the mummified “iceman”'. See <http://www.mummytombs.com/otzi/scientific.htm> for sources on Oetzi.
- p. 122 'The biologist Lee Silver'. Lee Silver, personal communication.
- p. 123 'For Adam Smith capital is “as it were, a certain quantity of labour stocked and stored up to be employed, if necessary, upon some other occasion”'. Smith, A. 1776. *The Wealth of Nations*.
- p. 124 'At one remarkable site, Ohalo II'. Piperno, D.R., Weiss, E., Holst, I. and Nadel, D. 2004. Processing of wild cereal grains in the Upper Palaeolithic revealed by starch grain analysis. *Nature* 430:670–3.
- p. 124 'One study notes an “extreme reluctance to shift to domestic foods”'.

- Johnson, A.W. and Earle, T.K. 2000. *The Evolution of Human Societies: from Foraging Group to Agrarian State*. Stanford University Press.
- p. 125 'The probable cause of this hiatus was a cold snap'. Rosen, A.M. 2007. *Civilizing Climate: Social Responses to Climate Change in the Ancient Near East*. Rowman AltaMira.
- p. 126 'the survivors took to nomadic hunter-gathering again'. Shennan, S. 2002. *Genes, Memes and Human History*. Thames & Hudson.
- p. 126 'Peru by 9,200 years ago'. Dillehay, T.D. et al. 2007. Preceramic adoption of peanut, squash, and cotton in northern Peru. *Science* 316:1890–3.
- p. 126 'millet and rice in China by 8,400 years ago'. Richerson, P.J., Boyd, R. and Bettinger, R.L. 2001. Was agriculture impossible during the Pleistocene but mandatory during the Holocene? A climate change hypothesis. *American Antiquity* 66:387–411.
- p. 126 'maize in Mexico by 7,300 years ago'. Pohl, M.E.D. et al. 2007. Microfossil evidence for pre-Columbian maize dispersals in the neotropics from San Andrés, Tabasco, Mexico. *PNAS* 104: 11874–81.
- p. 126 'taro and bananas in New Guinea by 6,900 years ago'. Denham, T.P., et al. 2003. Origins of agriculture at Kuk Swamp in the Highlands of New Guinea. *Science* 301: 189–93.
- p. 126 'This phenomenal coincidence'. Recent scholarship has made the coincidence much more striking. Until recently, agriculture in Peru, Mexico and New Guinea was believed to have started much later.
- p. 127 'agriculture was impossible during the last glacial, but compulsory in the Holocene.' Richerson, P.J., Boyd, R. and Bettinger, R.L. 2001. Was agriculture impossible during the Pleistocene but mandatory during the Holocene? A climate change hypothesis. *American Antiquity* 66(3): 387–411. Incidentally, there is a fascinating parallel between the sudden appearance of farming at the end of the last ice age and the sudden appearance of multicellular life after the mother of all ice ages, the snowball-earth period between 790 and 630 million years ago, when from time to time even the tropics lay under thick ice sheets. The isolated pockets of shivering bacterial refugees upon snowball earth found themselves so inbred, goes one ingenious argument, that individuals clubbed together as a 'body' and delegated breeding to specialised reproductive cells. See Boyle, R.A., Lenton, T.M., Williams, H.T.P. 2007. Neoproterozoic 'snowball Earth' glaciations and the evolution of altruism. *Geobiology* 5:337–49.
- p. 127 'It is no accident that modern Australia, with its unpredictable years of drought followed by years of wet, still looks a bit like that volatile glacial world'. Lourandos, H. 1997. *Continent of Hunter-Gatherers*. Cambridge University Press.
- p. 127 'One of the intriguing things about the first farming settlements is that they also seem to be trading towns'. Sherratt, A. 2005. The origins of farming in South-West Asia. ArchAtlas, January 2008, edition 3, <http://>

Notes and references

- www.archatlas.org/OriginsFarming/Farming.php, accessed 30 January 2008.
- p. 128 'Jane Jacobs suggested in her book *The Economy of Cities*'. Jacobs, J. 1969. *The Economy of Cities*. Random House.
- p. 128 'In Greece, farmers arrived suddenly and dramatically around 9,000 years ago.' Perles, C. 2001. *The Early Neolithic in Greece*. Cambridge University Press.
- p. 128 'so the genetic evidence suggests'. Cavalli-Sforza, L.L. and Cavalli-Sforza, E. C. 1995. *The Great Human Diasporas: the History of Diversity*. Addison-Wesley.
- p. 129 'Other descendants of the Black Sea refugees took to the plains of what is now Ukraine'. Fagan, B. 2004. *The Long Summer*. Granta.
- p. 129 'a genetic mutation, substituting G for A in a control sequence upstream of a pigment gene called OCA2'. Eiberg H. et al. 2008. Blue eye color in humans may be caused by a perfectly associated founder mutation in a regulatory element located within the HERC2 gene inhibiting OCA2 expression. *Human Genetics* 123:177–87.
- p. 130 'The carbon dioxide released by the fires may even have helped to warm the climate to its 6,000-years-ago balmy maximum'. Ruddiman, W.F. and Ellis, E.C. 2009. Effect of per-capita land use changes on Holocene forest clearance and CO₂ emissions. *Quaternary Science Reviews*. (doi:10.1016/j.quascirev.2009.05.022).
- p. 130 'the stamp seals of the Halaf people, 8,000 years ago'. <http://www.tellhalaf-projekt.de/de/tellhalaf/tellhalaf.htm>.
- p. 131 'Haim Ofek writes'. Ofek, H. 2001. *Second Nature: Economic Origins of Human Evolution*. Cambridge University Press.
- p. 131 'in the words of two theorists'. Richerson, P.J. and Boyd, R. 2007. The evolution of free-enterprise values. In Zak, P. (ed.) 2008. *Moral Markets* Princeton University Press.
- p. 131 'very early mining of pure copper-metal deposits around Lake Superior'. Pledger, T. 2003. A brief introduction to the Old Copper Complex of the Western Great Lakes: 4000–1000 BC. In *Proceedings of the Twenty-seventh Annual Meeting of the Forest History Association of Wisconsin, Inc.* Oconto, Wisconsin, 5 October 2002, pp. 10–18. See also <http://www.uwfox.uwc.edu/academics/depts/tpleger/oldcopper.html>.
- p. 132 'the Mitterberg copper miners'. Shennan, S.J. 1999. Cost, benefit and value in the organization of early European copper production. *Antiquity* 73:352–63.
- p. 132–3 'typical modern non-industrial people, living in traditional societies, directly consume between one-third and two-thirds of what they produce, and exchange the rest for other goods'. Davis, J. 1992. *Exchange*. Open University Press.
- p. 133 'Up to about 300 kilograms of food per head per year, people eat what they grow'. Clark, C. 1970. *Starvation or Plenty?* Secker and Warburg.
- p. 133 'Stephen Shennan satirises the attitude thus'. Shennan, S.J. 1999. Cost,

- benefit and value in the organization of early European copper production. *Antiquity* 73:352–63.
- p. 134 'The 'kula' system of the south Pacific'. Davis, J. 1992. *Exchange*. Open University Press.
- p. 135 'the worst mistake in the history of the human race'. Diamond, J. 1987. The worst mistake in the history of the human race? *Discover*, May: 64–6.
- p. 136 'polygamy enables poor women to share in prosperity more than poor men'. Shennan, S. 2002. *Genes, Memes and Human History*. Thames & Hudson.
- p. 137 'Fuegian men, who could not swim, left their wives to anchor canoes in kelp beds and swim ashore in snow storms'. Bridges, E.L. 1951. *The Uttermost Part of the Earth*. Hodder & Stoughton.
- p. 137 'One commentator writes'. Wood, J.W. et al. 1998. A theory of preindustrial population dynamics: demography, economy, and well-being in Malthusian systems. *Current Anthropology* 39:99–135.
- p. 137 'The archaeologist Steven LeBlanc says that the evidence of constant violence in the ancient past'. LeBlanc, S.A. and Register, K. 2003. *Constant Battles: Why We Fight*. St Martin's Griffin.
- p. 138 'In the Merzbach valley in Germany'. Shennan, S. 2002. *Genes, Memes and Human History*. Thames & Hudson.
- p. 138 'At Talheim around 4900 BC'. Bentley, R.A., Wahl, J., Price T.D. and Atkinson, T.C. 2008. Isotopic signatures and hereditary traits: snapshot of a Neolithic community in Germany. *Antiquity* 82:290–304.
- p. 138 'As Paul Seabright has written'. Seabright, P. 2008. *Warfare and the Multiple Adoption of Agriculture after the Last Ice Age*, IDEI Working Paper no. 522, April 2008.
- p. 138 'When Samuel Champlain accompanied (and assisted with his arquebus) a successful Huron raid upon the Mohawks in 1609'. Brook, T. 2008. *Vermeer's Hat*. Profile Books.
- p. 139 'Robert Malthus'. Yes, Robert: to call Thomas Robert Malthus by his first name which he did not use, is like calling the first director of the FBI John Hoover.
- p. 140 'the eminent British chemist Sir William Crookes gave a similar jeremiad'. Crookes, W. 1898. *The Wheat Problem*. Reissued by Ayers 1976.
- p. 140 'Fritz Haber and Carl Bosch'. Smil, V. 2001. *Enriching the Earth*. MIT Press.
- pp. 140–1 'As late as 1920, over three million acres of good agricultural land in the American Midwest lay uncultivated'. Clark, C. 1970. *Starvation or Plenty?* Secker and Warburg.
- p. 142 'a scientist working in Mexico called Norman Borlaug'. Easterbrook, G. 1997. Forgotten benefactor of humanity. *The Atlantic Monthly*.
- p. 143 'In 1968, after huge shipments of Mexican seed, the wheat harvest was extraordinary in both countries.' Hesser, L. 2006. *The Man Who Fed the*

Notes and references

- World*. Durban House. See Borlaug, N.E. 2000. Ending world hunger: the promise of biotechnology and the threat of antiscience zealotry. *Plant Physiology* 124:487–90. Also author's interview with N. Borlaug 2004.
- p. 144 'Intensification has saved 44 per cent of this planet for wilderness.' Goklany I. 2001. Agriculture and the environment: the pros and cons of modern farming. *PERC Reports* 19:12–14.
- p. 144 'Some argue that the human race already appropriates for itself an unsustainable fraction of the planet's primary production'. The World Wildlife Fund estimates that humankind is already overdrawn in its use of earth's resources, but it reaches this conclusion only by including a vast acreage of new forest planting needed to balance each person's carbon emissions.
- p. 144 'HANPP – the "human appropriation of net primary productivity"'. Haberl, H. et al. 2007. Quantifying and mapping the human appropriation of net primary production in earth's terrestrial ecosystems. *Proceedings of the National Academy of Sciences* 104:12942–7.
- p. 145 'These findings suggest that, on a global scale, there may be a considerable potential to raise agricultural output without necessarily increasing HANPP'. Haberl, H. et al. 2007. Quantifying and mapping the human appropriation of net primary production in earth's terrestrial ecosystems. *Proceedings of the National Academy of Sciences* 104:12942–7.
- p. 145 'Even the confinement of chickens, pigs and cattle to indoor barns and batteries'. Dennis Avery of the Hudson Institute has written on this. See http://www.hudson.org/index.cfm?fuseaction=publication_details&id=3988.
- p. 146 'Colin Clark calculated that human beings could in theory sustain themselves on just twenty-seven square metres of land each'. Clark, C. 1963. Agricultural productivity in relation to population. In *Man and His Future*, CIBA Foundation; also Clark, C. 1970. *Starvation or Plenty?* Secker and Warburg.
- p. 146 'the world grew about two billion tonnes of rice, wheat and maize on about half a billion hectares of land'. Statistics taken from the FAO: www.faostat.fao.org.
- p. 147 'would mean an extra seven billion cattle grazing an extra thirty billion acres of pasture'. Smil, V. 2001. *Enriching the Earth*. MIT Press. See also http://www.heartland.org/policybot/results/22792/Greenpeace_Farming_Plan_Would_Reap_Environmental_Havoc_around_the_World.html: Dennis Avery asked Vaclav Smil to make this calculation.
- p. 147 'Lester Brown points out that India depends heavily on a rapidly depleting aquifer and a slowly drying Ganges'. Brown, L. 2008. *Plan B 3.0: Mobilizing to Save Civilisation*. Earth Policy Institute.
- p. 148 'Once it is properly priced by markets, water is not only used more frugally'. Morriss, A.P. 2006. Real people, real resources and real choices:

- the case for market valuation of water. *Texas Tech Law Review* 38.
- p. 149 'as a professor and a chef have both suggested on my radio recently'. The professor and the chef I refer to are Tim Lang and Gordon Ramsey. 'Why are we buying food from other people which should be feeding developing countries?' asked Tim Lang, member of the Sustainable Development Commission, on the BBC *Today* programme, 4 March 2008. 'I don't want to see asparagus on menus in the middle of December. I don't want to see strawberries from Kenya in the middle of March. I want to see it home grown,' said Gordon Ramsey on 9 May 2008. (See 'Ramsey orders seasonal-only menu', <http://news.bbc.co.uk/1/hi/uk/7390959.stm>.) Apart from the increased emissions, imagine the terrible monotony of the British diet under these proposals. There would be no coffee or tea, no bananas or mangoes, no rice or curry powder, there would be strawberries only in June and July and no lettuce in winter. You would eat an awful lot of potatoes. The rich would heat their greenhouses and plant orange trees in them, or travel to foreign parts and smuggle papayas in their luggage. Meat would become a luxury only available to the professor and his fellow rich folk – for to grow a lamb chop requires ten times as much land as to grow a piece of bread of equivalent calories. There are no combine harvester factories in Britain, so unless the prof wants us hypocritically to import combines but not flour, we would all have to take our turn in the fields with sickles in August. These are no doubt mere inconveniences that the professor would sort out with some laws and some food police. The real problem lies elsewhere, conveniently out of sight in the developing world. The growers of coffee, tea, bananas, mangoes, rice and turmeric would all suffer. They would have to stop growing cash crops and start being more self-sufficient. Sounds charming, but self-sufficiency is the very definition of poverty. Unable to sell their cash crops, they would have to eat what they grow. As we in the north munched our potatoes and bread, so they in the tropics would be growing heartily sick of an endless diet of mangoes and turmeric. The cash economy enables me to eat mangoes and them to eat bread, thank goodness.
- p. 149 'again the acreage under the plough will have to balloon'. Or, to put the point in academic-ese: 'The additional harvest of 4–7 Pg C/yr needed to achieve this level of bioenergy use would almost double the present biomass harvest and generate substantial additional pressure on ecosystems.' Haberl, H. et al. 2007. Quantifying and mapping the human appropriation of net primary production in earth's terrestrial ecosystems. *Proceedings of the National Academy of Sciences* 104:12942–7.
- p. 149 'each needs little more than a thousand square metres, a tenth of a hectare'. Smil, V. 2000. *Feeding the World*. MIT Press.
- p. 150 'Organic farming is low-yield, whether you like it or not'. Avery, A. 2006. *The Truth about Organic Foods*. Henderson Communications. See also Goulding, K.W.T. and Trewavas, A.J. 2009. Can organic feed the

Notes and references

- world? AgBioview Special Paper 23 June 2009. http://www.agbioworld.org/newsletter_wm/index.php?caseid=archive&newsid=2894.
- p. 150 'With such help a particular organic plot can match non-organic yields, but only by using extra land elsewhere to grow the legumes and feed the cattle'. A recent study claimed that organic yields can be higher than those of conventional farming (<http://www.ns.umich.edu/htdocs/releases/story.php?id=5936>), but only by an extremely selective and biased misuse of the statistics (see <http://www.cgfi.org/2007/09/06/organic-abundance-report-fatally-flawed/>).
- p. 150 'a pound of organic lettuce, grown without synthetic fertilisers or pesticides in California, and containing eighty calories, requires 4,600 fossil-fuel calories to get it to a customer's plate'. Pollan, M. 2006 *The Omnivore's Dilemma: the Search for the Perfect Meal in a Fast Food World*. Bloomsbury.
- p. 150 'when a technology came along that promised to make organic farming both competitive and efficient, the organic movement promptly rejected it'. Ronald, P. and Adamchak, R.W. 2008. *Tomorrow's Table: Organic Farming, Genetics and the Future of Food*. Oxford University Press.
- p. 152 'a near-doubling of yield and a halving of insecticide use'. ISAAA 2009. *The Dawn of a New Era: Biotech Crops in India*. ISAAA Brief 39, 2009: <http://www.isaaa.org/resources/publications/downloads/The-Dawn-of-a-New-Era.pdf>.
- p. 152 'the use of insecticides is down by as much as 80 per cent'. Marvier M., McCreedy, C., Regetz, J. and Kareiva, P. 2007. A meta-analysis of effects of Bt cotton and maize on nontarget invertebrates. *Science* 316:1475–7; also Wu, K.-M. et al. 2008. Suppression of cotton bollworm in multiple crops in China in areas with Bt Toxin-containing cotton. *Science* 321:1676–8 (doi: 10.1126/science.1160550).
- p. 152 'the leaders of the organic movement locked themselves out of a new technology'. Ronald, P.C. and Adamchak, R.W. 2008. *Tomorrow's Table: Genetics, and the Future of Food*. Oxford University Press.
- p. 152 'the amount of pesticide *not* used because of genetic modification at over 200 million kilograms of active ingredients'. Miller, J.K. and Bradford, K.J. 2009. The pipeline of transgenic traits in specialty crops. Unpublished paper, Kent Bradford.
- p. 152 'writes the Missouri farmer Blake Hurst'. Hurst, B. 2009. The omnivore's delusion: against the agri-intellectuals. *The American*, journal of the American Enterprise Institute. 30 July 2009. <http://www.american.com/archive/2009/july/the-omnivore2019s-delusion-against-the-agri-intellectuals>.
- p. 152 '*Silent Spring*'. Carson, R. 1962. *Silent Spring*. Houghton Mifflin.
- p. 153 'These mutations were selected, albeit inadvertently'. Doebley, J. 2006. Unfallen grains: how ancient farmers turned weeds into crops. *Science* 312:1318–19.

- p. 153 'DNA sequences borrowed from mosses and algae'. Richardson, A.O. and Palmer, J.D. 2006. Horizontal gene transfer in plants. *Journal of Experimental Botany* 58:1-9.
- p. 153 'DNA has even been caught jumping naturally from snakes to gerbils with the help of a virus.' Piskurek, O. and Okada, N. 2007. Poxviruses as possible vectors for horizontal transfer of retroposons from reptiles to mammals. *PNAS* 29:12046-51.
- p. 154 'Only in parts of Europe and Africa were these crops denied to farmers and consumers'. Brookes, G. and Barfoot, P. 2007. Global impact of GM crops: socio-economic and environmental effects in the first ten years of commercial use. *AgBioForum* 9:139-51.
- p. 154 'what Stewart Brand calls their "customary indifference to starvation"'. Brand, S. 2009. *Whole Earth Discipline*. Penguin.
- p. 154 'Robert Paarlberg writes'. Paarlberg, R. 2008. *Starved for Science*. Harvard University Press.
- p. 154 'Ingo Potrykus thinks'. Potrykus, I. 2006. *Economic Times of India*, 26 December 2005. Reprinted at http://www.fighting diseases.org/main/articles.php?articles_id=568.
- p. 154 'Or as the Kenyan scientist Florence Wambugu puts it'. Quoted in Brand, S. 2009. *Whole Earth Discipline*. Penguin.
- pp. 154-5 'Per capita food production in Africa has fallen 20 per cent in thirty-five years'. Collier, P. 2008. The politics of hunger: how illusion and greed fan the food crisis. *Foreign Affairs* November/December 2008.
- p. 155 'Field trials begin in Kenya in 2010 of drought-resistant and insect-resistant maize'. Muthaka, B. 2009. GM maize for local trials. *Daily Nation* (Nairobi), 17 June 2009.
- p. 156 'For example, modern plant oils and plentiful red meat make for a diet low in omega-3 fatty acids'. Morris, C.E. and Sands, D. 2006. The breeder's dilemma: resolving the natural conflict between crop production and human nutrition. *Nature Biotechnology* 24: 1078-80.
- p. 156 'The Indian activist Vandana Shiva'. Quoted in Avery, D.T. 2000. What do environmentalists have against golden rice? Center for Global Food Issues, http://www.cgfi.org/materials/articles/2000/mar_7_00.htm. See also www.goldenrice.org for more of the shocking story of opposition to this humanitarian project.

Chapter 5

- p. 157 'Imports are Christmas morning; exports are January's MasterCard bill.' O'Rourke, P.J. 2007. *On The Wealth of Nations*. Atlantic Monthly Press.
- p. 157 Death rates from water-related disease graph. Goklany, I. 2009. *Electronic Journal of Sustainable Development*. www.ejsd.org.
- p. 158 'A modern combine harvester, driven by a single man, can reap enough wheat in a single day to make half a million loaves.' Half a kilogram of flour per loaf, 3,500 kg per acre, eighty acres per day =

Notes and references

- 560,000 loaves per day. These are numbers my colleagues achieve on my own farm.
- p. 158 'a distinctive 'Ubaid' style of pottery, clay sickles and house design'. Stein, G.J. and Ozbal, R. 2006. A tale of two Oikumenai: variation in the expansionary dynamics of 'Ubaid' and Uruk Mesopotamia. Pp. 356–70 in Stone, E. C. (ed.) *Settlement and Society: Ecology, Urbanism, Trade and Technology in Mesopotamia and Beyond* (Robert McC. Adams Festschrift). Los Angeles, Cotsen Institute of Archaeology.
- p. 159 'in the words of the archaeologist Gil Stein'. Stein, G.J. and Ozbal, R. 2006. A tale of two Oikumenai: variation in the expansionary dynamics of 'Ubaid' and Uruk Mesopotamia. Pp. 356–70 in Stone, E. C. (ed.) *Settlement and Society: Ecology, Urbanism, Trade and Technology in Mesopotamia and Beyond* (Robert McC. Adams Festschrift). Los Angeles, Cotsen Institute of Archaeology.
- p. 160 'The message those tablets tell is that the market came long before the other appurtenances of civilisation.' Basu, S., Dickhaut, J.W., Hecht, G., Towry, K.L. and Waymire, G.B. 2007. Recordkeeping alters economic history by promoting reciprocity. *PNAS* 106:1009–14.
- p. 161 'Merchants and craftsmen make prosperity; chiefs, priests and thieves fritter it away.' Incidentally, I find it strange to recall that my education was utterly dominated by two stories: the Bible's and Rome's. Both were disappointing examples of history. One told the story of an obscure, violent and somewhat bigoted tribe and one of its later cults, who sat around gazing at their theological navels for a few thousand years while their fascinating neighbours – the Phoenicians, Philistines, Canaanites, Lydians and Greeks – invented respectively maritime trade, iron, the alphabet, coins and geometry. The other told the story of a barbarically violent people who founded one of the empires that institutionalised the plundering of its commercially minded neighbours, then went on to invent practically nothing in half a millennium and achieve an actual diminution in living standards for its citizens, very nearly extinguishing literacy as it died. I exaggerate, but there are more interesting figures in history than Jesus Christ or Julius Caesar.
- p. 161 'Unlike hunter-gatherers or herders, farmers faced with taxes have to stay put and pay'. Carneiro, R.L. 1970. A theory of the origin of the state. *Science* 169: 733–8.
- p. 161 'in the words of two modern historians'. Moore, K. and Lewis, D. 2000. Foundations of Corporate Empire. *Financial Times/Prentice Hall*.
- p. 162 'As Sir Mortimer Wheeler wrote in his autobiography'. Quoted by Sally Greene in 1981, introduction to illustrated edition of *Man Makes Himself*. Childe, V. Gordon. 1956. Pitman Publishing.
- p. 162 'the archaeologist Shereen Ratnagar concluded'. Ratnagar, S. 2004. *Trading Encounters: From the Euphrates to the Indus in the Bronze Age*. Oxford University Press India.
- p. 162 'great wealth of the Indus cities was generated by trade'. Possehl, G.L.

2002. *The Indus Civilization: A Contemporary Perspective*. Rowman AltaMira.
- p. 162 'the so-called Norte Chico civilisation'. Haas, J. and Creamer, W. 2006. Crucible of Andean civilization: The Peruvian coast from 3000 to 1800 BC. *Current Anthropology* 47:745–75.
- pp. 163–4 'Intensification of trade came first'. The Chinese case remains unexplored here for the simple reason that the key moment in China, the Longshan culture, remains too poorly known, especially in terms of how much trade occurred.
- p. 165 'silver-based prices, which fluctuated freely'. Aubet, M.E. 2001. *The Phoenicians and the West*. 2nd edition. Cambridge University Press.
- p. 165 'the Uruk word for high priest is the same as the word for accountant'. Childe, V.G. 1956/1981. *Man Makes Himself*. Moonraker Press.
- p. 165 'merchants from Ashur operated in "karum" enclaves'. Moore, K. and Lewis, D. 2000. *Foundations of Corporate Empire*. Pearson.
- p. 165 'The profit margin was 100 per cent on tin and 200 per cent on textiles'. Chanda, N. 2007. *Bound Together: How Traders, Preachers, Adventurers and Warriors Shaped Globalisation*. Yale University Press.
- p. 166 'Such merchants "did not devote themselves to trading in copper and wool because Assyria needed them, but because that trade was a means of obtaining more gold and silver".' Aubet, M.E. 2001. *The Phoenicians and the West*. 2nd edition. Cambridge University Press.
- p. 167 'a different Phoenician invention, the bireme galley'. Holst, S. 2006. *Phoenicians: Lebanon's Epic Heritage*. Sierra Sunrise Publishing.
- p. 168 "'Homer" displays a relentlessly negative attitude to Phoenician traders'. Aubet, M.E. 2001. *The Phoenicians and the West*. 2nd edition. Cambridge University Press.
- p. 168 'Tyrian traders founded Gadir, present-day Cadiz, around 750 BC'. Aubet, M.E. 2001. *The Phoenicians and the West*. 2nd edition. Cambridge University Press.
- p. 169 'said a Montagnais trapper to a French missionary in seventeenth-century Canada'. Brook, T. 2008. *Vermeer's Hat*. Profile Books.
- p. 169 'When HMS *Dolphin*'s sailors found that a twenty-penny iron nail could buy a sexual encounter on Tahiti in 1767'. Bolyanatz, A. H. 2004. *Pacific Romanticism: Tahiti and the European Imagination*. Greenwood Publishing Group.
- p. 170 'advanced by David Hume'. This argument goes back to David Hume's *History of Great Britain*, and has been pursued recently by Douglass North.
- p. 170 'Miletus, the most successful of the Ionian Greek cities, sat "like a bloated spider" at the junction of four trade routes'. Cunliffe, B. 2001. *The Extraordinary Voyage of Pytheas the Greek*. Penguin.
- p. 172 'Humanity's great battle over the last 10,000 years has been the battle against monopoly.' Kealey, T. 2008. *Sex, Science and Profits*. Random House.

Notes and references

- p. 172 'The Mauryan empire in India'. Khanna, V. S. 2005. *The Economic History of the Corporate Form in Ancient India* (1 November 2005). Social Sciences Research Network.
- p. 173 'without question the economic superpower of the day'. Maddison, A. 2006. *The World Economy*. OECD Publishing.
- p. 173 'wrote Thomas Carney'. Carney, T.F. 1975. *The Shape of the Past*. Coronado Press.
- p. 174 'Ostia was a trading city as surely as Hong Kong is today'. Moore, K. and Lewis, D. 2000. *Foundations of Corporate Empire*. Pearson.
- p. 174 'Rome's continuing prosperity once the republic became an empire may be down at least partly to the "discovery" of India'. Chanda, N. 2007. *Bound Together: How Traders, Preachers, Adventurers and Warriors Shaped Globalisation*. Yale University Press.
- p. 176 'The predatory expansion of the Carolingian Franks in the eighth century'. Kohn, M. 2008. How and why economies develop and grow: lessons from preindustrial Europe and China. Unpublished manuscript.
- p. 177 'A dhow that sank off Belitung in Indonesia in AD 826'. Flecker, M. 2001. A 9th-century Arab or Indian shipwreck in Indonesian waters. *International Journal of Nautical Archaeology*.29:199–217.
- p. 177 'Once the priesthood tightened its grip'. Norberg, J. 2006. *When Man Created the World*. Published in Swedish as *När människan skapade världen*. Timbro.
- p. 178 'Maghribi traders developed their own rules of contract enforcement and punishment by ostracism'. Greif, A. 2006. *Institutions and the Path to the Modern Economy: Lessons from Medieval Trade*. Cambridge University Press.
- p. 178 'a Pisan trader living in north Africa, Fibonacci'. Ferguson, N. 2008. *The Ascent of Money*. Allen Lane.
- p. 178 'Genoa's trade with North Africa doubled after an agreement for the protection of merchants was reached'. Chanda, N. 2007. *Bound Together: How Traders, Preachers, Adventurers and Warriors Shaped Globalisation*. Yale University Press.
- p. 179 'by 1500 Italy's GDP per capita was 60 per cent higher than the European average'. Maddison, A. 2006. *The World Economy*. OECD Publishing.
- p. 179 'As late as 1600, European trade with Asia, dominated because of transport costs by luxuries such as spices, was only half the value of the inter-regional European trade in cattle alone'. Kohn, M. 2008. How and why economies develop and grow: lessons from preindustrial Europe and China. Unpublished manuscript.
- p. 180 'According to Angus Maddison's estimates'. Maddison, A. 2006. *The World Economy*. OECD Publishing.
- p. 181 'One of the paradoxical features of modern China is the weakness of a central, would-be authoritarian government.' Fukuyama, F. 2008. *Los Angeles Times*, 29 April 2008.

- p. 181 'multi-spindle cotton wheels, hydraulic trip hammers, as well as umbrellas, matches, toothbrushes and playing cards'. Baumol, W. 2002. *The Free-market Innovation Machine*. Princeton University Press.
- p. 181 'The Black Death'. Durand, J. 1960. The population statistics of China, A.D. 2–1953. *Population Studies* 13:209–56.
- p. 182 'serfdom was effectively restored'. Findlay, R. and O'Rourke, K.H. 2007. *Power and Plenty: Trade, War and the World Economy*. Princeton University Press.
- p. 182 'as Peter Turchin argues following the lead of the medieval geographer Ibn Khaldun'. Turchin, P. 2003. *Historical Dynamics*. Princeton University Press.
- p. 182 'most clever people still call for government to run more things'. Note that this is also true of the financial crisis of 2008: government mismanagement of housing policy, interest rates and exchange rates bears just as big a responsibility as corporate mismanagement of risk. I wish there was space to expand upon this point, but see the writings of Northcote Parkinson, Mancur Olson, Gordon Tullock and Deepak Lal. It is strange to me that most people assume companies will be imperfect (as they are), but then assume that government agencies will be perfect, which they are not.
- p. 182 'Not only did the Ming emperors nationalise much of industry and trade, creating state monopolies in salt, iron, tea, alcohol, foreign trade and education'. Landes, D. 1998. *The Wealth and Poverty of Nations*. Little, Brown.
- p. 183 'As Etienne Balazs put it'. Balazs, E. quoted in Landes, D. 1998. *The Wealth and Poverty of Nations*. Little, Brown.
- p. 183 'The behaviour of Hongwu, the first of the Ming emperors'. Brook, T. 1998. *The Confusions of Pleasure: Commerce and Culture in Ming China*. University of California Press.
- p. 183 'a large Spanish galleon stuffed with silver'. Brook, T. 2008. *Vermeer's Hat*. Profile Books.
- p. 184 'said Lactantius'. Quoted in Harper, F.A. 1955. Roots of economic understanding. *The Freeman* vol. 5, issue 11. <http://www.thefreemanonline.org/columns/roots-of-economic-understanding>.
- pp. 184–5 'The man in question, Johann Friedrich Bottger'. Gleason, J. 1998. *The Arcanum*. Bantam Press.
- p. 185 'the Dutch so dominated European international trade that their merchant marine was bigger than that of France, England, Scotland, the Holy Roman Empire, Spain and Portugal – combined'. Blanning, T. 2007. *The Pursuit of Glory*. Penguin.
- p. 186 'Both sides of the estuary of the River Plate became a vast slaughterhouse'. Edgerton, D. 2006. *The Shock of the Old: Technology and Global History since 1900*. Profile Books.
- p. 186 'Yet in the aftermath of the First World War, one by one countries tried beggaring their neighbours in the twentieth century'. Findlay, R.

Notes and references

- and O'Rourke, K.H. 2007. *Power and Plenty: Trade, War and the World Economy*. Princeton University Press.
- p. 187 'China's Open Door policy, which cut import tariffs from 55 per cent to 10 per cent in twenty years, transformed it from one of the most protected to one of the most open markets in the world.' Lal, D. 2006. *Reviving the Invisible Hand*. Princeton University Press.
- p. 188 'Farm subsidies and import tariffs on cotton, sugar, rice and other products cost Africa \$500 billion a year in lost export opportunities'. Moyo, D. 2009. *Dead Aid*. Allen Lane.
- p. 188 'Ford Madox Ford celebrated in his Edwardian novel *The Soul of London*'. Ford, F.M. 1905. *The Soul of London*. Alston Rivers.
- p. 189 'says Suketa Mehta'. Mehta, S. Dirty, crowded, rich and wonderful. *International Herald Tribune*, 16 July 2007. Quoted in Williams, A. 2008. *The Enemies of Progress*. Societas.
- p. 189 'writes Stewart Brand'. Brand, S. 2009. *Whole Earth Discipline*. Penguin.
- p. 189 'says Deroi Kwesi Andrew, a teacher earning \$4 a day in Accra'. Harris, R. 2007. Let's ditch this nostalgia for mud. *Spiked*, 4 December 2007.
- p. 190 'people prefer to press into ever closer contact with each other in glass towers to do their exchanging'. Jacobs, J. 2000. *The Nature of Economies*. Random House.
- p. 190 'As Edward Glaeser put it'. Glaeser, E. 2009. Green cities, brown suburbs. *City Journal* 19: http://www.city-journal.org/2009/19_1_green-cities.html.
- p. 190 'the ecologist Paul Ehrlich had an epiphany'. Ehrlich, P. 1968. *The Population Bomb*. Ballantine Books.

Chapter 6

- p. 191 'The great question is now at issue'. Malthus, T. R. 1798. *Essay on Population*.
- p. 191 Percentage increase in world population graph. United Nations Population Division.
- p. 192 'The economist Vernon Smith, in his memoirs'. Smith, V.L. 2008. *Discovery – a Memoir*. Authorhouse.
- p. 193 'The Malthusian crisis comes not as a result of population growth directly, but because of decreasing specialisation.' My argument here is part-way between the Malthusian one advanced by historians such as Greg Clark and the view that pre-industrial economies were always capable of greater productivity, but predation and other intrinsic factors prevented them – as advanced by George Grantham. See e.g. Grantham, G. 2008. Explaining the industrial transition: a non-Malthusian perspective. *European Review of Economic History* 12:155–65. See also Persson, K.-G. 2008. The Malthus delusion. *European Review of Economic History* 12: 165–73.
- p. 193 'As Greg Clark puts it'. Clark, G. 2007. *A Farewell to Alms*. Princeton University Press.

- p. 193 'Malthus'. Malthus, T.R. 1798. *Essay on Population*.
- p. 193 'Ricardo'. Ricardo, D. 1817. *The Principles of Political Economy and Taxation*. (Adam Smith, looking at China, India and Holland, had thought the same.)
- p. 194 'the Wiltshire village of Damerham'. Langdon, J. and Masschaele, J. 2006. Commercial activity and population growth in medieval England. *Past and Present* 190:35–81.
- p. 195 'a miller in Feering in Essex'. Langdon, J. and Masschaele, J. 2006. Commercial activity and population growth in medieval England. *Past and Present* 190:35–81.
- p. 195 'It came suddenly in the sodden summers of 1315 and 1317, when wheat yields more than halved all across the north of Europe.' Jordan, W.C. 1996. *The Great Famine: Northern Europe in the Early Fourteenth Century*. Princeton University Press.
- p. 196 'neither the boom of the thirteenth century, nor the bust of the fourteenth, can be described in simplistic Ricardian and Malthusian terms'. See Meir Kohn's book *How and Why Economies Develop and Grow* at www.dartmouth.edu/~mkohn/Papers/lessons%201r3.pdf.
- pp. 196–7 'the site of a new windmill being constructed at Dover Castle in 1294'. Langdon, J. and Masschaele, J. 2006. Commercial activity and population growth in medieval England. *Past and Present* 190:35–81.
- p. 197 'in Joel Mokyr's words'. Mokyr, J. 1990. *Lever of Riches*. Oxford University Press.
- p. 197 'the Japanese had conquered Korea carrying tens of thousands of home-made arquebuses'. Noted in Perrin, N. 1988. *Giving Up the Gun: Japan's Reversion to the Sword*. Grodine.
- p. 197–8 'As the traveller Isabella Bird remarked in 1880'. Macfarlane, A. and Harrison, S. 2000. Technological evolution and involution: a preliminary comparison of Europe and Japan. In Ziman, J. (ed.) *Technological Innovation as an Evolutionary Process*. Cambridge University Press.
- p. 198 'Where Europeans used animal, water and wind power, the Japanese did the work themselves.' Macfarlane, A. and Harrison, S. 2000. Technological evolution and involution: a preliminary comparison of Europe and Japan. In Ziman, J. (ed.) *Technological Innovation as an Evolutionary Process*. Cambridge University Press.
- p. 198 'They even gave up capital-intensive guns in favour of labour-intensive swords'. Perrin, N. 1988. *Giving Up the Gun: Japan's Reversion to the Sword*. Grodine.
- p. 199 'Sir William Petty'. Petty, W. 1691. *Political Arithmetick*.
- p. 199 'Adam Smith begged to differ'. *The Wealth of Nations*, quoted in Blanning, T. 2007. *The Pursuit of Glory*. Penguin.
- p. 200 'By the 1800s, Denmark had become a country that was trapped by its own self-sufficiency.' Pomeranz, K. 2000. *The Great Divergence*. Princeton University Press.
- p. 200 'On average a merchant in Britain who left £1,000 in his will had four

Notes and references

- surviving children, while a labourer who left £10 had only two'. Clark, G. 2007. *A Farewell to Alms*. Princeton University Press.
- p. 203 'Johnson supposedly replied'. Epstein, H. 2008. The strange history of birth control. *New York Review of Books*, 18 August 2008.
- p. 203 'Garrett Hardin, in his famous essay'. Hardin, G. 1968. The tragedy of the commons. *Science* 162:1243–8.
- p. 203 'Hardin's view was nearly universal'. An exception was Barry Commoner, who argued at the UN conference on population in Stockholm in 1972 that the demographic transition would solve population growth without coercion.
- p. 203 'wrote John Holdren (now President Obama's science adviser) and Paul and Anne Ehrlich in 1977'. Ehrlich, P., Ehrlich, A. and Holdren, J.F. 1977. *Eco-science*. W.H. Freeman.
- p. 203 'Sanjay Gandhi, the son of the Indian prime minister, ran a vast campaign of rewards and coercion'. Connelly, M. 2008. *Fatal Misconception: the Struggle to Control World Population*. Harvard University Press.
- p. 204 'Bangladesh had a birth rate of 6.8 children per woman'. The standard way of measuring the birth rate is the 'total fertility rate', which presumes to average the completed family size of each age cohort of the population. This is imperfect and confuses deferred reproduction with falling family size. But it is the best that is available and I have used it in this chapter for lack of a better measure.
- p. 205 'As the environmentalist Stewart Brand puts it'. Brand, S. 2005. Environmental heresies. *Technology Review*, May 2005.
- p. 206 'the entire world is experiencing the second half of a "demographic transition"'. Caldwell, J. 2006. *Demographic Transition Theory*. Springer.
- p. 207 'a condescending blast by Paul Ehrlich and John Holdren'. Maddox's book was called *The Doomsday Syndrome* (1973, McGraw Hill) and Holdren's and Ehrlich's review is quoted by John Tierney at <http://tierneylab.blogs.nytimes.com/2009/04/15/the-skeptical-prophet/>.
- p. 207 'demographic transition theory is a splendidly confused field.' Or to put it in academic-ese, 'the debate continues with a plethora of contending theoretical frameworks, none of which has gained wide adherence.' Hirschman, quoted in Bongaarts, J. and Watkins, S.C. 1996. Social interactions and contemporary fertility transitions. *Population and Development Review* 22:639–82.
- p. 208 'Jeffrey Sachs recounts'. Sachs, J. 2008. *Common Wealth: Economics for a Crowded Planet*. Allen Lane.
- p. 209 'Probably by far the best policy for reducing population is to encourage female education.' Connelly, M. 2008. *Fatal Misconception: the Struggle to Control World Population*. Harvard University Press.
- p. 210 'A bold programme, driven by philanthropy or even government aid'. Sachs, J. 2008. *Common Wealth: Economics for a Crowded Planet*. Allen Lane.

- p. 211 'Seth Norton found'. Norton, S. 2002. *Population Growth, Economic Freedom and the Rule of Law*. PERC Policy Series no. 24.
- p. 211 'The Anabaptist sects in North America, the Hutterites and Amish, have largely resisted the demographic transition'. Richerson, P. and Boyd, R. 2005. *Not by Genes Alone*. Chicago University Press.
- p. 211 'As Ron Bailey puts it'. Bailey, R. 2009. The invisible hand of population control. *Reason*, 16 June 2009. <http://www.reason.com/news/show/134136.html>.
- p. 212 'Hans-Peter Kohler of the University of Pennsylvania'. Myrskylä, M., Kohler, H.-P. and Billari, F.C. 2009. Advances in development reverse fertility declines. *Nature*, 6 August 2009 (doi:10.1038/nature 08230).

Chapter 7

- p. 213 'With coal almost any feat is possible or easy; without it we are thrown back in the laborious poverty of earlier times'. Jevons, W.S. 1865. *The Coal Question: An Inquiry Concerning the Progress of the Nation, and the Probable Exhaustion of our Coal-mines*. Macmillan.
- p. 213 Metal prices relative to US wages graph. Goklany, I. 2009. *Electronic Journal of Sustainable Development*. www.ejsd.org.
- p. 214 'Writes the economist Don Boudreaux'. http://www.pittsburghlive.com/x/pittsburghtrib/opinion/columnists/boudreaux/s_304437.html.
- p. 215 'In England, horses were 20 per cent of draught animals in 1086'. Fouquet, R. and Pearson, P.J.G. 1998. A thousand years of energy use in the United Kingdom. *Energy Journal* 19:1-41.
- p. 215 'one for every fifty people in southern England'. Mokyr, J. 1990. *Lever of Riches*. Oxford University Press.
- p. 215 'At Clairvaux'. The abbot of Clairvaux is quoted in Gimpel, J. 1976. *The Medieval Machine*. Penguin.
- pp. 215-16 'peat gave the Dutch their chance'. De Zeeuw, J.W. 1978. Peat and the Dutch golden age. See <http://www.peatandculture.org/documenten/Zeeuw.pdf>.
- p. 218 'In Gregory King's survey of the British population in 1688'. Kealey, T. 2008. *Sex, Science and Profits*. William Heinemann.
- p. 218 'Even farm labourers' income rose during the industrial revolution'. Clark, G. 2007. *A Farewell to Alms*. Princeton University Press.
- p. 218 'a patent for a hand-driven linen spinning machine from 1678'. Friedel, R. 2007. *A Culture of Improvement*. MIT Press.
- p. 218 'The average Englishman's income, having apparently stagnated for three centuries, began to rise around 1800'. This is Clark's estimate. Others argue that because of the rapidly falling prices of goods like sugar, the purchasing power of average income was rising steadily in the 1700s. See Clark, G. 2007. *A Farewell to Alms*. Princeton University Press.
- p. 219 'Here are three anecdotes'. The first case comes from an unpublished history of the village of Stannington written by my grandmother and others in the 1950s. The other two cases are cited in Rivoli, P. 2005. *The*

Notes and references

- Travels of a T-shirt in the Global Economy*. John Wiley.
- p. 221 A famous print entitled ‘The Distinguished Men of Science of Great Britain Living in the Year 1807-8’. The print was published alongside a book edited and published by William Walker, *Memoirs of the Distinguished Men of Science of Great Britain Living in the Year 1807-08*.
- pp. 221-2 ‘like Gordon Moore and Robert Noyce, Steve Jobs and Sergey Brin, Stanley Boyer and Leroy Hood’. Moore founded Intel, Noyce the microchip, Jobs Apple, Brin Google, Boyer Genentech, Hood Applied Biosystems.
- p. 222 ‘explained one Hungarian liberal’. Gergely Berzeviczy, quoted in Blanning, T. 2007. *The Pursuit of Glory*. Penguin.
- p. 222 ‘France, three times as populous as England, was “cut up by internal customs barriers into three major trade areas”’. Landes, D.S. 2003. *The Unbound Prometheus: Technological Change and Industrial Development in Western Europe from 1750 to the Present*. 2nd edition. Cambridge University Press.
- p. 222 ‘Spain was “an archipelago, islands of local production and consumption, isolated from each other by centuries of internal tariffs”’. John Lynch, quoted in Blanning, T. 2007. *The Pursuit of Glory*. Penguin.
- p. 223 ‘a “glorious revolution” against James II’s arbitrary government’. Jardine, L. 2008. *Going Dutch*. Harper.
- p. 223 ‘this was not a bad place to start or expand a business in say 1700’. Baumol, W. 2002. *The Free-market Innovation Machine*. Princeton University Press.
- p. 223 ‘says David Landes’. Landes, D.S. 2003. *The Unbound Prometheus: Technological Change and Industrial Development in Western Europe from 1750 to the Present*. 2nd edition. Cambridge University Press.
- p. 224 ‘says Robert Friedel’. Friedel, R. 2007. *A Culture of Improvement*. MIT Press.
- p. 224 ‘writes Neil McKendrick’. Quoted in Blanning, T. 2007. *The Pursuit of Glory*. Penguin.
- p. 224 ‘Daniel Defoe, writing in 1728’. Quoted in Mokyr, J. 1990. *Lever of Riches*. Oxford University Press; Friedel, R. 2007. *A Culture of Improvement*. MIT Press.
- p. 225 ‘it was by copying these Oriental imports that the industrialists got started’. Mokyr, J. 1990. *Lever of Riches*. Oxford University Press; Friedel, R. 2007. *A Culture of Improvement*. MIT Press.
- p. 226 ‘the Calico Act’. Friedel, R. 2007. *A Culture of Improvement*. MIT Press; Rivoli, P. 2005. *The Travels of a T-shirt in the Global Economy*. John Wiley.
- p. 226 ‘enclosure actually increased paid employment for farm labourers’. Here is how Landes puts it: ‘For a long time, the most accepted view has been that propounded by Marx and repeated and embellished by generations of socialist and even non-socialist historians. This position explains the accomplishment of so enormous a social change – the creation of an industrial proletariat in the face of tenacious resistance –

- by postulating an act of forcible expropriation: the enclosures uprooted the cottager and small peasant and drove them into the mills. Recent empirical research has invalidated this hypothesis; the data indicate that the agricultural revolution associated with the enclosures increased the demand for farm labour, and that indeed those rural areas that saw the most enclosure saw the largest increase in resident population. From 1750 to 1830 Britain's agricultural counties doubled their inhabitants. Whether objective evidence of this kind will suffice, however, to do away with what has become an article of faith is doubtful.' Landes, D.S. 2003. *The Unbound Prometheus: Technological Change and Industrial Development in Western Europe from 1750 to the Present*. 2nd edition. Cambridge University Press, pp. 114–15.
- p. 227 'The historian Edward Baines noted in 1835'. Baines, E. 1835. *History of the Cotton Manufacture in Great Britain*. Quoted in Rivoli, P. 2005. *The Travels of a T-shirt in the Global Economy*. John Wiley.
- p. 227 'reflected Joseph Schumpeter'. Schumpeter, J.A. 1943. *Capitalism, Socialism, and Democracy*. Allen & Unwin.
- p. 227 'As the twentieth-century economist Colin Clark put it'. Clark, C. 1970. *Starvation or Plenty?* Secker and Warburg.
- p. 228 'by 1800 the jenny was already obsolete'. Landes, D.S. 2003. *The Unbound Prometheus: Technological Change and Industrial Development in Western Europe from 1750 to the Present*. 2nd edition. Cambridge University Press.
- p. 228 'price of a pound of fine-spun cotton yarn fell'. Friedel, R. 2007. *A Culture of Improvement*. MIT Press.
- p. 228 'Cotton accounted for half of all American exports by value between 1815 and 1860.' Slavery delivered cheapness through increasing quantity of output, not by undercutting prices. Indian production did not decline in the nineteenth century: it expanded, but not as fast as American. Fogel, R.W. and Engerman, S.L. 1995. *Time on the Cross: The Economics of American Negro Slavery*. Reissue edition. W.W. Norton and Company.
- p. 228 'As the economist Pietra Rivoli puts it'. Rivoli, P. 2005. *The Travels of a T-shirt in the Global Economy*. John Wiley.
- p. 229 'There was never going to be enough wind, water or wood in England to power the factories, let alone in the right place.' Rolt, L.T.C. 1965. *Tools for the Job*. Batsford Press. Incidentally, coked coal was used to make iron (by Abraham Darby at Coalbrookdale in Shropshire) as early as 1709, but only inferior cast iron.
- p. 230 'the country's demographic and economic centre of gravity shifted south to the Yangtze valley'. Pomeranz, K. 2000. *The Great Divergence*. Princeton University Press.
- p. 230 'Coal's cost per tonne at the pithead in Newcastle rose slightly between the 1740s and 1860s'. Clark, G. and Jacks, D. 2006. *Coal and the Industrial Revolution, 1700–1869*. Working Paper #06-15, Department of Economics, University of California, Davis.

Notes and references

- p. 231 'The wages of a coal hewer in the North-east of England were twice as high, and rising twice as fast, as those of a farm worker in the nineteenth century.' Clark, G. and Jacks, D. 2006. *Coal and the Industrial Revolution, 1700–1869*. Working Paper #06-15, Department of Economics, University of California, Davis. As one young English woman (my ancestor), the daughter of a judge, wrote to her mother after moving north from Bedfordshire to Northumberland in 1841: 'The more I see of the poor people about here the more I feel puzzled as to the possibility of doing them any good ... They all have immense wages and plenty of coal and are quite rich in comparison with our Millbrook people.' From Ridley, U. 1958/1990. *The Life and Letters of Cecilia Ridley 1819–1845*. Spredden Press.
- p. 231 'As the historian Tony Wrigley has put it'. Wrigley, E.A. 1988. *Continuity, Chance and Change: the Character of the Industrial Revolution in England*. Cambridge University Press.
- p. 232 'an Indian weaver could not compete with the operator of a steam-driven Manchester mule'. Clark, G. 2007. *A Farewell to Alms*. Princeton University Press.
- p. 233 'Today most coal is used for generating electricity.' Fouquet, R. and Pearson, P.J.G. 1998. A thousand years of energy use in the United Kingdom. *Energy Journal* 19:1–41.
- p. 234 'pulling ploughs by cable through a field at the Menier estate near Paris'. Rolt, L.T.C. 1967. *The Mechanicals*. Heinemann.
- p. 234 'like the computer it took decades to show up in the productivity statistics'. David, P.A. 1990. The dynamo and the computer: an historical perspective on the modern productivity paradox. *American Economic Review* 80:355–61.
- p. 234 'One recent study in the Philippines'. Barnes, D.F. (ed.). 2007. *The Challenge of Rural Electrification*. Resources for the Future Press.
- p. 235 'Joule for joule, wood is less convenient than coal, which is less convenient than natural gas, which is less convenient than electricity, which is less convenient than the electricity currently trickling through my mobile telephone.' Huber, P.W. and Mills, M.P. 2005. *The Bottomless Well: the Twilight of Fuel, the Virtue of Waste, and Why We Will Never Run Out of Energy*. Basic Books.
- p. 236 'in Adam Smith's words'. *The Wealth of Nations*.
- p. 236 'the average person on the planet consumes power at the rate of about 2,500 watts'. A watt is a joule per second. A calorie is 4.184 joules. The figures of energy consumption in watts per capita come from the International Energy Agency. See http://en.wikipedia.org/wiki/Image:Energy_consumption_versus_GDP.png.
- p. 236 'it would take 150 slaves'. By the way, twice as much energy is wasted turning grain into bicycle-cargo motion as is wasted turning oil into truck-cargo motion: or sixteen times as much if the grain goes into the cyclist via a chicken. Huber, P.W. and Mills, M.P. 2005. *The Bottomless*

Well: the Twilight of Fuel, the Virtue of Waste, and Why We Will Never Run Out of Energy. Basic Books.

- p. 237 'an anxiety as old as fossil fuels themselves'. Jevons, W.S. 1865. *The Coal Question: An Inquiry Concerning the Progress of the Nation, and the Probable Exhaustion of our Coal-mines*. Macmillan.
- p. 238 'If America were to grow all its own transport fuel as biofuel it would need 30 per cent more farmland'. Dennis Avery, cited in Bryce, R. 2008. *Gusher of Lies*. Perseus Books.
- p. 239 'or hydroelectric dams with catchments one-third larger than all the continents put together'. The assumptions behind these calculations are optimistic, rather than conservative: that solar power can generate about 6 watts per square metre; wind about 1.2, hay-fed horses 0.8 (one horse needs 8 hectares of hay and pulls 700 watts, or one horse power); firewood 0.12; and hydro 0.012. America consumes 3,120 gigawatts. Spain covers 504,000 sq km; Kazakhstan 2.7m sq km; India and Pakistan 4m sq km; Russia and Canada 27m sq km; all the continents 148m sq km. All power density figures except horses are from Ausubel, J. 2007. Renewable and nuclear heresies. *International Journal of Nuclear Governance, Economy and Ecology* 1:229-43.
- p. 239 'Just one wind farm at Altamont in California kills twenty-four golden eagles every year'. Bird risk behaviors and fatalities at the Altamont Pass wind resource area, by C.G. Thelander, K.S. Smallwood and L. Ruge of BioResource Consultants in Ojai, California, NREL/SR-500-33829, December 2003. To those who say far more birds are killed flying into windows – yes, but not golden eagles, which are both peculiarly rare and peculiarly vulnerable to wind turbines. When did a golden eagle last crash into your conservatory? As for the charge that an oil company would be prosecuted for causing such bird deaths, see Bryce, R. 2009. Windmills are killing our birds: one standard for oil companies, another for green energy sources. *Wall Street Journal*, 7 September 2009. http://online.wsj.com/article/SB10001424052970203706604574376543308399048.html?mod=googlenews_wsj.
- p. 239 'Hundreds of orang-utans are killed a year because they get in the way of oil-palm biofuel plantations'. <http://www.telegraph.co.uk/earth/main.jhtml?xml=/earth/2007/08/14/eaorang114.xml>.
- p. 239 'says the energy expert Jesse Ausubel'. Ausubel, J. 2007. Renewable and nuclear heresies. *International Journal of Nuclear Governance, Economy and Ecology* 1:229-43.
- p. 241 'Between 2004 and 2007 the world maize harvest increased by fifty-one million tonnes'. Avery, D.T. 2008. *The Massive Food and Land Costs of US Corn Ethanol: an Update*. Competitive Enterprise Institute no. 144, 29 October 2008.
- p. 241 'American car drivers were taking carbohydrates out of the mouths of the poor to fill their tanks'. Mitchell, D.A. 2008. *Note on Rising Food Prices*. World Bank Policy Research Working Paper no. 4682. Available

Notes and references

- at SSRN: <http://ssrn.com/abstract=1233058>.
- p. 241 'So the question is: how much fuel does it take to grow fuel? Answer: about the same amount.' Bryce, R. 2008. *Gusher of Lies*. Perseus Books.
- p. 242 'says Joseph Fargione of the Nature Conservancy'. Fargione, J. et al. 2008. Land clearing the biofuel carbon debt. *Science* 319:1235–8.
- p. 242 'the biofuel industry is not just bad for the economy. It is bad for the planet, too.' Bryce, R. 2008. *Gusher of Lies*. Perseus Books.
- p. 243 'to quote the ecologist E.O. Wilson'. Wilson, E.O. 1999. *The Diversity of Life*. Penguin.
- p. 244 'as Peter Huber and Mark Mills put it'. Huber, P.W. and Mills, M.P. 2005. *The Bottomless Well: the Twilight of Fuel, the Virtue of Waste, and Why We Will Never Run Out of Energy*. Basic Books.
- p. 244 'A modern combined-cycle'. A combined-cycle turbine uses burning gas itself to drive one turbine and then uses the heat to generate steam to drive another.
- p. 245 'the Victorian economist Stanley Jevons'. Jevons, S. 1865. *The Coal Question: An Inquiry Concerning the Progress of the Nation, and the Probable Exhaustion of our Coal-mines*. Macmillan, p. 103.
- p. 246 'Thomas Edison deserves the last word'. Edison in 1910, quoted in Collins, T. and Gitelman, L, *Thomas Edison and Modern America*. New York: Bedford/St Martin's, 2002, p. 60. Source: Bradley, R.J. 2004. *Energy: the Master Resource*. Kendall/Hunt.

Chapter 8

- p. 247 'He who receives an idea from me'. Thomas Jefferson letter to Isaac McPherson, 13 August 1813. <http://www.let.rug.nl/usa/P/tj3/writings/brf/jefl220.htm>.
- p. 247 World product graph. Maddison, A. 2006. *The World Economy*. OECD Publishing.
- p. 249 'said Ricardo'. Ricardo, D. 1817. *The Principles of Political Economy and Taxation*.
- p. 249 'neo-classical economics gloomily forecast the end of growth'. Beinhocker, E. 2006. *The Origin of Wealth*. Random House.
- p. 249 'As the economist Eamonn Butler puts it'. Butler, E. 2008. *The Best Book on the Market*. Capstone.
- p. 250 'the failure of any particular market to match the perfect market no more constitutes "market failure"'. This point is made in Booth, P. 2008. Market failure: a failed paradigm. *Economic Affairs* 28:72–4.
- p. 250 'the science of ecology has an enduring fallacy that in the natural world there is some perfect state of balance to which an ecosystem will return'. Kricher, J. 2009. *The Balance of Nature: Ecology's Enduring Myth*. Princeton University Press. 'As a result of research over the past several decades, ecologists have come to understand the reality of ecosystem dynamics, and have largely abandoned the notion that nature exists in some sort of meaningful natural balance.'

- p. 251 'No country remains for long the leader in knowledge creation.'
Indeed, so iron is the rule of ephemeral innovation that it has been given its own named law: Cardwell's Law. See Mokyr, J. 2003. *The Gifts of Athena*. Princeton University Press. That said, William Easterly has pointed out that since 1000 BC certain areas of the world have consistently stood at the forefront of technology and growth: Comin, D., Easterly, W. and Gong, E. 2006. *Was the Wealth of Nations Determined in 1000 BC?* NBER Working Paper no. 12657.
- p. 252 'As Joel Mokyr puts it'. Mokyr, J. 2003. *The Gifts of Athena*. Princeton.
- p. 253 'George Orwell was tired of the way the world appeared to be shrinking'. Orwell, G. 1944. *Tribune*, 12 May 1944.
- p. 254 'when the credit card took off'. Nocera, J. 1994. *A Piece of the Action*. Simon and Schuster. (That said, there is little doubt that finance is one area of human activity in which too much innovation can be a bad thing. As Adair Turner has put it, whereas the loss of the knowledge of how to make a vaccine would harm human welfare, 'if the instructions for creating a CDO squared [a collateral debt obligation of collateral debt obligations] had somehow been mislaid, we will I think get along quite well without it.'). See Turner, A. 2009. 'The Financial Crisis and the Future of Financial Regulation'. Inaugural Economist City Lecture, 21 January 2009. Financial Services Authority.
- p. 254 'Lewis Mandell discovered'. Quoted in Nocera, J. 1994. *A Piece of the Action*. Simon and Schuster.
- p. 254 'Michael Crichton once told me'. M. Crichton, email to the author, June 2007.
- p. 254 'said William Petty in 1679'. Quoted in Mokyr, J. 2003. *The Gifts of Athena*. Princeton University Press.
- p. 255 'in Alfred North Whitehead's words'. Whitehead, A.N. 1930. *Science and the Modern World*. Cambridge University Press.
- p. 255 'As the scientist Terence Kealey has observed'. Kealey, T. 2007. *Sex, Science and Profits*. William Heinemann.
- p. 256 'the biggest advances in the steam engine'. Kealey, T. 2008. *Sex, Science and Profits*. William Heinemann. Kealey argues that Watt vehemently denied any influence from Joseph Black. Joel Mokyr (in *The Gifts of Athena*) quotes Watt to the contrary.
- p. 256 'efforts by eighteenth-century scientists to prove that Newcomen got his insights from Papin's theories have proved to be wholly without foundation'. Rolt, L.T.C. 1963. *Thomas Newcomen: the Prehistory of the Steam Engine*. David and Charles. Likewise, the establishment was so incredulous that the humble mine engineer George Stephenson could have invented a miner's safety lamp in 1815 without understanding the principle behind it, that they effectively accused him of stealing the idea from the scientist Sir Humphry Davy. The reverse accusation is more plausible: that Davy heard of Stephenson's experiments from the

Notes and references

- engineer John Buddle, who heard of them from the colliery doctor named Burnet, who had been told by Stephenson. See Rolt, L.T.C. 1960. *George and Robert Stephenson*. Longman.
- p. 256 'the famous Lunar Society'. For more on the Lunar Society see Uglow, J. 2002. *The Lunar Men*. Faber and Faber.
- p. 257 'a semi-directed, groping, bumbling process of trial and error by clever, dexterous professionals with a vague but gradually clearer notion of the processes at work'. Mokyr, J. 2003. *The Gifts of Athena*. Princeton.
- p. 257 'It is a stretch to call most of this science'. Joel Mokyr has recently suggested (Mokyr, J. 2003. *The Gifts of Athena*. Princeton) that although the scientific revolution did not start the industrial, none the less the broadening of the epistemic base of knowledge – the sharing and generalisation of understanding – allowed a host of new applications of knowledge, which escaped diminishing returns and enabled the industrial revolution to continue indefinitely. I am not convinced. I think the prosperity generated by industry paid for an expansion of knowledge, which sporadically returned the favour. Even when, by the late nineteenth and early twentieth centuries, science appeared to make mighty contributions to new industries, the philosophers still played second fiddle to the engineers. Lord Kelvin's contributions to the physics of resistance and induction were driven more by practical problem-solving in the telegraph industry than esoteric rumination. And though it is true that the physics of James Clerk Maxwell produced an electrical revolution, the chemistry of Fritz Haber spawned an agricultural revolution, Leo Szilard's idea of a chain reaction of neutrons led to nuclear weapons and the biology of Francis Crick fathered biotechnology, it is none the less also true that these sages needed legions of engineers to turn their insights into things that could change living standards. Tinkering Thomas Edison, with his team of forty engineers, was more important to electrification than thinking Maxwell; practical Carl Bosch mattered more than esoteric Haber; administrative Leslie Groves than dreamy Szilard; practical Fred Sanger than theoretical Crick.
- p. 258 'One of Britain's advantages in the eighteenth century'. Hicks, J.R. 1969. *A Theory of Economic History*. Clarendon Press.
- p. 259 'By contrast in France'. Ferguson, N. 2008. *The Ascent of Money*. Allen Lane.
- p. 259 'fully one-third of successful start-ups in California between 1980 and 2000 had Indian- or Chinese-born founders'. Baumol, W.J., Litan, R.E. and Schramm, C.J. 2007. *Good Capitalism, Bad Capitalism*. Yale University Press.
- p. 259 'A telling anecdote about glass repeated by several Roman authors'. Moses Finley, cited in Baumol, W. 2002. *The Free-market Innovation Machine*. Princeton University Press.
- p. 260 'A Christian missionary in Ming China wrote'. Quoted in Rivoli, P. 2005. *The Travels of a T-shirt in the Global Economy*. John Wiley.

- p. 260 'The proportion of GDP spent by firms on research and development in America has more than doubled'. Kealey, T. 2007. *Sex, Science and Profits*. William Heinemann.
- p. 261 'The pioneer venture capitalist Georges Doriot said'. Quoted in Evans, H. 2004. *They Made America*. Little, Brown.
- p. 262 'as Don Tapscott and Anthony Williams call it'. Tapscott, D. and Williams, A. 2007. *Wikinomics*. Atlantic.
- p. 263 'The dye industry relied mostly on secrecy till the 1860s'. See Moser, P. 2009. Why don't inventors patent? <http://ssrn.com/abstracts=930241>.
- p. 264 'Emmanuelle Fauchart discovered by interviewing ten chefs de cuisine'. Fauchart, E. and Hippel, E. von. 2006. *Norm-based Intellectual Property Systems: the Case of French Chefs*. MIT Sloan School of Management working paper 4576-06. <http://web.mit.edu/evhippel/www/papers/vonhippelfauchart2006.pdf>.
- p. 264 'Yet there is little evidence that patents are really what drive inventors to invent.' There is a lively debate going on about whether James Watt's aggressive enforcement of his broadly worded patents on steam engines in 1769 and 1775 actually shut down innovation in the steam industry. See Rolt, L.T.C. 1960. *George and Robert Stephenson*. Longman. ('With coal so readily available, the north country colliery owners preferred to forgo the superior economy of the Watt engine rather than pay the dues demanded by Messrs. Boulton and Watt.');
- also www.thefreemanonline.org/featured/do-patents-encourage-or-hinder-innovation-the-case-of-the-steam-engine/; Boldrin, M. and Levine, D.K. 2009. Against intellectual monopoly. Available online: <http://www.micheleboldrin.com/research/aim.html>; and Von Hippel, E. 2005. *Democratizing Innovation*. MIT Press. The contrary view, that Watt's patent did little to hinder innovation and that without it he would never have attracted Boulton's backing, is put by George Selgin and John Turner: Selgin, G. and Turner, J.L. 2006. James Watt as intellectual monopolist: comment on Boldrin and Levine. *International Economic Review* 47:1341-8; and Selgin, G. and Turner, J.L. 2009. Watt, again? Boldrin and Levine still exaggerate the adverse effect of patents on the progress of steam power. 18 August 2009, prepared for the Center for Law, Innovation and Economic Growth conference, Washington University School of Law, April 2009.
- p. 264 'the list of significant twentieth-century inventions that were never patented is a long one'. Cited in Shermer, M. 2007. *The Mind of the Market*. Times Books.
- p. 264 'the Wright brothers effectively grounded the nascent aircraft industry'. Heller, M. 2008. *The Gridlock Economy*. Basic Books.
- p. 264 'a logjam in the manufacture of radios caused by the blocking patents held by four firms'. Benkler, Y. 2006. *The Wealth of Networks*. Yale University Press.
- p. 265 'the biggest generators of new patents in the US system are "patent

Notes and references

- trolls” – firms that buy up weak patent applications’. I am indebted to R. Litan for this information.
- p. 265 ‘Research in Motion, the Canadian company that manufactures BlackBerries’. Baumol, W.J., Litan, R.E. and Schramm, C.J. 2007. *Good Capitalism, Bad Capitalism*. Yale University Press.
- p. 265 ‘Michael Heller’s analogy for the patent trolls is to the state of the river Rhine between the decay of Holy Roman imperial power and the emergence of modern states’. Heller, M. 2008. *The Gridlock Economy*. Basic Books.
- p. 266 ‘In one survey of 650 R&D executives from 130 different industries’. Von Hippel, E. 2005. *Democratizing Innovation*. MIT Press.
- p. 266 ‘most of the money goes towards me-too drugs for diseases of Westerners’. Boldrin, M. and Levine, D.K. 2009. Against intellectual monopoly. Available online: <http://www.micheleboldrin.com/research/aim.html>.
- p. 267 ‘only one country had allowed the copyrighting of music’. Boldrin, M. and Levine, D.K. 2009. Against intellectual monopoly. Available online: <http://www.micheleboldrin.com/research/aim.html>.
- p. 267 ‘Just as newspapers have derived little of their income from licensing copyrights’. Benkler, Y. 2006. *The Wealth of Networks: How Social Production Transforms Markets and Freedom*. Yale University Press. (Benkler’s book, true to his argument, is available free online.)
- p. 268 ‘chronically entrepreneurial’. Audretsch, D.B. 2007. *The Entrepreneurial Society*. Oxford University Press.
- p. 268 ‘laying the foundations for their global dominance at the expense of precisely the big companies dirigistes admired’. Postrel, V. 1998. *The Future and Its Enemies*. Free Press.
- p. 269 ‘A large study by the OECD’. Quoted in Kealey, T. 2007. *Sex, Science and Profits*. William Heinemann.
- p. 270 ‘a recent survey of forty-six major inventions’. Agarwal, R. and Gort, M. 2001. First mover advantage and the speed of competitive entry: 1887–1986. *Journal of Law and Economics* 44:161–78.
- p. 270 ‘sired by the bicycle out of the horse carriage’. Rolt, L.T.C. 1967. *The Mechanicals*. Heinemann.
- p. 271 ‘cross-fertilisation ... does ... happen between species of bacteria, 80 per cent of whose genes have been borrowed from other species’. Dagan, T., Artzy-Randrup, Y. and Martin, W. 2008. Modular networks and cumulative impact of lateral transfer in prokaryote genome evolution. *PNAS* 105:10039–44: ‘At least 81 +/- 15% of the genes in each genome studied were involved in lateral gene transfer at some point in their history.’
- p. 271 ‘able to produce only sterile offspring’. The sterility of hybrids was a problem that greatly exercised Charles Darwin, chiefly because it was being claimed by some American anthropologists that black people were a separately created species, which justified slavery, and even that

- hybrids between blacks and whites were sterile. See Desmond, A. and Moore, J. 2009. *Darwin's Sacred Cause*. Penguin.
- p. 271 'Technologies emerge from the coming together of existing technologies into wholes that are greater than the sum of their parts.' Arthur, B. and Polak, W. 2004. *The Evolution of Technology within a Simple Computer Model*. Santa Fe working paper 2004-12-042.
- p. 271 'Henry Ford once candidly admitted'. Evans, H. 2004. *They Made America*. Little, Brown.
- p. 272 'in the historian George Basalla's words'. Basalla, G. 1988. *The Evolution of Technology*. Cambridge University Press.
- p. 272 'an invention looking for a job'. <http://laserstars.org/history/ruby.html>.
- p. 273 'Eric von Hippel, incidentally, practises what he preaches'. Von Hippel, E. 2005. *Democratizing Innovation*. MIT Press.
- p. 274 'as Geoffrey Miller reminds us'. Miller, G. 2009. *Spent*. Heinemann.
- p. 275 'full-scale trebuchets capable of tossing pianos more than 150 yards'. *Wall Street Journal*, 15 January 1992.
- p. 276 'It was Paul Romer's great achievement in the 1990s to rescue the discipline of economics from the century-long cul-de-sac into which it had driven by failing to incorporate innovation.' Warsh, D. 2006. *Knowledge and the Wealth of Nations*. W.W. Norton.
- p. 276 'As Paul Romer puts it'. Romer, P. 1995. *Beyond the Knowledge Worker*. Wordlink.

Chapter 9

- p. 279 'I have observed that not the man who hopes when others despair'. Speech by John Stuart Mill to the London Debating Society on 'perfectibility', 2 May 1828.
- p. 279 US air pollutant emissions graph. US Environmental Protection Agency.
- p. 280 'the economist Julian Simon tried it in the 1990s'. Simon, J. 1996. *The Ultimate Resource 2*. Princeton University Press.
- p. 280 'Bjørn Lomborg tried it in the 2000s'. Lomborg, B. 2001. *The Sceptical Environmentalist*. Cambridge University Press.
- p. 280 'said Hayek'. Hayek, F.A. 1960. *The Constitution of Liberty*. Routledge.
- p. 280 'As Warren Meyer has put it'. http://www.coyoteblog.com/coyote_blog/2005/02/in_praise_of_ro.html.
- p. 280 'The environmentalist Lester Brown, writing in 2008'. Brown, L. 2008. *Plan B 3.0: Mobilizing to Save Civilisation*. Earth Policy Institute.
- p. 283 'Pessimists have always been ubiquitous and have always been feted'. Herman, A. 1997. *The Idea of Decline in Western History*. The Free Press.
- p. 283 'wrote Adam Smith at the start of the industrial revolution'. Smith, A. 1776. *The Wealth of Nations*.
- pp. 283-4 'cried the *Quarterly Review*'. Smiles, S. 1857. *The Life of George Stephenson, Railways Engineer*. John Murray.

Notes and references

- p. 284 'Dr Arnold was more enlightened'. Quoted in Williams, A. 2008. *The Enemies of Progress*. Societas.
- p. 284 'Robert Southey had just published a book'. Southey, R. 1829. *Sir Thomas More: Or, Colloquies on the Progress and Prospects of Society*. John Murray.
- p. 285 'the modern philosopher John Gray'. Quoted in Postrel, V. 1998. *The Future and Its Enemies*. Free Press.
- p. 285 'Thomas Babington Macaulay'. Macaulay, T.B. 1830. Review of Southey's Colloquies on Society. *Edinburgh Review*, January 1830.
- p. 286 'in his *History of England*'. Macaulay, T.B. 1848. *History of England from the Accession of James the Second*.
- p. 287 'said Macaulay in 1830'. Macaulay, T.B. 1830. Review of Southey's Colloquies on Society. *Edinburgh Review*, January 1830.
- p. 288 'a book called *Degeneration*, by the German Max Nordau'. Quoted in Leadbetter, C. 2002. *Up the Down Escalator: Why the Global Pessimists Are Wrong*. Viking.
- p. 288 'said Winston Churchill in a memo to the prime minister'. Asquith papers, December 1910, quoted in Addison, P. 1992. *Churchill on the Home Front 1900–1955*. Jonathan Cape.
- p. 288 'Theodore Roosevelt was even more explicit'. *The Works of Theodore Roosevelt*, National Edition, XII, p. 201.
- p. 288 'as Isaiah Berlin put it'. Quoted in Byatt, I. 2008. Weighing the present against the future: the choice and use of discount rates in the analysis of climate change. In *Climate Change Policy: Challenging the Activists*. Institute of Economic Affairs.
- p. 289 'Oswald Spengler in 1923 in his bestselling polemic *The Decline of the West*'. Spengler, O. 1923. *The Decline of the West*. George Allen & Unwin.
- p. 290 'the opening words of Agenda 21'. Preamble to Agenda 21, 1992.
- p. 290 'in the words of Charles Leadbetter'. Leadbetter, C. 2002. *Up the Down Escalator: Why the Global Pessimists Are Wrong*. Viking.
- p. 291 'groaned the wealthy environmentalist Edward Goldsmith'. Quoted in Postrel, V. 1998. *The Future and Its Enemies*. Free Press.
- p. 291 'in the words of the Prince of Wales'. HRH Prince of Wales 2000. The civilized society. *Temenos Academy Review*. See http://www.princeofwales.gov.uk/speechesandarticles/an_article_by_hrh_the_prince_of_wales_titled_the_civilised_s_93.html
- p. 291 'says a professor of psychology'. Barry Schwartz, quoted in Easterbrook, G. 2003. *The Progress Paradox*. Random House.
- p. 291 'This notion dates from Herbert Marcuse'. Saunders, P. 2007. Why capitalism is good for the soul. *Policy Magazine* 23:3–9.
- p. 291 'the poet Hesiod was nostalgic for a lost golden age'. Hesiod, *Works and Days* II.
- p. 292 'Plato, who deplored writing as a destroyer of memorising'. Barron, D. 2009. *A Better Pencil*. Oxford University Press.

- p. 292 'scalded and defoliated by a kind of cognitive Agent Orange'. John Cornwell. Is technology ruining our children? *The Times*, 27 April 2008.
- p. 292 'The psychoanalyst Adam Phillips'. Phillips, A. and Taylor, B. 2009. *On Kindness*. Hamish Hamilton. Excerpted in *The Guardian*, 3 January 2009.
- p. 293 'Bill McKibben's best-selling dirge of 1989'. McKibben, W. 1989. *The End of Nature*. Random House.
- p. 293 'Robert Kaplan told the world in 1994'. www.theatlantic.com/doc/199402/anarchy.
- p. 293 'our stolen future'. Colburn, T., Dumanoski, D. and Myers, J.P. 1996. *Our Stolen Future*. Dutton. See Breithaupt, H. 2004. *A Cause without a Disease*. EMBO Reports 5:16–18.
- p. 293 'Jared Diamond fell under the spell of fashionable pessimism'. Diamond, J. 1995. *The Rise and Fall of the Third Chimpanzee*. Radius.
- p. 294 'Martin Rees in his book'. Rees, M. 2003. *Our Final Century*. Heinemann.
- p. 294 'what Greg Easterbrook calls'. Easterbrook, G. 2003. *The Progress Paradox*. Random House.
- p. 294 'People ... tend to assume that they will live longer, stay married longer and travel more than they do'. Gilbert, D. 2007. *Stumbling on Happiness*. Harper Press.
- p. 294 'Dane Stangler calls this'. Stangler, D., personal communication.
- p. 294 'people much more viscerally dislike losing a sum of money than they like winning the same sum'. McDermott, R., Fowler, J.H. and Smirnov, O. 2008. On the evolutionary origin of prospect theory preferences. *The Journal of Politics* 70:335–50.
- p. 294 'pessimism genes might quite literally be commoner than optimism genes'. Fox, E., Ridgewell, A. and Ashwin, C. 2009. Looking on the bright side: biased attention and the human serotonin transporter gene. *Proceedings of the Royal Society B* (doi:10.1098/rspb.2008.1788).
- p. 295 'the 7-repeat version of the DRD4 gene accounts for 20 per cent of financial risk taking in men'. Dreber, A. et al. 2009. The 7R polymorphism in the dopamine receptor D4 gene (DRD4) is associated with financial risk taking in men. *Evolution and Human Behavior* (in press).
- p. 295 'The day I was writing a first draft of this paragraph, the BBC reported'. 1 May 2008.
- p. 295 'how the *New York Times* reported the reassuring news in 2009 that world temperature had not risen for a decade'. *New York Times*, 23 September 2009.
- p. 296 'a new theory suggests that cosmic rays are a bigger cause of the Antarctic ozone hole than chlorine is'. Lu, Q.-B. 2009. Correlation between cosmic rays and ozone depletion. *Physical Review Letters* 102:118501–9400.
- p. 297 'Rachel Carson, influenced by Hueper, set out in her book *Silent Spring* (1962) to terrify her readers'. Carson, R. 1962. *Silent Spring*. Houghton Mifflin.

Notes and references

- p. 297 'other causes of childhood death were declining faster'. Bailey, R. 2002. Silent Spring at 40. *Reason*, June 2002. <http://www.reason.com/news/show/34823.html>.
- p. 298 'wrote the environmentalist Paul Ehrlich in 1971'. Ehrlich, P. 1970. *The Population Bomb*. 2nd edition. Buccaneer Press.
- p. 298 'Later he was more specific'. Special Earthday edition of *Ramparts* magazine, 1970.
- p. 298 'both cancer incidence and death rate from cancer fell steadily'. Ames, B.N. and Gold, L.S. 1997. Environmental pollution, pesticides and the prevention of cancer: misconceptions. *FASEB Journal* 11:1041–52.
- p. 298 'Richard Doll and Richard Peto had concluded that age-adjusted cancer rates were falling'. Doll, R. and Peto, R. 1981. The causes of cancer: quantitative estimates of avoidable risks of cancer in the United States today. *Journal of the National Cancer Institute* 66:1193–1308.
- p. 298 'As Bruce Ames famously demonstrated in the late 1990s'. Ames, B.N. and Gold, L.S. 1997. Environmental pollution, pesticides, and the prevention of cancer: misconceptions. *FASEB Journal* 11:1041–52.
- p. 299 'Ames says'. Bruce Ames, personal communication.
- p. 299 'sparing, targeted use of DDT against malarial mosquitoes can be done without any such threat to wildlife'. <http://www.nationalreview.com/comment/bate200406030904.asp>; http://www.prospect-magazine.co.uk/article_details.php?id=10176.
- p. 300 'says Greg Easterbrook'. Easterbrook, G. 2003. *The Progress Paradox*. Random House.
- p. 300 'Lester Brown predicted'. Various sources for these Brown quotes, including Smil, V. 2000. *Feeding the World*. MIT Press, and Bailey, R. 2009. Never right, but never in doubt: famine-monger Lester Brown still gets it wrong after all these years. *Reason* magazine, 12 May 2009: <http://reason.com/archives/2009/05/05/never-right-but-never-in-doubt>. See also Brown, L. 2008. *Plan B 3.0: Mobilizing to Save Civilization*. Earth Policy Institute.
- p. 301 'by William and Paul Paddock'. Paddock, W. and Paddock, P. 1967. *Famine, 1975! America's Decision: Who Will Survive?* Little, Brown.
- p. 301 'William Paddock was calling for a moratorium'. Paddock, William C. Address to the American Phytopathological Society, Houston, Texas 12 August 1975.
- p. 301 '*The Population Bomb*'. Ehrlich, P. 1971. *The Population Bomb*. 2nd edition. Buccaneer.
- p. 301 '*The Dominant Animal*'. Ehrlich, P. and Ehrlich, A. 2008. *The Dominant Animal*. Island Press.
- p. 302 'wrote the economist Joseph Schumpeter in 1943'. Schumpeter, J.A. 1943. *Capitalism, Socialism, and Democracy*. Allen & Unwin.
- p. 302 '*Limits to Growth*'. It should be noted that the authors of *Limits to Growth* have argued since that they only wished to illustrate what might happen if exponential use continued and no new reserves of these

minerals were discovered, which they realised was unlikely. But this is a highly generous reading of both their mathematics and their prose. 'There will be a desperate arable land shortage before the year 2000' and 'The world population will be 7 billion in 2000' sound like predictions to me. Even in more recent updates, the main prognosis remains that civilisation will – or should – collapse for lack of resources in the current century: 'Humanity must draw back, ease down, and heal if it wants to continue to live.' See Meadows, D.H., Meadows, D.L. and Randers, J. 1992. *Beyond the Limits*. Chelsea Green Publishing; and Meadows, D.H., Randers, J. and Meadows, D. 2004. *Limits to Growth: The 30-Year Update*. Chelsea Green Publishing.

- p. 303 'school textbooks soon parroting its predictions minus the caveats'. See Bailey, R. 2004. science and public policy. *Reason*: <http://www.reason.com/news/show/34758.html>.
- p. 303 'In 1990 the economist Julian Simon won \$576.07 in settlement of a wager'. Simon, J. 1996. *The Ultimate Resource 2*. Princeton University Press.
- p. 304 'Life magazine promised its readers'. Quoted in <http://www.ihate.themedia.com/earth-day-predictions-of-1970-the-reason-you-should-not-believe-earth-day-predictions-of-2009>.
- p. 304 'Professor Bernd Ulrich said it was already too late for Germany's forests'. Mauch, C. 2004. *Nature in German History*. Berghahn Books.
- p. 305 'The *New York Times* declared "a scientific consensus"'. Easterbrook, G. 1995. *A Moment on the Earth*. Penguin. See also *Fortune* magazine, April 1986.
- p. 305 'When asked if he had been pressured to be optimistic, one of the authors said the reverse was true'. Mathiesen, M. 2004. *Global Warming in a Politically Correct Climate*. Universe Star.
- p. 306 'The activist Jeremy Rifkin said'. Miller, H.I. 2009. The human cost of anti-science activism. *Policy Review*, April/May 2009. <http://www.hoover.org/publications/policyreview/41839562.html>.
- p. 307 'Ebola outbreaks'. Colebunders, R. 2000. Ebola haemorrhagic fever – a review. *Journal of Infection* 40:16–20.
- pp. 307–8 'The proportion of the population infected with HIV is falling'. http://data.unaids.org/pub/GlobalReport/2008/JC1511_GR08_ExecutiveSummary_en.pdf.
- p. 308 'Hugh Pennington'. <http://news.bbc.co.uk/1/hi/sci/tech/573919.stm>.
- p. 308 'the number of deaths has reached 166'. See <http://www.cjd.ed.ac.uk/figures.htm>
- p. 308 'no extra birth defects at all'. Little, J. 1993. The Chernobyl accident, congenital anomalies and other reproductive outcomes. *Paediatric Perinatal Epidemiology* 7:121–51. The World Health Organisation concluded in 2006 that: 'A modest but steady increase in reported congenital malformations in both contaminated and uncontaminated areas of Belarus appears related to better reporting, not radiation.' See

Notes and references

- <http://www.iaea.org/NewsCenter/Focus/Chernobyl/pdfs/pr.pdf>.
- p. 308 'The evacuation of the area has caused wildlife to flourish there to an extraordinary degree'. Brand, S. 2009. *Whole Earth Discipline*. Penguin.
- p. 309 'As one commentator concluded'. Fumento, M. 2006. The Chicken Littles were wrong: bird flu threat flew the coop. *The Standard*, 25 December 2006.
- pp. 309–10 'you are far more likely to get the flu from a person who is well enough to go to work than one who is ill enough to stay at home'. Wendy Orent. Swine flu poses a risk, but no reason to panic. *Los Angeles Times*, 29 April 2009. <http://articles.latimes.com/2009/apr/29/opinion/oe-orent29>.
- p. 311 'in the words of President Obama's science adviser John Holdren'. Holdren, J., Ehrlich, A. and Ehrlich, P. 1973. *Human Ecology: Problems and Solutions*. W.H. Freeman and Company, p.279.
- p. 311 'in the words of Maurice Strong, first executive director of the United Nations Environment Programme (UNEP)'. <http://www.spiked-online.com/index.php/site/article/7314>.
- p. 311 'in the words of the journalist George Monbiot'. *The Guardian*, 18 August 2009.
- p. 311 'When they speak of retreat'. See <http://www.climate-resistance.org/2009/08/foлие-a-deux.html>.

Chapter 10

- p. 313 'It is possible to believe that all the past is but the beginning of a beginning'. Wells, H.G. 'The Discovery of the Future' Lecture at the Royal Institution, 24 January 1902, published in *Nature* 65:326–31. Reproduced with the permission of AP Watt Ltd on behalf of the Literary Executors of the Estate of H.G. Wells.
- p. 313 Greenland ice cap temperature graph. NCDC. See ncdc.noaa.gov.
- p. 314 'says the environmentalist Jonathan Porritt'. Ecologist Online April 2007. See www.optimumpopulation.org/ecologist.j.porritt.April07.doc.
- p. 315 'Paul Collier's phrase'. Collier, P. 2007. *The Bottom Billion*. Oxford University Press.
- p. 316 'life expectancy is rising rapidly'. As of this writing, life expectancy is still falling in South Africa, Mozambique, and of course Zimbabwe.
- pp. 316–7 'Paul Collier and his colleagues at the World Bank encountered a storm of protest'. Collier, P. 2007. *The Bottom Billion*. Oxford University Press.
- p. 317 'would by now have given Zambians the income per head of the Portuguese'. Moyo, D. 2009. *Dead Aid*. Allen Lane.
- p. 317 'these conclusions were later dashed by Raghuram Rajan and Arvind Subramanian of the International Monetary Fund'. Rajan, R.G. and Subramanian, A. 2005. *Aid and Growth: What Does the Cross-Country Evidence Really Show?* NBER Working Papers 11513, National Bureau of Economic Research.

- p. 318 'the recommendations of the Zambian economist Dambisa Moyo'. Moyo, D. 2009. *Dead Aid*. Allen Lane.
- p. 318 'As William Easterly puts it'. Easterly, W. 2006. *The White Man's Burden: Why the West's Efforts to Aid the Rest Have Done So Much Ill and So Little Good*. Oxford University Press.
- p. 318 'the example of insecticide-treated mosquito bed nets'. Easterly, W. 2006. *The White Man's Burden: Why the West's Efforts to Aid the Rest Have Done So Much Ill and So Little Good*. Oxford University Press.
- p. 321 'consistently the most successful economy in the world in recent decades'. Acemoglu, D., Johnson, S.H. and Robinson, J.A. 2001. *An African Success Story: Botswana*. MIT Department of Economics Working Paper no. 01-37.
- p. 323 'developers leave the poor to build their own slums'. Boudreaux, K. 2008. Urbanisation and informality in Africa's housing markets. *Economic Affairs*, June 2008: 17–24.
- p. 323 'a Cairo house owner will build up to three illegal storeys on top of his house'. De Soto, H. 2000. *The Mystery of Capital*. Bantam Press.
- p. 323 'the end of a long, exhausting and bitter struggle between elitist law and a new order brought about by massive migration and the needs of an open and sustainable society'. De Soto, H. 2000. *The Mystery of Capital*. Bantam Press.
- p. 324 'Bart Wilson and his colleagues set up a land of three virtual villages inhabited by real undergraduates'. Kimbrough, E.O., Smith, V.L. and Wilson, B.J. 2008. Historical property rights, sociality, and the emergence of impersonal exchange in long-distance trade. *American Economic Review* 98:1009–39.
- p. 324 'well crafted property rights are also the key to wildlife and nature conservation'. Anderson, T. and Huggins, L. 2008. *Greener Than Thou*. Hoover Institution Press.
- p. 324 'fish off Iceland'. Costello, C., Gaines, S.D. and Lynham, J. 2008. Can catch shares prevent fisheries collapse? *Science* 321:1678–80. (doi: 0.1126/ science.1159478).
- p. 325 'De Soto's assistants found that to do the same in Tanzania would take 379 days'. Institute of Liberty and Democracy. 2005. Tanzania: the diagnosis. <http://www.ild.org.pe/en/wnatwedo/diagnosis/tanzania>.
- p. 326 'Bamako in Mali could build upon its strong musical traditions'. Schulz, M. and van Gelder, A. 2008. *Nashville in Africa: Culture, Institutions, Entrepreneurship and Development*. Trade, Technology and Development discussion paper no. 2, International Policy Network.
- p. 326 'Micro-finance banking, mobile telephony and the internet are now merging'. Talbot, D. 2008. Upwardly mobile. *Technology Review*, November/December 2008: 48–54.
- p. 326 'opportunities to the poor of Africa that were not available to the poor of Asia a generation ago'. Rodrik, D. (ed.). 2003. *In Search of Prosperity*. Princeton University Press.

Notes and references

- p. 327 'a study of the sardine fishermen of Kerala in southern India'. Jensen, Robert T. 2007. The digital divide: information (technology), market performance and welfare in the South Indian fisheries sector. *Quarterly Journal of Economics* 122: 879–924.
- p. 328 'demographic dividend'. Bloom, D.E. et al. 2007. *Realising the Demographic Dividend: Is Africa Any Different?* PGDA Working Paper no. 23, Harvard University.
- p. 328 'charter city in Africa'. www.chartercities.com.
- p. 329 'The weather is always capricious'. *Newsweek*, 22 January 1996. On the web at <http://www.newsweek.com/id/101296/page/1>.
- p. 329 'Meteorologists disagree about the cause and extent'. *Newsweek*, 28 April 1975. On the web at http://www.denisdutton.com/cooling_world.htm.
- p. 329 'that the last three decades of relatively slow average temperature changes are more compatible with a low-sensitivity than a high-sensitivity model of greenhouse warming'. Lindzen, R.S. and Choi, Y.S. 2009. On the determination of climate feedbacks from ERBE data. *Geophysical Research Letters*. In press. Schwartz, S.E., R.J. Charlson, and H. Rhode, 2007: Quantifying climate change – too rosy a picture? *Nature Reports Climate Change* 2:23-24, and Schwartz S. E. 2008. Reply to comments by G. Foster et al., R. Knutti et al., and N. Scafetta on Heat capacity, time constant, and sensitivity of Earth's climate system. *J. Geophys. Res.* 113, D15105. (doi:10.1029/2008JD009872).
- p. 329 'that clouds may slow the warming as much as water vapour may amplify it'. Paltridge, G., Arking, and Pook, M. 2009. Trends in middle- and upper-level tropospheric humidity from NCEP reanalysis data. *Theoretical and Applied Climatology*. (doi: 10.1007/s00704-009-0117-x).
- p. 329 'that the increase in methane has been (erratically) decelerating for twenty years'. M.A.K. Khalil, C.L. Butenhoff and R.A. Rasmussen, Atmospheric methane: trends and cycles of sources and sinks, *Environmental Science & Technology* 41:2131–7.
- p. 329 'that there were warmer periods in earth's history in medieval times and about 6,000 years ago yet no accelerations or 'tipping points' were reached'. Loehle, C. 2007. A 2000-year global temperature reconstruction based on non-treering proxies. *Energy & Environment* 18: 1049-58; and Moberg, A., D.M. Sonechkin, K. Holmgren, N.M. Datsenko, and W. Karlén, 2005. Highly variable Northern Hemisphere temperatures reconstructed from low- and high-resolution proxy data. *Nature* 433:613-7. 'the Intergovernmental Panel on Climate Change (IPCC)'. The full IPCC reports are available at www.ipcc.ch.
- p. 331 'the Dutch economist Richard Tol'. www.ff.org/centers/csspp/pdf/20061031_tol.pdf.
- p. 331 'With a higher discount rate, Stern's argument collapses'. See Weitzman, M. 2007. Review of the Stern Review on the economics of climate change. *Journal of Economic Literature* 45 (3): 'The present

discounted value of a given global-warming loss from a century hence at the non-Stern annual interest rate of 6 per cent is one-hundredth of the value of the same loss at Stern's centuries-long discount rate of 1.4 per cent.'

- p. 331 'Nigel Lawson asks, reasonably enough'. Lawson, N. 2008. *An Appeal to Reason*. Duckworth.
- p. 331 'all six of the IPCC's scenarios assume that the world will experience so much economic growth that the people alive in 2100 will be on average 4–18 times as wealthy as we are today'. <http://www.ipcc.ch/ipccreports/sres/emission/014.htm>.
- p. 332 'In the hottest scenario, income rises from \$1,000 per head in poor countries today to more than \$66,000 in 2100 (adjusted for inflation)'. Goklany, I. 2009. Is climate change 'the defining challenge of our age'? *Energy and Environment* 20: 279–302.
- p. 332 'Note that this is true even if climate change itself cuts wealth by Stern's 20 per cent by 2100: that would mean the world becoming 'only' 2–10 times as rich.' See http://sciencepolicy.colorado.edu/prometheus/archives/climate_change/001165a_comment_on_ipcc_wo.html.
- p. 332 'the Prince of Wales said in 2009'. <http://www.spectator.co.uk/politics/all/5186108/the-spectators-notes.shtml>.
- p. 332 'All the futures use market exchange rates instead of purchasing power parities for GDP, further exaggerating warming.' Castles, I. and Henderson, D. 2003. Economics, emissions scenarios and the work of the IPCC. *Energy and Environment* 14:422–3. See also Maddison, A. 2007. *Contours of the World Economy*. Oxford University Press.
- pp. 332–3 'The trouble with this reasoning is that it applies to all risks, not just climate change.' <http://cowles.econ.yale.edu/P/cd/d16b/d1686.pdf>; and <http://www.economics.harvard.edu/faculty/weitzman/files/ReactionsCritique.pdf>.
- p. 334 'some countries will continue to gain more land from siltation than they lose to erosion'. Despite this, the journalist George Monbiot incites murder: 'Every time someone dies as a result of floods in Bangladesh, an airline executive should be dragged out of his office and drowned.' (*Guardian*, 5 December 2006); and James Hansen demands trials for crimes against humanity for having an outlying view: 'James Hansen, one of the world's leading climate scientists, will today call for the chief executives of large fossil fuel companies to be put on trial for high crimes against humanity and nature, accusing them of actively spreading doubt about global warming' (*Guardian*, 23 June 2008).
- p. 334 'even the highest estimates of Greenland's melting'. Luthke, S.B. et al. 2006. Recent Greenland ice mass loss from drainage system from satellite gravity observations. *Science* 314:1286–9. If anything the rate of melting in Greenland is slowing; van de Wal, R.S.W., et al. 2008. Large and rapid melt-induced velocity changes in the ablation zone of the Greenland ice sheet. *Science* 321:111.

Notes and references

- p. 334 'warming will itself reduce the total population at risk for water shortage'. Arnell, N.W., 2004. Climate change and global water resources: SRES emissions and socio-economic scenarios. *Global Environmental Change* 14: 31–52. Commenting on how the IPCC's summary for policymakers misreported this paper by omitting all mention of the positive effects caused by more rain falling on populated areas, Indur Goklany writes: 'To summarize, with respect to water resources, Figure SPM.2 – and its clones – don't make any false statements, but by withholding information that might place climate change in a positive light, they have perpetrated a fraud on the readers.' See <http://wattsupwiththat.com/2008/09/18/how-the-ipcc-portrayed-a-net-positive-impact-of-climate-change-as-a-negative/#more-3138>.
- p. 334 'previous warm episodes'. The famous 'hockey stick' graph that seemed to prove that the Medieval Warm Period never happened has since been comprehensively discredited. It relied far too heavily on two sets of samples from bristlecone pine trees and Siberian larch trees that have since been shown to be highly unreliable; it spliced together proxies and real thermometer data in a selective way, obscuring the fact that the proxies did not mirror modern temperatures, and it used statistical techniques that made a hockey stick out of red noise. Subsequent non-tree-ring proxies have emphatically reinstated the Medieval Warm Period as warmer than today. See <http://www.climateaudit.org/?p=7168>. Holland, D. 2007. Bias and concealment in the IPCC process: the 'hockey-stick' affair and its implications. *Energy and Environment* 18:951–83; http://republicans.energycommerce.house.gov/108/home/07142006_Wegman_Report.pdf; www.climateaudit.org/?p=4866#more-4866; <http://wattsupwiththat.com/2009/03/18/steve-mcintyres-iccc09-presentation-with-notes/#more-6315>; <http://www.climateaudit.org/?p=7168>. See also Loehle, C. 2007. A 2000-year global temperature reconstruction based on non-tree ring proxies. *Energy and Environment* 18:1049–58; and Moberg, A., Sonechkin, D.M., Holmgren, K., Datsenko, N.M. and Karlén, W, 2005. Highly variable Northern Hemisphere temperatures reconstructed from low- and high-resolution proxy data. *Nature* 433:613–17. For papers on the Holocene warm period, between 8,000 and 5,000 years ago, see <http://climatesanity.wordpress.com/2008/10/15/dont-panic-the-arctic-has-survived-warmer-temperatures-in-the-past/>; <http://adsabs.harvard.edu/abs/2007AGUFMPP11A0203F>; and <http://meetingorganizer.copernicus.org/EGU2009/EGU2009-13045.pdf>; and http://nsidc.org/arcticseaicenews/faq.html#summer_ice.
- p. 334 'the net population at risk of water shortage by 2100 falls under all their scenarios'. Goklany, I. 2009. Is climate change the defining challenge of our age? *Energy and Environment* 20:279–302.
- p. 335 'no increase in either the number or the maximum wind speed of Atlantic hurricanes making landfall'. Pielke, R.A., Jr., Gratz, J., Landsea, C.W., Collins, D., Saunders, M.A. and Muslin, R, 2008: Normalized

- hurricane damage in the United States: 1900–2005. *Natural Hazard Review* 9:29–42.
- p. 335 ‘death rate from weather-related natural disasters has declined by a remarkable 99 per cent’. Goklany, I. 2007. Deaths and death rates due to extreme weather events. *Civil Society Report on Climate Change*. International Policy Network.
- p. 335 ‘cold weather continues to exceed the number of excess deaths during heatwaves by a large margin’. Lomborg, B. 2007. *Cool It*. Marshall Cavendish.
- p. 336 ‘malaria is not limited by climate’. Reiter, P. 2008. Global warming and malaria: knowing the horse before hitching the cart. *Malaria Journal* 7 (supplement 1):S3.
- p. 336 ‘says Paul Reiter, a malaria expert’. Reiter, P. 2007. Human ecology and human behavior. *Civil Society Report on Climate Change*. International Policy Network.
- p. 336 ‘the possibility that global warming might increase that number by 30,000’. Goklany, I. 2004. Climate change and malaria. *Science* 306:56–7. The treatment of Paul Reiter, an expert on malaria, by the IPCC is a strange tale: ‘The IPCC rejected Professor Reiter’s nomination to write the malaria segment of the health chapter of its 2007 Climate Assessment Report first by pretending he had not been nominated and then by pretending that it had not received the four copies of the nomination papers that he had sent to separate officials. The two lead authors of that segment, unlike Professor Reiter, were not experts on malaria, and had published only one paper on the subject between them. One was not a scientist but an environmental campaigner.’ From http://scienceandpublicpolicy.org/images/stories/papers/scarewatch/scarewatch_agw_spread_malaria.pdf.
- p. 336 ‘a jump in tick-borne disease in eastern Europe around 1990’. Randolph, S.E. 2008. Tick-borne encephalitis in Central and Eastern Europe: consequences of political transition. *Microbes and Infection* 10:209–16.
- p. 337 ‘Kofi Annan’s Global Humanitarian Forum doubled the number of climate deaths to 315,000 a year’. For a good discussion of this issue see <http://sciencepolicy.colorado.edu/prometheus/what-is-wrong-with-non-empirical-science-5410>; also <http://www.climate-resistance.org/2009/06/the-age-of-the-age-of-stupid.html>; also the *Wall Street Journal*: <http://online.wsj.com/article/SB124424567009790525.html>.
- p. 337 ‘Wheat, for example, grows 15–40 per cent faster in 600 parts per million of carbon dioxide’. Pinter, P.J., Jr., Kimball, B.A., Garcia, R.L., Wall, G.W., Hunsaker, D.J. and LaMorte, R.L. 1996. Free-air CO₂ enrichment: Responses of cotton and wheat crops. In Koch, G.W. and Mooney, H.A. (eds). 1996. *Carbon Dioxide and Terrestrial Ecosystems*. Academic Press.
- pp. 337–8 ‘leaving only 5 per cent of the world under the plough in 2100,

Notes and references

- compared with 11.6 per cent today'. Goklany, I. cited in Bailey, R. 2009. What planetary emergency? *Reason*, 10 March 2009. See <http://www.reason.com/news/show/132145.html>.
- p. 338 'The richest and warmest version of the future will have the least hunger'. Parry, M.L., Rosenzweig, C., Iglesias, A., Livermore, M. and Fischer, G, 2004: Effects of climate change on global food production under SRES emissions and socio-economic scenarios. *Global Environmental Change* 14:53–67.
- p. 338 'will have ploughed the least extra land to feed itself'. Levy, P.E. et al. 2004. Modelling the impact of future changes in climate, CO₂ concentration and future land use on natural ecosystems and the terrestrial carbon sink. *Global Environmental Change* 14:21–30.
- p. 338 'hunger, dirty water, indoor smoke and malaria, which kill respectively about seven, three, three and two people per minute'. UN estimates: 3.7m deaths from hunger each year; 1.7m from dirty water, 1.6m from indoor smoke; 1.1m from malaria.
- p. 338 'Economists estimate that a dollar spent on mitigating climate change brings 90 cents of benefits'. Lomborg, B. 2008. How to get the biggest bang for 10 billion bucks. *Wall Street Journal*, 28 July 2008.
- p. 338 'The polar bear, still thriving today (eleven of thirteen populations are growing or steady)'. <http://www.sciencedaily.com/releases/2008/10/081020095850.htm>. See also Dyck, M.G., Soon, W., Baydack, R.K., Legates, D.R., Baliunas, S., Ball, T.F. and Hancock, L.O. 2007. Polar bears of western Hudson Bay and climate change: Are warming spring air temperatures the 'ultimate' survival control factor? *Ecological Complexity* 4:73–84. See also Dr Mitchell Taylor's presentation at <http://www.youtube.com/watch?v=I63Dl14Pcmc>.
- pp. 339–40 'Charlie Veron, an Australian marine biologist ... Alex Rogers of the Zoological Society of London'. Both quoted in the *Guardian*, 2 September 2009. <http://www.guardian.co.uk/environment/2009/sep/02/coral-catastrophic-future>.
- p. 340 'not even in the Persian Gulf where water temperatures reach 35C'. This is what a Canadian biologist wrote on a blog in August 2008: 'I just got back from Iranian side of the Persian Gulf – the Asaluyeh/Nyband Bay region. Air temps 40, sea temps 35. (Email me privately if you want comments on the joys of doing field work under those conditions.) We observed corals at depths from 4–15m. No corals, at any depths, were bleached. Gives perhaps some relevance to the term "resilience." BTW, those mostly undescribed reefs had coral cover of approx 30% – higher than the Florida Keys.' <http://coral.aoml.noaa.gov/pipermail/coral-list/2008-August/037881.html>.
- p. 340 'corals become more resilient the more they experience sudden warmings'. Oliver, T.A. and Palumbi, S.R. 2009. Distributions of stress-resistant coral symbionts match environmental patterns at local but not regional scales. *Marine Ecology Progress Series* 378:93–103. See also

- Baker, A.C. et al. 2004. Coral reefs: Corals' adaptive response to climate change. *Nature* 430:741, who say: 'The adaptive shift in symbiont communities indicates that these devastated reefs could be more resistant to future thermal stress, resulting in significantly longer extinction times for surviving corals than had been previously assumed.'
- p. 340 'Some reefs may yet die if the world warms rapidly in the twenty-first century, but others in cooler regions may expand.' Kleypas, J.A., Danabasoglu, G. and Lough. J.M. 2008. Potential role of the ocean thermostat in determining regional differences in coral reef bleaching events, *Geophysical Research Letters* 35: L03613. (doi:10.1029/2007GL032257).
- p. 341 'a rash of empirical studies showing that increased carbonic acid either has no effect or actually increases the growth of calcareous plankton'. Iglesias-Rodriguez, M.D. et al. 2008. Phytoplankton calcification in a high-CO₂ world. *Science* 320:336–40. Other studies of the carbonate issue are summarised by Idso, C. 2009. *CO₂, Global Warming and Coral Reefs*. Vales Lake Publishing.
- p. 341 'said Bill Clinton once'. Speech to the US National Academy of Sciences, 15 July 1998.
- p. 341 'As Indur Goklany puts it'. Goklany, I. 2008. *The Improving State of the World*. Cato Institute.
- p. 341 'The results of thirteen economic analyses of climate change'. Summarised in Tol, R. S. J. 2009. The Economic Effects of Climate Change. *Journal of Economic Perspectives*, 23:29–51. [http://www.aeaweb.org/articles.php? doi=10.1257/jep.23.2.29](http://www.aeaweb.org/articles.php?doi=10.1257/jep.23.2.29). See also the essay by Jerry Taylor at <http://www.masterresource.org/2009/11/the-economics-of-climate-change-essential-knowledge>.
- p. 342 'quoting from the IPCC's 2007 report'. IPCC AR4, Working Group III, p. 204.
- p. 342 'says the physicist David MacKay'. MacKay, D. 2009. *Sustainable Energy – without the Hot Air*. UIT, Cambridge.
- p. 343 '125 kilowatt-hours per day per person of work that give Britons their standard of living'. Numbers in this paragraph recalculated from MacKay, D. 2009. *Sustainable Energy – without the Hot Air*. UIT, Cambridge. Compare this number (125 kWh per person per day) with the number given in chapter 7 from a different source: England consumes 250 gigawatts (250 gigajoules per second) in total, or 5,000 joules per person per second, assuming the population of England is 50m. There are 3.6m joules in a kilowatt hour and 86,400 seconds in a day so 5,000 x 86,400 = 432m joules per person per day. 432/3.6 = 120 kWh per person per day.
- p. 344 'a Spanish study confirms that wind power subsidies destroy jobs'. Donald Hertzmark, 6 April 2009 at <http://masterresource.org/?p=1625>. See also <http://www.juandemariana.org/pdf/090327-employment-public-aid-renewable.pdf>, and <http://masterresource.org/?p=5046#more-5046>.

Notes and references

- p. 344 'writes Peter Huber'. Huber, P. 2009. Bound to burn. *City Journal*, spring 2009.
- p. 344 'quite soon engineers will be able to use sunlight to make hydrogen directly from water with ruthenium dye as a catalyst'. Bullis, K. 2008. Sun + water = fuel. *Technology Review*, November/December, 56–61.
- pp. 344–5 'Once solar panels can be mass-produced at \$200 per square metre and with an efficiency of 12 per cent, they could generate the equivalent of a barrel of oil for about \$30'. Ian Pearson, 8.9.08: <http://www.futurizon.net/blog.htm>.
- p. 345 'human energy use over the past 150 years as it migrated from wood to coal to oil to gas'. Ausubel, J.H. 2003. 'Decarbonisation: the Next 100 Years'. Lecture at Oak Ridge National Laboratory, June 2003. http://phe.rockefeller.edu/PDF_FILES/oakridge.pdf.
- p. 346 'Jesse Ausubel predicts'. Ausubel, J.H. and Waggoner, P.E. 2008. Dematerialization: variety, caution and persistence. *PNAS* 105:12774–9. See also: <http://www.nytimes.com/2009/04/21/science/earth/21tier.html>.
- p. 346 'carbon-rich oceanic organisms called salps'. Lebrato, M. and Jones, D.O.B. 2009. Mass deposition event of *Pyrosoma atlanticum* carcasses off Ivory Coast (West Africa). *Limnology and Oceanography* 54:1197–1209.

Chapter 11

- p. 349 'I hear babies cry, I watch them grow'. Thiele, B. and Weiss, G. D. 1967. 'What a Wonderful World'. Range Road Music, Inc., Bug Music – Quartet Music, Inc. and Abilene Music, Inc., USA. Copyright renewed. All rights reserved. Reproduced with permission of Carlin Music Corp., London.
- p. 349 IPCC projections for world GDP graph. Intergovernmental Panel on Climate Change, 4th Assessment Report 2007.
- p. 352 'said H.G. Wells'. Wells, H.G. 'The Discovery of the Future' Lecture at the Royal Institution, 24 January 1902, published in *Nature* 65:326–31. Reproduced with the permission of AP Watt Ltd on behalf of the Literary Executors of the Estate of H.G. Wells.
- p. 354 'As Paul Romer puts it'. Quotes are from Romer, P. 'Economic growth' in the *Concise Encyclopedia of Economics* (edited by David R Henderson, published by Liberty Fund); and Romer, P. 1994. New goods, old theory, and the welfare costs of trade restrictions. *Journal of Development Economics* 43:5–38.
- p. 355 'the world economy will be doubling in months or even weeks'. Hanson, R. 2008. Economics of the Singularity. *IEEE Spectrum* (June 2008) 45:45–50.
- p. 355 'a technological "singularity"'. This notion has been explored by Vernor Vinge and Ray Kurzweil. See Kurzweil, R. 2005. *The Singularity Is Near*. Penguin.
- p. 355 'says Stephen Levy.' Levy, S. 2009. Googlenomics. *Wired*, June 2009.
- p. 356 'says the author Clay Shirky'. Shirky, C. 2008. *Here Comes Everybody*. Penguin.

www.rationaloptimist.com

- p. 356 'Says Kevin Kelly'. Kelly, K. 2009. The new socialism. *Wired*, June 2009.
- p. 358 'The wrong kind of chiefs, priests and thieves could yet snuff out future prosperity on earth.' Meir Kohn has written eloquently on this point. See [www.dartmouth.edu/~mkohn/Papers/lessons% 201r3.pdf](http://www.dartmouth.edu/~mkohn/Papers/lessons%201r3.pdf).
- p. 359 'Said Lord Macaulay'. Macaulay, T.B. 1830. Southey's Colloquies on Society. *Edinburgh Review*, January 1830.
- p. 359 'In Thornton Wilder's play *The Skin of Our Teeth*'. Wilder, T. 1943. *The Skin of Our Teeth*. HarperCollins.