

Notes

General Introduction

1. 'Emerging Technologies' (2010), Bitpipe Website, <http://www.bitpipe.com/tlist/Emerging-Technologies.html>, date accessed 17 August 2010.
2. 'Emerging Technologies' (2010), BusinessDictionary Website, <http://www.businessdictionary.com/definition/emerging-technologies.html>, date accessed 17 August 2010.
3. J. Erlendsson (2004), 'Emerging Technology', University of Iceland: Scientific and Technical Information Services Website, 20 April, <http://www3.hi.is/~joner/eaps/emergtd.htm>, date accessed 17 August 2010.
4. J.H. Barton (2006), 'Scientific and Technical Information for Developing Nations' in Secretariat of the International Task Force on Global Public Goods (eds) *Expert Paper Series, Expert Paper Six: Knowledge* (Washington, D.C.: The Secretariat of the International Task Force on Global Public Goods), p. 1.
5. Ibid.
6. International Task Force on Global Public Goods (2006), *Meeting Global Challenges: International Cooperation in the National Interest* (Stockholm: Erlanders Infologistics Väst AB).
7. Barton (2006), 'Scientific and Technical Information for Developing Nations', p. 1.
8. Ibid., p. 2.
9. N.R.F. Al-Rodhan (2009), *Sustainable History and the Dignity of Man: A Philosophy of History and Civilisational Triumph* (Berlin: LIT), p. 125.
10. Ibid., p. 127.
11. Ibid.
12. Ibid., p. 108.
13. Ibid., p. 101.
14. Ibid., p. 131.
15. Ibid., p. 127.
16. Ibid., pp. 126–127.
17. Ibid., p. 131.
18. Ibid.
19. Ibid., p. 437.
20. Ibid., p. 125.
21. Ibid.
22. Ibid., p. 101.
23. S. Fuller (2007), *New Frontiers in Science and Technology Studies* (Cambridge: Polity Press), p. 1.
24. W.K. Bauchspies, J. Croissant and S. Restivo (2006), *Science, Technology, and Society* (Oxford: Blackwell Publishing), p. vii.
25. Ibid., p. viii.

26. Ibid., p. 4.
27. Ibid.
28. Al-Rodhan (2009), *Sustainable History and the Dignity of Man: A Philosophy of History and Civilisational Triumph*, p. 133.
29. Ibid., p. 130.
30. Cf. N. R.F. Al-Rodhan (2007), *The Five Dimensions of Global Security: Proposal for a Multi-sum Security Principle* (Berlin: LIT).

1 Introduction

1. 'Fascinating Facts about the Invention of the Wheel' (2005), IdeaFinder Website, March, <http://www.ideafinder.com/history/inventions/wheel.htm>, date accessed 4 August 2010.
2. 'Starfish Prime' (2010), Absolute Astronomy Website, http://www.absoluteastronomy.com/topics/Starfish_Prime, date accessed 17 August 2010.
3. R.G. Lipsey, K.I. Carlaw and C.T. Bekar (2005), *Economic Transformations: General Purpose Technologies and Long-Term Economic Growth* (Oxford: Oxford University Press), p. 99.
4. Ibid., p. 131.
5. Ibid.
6. Ibid., p. 133.

2 Information and Communications Technology (ICT)

1. Cf. B. Gates (2007), 'The Tech Revolution Has Just Begun: The Big Picture', *PC Magazine*, Vol. 27, No. 1/2, <http://www.pcmag.com/article2/0,2817,2238181,00.asp>, date accessed 2 February 2011.
2. N.L. Rudenstein (2001), *Pointing Our Thoughts: Reflections on Harvard and Higher Education, 1991–2001* (Cambridge, MA: Harvard University), p. 140.
3. E.J. Wilson III (1998), *Globalization, Information Technology, and Conflict in the Second and Third Worlds: A Critical Review of the Literature* (New York: Rockefeller Brothers Fund), p. 6.
4. J.P. Singh (2002), 'Introduction: Information Technologies and the Changing Scope of Global Power and Governance' in J.N. Rosenau and J.P. Singh (eds) *Information Technologies and Global Politics: The Changing Scope of Power and Governance* (Albany, NY: State University of New York Press), p. 2.
5. R. Silbergliitt, P.S. Anton, D.R. Howell, A. Wong, N. Gassman, B.A. Jackson, E. Landree, S. L. Pfleeger, E.M. Newton and F. Wu (2006), *The Global Technology Revolution 2020 – In-Depth Analyses: Bio/Nano/Materials/Information Trends, Drivers, Barriers, and Social Implications* (Santa Monica, CA: RAND), p. 14.
6. 'Internet Usage Statistics' (2009), Internet World Stats Website, 31 March, <http://www.internetworldstats.com/stats.htm>, date accessed 10 August 2010.
7. 'Global ICT Spending Tops \$3.5 Trillion' (2008), *JCN Newswires*, 20 May, http://www.japancorp.net/Article.Asp?Art_ID=18281, date accessed 10 August 2010.
8. Ibid.

9. Organisation for Economic Cooperation and Development (OECD) (2008), 'OECD Information Technology Outlook 2008 Highlights', www.oecd.org/sti/ito, date accessed 4 August 2010.
10. R. MacManus (2007), '10 Future Web Trends', Read Write Web Website, 5 September, http://www.readwriteweb.com/archives/10_future_web_trends.php, date accessed 4 August 2010.
11. B.M. Leiner, V.G. Cerf, D.D. Clark, R.E. Kahn, L. Kleinrock, D.C. Lynch, J. Postel, L.G. Roberts, and S. Wolff (2003), 'A Brief History of the Internet', Internet Society Website, 10 December, <http://www.isoc.org/internet/history/brief.shtml>, date accessed 4 August 2010.
12. Ibid.
13. T. Berners-Lee (2010), 'Frequently Asked Questions', World Wide Web Consortium Website, <http://www.w3.org/People/Berners-Lee/FAQ.html#InternetWeb>, date accessed 4 August 2010.
14. 'The Difference Between the Internet and the World Wide Web' (2008), Webopedia Website, 29 February, http://www.webopedia.com/DidYouKnow/Internet/2002/Web_vs_Internet.asp, date accessed 4 August 2010.
15. Berners-Lee, 'Frequently Asked Questions'.
16. J.R. Okin (2005), *The Internet: The Not-for-Dummies Guide to the History, Technology, and Use of the Internet* (Winter Harbor, ME: Ironbound Press), p. 24.
17. Ibid., p. 26.
18. A. Paris (2008), 'Cyberethics: The Emerging Codes of Online Conduct', *Policy Innovations, A Publication of the Carnegie Council*, 9 April, <http://www.policyinnovations.org/ideas/briefings/data/000046>, date accessed 4 August 2010.
19. A.G.K. Solomon (2005), *Technology Futures and Global Power, Wealth, and Conflict* (Washington, D.C.: Center for Strategic and International Studies), p. vi.
20. OECD (2007), 'Social and Economic Factors Shaping the Future of the Internet, Workshop Proceedings, DSTI/ICCP(2007),12/FINAL', 25 July, <http://www.oecd.org/dataoecd/43/13/38818332.pdf>, date accessed 10 August, p. 5.
21. Okin (2005), *The Internet: The Not-for-Dummies Guide to the History, Technology, and Use of the Internet*, p. 4.
22. Federal Communications Commission (FCC) (2009), 'What Is Broadband?' <http://www.fcc.gov/broadband/>, date accessed 18 August 2010.
23. Ibid.
24. P. Anderson (2007), 'What is Web 2.0? Ideas, Technologies and Implications for Education', JISC Technology & Standards Watch Website, February, <http://www.jisc.ac.uk/whatwedo/services/techwatch/reports/horizonscanning/hs0701.aspx>, date accessed 17 August 2010, 5.
25. T. O'Reilly 'Web 2.0: Compact Definition?', O'Reilly Radar Website, <http://radar.oreilly.com/archives/2005/10/web-20-compact-definition.html>, date accessed 4 August 2010
26. D. Tapscott and A.D. Williams (2008), *Wikinomics: How Mass Collaboration Changes Everything*, expanded edn (London: Atlantic Books), p. 19.
27. B. Evangelista (2010), 'Facebook Directs More Users Online than Google', SF Gate Website, 15 February, <http://articles.sfgate.com/2010-02-15/>

- business/17876925_1_palo-alto-s-facebook-search-engine-gigya, date accessed 10 August 2010.
28. N.R.F. Al-Rodhan (2007), *The Emergence of Blogs as a Fifth Estate and Their Security Implications* (Geneva: Slatkine), p. 29.
 29. *Ibid.*, p. 16.
 30. *Ibid.*, p. 29.
 31. *Ibid.*
 32. N. Aranda (2007), 'A Brief History of Mobile Computing', Ezine Articles Website, 27 March, <http://ezinearticles.com/?A-Brief-History-of-Mobile-Computing&id=505215>, date accessed 4 August 2010.
 33. 'What is Wi-Fi?' (2010), Webopedia Website, http://www.webopedia.com/TERM/W/Wi_Fi.html, date accessed 4 August 2010.
 34. 'Internet's Future in 2020 Debated' (2006), *BBC News*, 24 September, <http://news.bbc.co.uk/2/hi/technology/5370688.stm>, date accessed 4 August 2010.
 35. International Telecommunication Union (ITU) (2009), *Confronting the Crisis: ICT Stimulus Plans for Economic Growth*, 2nd edn (Geneva: ITU), p. 62.
 36. R. MacManus (2007), '10 Future Web Trends', Read Write Web Website, 5 September, http://www.readwriteweb.com/archives/10_future_web_trends.php, date accessed 4 August 2010.
 37. 'Reality, Improved' (2009), *The Economist*, 3 September, <http://www.economist.com/node/14299602>, date accessed 10 August 2010.
 38. *Ibid.*
 39. *Ibid.*
 40. *Ibid.*
 41. *Ibid.*
 42. 'Definitions', Cloud Computing Website, http://searchcloudcomputing.techtarget.com/sDefinition/0,,sid201_gci1287881,00.html, date accessed 10 August 2010.
 43. 'Press Release: Gartner Identifies the Top 10 Strategic Technologies for 2009' (2009), Gartner Website, 12–16 October, <http://www.gartner.com/it/page.jsp?id=777212>, date accessed 10 August 2010.
 44. E. Knorr and G. Gruman (2009), 'What Cloud Computing Really Means', Info World Website, 2 May, <http://www.infoworld.com/d/cloud-computing/what-cloud-computing-really-means-031>, accessed 4 August 2010.
 45. D. Talbot (2009), 'TR10: HashCache', *MIT Technology Review*, March/April, http://www.technologyreview.com/printer_friendly_article.aspx?id=22119&channel=specialsections§ion=tr10, date accessed 17 August 2010.
 46. *Ibid.*
 47. *Ibid.*
 48. Global Strategy Institute, Centre for Strategic & International Studies (CSIS) 'Revolution 3 – Technology', http://gsi.csis.org/index.php?option=com_content&task=view&id=24&Itemid=53, date accessed 4 August 2010.
 49. *Ibid.*
 50. 'Moore's Law' (2008), Webopedia Website, 29 February, http://www.webopedia.com/TERM/M/Moores_Law.html, date accessed 4 August 2010.
 51. E. Schmidt (2008), 'Inspiring Innovation and Exploration', NASA's 50th Anniversary Lecture Series, 17 January, www.nasa.gov/50th/NASA_lecture_series/schmidt.html, date accessed 4 August 2010.

52. J. Stokes (2008), 'Understanding Moore's Law', *Ars Technica*, 27 September, <http://arstechnica.com/hardware/news/2008/09/moore.ars/5>, date accessed 4 August 2010.
53. 'How Important Is a Fast CPU?' (2009), Help Desk Geek Website, 1 August, <http://helpdeskgeek.com/windows-xp-tips/importance-of-cpu-in-compute/>, date accessed 10 August 2010.
54. 'The Top 20 Applications for an Infinitely Fast Computer' (2009), Skytopia Website, 13 July, <http://www.skytopia.com/project/cpu/cpu.html>, date accessed 10 August 2010.
55. Ibid.
56. 'Memories Are Made of This' (2009), *The Economist*, 3 September, Vol. 392, <http://www.economist.com/node/14299550>, date accessed 10 August 2010, 14.
57. Ibid.
58. Ibid.
59. W. Drake (2004), 'Reframing Internet Governance Discourse: Fifteen Baseline Propositions. Memo #2 for the Social Science Research Council's Research Network on IT and Governance, Paper Based on Presentation at the Workshop on Internet Governance, ITU, Geneva, 26–27 February and the UN ICT Task Force Global Forum on Internet Governance', New York City, 25–26 March, <http://www.un-ngls.org/orf/drake.pdf>, date accessed 17 August 2010, p. 5.
60. Europe's Information Society (2009), 'Internet Governance', 18 June, http://ec.europa.eu/information_society/policy/internet_gov/index_en.htm, date accessed 4 August 2010.
61. Drake (2004), 'Reframing Internet Governance Discourse: Fifteen Baseline Propositions. Memo #2 for the Social Science Research Council's Research Network on IT and Governance', p. 5.
62. Ibid.
63. D. McGuire (2003), 'U.N. Summit to Focus on Internet', *Washington Post*, 5 December, <http://pqasb.pqarchiver.com/washingtonpost/access/477322551.html?FMT=ABS&FMTS=ABS:FT&date=Dec+5%2C+2003&author=David+McGuire&pub=The+Washington+Post&edition=&startpage=E.05&desc=U.N.+Summit+to+Focus+on+Internet%3B+Officials+to+Discuss+Shifting+of+Control+to+International+Body>, date accessed 10 August 2010.
64. 'Can ICANN Cope?' (2001), *Foreign Policy*, No. 126, September/October, 99.
65. M.L. Mueller, J. Mathiason and H. Klein (2007), 'The Internet and Global Governance: Principles and Norms for a New Regime', *Global Governance*, Vol. 13, No. 2, April–June, 238.
66. 'ICANN Be Independent' (2009), *The Economist*, 26 September, Vol. 392, No. 8650, <http://www.economist.com/node/14517430>, date accessed 10 August 2010.
67. 'ICANN Approves Internet Addresses in Arabic' (2010), Agence France Presse Website, 22 January, http://www.google.com/hostednews/afp/article/ALeqM5hdOGa_b355dSfA2Lhasd0mAYRzuw, date accessed 4 August 2010.
68. W. J. Drake (2001), 'Communications' in P.J. Simmons and C. de Jonge Oudraat (eds) *Managing Global Issues: Lessons Learned* (Washington, D.C.: Carnegie Endowment for International Peace), p. 41.
69. Ibid.

70. Ibid.
71. E.A. Fischer (2005), 'Creating a National Framework for Cybersecurity: An Analysis of Issues and Options' in L.V. Choi (ed.) *Cybersecurity and Homeland Security* (New York: Nova Science Publishers, Inc.), p. 1.
72. J.J. Hamre, P. Ambegaonkar and K.C. Zuback (2006), 'Bringing International Governance to Cyber Space' in J.A. Lewis (ed.) *Cyber Security: Turning National Solutions into International Cooperation* (Washington, D.C.: Center for Strategic and International Studies), p. 116.
73. S.E. Goodman (2006), 'Toward a Treaty-Based International Regime on Cyber Crime and Terrorism' in Lewis (2006), *Cyber Security: Turning National Solutions into International Cooperation*, p. 74.
74. N. Miwa (2006), 'Informal, Non-Treaty-Based Multilateral Coordination' in Lewis (2006), *Cyber Security: Turning National Solutions into International Cooperation*, p. 103.
75. N.R.F. Al-Rodhan (ed.) (2006), 'Editorial of Policy Brief on Information Technology, Terrorism, and Global Security', *Policy Briefs on the Transcultural Aspects of Security and Stability* (Berlin: LIT), p. 181.
76. Ibid.
77. Ibid.
78. S. Ham and R.D. Atkinson (2001), *A Third Way Framework for Global E-Commerce* (Washington, D.C.: Progressive Policy Institute).
79. Ibid.
80. ITU 'About ITU', <http://www.itu.int/net/about/index.aspx>, date accessed 4 August 2010.
81. Ibid.
82. Ibid.
83. ITU 'The ITU Mission', <http://www.itu.int/net/about/mission.aspx>, date accessed 4 August 2010.
84. UN Global Alliance for ICT and Development (GAID) 'Mission and Objectives', <http://www.un-gaid.org/About/OurMission/tabid/893/language/en-US/Default.aspx>, date accessed 4 August 2010.
85. GAID, 'GAID Areas of Focus', <http://www.un-gaid.org/Activities/PriorityAreas/tabid/862/language/en-US/Default.aspx>, date accessed 4 August 2010.
86. B.S. Buckland, F. Schreider and T.H. Winkler (2010), *Democratic Governance Challenges of Cyber Security*, DCAF Horizon 2015 Working Paper Series 1 (Geneva: DCAF), p. 12.
87. Ibid.
88. F. Assandri and D. Martings (eds) (2009), *From Early Tang Court Debates to China's Peaceful Rise* (Amsterdam: ICAS/Amsterdam University Press), pp. 143–144.
89. S. Lafraniere (2010), 'China Moves to Tighten Data Controls', *The New York Times*, 27 April, http://www.nytimes.com/2010/04/28/world/asia/28china.html?_r=1&scp=1&sq=China%20moves%20to%20tighten%20Data%20Controls%E2%80%99&st=cse, date accessed 10 August 2010.
90. 'Google darf in China weitermachen' (2010), *Zeit Online*, 9 July, <http://www.zeit.de/digital/internet/2010-07/google-china-zensur>, date accessed 10 August 2010.

91. Center for Strategic and International Studies Commission on Cybersecurity for the 44th Presidency (2008), *Securing Cyberspace for the 44th Presidency* (Washington, D.C.: Center for Strategic and International Studies), pp. 1–3.
92. J. Markoff (2010), 'Step Taken to End Impasse Over Cybersecurity Talks', *The New York Times*, 16 July, http://www.nytimes.com/2010/07/17/world/17cyber.html?ref=john_markoff, date accessed 19 August 2010.
93. Buckland et al. (2010), *Democratic Governance Challenges of Cyber Security*, p. 29.
94. Drake (2001), 'Communications', p. 41.
95. Drake (2004), 'Reframing Internet Governance Discourse: Fifteen Baseline Propositions. Memo #2 for the Social Science Research Council's Research Network on IT and Governance', p. 5.
96. Malkoff (2010), 'Step Taken to End Impasse Over Cybersecurity Talks'.
97. S. Buckley (2000), 'Radio's New Horizons: Democracy and Popular Communication in the Digital Age', *International Journal of Cultural Studies*, Vol. 3, No. 2, 181.
98. Drake (2001), 'Communications', pp. 25–26.
99. J.S. Nye (2010), *Cyber Power* (Cambridge, MA: Harvard Kennedy School, Belfer Center), p. 11.
100. J.A. Lewis (2006), 'Introduction' in Lewis (2006), *Cyber Security: Turning National Solutions into International Cooperation*, p. xiii.
101. Ibid.
102. Goodman (2006), 'Toward a Treaty-Based International Regime on Cyber Crime and Terrorism', p. 74.
103. Drake (2001), 'Communications', p. 47.
104. Schmidt (2008), 'Inspiring Innovation and Exploration'.
105. E.B. Skolnikoff (2001), 'International Governance in a Technological Age' in J. De La Mothe (ed.) *Science, Technology and Governance* (Trombridge, Wilts: Crombrell Press), p. 4.
106. Ibid.
107. Ibid., p. 3.
108. Ibid.
109. European Commission, Information Society and Media (2006), 'EU–US Summit on Cyber Trust: System Dependability and Security, Workshop Report', 15–16 November, p. 4.
110. McAfee and Security and Defence Agenda (SDA) (2010), 'Cyber Security: A Transatlantic Perspective', SDA Evening Debate Report, 22 March, http://www.securitydefenceagenda.org/Portals/7/2010/Publications/Report_Cyber_security_Final.pdf, date accessed 10 August 2010, p. 5.
111. P. Biggs, 'Trends in Social Media & the Social Web', ITU.
112. C. Arthur (2010), 'Facebook Privacy Lets You See Where Strangers Plan to Go', *The Guardian*, 26 April, <http://www.guardian.co.uk/technology/2010/apr/26/facebook-privacy-hole>, date accessed 10 August 2010.
113. R. Waters (2010), 'Google's Buzz criticized by Privacy Regulators', *The Financial Times*, 20 April, <http://www.ft.com/cms/s/0/63d763c4-4ca6-11df-9977-00144feab49a.html>, date accessed 10 August 2010.
114. K. Allison (2007), 'Key to It All', *The Financial Times*, 24 September, <http://www.ft.com/cms/s/0/82693014-6a32-11dc-a571-0000779fd2ac.html>, date accessed 10 August 2010.

115. M.S. Smith (2003), 'Internet Privacy: Overview and Pending Legislation', CRS Report for Congress, 10 July, <http://www.firstamendmentcenter.org/pdf/CRS.internet1.pdf>, date accessed 4 August 2010, p. 2.
116. S. Hansel (2009), 'Agency Skeptical of Internet Privacy Policies', *The New York Times*, 12 February, <http://www.nytimes.com/2009/02/13/technology/internet/13privacy.html?scp=1&sq=Agency%20Skeptical%20of%20Internet%20Privacy%20Policies&st=cse>, date accessed 10 August 2010.
117. R.J. Deibert (2002), 'Circuits of Power: Security in the Internet Environment' in J.N. Rosenau and J.P. Singh (eds) *Information Technologies and Global Politics: The Changing Scope of Power and Governance* (Albany, NY: State University of New York Press), p. 126.
. Ibid., p. 128.
119. Smith (2003), 'Internet Privacy: Overview and Pending Legislation', p. 4.
120. Ibid., p. 2.
121. Ibid.
122. S. Rodotà (2006), 'Europe and Cyber Security' in Lewis (2006), *Cyber Security: Turning National Solutions into International Cooperation*, p. 83.
123. Ibid., p. 83.
124. Allison (2007), 'Key to It All', p. 11.
125. Ibid.
126. Rodotà (2006), 'Europe and Cyber Security', p. 83.
127. J. Brodtkin (2008), 'Gartner's Top 10 Strategic Technologies for 2008', Networked World Website, <http://www.networkworld.com/news/2007/100907-10-strategic-technologies-gartner.html>, date accessed 4 August 2010.
128. R. Stancich (2008), 'Green ICT: Banking on a Software Solution to Climate Change', Climate Change Corp Website, 22 October, <http://www.climatechangecorp.com/content.asp?contentid=5727>, date accessed 4 August 2010.
129. 'Smart 2020: Enabling the Low Carbon Economy in the Information Age: United States Addendum' (2008), Global E-Sustainability Initiative and the Boston Consulting Group Website, http://www.smart2020.org/_assets/files/Smart2020UnitedStatesReportAddendum.pdf, p. 6.
130. ITU (2009), 'Confronting the Crisis: Its Impact on the ICT Industry', pp. 65–67.
131. D.W. Drezner (2005), 'Weighing the Scales: the Internet's Effect on State-Society Relations', March, <http://www.danieldrezner.com/research/scales.pdf>, accessed 6 August 2010.
132. 'Moldova's "Twitter Revolutionary" Speaks Out' (2009), *BBC News*, 25 April, <http://news.bbc.co.uk/2/hi/europe/8018017.stm>, date accessed 4 August 2010.
133. N. Hodge (2009), 'Inside Moldova's Twitter Revolution', *Wired*, 8 April, <http://www.wired.com/dangerroom/2009/04/inside-moldovas>, date accessed 4 August 2010.
134. United Nations Educational, Scientific, and Cultural Organization (UNESCO) (2005), 'Women, Poverty and ICT: Mediating Social Change', 25 March, http://portal.unesco.org/ci/en/ev.php-URL_ID=18443&URL_DO=DO_TOPIC&URL_SECTION=201.html, date accessed 4 August 2010.
135. Ibid.

136. N.R.F. Al-Rodhan (2006), 'Editorial of Policy Brief on Xenophobia, Media Stereotyping, and Their Role in Global Insecurity' in Al-Rodhan (2006), *Policy Briefs on the Transcultural Aspects of Security and Stability*, p. 38.
137. Ibid.
138. G. Herd and N.R.F. Al-Rodhan (2006), 'Danish Cartoons: A Symptom of Global Insecurity' in Al-Rodhan (2006), *Policy Briefs on the Transcultural Aspects of Security and Stability*, p. 49.
139. Ibid.
140. Ibid., p. 50.
141. L.F. Baron Porras (2003), 'IC(K)Ts, Civil Society and New Social Debates', Center of Research & Popular Education (CINEP), March, p. 2.
142. M. Vatis (2006), 'International Cyber-Security Cooperation: Informal Bilateral Models' in Lewis (2006), *Cyber Security: Turning National Solutions into International Cooperation*, p. 10.
143. D. Ventre (2009), *Information Warfare* (Hoboken, NJ, London: Wiley-ISTE), p. 213.
144. McAfee and SDA (2010), *Cyber Security: A Transatlantic Perspective*, p. 11.
145. Fischer (2005), 'Creating a National Framework for Cybersecurity: An Analysis of Issues and Options', p. 13.
146. World Economic Forum (WEF) (2008), *Global Risks 2008: A Global Risk Network Report, A World Economic Forum Report in Collaboration with Citigroup, Marsh & McLennan Companies (MMC), Swiss Re, Wharton School Risk Center, Zurich Financial Services* (Cologny/Geneva: WEF), p. 22.
147. M. Vatis (2006), 'The Next Battlefield', *Harvard International Review*, Vol. 28, No. 3, 60.
148. Ibid.
149. Nye (2010), *Cyber Power*, p. 1.
150. J.A. Lewis (2007), 'Cyber Attacks Explained', CSIS: Commentary, 15 June, http://csis.org/files/media/isis/pubs/070615_cyber_attacks.pdf, date accessed 10 August, p. 1.
151. B. Griggs (2008), 'US at Risk of Cyberattacks, Experts Say', *CNN*, 18 August, <http://edition.cnn.com/2008/TECH/08/18/cyber.warfare/index.html>, date accessed 4 August.
152. S. Gorman (2008), 'Cyberattacks on Georgian Web Sites Are Reigning a Washington Debate', *The Wall Street Journal*, 14 August, http://online.wsj.com/article/SB121867946115739465.html?mod=googlenews_wsj, accessed 4 August 2010.
153. J.A. Lewis (2009), 'Crisis in Cyberspace' in N.R.F. Al-Rodhan (ed.) (2009), *Potential Global Strategic Catastrophes: Balancing Transnational Responsibilities and Burden-sharing with Sovereignty and Human Dignity* (Berlin: LIT), p. 189.
154. Gorman (2008), 'Cyberattacks on Georgian Web Sites Are Reigning a Washington Debate'.
155. S. Hoffman (2008), 'Russian Cyber Attacks Shut Down Georgian Websites', ChannelWeb Website, 12 August, <http://www.crn.com/security/210003057>, date accessed 4 August 2010.
156. Ventre (2009), *Information Warfare*, pp. 209–210.
157. Ibid., p. 212.
158. Cf. McAfee and SDA (2010), 'Cyber Security: A Transatlantic Perspective'.

159. Buckland et al. (2010), *Democratic Governance Challenges of Cyber Security*, p. 10.
160. Gorman (2008), 'Cyberattacks on Georgian Web Sites Are Reigning a Washington Debate'.
161. Ibid.
162. Ibid.
163. 'War in the Fifth Domain: Are the Mouse and the Keyboard the New Weapons of Conflict?' (2010), *The Economist*, 1 July, <http://www.economist.com/node/16478792>, date accessed 6 August 2010.
164. Fischer (2005), 'Creating a National Framework for Cybersecurity: An Analysis of Issues and Options', p. 2.
165. 'Cyber Crime', Privacy International Website, <http://www.privacyinternational.org/issues/cybercrime/index2.html>, date accessed 6 August 2010.
166. T. Burghardt (2009), 'The Launching of the US Cyber Command (CYBERCOM) Offensive Operations in Cyberspace', Global Researcher: Centre for Research on Globalisation Website, 1 July, <http://www.globalresearch.ca/index.php?context=va&aid=14186>, date accessed 6 August 2010.
167. S. Baker (2008), 'Cyber-Security: A Hard Sell', *Business Week Online*, 9 December, http://www.businessweek.com/technology/content/dec2008/tc2008128_182619.htm, date accessed 6 August 2010.
168. R.C. Hodgkin (2009), 'FBI Ranks Cyber Attacks Third Most Dangerous behind Nuclear War and WMDs', *TG Daily*, 7 January, <http://www.tgdaily.com/security-features/40861-fbi-ranks-cyber-attacks-third-most-dangerous-behind-nuclear-war-and-wmds>, date accessed 6 August 2010, p. 1.
169. T. Nakatomi (2001), 'Threats to the Information Society', *The OECD Observer*, January, No. 224, http://www.oecdobserver.org/news/fullstory.php/aid/410/Threats_to_the_information_society.html, date accessed 10 August 2010.
170. Vatis (2006), 'The Next Battlefield', 60.
171. Fischer (2005), 'Creating a National Framework for Cybersecurity: An Analysis of Issues and Options', p. 7.
172. Lewis (2009), 'Crisis in Cyberspace', p. 181.
173. Vatis (2006), 'The Next Battlefield', 60.
174. P. Mukundan (2006), 'Laying the Foundations for a Cyber-Secure World' in Lewis (2006), *Cyber Security: Turning National Solutions into International Cooperation*, p. 31.
175. Ibid. p. 32.
176. Lewis (2006), 'Introduction', p. xiv.
177. Ventre (2009), *Information Warfare*, p. xviii.
178. Ibid., pp. 252–266
179. G. Bruno (2008), 'The Evolution of Cyber Warfare', Council on Foreign Relations Website, 27 February, <http://www.cfr.org/publication/15577/>, date accessed 6 August.
180. Ibid.
181. Fischer (2005), 'Creating a National Framework for Cybersecurity: An Analysis of Issues and Options', p. 8.
182. Ibid., p. 9.
183. Ibid.

184. J. Markoff (2009), 'Do We Need a New Internet?' *The New York Times*, 14 February, [http://www.nytimes.com/2009/02/15/weekinreview/15markoff.html?_r=1&scp=1&sq=internet percent20security&st=cse](http://www.nytimes.com/2009/02/15/weekinreview/15markoff.html?_r=1&scp=1&sq=internet%20security&st=cse), date accessed 6 August 2010.
185. Fischer (2005), 'Creating a National Framework for Cybersecurity: An Analysis of Issues and Options', p. 2.
186. Markoff (2009), 'Do We Need a New Internet?'
187. Ibid.
188. Ibid.
189. Lewis (2009), 'Crisis in Cyberspace', p. 180.
190. Fischer (2005), 'Creating a National Framework for Cybersecurity: An Analysis of Issues and Options', p. 2.
191. Lewis (2009), 'Crisis in Cyberspace', p. 181.
192. Ibid. p. 182.
193. ITU (2008), 'The ICT Opportunity Index: The Evolution of the Digital Divide', http://www.itu.int/ITU-D/ict/statistics/ict_oi.html, date accessed 6 August 2010.
194. United Nations Conference on Trade and Development (UNCTAD) (2006), *The Digital Divide Report: ICT Diffusion Index 200* (New York and Geneva: United Nations), p. iii.
195. Ibid.
196. ITU (2009), *Confronting the Crisis: ICT Stimulus Plans for Economic Growth*, p. 55.
197. A. Cane (2006), 'Digital Divide Stops Growing', *The Financial Times*, 4 December, <http://www.ft.com/cms/s/0/9341842e-833b-11db-a38a-0000779e2340.html>, date accessed 6 August 2010.
198. 'Digital Divide: What It Is and Why It Matters', DigitalDivide Website, <http://www.digitaldivide.org/digitaldivide.html>, date accessed 6 August 2010.
199. Ibid.
200. Cane (2006), 'Digital Divide Stops Growing', 6.
201. R.D. Atkinson and A.S. McKay (2007), 'Digital Prosperity: Understanding the Economic Benefits of the Information Technology Revolution', The Information Technology & Innovation Foundation Website, March, <http://archive.itif.org/index.php?id=34>, date accessed 18 August 2010.
202. 'Global Digital Divide "Narrowing"' (2005), *BBC News*, 25 February, <http://news.bbc.co.uk/2/hi/technology/4296919.stm>, date accessed 6 August 2010.
203. K. Banks (2008), 'Mobile Phones and the Digital Divide', *PC World*, 29 July, http://www.pcworld.com/article/149075/mobile_phones_and_the_digital_divide.html, date accessed 6 August 2010.
204. E. Hansberry (2009), 'Are Mobile Devices Closing the Digital Divide?' *Information Week*, 30 July, http://www.informationweek.com/blog/main/archives/2009/07/are_mobile_devi_1.html;jsessionid=BGBO1EYZ1HTDTQE1GHPCCKHWATMY32JVN, date accessed 6 August 2010.
205. Al-Rodhan (2007), *The Emergence of Blogs as a Fifth Estate and Their Security Implications*, p. 57.
206. Ibid.

207. E. MacAskill (2005), 'Tighter Restrictions on Military Blogs Angers U.S. Soldiers', *The Guardian*, 5 May, <http://www.guardian.co.uk/technology/2007/may/05/news.usnews>, date accessed 6 August 2010.
208. Al-Rodhan (2007), *The Emergence of Blogs as a Fifth Estate and Their Security Implications*, p. 149.
209. *Ibid.*, pp. 150–151.
210. *Ibid.*, p. 154.
211. *Ibid.*, p. 155.
212. *Ibid.*, p. 156.

3 Energy and Climate Change

1. Intergovernmental Panel on Climate Change (IPCC) (2007), 'Summary for Policymakers' in M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson (eds) *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge: Cambridge University Press), p. 21.
2. T. Ries (2009), 'Global Warming' in N.R.F. Al-Rodhan (ed.) *Potential Global Strategic Catastrophes: Balancing Transnational Responsibilities and Burden-sharing with Sovereignty and Human Dignity* (Berlin: LIT), pp. 127–128.
3. K.A. Baumert (2005), 'The Challenge Of Climate Protection: Balancing Energy and Environment' in J.H. Kalicki and D.L. Goldwyn (eds) *Energy & Security: Toward a New Foreign Policy Strategy* (Washington, D.C.: Woodrow Wilson Center Press), p. 486.
4. US Department of Commerce, 'Trends in Atmospheric Carbon Dioxide', NOAA Research Website, <http://www.esrl.noaa.gov/gmd/ccgg/trends/>, date accessed 30 July 2010.
5. N. Stern (2006), *The Stern Review: The Economics of Climate Change* (London: HM Treasury), http://www.hm-treasury.gov.uk/media/3/2/Summary_of_Conclusions.pdf, date accessed 6 August 2010, p. ix.
6. J. Podesta and P. Ogden (2007/08) 'The Security Implications of Climate Change', *The Washington Quarterly*, Vol. 31, No. 1, 115.
7. M. Wahlström (2007), 'Before the Next Disaster Strikes: The Humanitarian Impact of Climate Change', *UN Chronicle Online Edition*, Issue 2, http://www.un.org/wcm/content/site/chronicle/cache/bypass/home/archive/issues2007/pid/4829?ctnscroll_articleContainerList=1_0&ctnlistpaginati on_articleContainerList=true, date accessed 10 August 2010.
8. The CAN Corporation (2007), *National Security and the Threat of Climate Change* (Alexandria, VA: The CAN Corporation), p. 15.
9. N.R.F. Al-Rodhan (ed.) (2007), 'Editorial of Policy Brief on Natural Disasters, Globalization, and the Implications for Global Security', *Policy Briefs on the Transnational Aspects of Security and Stability* (Berlin: LIT), p. 163.
10. *Ibid.*
11. The CAN Corporation (2007), *National Security and the Threat of Climate Change*, p. 13.
12. World Health Organization (WHO) (2005), 'Climate and Health: Fact Sheet', July, <http://www.who.int/globalchange/news/fsclimandhealth/en/index.html>, date accessed 6 August 2010.

13. Ibid.
14. Podesta and Ogden (2007/08) 'The Security Implications of Climate Change', pp. 115–116.
15. Ibid., p. 117.
16. S. Dalby (2009), 'The Relevance of Environmental Security', Presentation at the 8th International Security Forum, Geneva, Switzerland, 18 May.
17. A. Gore (2007), 'Nobel Lecture', The Nobel Peace Prize 2007, 10 December, http://nobelprize.org/nobel_prizes/peace/laureates/2007/gore-lecture_en.html, date accessed 6 August 2010.
18. German Advisory Council on Global Change (WBGU) (2007), *Climate Change as a Security Risk* (London and Sterling: Earthscan), p. 1.
19. International Energy Agency (IEA) (2009), *World Energy Outlook 2009 Fact Sheet* (Paris: OECD/IEA), p. 1.
20. Ibid.
21. IEA (2007), *World Energy Outlook 2007, Executive Summary: China and India Insights* (Paris: OECD/IEA), p. 4.
22. IEA (2009), *World Energy Outlook 2009 Fact Sheet*, p. 1.
23. E. Crooks (2008), 'Energy: Center of Power Is on the Move', *The Financial Times*, 23 January, http://www.ft.com/cms/s/0/49d8d9ce-c7c1-11dc-a0b4-0000779fd2ac,dwp_uid=73b9f204-baa7-11dc-9fbc-0000779fd2ac.html, date accessed 6 August 2010.
24. Ibid.
25. Cf. IEA (2009), *World Energy Outlook 2009 Fact Sheet*.
26. Crooks (2008), 'Energy: Center of Power Is on the Move'.
27. Ibid.
28. World Economic Forum (WEF) in Partnership with Cambridge Energy Research Associates (2006), *The New Energy Security Paradigm* (Geneva: WEF), p. 20.
29. 'The Power and the Glory' (2008), *The Economist*, 19 June, http://www.economist.com/specialreports/displaystory.cfm?story_id=11565685, accessed 6 August 2010.
30. Ibid.
31. P. Taylor (2008), 'Europe Makes Pitch for Green Leadership', *International Herald Tribune*, 28 January, <http://www.iht.com/articles/2008/01/28/business/rtrinside29.php>, date accessed 6 August 2010.
32. Podesta and Ogden (2007/08) 'The Security Implications of Climate Change', p. 131.
33. Europa Press Releases (2008), 'Memo on the Renewable Energy and Climate Change Package, MEMO/08/33 D', Brussels, 23 January, <http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/08/33>, date accessed 6 August 2010.
34. K. Mallon (2006), *Renewable Energy Policy and Politics: A Handbook for Decision-Making* (London: EarthScan Publications Ltd), p. 149.
35. S. Lozanova (2008), 'Renewable Energy: How Storage Can Make It Cheaper and More Reliable', CleanTechnica Website, 21 August, <http://cleantechnica.com/2008/08/21/renewable-energy-how-storage-can-make-it-cheaper-more-reliable/>, date accessed 6 August 2010.
36. US Department of Energy: Energy Efficiency and Renewable Energy (2010), 'Biomass Program', <http://www1.eere.energy.gov/biomass>, date accessed 6 August 2010.

37. IEA (2007), *Energy Technologies at the Cutting Age: International Energy Technology Collaboration, IEA Implementing Agreements*, p. 75.
38. 'Quick Guide: Biofuels' (2007), *BBC News*, 24 January, <http://news.bbc.co.uk/2/hi/science/nature/6294133.stm>, date accessed 6 August 2010.
39. Committee on Science, United States House of Representatives (2005), 'Testimony of Dr. Gal Luft, Executive Director, Institute for the Analysis of Global Security (IAGS)', 9 February, <http://www.internationalrelations.house.gov/archives/109/luf072705.pdf>, date accessed 20 August 2010, p. 4.
40. National Renewable Energy Laboratory (NREL) 'Biomass Research', <http://www.nrel.gov/biomass/>, date accessed 18 August 2010.
41. Biotechnology Industry Organization (BIO) (2008), *Guide to Biotechnology 2008* (Washington, D.C.: BIO), <http://bio.org/speeches/pubs/er/Biotech-Guide2008.pdf>, date accessed 17 August 2010, p. 65.
42. M. Scott (2008), 'Business and the Environment: Innovative Plans May Be Key for Green Future', *The Financial Times*, 17 April, http://www.ft.com/cms/s/0/afa073fa-0b6b-11dd-8ccf-0000779fd2ac,dwp_uuid=cfa40b38-0b6d-11dd-8ccf-0000779fd2ac.html, date accessed 6 August 2010.
43. Ibid.
44. US Department of Energy: Energy Efficiency and Renewable Energy 'Solar Energy Technologies Program', <http://www1.eere.energy.gov/solar/>, date accessed 9 August 2010.
45. IEA (2007), *Energy Technologies at the Cutting Age: International Energy Technology Collaboration, IEA Implementing Agreements* (Paris: OECD/IEA), p. 82.
46. Ibid.
47. US Department of Energy: Energy Efficiency and Renewable Energy (2008), 'Geothermal Technologies Program', http://www1.eere.energy.gov/geothermal/geothermal_basics.html, date accessed 9 August 2010.
48. IEA (2007), *Energy Technologies at the Cutting Age: International Energy Technology Collaboration, IEA Implementing Agreements*, p. 77.
49. IEA (2008), *World Energy Outlook 2008* (Paris: OECD / IEA), p. 170.
50. 'Geothermal Power', Clean Energy Ideas Website, http://www.clean-energy-ideas.com/geothermal_power.html, date accessed 9 August 2010.
51. Ibid.
52. US Department of Energy: Energy Efficiency and Renewable Energy (2010), 'Wind and Hydropower Technologies Program', http://www1.eere.energy.gov/windandhydro/wind_basics.html, date accessed 9 August 2010.
53. Ibid.
54. M. Scott (2008), 'Business and the Environment: Innovative Plans May Be Key for Green Future'.
55. Ibid.
56. 'Tilting in the Breeze' (2009), *The Economist*, 3 September, http://www.economist.com/sciencetechnology/tq/displaystory.cfm?story_id=E1_TQNJJGQQ, date accessed 10 August 2010.
57. Ibid.
58. Canadian Hydropower Association, 'About Hydro', http://www.canhydropower.org/hydro_e/p_hyd_b.htm, date accessed 9 August 2010.
59. IEA (2008), *World Energy Outlook 2008*, p. 165.

60. International Hydropower Association, International Commission on Large Dams, Implementing Agreement on Hydropower Technologies and Programmes/ International Energy Agency, Canadian Hydropower Association (2000), 'Hydropower and the World's Energy Future: The Role of Hydropower in Bringing Clean, Renewable, Energy to the World', November, <http://www.ieahydro.org/reports/Hydrofut.pdf>, date accessed 9 August 2010, p. 2.
61. Ibid.
62. R. Lafitte, 'World Hydro Power Potential', <http://www.uniseo.org/hydropower.html>, date accessed 9 August 2010.
63. Canadian Hydropower Association, 'About Hydro'.
64. M. Anastasio, M. Kluse, S. Aronson, T. Mason, S. Chu, G.H. Miller, J. Grossenbacher, R. Rosner, T. Hunter and S. Bhattacharyya (2008), 'A Sustainable Energy Future: The Essential Role of Nuclear Energy', US Department of Energy: Nuclear Energy, http://www.ne.doe.gov/pdf/files/rpt_sustainableenergyfuture_aug2008.pdf, date accessed 19 August 2010, p. 3.
65. US Environmental Protection Agency, 'Nuclear Energy', <http://www.epa.gov/cleanenergy/energy-and-you/affect/nuclear.html>, date accessed 9 August 2010.
66. Ibid.
67. C.D. Ferguson (2007), 'Nuclear Energy: Balancing Benefits and Risks', Council on Foreign Relations, Council on Foreign Relations (CSR) No. 28, <http://www.cfr.org/content/publications/attachments/NuclearEnergyCSR28.pdf>, date accessed 9 August 2010, p. 3.
68. Ibid., p. 5.
69. Ibid., p. 6.
70. Ibid.
71. M. Wald (2009), 'TR10: Traveling-Wave Reactor', *Technology Review*, March/April, <http://www.technologyreview.com/energy/22114/>, date accessed 9 August 2010.
72. Ibid.
73. A.E. Sieminski (2005), 'World Energy Futures' in J.H. Kalicki and D.L. Goldwyn (eds) *Energy & Security: Toward a New Foreign Policy Strategy* (Washington, D.C.: Woodrow Wilson Center Press), p. 47.
74. IEA (2007), *Energy Technologies at the Cutting Age: International Energy Technology Collaboration, IEA Implementing Agreements*, p. 78.
75. Ibid.
76. Sieminski (2005), 'World Energy Futures', p. 27.
77. IEA (2007), *Energy Technologies at the Cutting Age: International Energy Technology Collaboration, IEA Implementing Agreements*, p. 79.
78. Ibid., p. 46.
79. IEA (2006), *Mobilising Energy Technology: Activities of the IEA Working Parties and Expert Groups* (Paris: OECD/IEA), p. 44.
80. IEA (2007), 'IEA Energy Technology Essentials', p. 1.
81. IEA (2008), *World Energy Outlook*, p. 171.
82. H. Whiteman and I. Hart (2008), 'Carbon Capture and Storage: How Does It Work?' *CNN*, 7 August, <http://edition.cnn.com/2008/TECH/science/07/29/carbon.capture/index.html>, date accessed 9 August 2010.

83. Cf. H.N. Soud (2000), *Developments in FGD* (London: IEA Clean Coal Centre).
84. The World Bank (2000), 'Wet Flue Gas Desulfurization' (FGD).
85. Cf. H.N. Soud (2000), *Developments in FGD*.
86. The World Bank (2000), 'Wet Flue Gas Desulfurization (FDG)'.
87. Ibid.
88. Ibid.
89. United States Department of Energy (2007), 'How Coal Gasification Power Plants Work', 11 September, <http://fossil.energy.gov/programs/powersystems/gasification/howgasificationworks.html>, date accessed 10 August 2010.
90. Ibid.
91. P. Fairley (2007), 'China's Coal Future I', *Technology Review*, 1 January, <http://www.technologyreview.com/energy/18069/>, date accessed 5 September 2010.
92. Ibid.
93. Ibid.
94. Cf. Development, Security, and Cooperation Policy and Global Affairs, National Research Council of the National Academies, National Academy of Engineering of the National Academies, Chinese Academy of Engineering, Chinese Academy of Sciences (2004), *Urbanization, Energy, and Air Pollution in China: The Challenges Ahead – Proceedings of a Symposium* (Arlington, VA: The National Academies Press).
95. Fairley (2007), 'China's Coal Future I'.
96. IEA Clean Coal Centre, 'Clean Coal Technologies: Integrated Gasification Combined Cycle', http://www.iea-coal.org.uk/site/ieacoal_old/clean-coal-technologies-pages/clean-coal-technologies-integrated-gasification-combined-cycle-igcc?, date accessed 19 August 2010.
97. Ibid.
98. Whiteman and Hart (2008), 'Carbon Capture and Storage: How Does It Work?'.
99. Ibid.
100. University of California, Berkeley, 'Hybrid Vehicles', <http://www.ocf.berkeley.edu/~coreyp/hybridhome3.html>, date accessed 10 August 2010.
101. 'Buying a Small Hybrid Car' (2008), *BBC News*, 30 April, <http://www.bbc.co.uk/bloom/actions/hybridcar.shtml#quickjump>, date accessed 10 August 2010.
102. Ibid.
103. University of California, Berkeley, 'Hybrid Vehicles'.
104. B. Vlasic and N. Bunkley (2010), 'A Future that Doesn't Guzzle', *The New York Times*, 11 January, <http://www.nytimes.com/2010/01/12/automobiles/autoshow/12electric.html>, date accessed 10 August 2010.
105. K. Nice and C.W. Bryant, 'How Catalytic Converters Work', HowStuffWorks Website, <http://auto.howstuffworks.com/catalytic-converter.htm>, date accessed 10 August 2010.
106. M. Gerson (2007), 'Hope on Climate Change? Here's Why', *The Washington Post*, 15 August, <http://www.washingtonpost.com/wp-dyn/content/article/2007/08/14/AR2007081401327.html>, date accessed 20 August 2010.

107. 'Keeping a Grip' (2009), *The Economist*, 3 September, http://www.economist.com/sciencetechnology/tq/displaystory.cfm?story_id=E1_TQNJGGSQ, date accessed 10 August 2010.
108. T. Ries (2007), 'Global Warming' in Al-Rodhan (2007), *Potential Global Strategic Catastrophes: Balancing Transnational Responsibilities and Burden-sharing with Sovereignty and Human Dignity*, p. 133.
109. *Ibid.*, p. 132.
110. B. Ki-Moon (2007), 'Now is the Time: We Must Find a Global Response to the Most Global Problems', *UN Chronicle Online Edition*, Issue 2, http://www.un.org/wcm/content/site/chronicle/cache/bypass/home/archive/issues2007/pid/4818?ctnscroll_articleContainerList=1_0&ctnlistpagination_articleContainerList=true, date accessed 10 August 2010.
111. United Nations Environment Programme (UNEP) (1972), 'Report of the United Nations Conference on the Human Environment', <http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=97>, date accessed 10 August 2010.
112. UNEP, 'About UNEP', <http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=43&ArticleID=3301&l=en>, date accessed 10 August 2010.
113. Intergovernmental Panel on Climate Change (IPCC), 'History', http://www.ipcc.ch/organization/organization_history.htm, date accessed 17 August 2010.
114. Earth Summit (1992), 'United Nations Conference on Environment and Development (UNCED)' <http://www.un.org/geninfo/bp/enviro.html>, date accessed 10 August 2010.
115. A. Steiner (2007), 'The UN Role in Climate Change Action: Taking the Lead Towards a Global Response', *UN Chronicle Online Edition*, Issue 2, http://www.un.org/wcm/content/site/chronicle/cache/bypass/home/archive/issues2007/pid/4827?ctnscroll_articleContainerList=1_0&ctnlistpagination_articleContainerList=true, date accessed 10 August 2010.
116. United Nations Industrial Development Organization (UNIDO), 'Montreal Protocol', <http://www.unido.org/index.php?id=7854>, date accessed 10 August 2010.
117. United Nations Framework Convention on Climate Change (UNFCCC), 'Kyoto Protocol', http://unfccc.int/kyoto_protocol/items/2830.php, date accessed 10 August 2010.
118. M. Hulme (2010), 'Moving Beyond Climate Change', *Environment*, Vol. 52, No. 3, 15–19.
119. *Ibid.*; F. Schreier (2010), *Trends and Challenges in International Security: An Inventory*, Geneva Centre for Democratic Control of Armed Forces (DCAF) Occasional Paper Number 19 (Geneva: DCAF), p. 43.
120. G. Dvorsky (2010), 'Five Reasons the Copenhagen Climate Conference Failed', Institute for Ethics and Emerging Technologies (IEET) Website, 8 January, <http://ieet.org/index.php/IEET/more/3639>, date accessed 1 August 2010.
121. Podesta and Ogden (2007/08) 'The Security Implications of Climate Change', p. 115.
122. Stern (2006), *The Stern Review: The Economics of Climate Change*, p. vii.
123. *Ibid.*

124. 'Lightly Carbonated' (2007), *The Economist*, 4 August, <http://www.economist.com/node/9587705>, date accessed 10 August 2010.
125. Ibid.
126. N. Stern (2006), *The Stern Review: The Economics of Climate Change* (London: HM Treasury), http://www.hm-treasury.gov.uk/media/3/2/Summary_of_Conclusions.pdf, p. vii.
127. Ibid.
128. M.E. Porter and F.L. Reinhardt (2007), 'Grist: A Strategic Approach to Climate', *Harvard Business Review*, October, <http://www.erb.umich.edu/News-and-Events/news-events-pics/HBR-Oct07.pdf>, date accessed 5 September 2010.
129. Ibid.
130. Ibid.
131. Ibid.
132. Global Reporting Initiative (GRI), 'About GRI', <http://www.globalreporting.org/AboutGRI/>, date accessed 10 August 2010.
133. C. Bortz (2007), 'Conversation: Alyson Slater, Global Reporting Initiative's Director of Strategy, On How Disclosing Emissions Benefits Companies', *Harvard Business Review*, October, <http://www.erb.umich.edu/News-and-Events/news-events-pics/HBR-Oct07.pdf>, date accessed 5 September 2010.
134. F. Harvey (2008), 'Environment: Airlines Under Pressure to Turn Skies Green', *The Financial Times*, 14 July, http://www.ft.com/cms/s/0/0677f170-4ede-11dd-ba7c-000077b07658,dwp_uuid=f0cf5ee-4708-11dd-876a-0000779fd2ac.html, date accessed 10 August 2010.
135. K. Done and J. Boxell (2007), 'Sector Soars Above Green Fears', *The Financial Times*, 18 June, http://www.ft.com/cms/s/1/c7f50f64-1b44-11dc-bc55-000b5df10621,dwp_uuid=dacfc068-1769-11dc-86d1-000b5df10621.html, date accessed 10 August 2010.
136. D. Cameron (2007), 'Environmental Issues: Industry to Redress Imbalance', *The Financial Times*, 18 June, http://www.ft.com/cms/s/1/c691bd3e-1b44-11dc-bc55-000b5df10621,dwp_uuid=dacfc068-1769-11dc-86d1-000b5df10621.html, date accessed 10 August 2010.
137. Ibid.
138. Harvey (2008), 'Environment: Airlines Under Pressure to Turn Skies Green'.
139. M. Palmer (2008), 'Information Technology: Cool Is Hot for Data Storage', *The Financial Times*, 17 April, http://www.ft.com/cms/s/0/a9f1b0c2-0b6b-11dd-8ccf-0000779fd2ac,dwp_uuid=cfa40b38-0b6d-11dd-8ccf-0000779fd2ac.html, date accessed 10 August 2010.
140. Ibid.
141. Ibid.
142. Ibid.
143. Ibid.
144. Ibid.
145. IPCC (2007), 'Summary for Policymakers' in Parry et al. (2007), *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, p. 20.

146. International Task Force on Global Public Goods (2006), *Meeting Global Challenges: International Cooperation in the National Interest* (Stockholm: Erlanders Infologistics Väst AB), p. 42.
147. M.A. Levy (2009), 'Climate Change and the Future of Geopolitics', Presentation at the 8th International Security Forum, Geneva, Switzerland, 18 May.
148. 'London Summit: Leader's Statement' (2009), G20 Communiqué, Climate Café Website, 20 April, http://www.climatecafe.org/g20_communique_020409.pdf, date accessed 18 August 2010.
149. 'Food vs. Fuel' (2007), *Business Week Online*, 5 February, http://www.businessweek.com/magazine/content/07_06/b4020093.htm?chan=search, date accessed 10 August 2010.
150. A. Faiola (2008), 'The New Economics of Hunger', *The Washington Post*, 27 April, <http://www.washingtonpost.com/newssearch/search.html?st=%E2%80%98The+New+Economics+of+Hunger&fn=&sfm=&sa=&cp=1&hl=true&sb=-1&sd=undefined&ed=20100810&blt=&bln=&sdt=1987++Current&dpp=10&scoa=1987++Current&addedNav=>, date accessed 10 August 2010.
151. S. Mufson (2008), 'Siphoning Off Corn to Fuel Our Cars', *The Washington Post*, 30 April, <http://www.washingtonpost.com/newssearch/search.html?st=Siphoning+Off+Corn+to+Fuel+Our+Cars%2C&fn=&sfm=&sa=&cp=1&hl=true&sb=-1&sd=undefined&ed=20100810&blt=&bln=&sdt=1987++Current&dpp=10&scoa=1987++Current&addedNav=>, date accessed 10 August 2010.
152. A. Elobeid and C. Hart (2007), 'Ethanol Expansion in the Food versus Fuel Debate: How Will Developing Countries Fare?', *Journal of Agricultural & Food Industrial Organization*, Vol. 5, No. 2, 3.
153. A. Chakraborty (2008), 'Secret Report: Biofuel Caused Food Crisis', *The Guardian*, 3 July, <http://www.guardian.co.uk/environment/2008/jul/03/biofuels.renewableenergy>, date accessed 10 August 2010.
154. C.W. Calomiris (2007), 'Food for Fuel? Debating the Tradeoffs of Corn-Based Ethanol', *Foreign Affairs*, Vol. 86, No. 5, September/October, 157.
155. 'Food vs. Fuel' (2007), *Business Week Online*.
156. 'Developing Countries Lack Means To Acquire More Efficient Technologies' (2008), *Science Daily*, 24 December, <http://www.sciencedaily.com/releases/2008/12/081209125931.htm>, date accessed 10 August 2010.
157. 'Developing Country Commitments? Ask George Bush (Senior)', The Center for International Environmental Law (CIEL) Website, <http://www.ciel.org/Climate/devcountrycommit.html>, date accessed 10 August 2010.
158. United States Energy Information Administration (EIA) (2009), *International Energy Outlook 2009* (Washington, D.C.: EIA), <http://www.eia.doe.gov/oiar/archive/ieo09/index.html>, date accessed 10 August 2010.
159. M. ElBaradei (2008), 'Addressing the Global Energy Crisis', International Atomic Energy Agency (IAEA), 6–8 October, <http://www.iaea.org/NewsCenter/Transcripts/2008/cfm061008.pdf>, date accessed 18 August 2010, p. 1.
160. M.B. Zuckerman (2007), 'The Energy Emergency', *US News & World Report*, Vol. 143, No. 8, 10 September, 72.

161. N. Snow (2008), 'Shell Officials Outline Routes to World's Energy Future', *Oil & Gas Journal*, Vol. 106, No. 13, 7 April, 30.
162. J. Raloff (2008), 'US Must Invest in Technologies to Avoid Energy Crisis: Interview with Steven Chu', *Science News*, Vol. 174, No. 9, 25 October, 32.
163. Ibid.
164. ElBaradei (2008), 'Addressing the Global Energy Crisis', p. 1.
165. Ferguson (2007), 'Nuclear Energy: Balancing Benefits and Risks', p. 3.
166. M.A. Kenderdine and E.J. Moniz (2005), 'Technology Development and Energy Security' in J.H. Kalicki and D.L. Goodwyn (eds) *Energy & Security: Toward a New Foreign Policy Strategy* (Washington, D.C.: Woodrow Wilson Center Press), p. 427.
167. Ferguson (2007), 'Nuclear Energy: Balancing Benefits and Risks', p. 14.
168. Ibid., p. 36.
169. 'World Energy Needs and Nuclear Power' (2010), World Nuclear Association Website, June, <http://www.world-nuclear.org/info/inf16.html>, date accessed 10 August 2010.
170. Kenderdine and Moniz (2005), 'Technology Development and Energy Security', p. 449.
171. Ibid.
172. Baumert (2005), 'The Challenge Of Climate Protection: Balancing Energy and Environment', p. 485.

4 Health Care

1. International Task Force on Global Public Goods (2006), *Meeting Global Challenges: International Cooperation in the National Interest* (Stockholm: Erlanders Infologistics Väst AB), p. 9.
2. N.R.F. Al-Rodhan (ed.) (2007), 'Editorial of Policy Brief on Changing Health Paradigms, Globalization, and Global Security', *Policy Briefs on the Transnational Aspects of Security and Stability* (Berlin: LIT), p. 179.
3. P.B. Mansourian (2005), 'The Promise of Technology' in S.W.A. Gunn, P.B. Mansourian, A.M. Davies, A. Piel, and B.McA. Sayers (eds) *Understanding the Global Dimensions of Health* (New York: Springer), p. 126.
4. World Health Organization (WHO) 'Health Technologies – the Backbone of Health Services', <http://www.who.int/eht/en/Backbone.pdf>, date accessed 10 August 2010, p. 1.
5. Mansourian (2005), 'The Promise of Technology', p. 130.
6. Ibid.
7. Ibid.
8. Al-Rodhan (2007), 'Editorial of Policy Brief on Changing Health Paradigms, Globalization, and Global Security', p. 181.
9. Ibid.
10. Organisation for Economic Co-operation and Development (OECD) (2010), 'Growing Health Spending Puts Pressure on Government Budgets, According to OECD Health Data 2010', 29 June, http://www.oecd.org/document/11/0,3343,en_2649_34631_45549771_1_1_1_37407,00.html, date accessed 10 August 2010.

11. 'Medical Industry Overview', The Medica Website, <http://www.themedica.com/industry-overview.html>, date accessed 10 August 2010.
12. Ibid.
13. 'Executive Summary: Health Care'08: Global Trends and Best Practices' (2008), American Association of Retired Persons (AARP) International Website, 1 May, www.aarpinternational.org/resourcelibrary/resourcelibrary_show.htm?doc_id=714368, date accessed 10 August 2010.
14. Ibid.
15. A.D. Barker (2005), 'The Need for Harmonization in Biobanking to Realize the Potential of 21st Century Medicine', IBM World Wide Biobank Summit IV, National Cancer Institute, National Institutes of Health, 8 November.
16. Ibid.
17. Ibid.
18. WHO (2007), *World Health Statistics 2007* (Geneva: WHO), <http://www.who.int/whosis/whostat2007.pdf>, accessed 10 August 2010, p. 12.
19. Mansourian (2005), 'The Promise of Technology', p. 128.
20. Biotechnology Industry Organization (BIO) (2008), *Guide to Biotechnology 2008* (Washington, D.C.: BIO), <http://bio.org/speeches/pubs/er/Biotech-Guide2008.pdf>, date accessed 17 August 2010, p. 31.
21. Mansourian (2005), 'The Promise of Technology', p. 128.
22. Ibid.
23. T. Pang (2002), 'The Impact of Genomics on Global Health', *American Journal of Public Health*, Vol. 92, No. 7, July, <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1447192>, date accessed 10 August 2010.
24. Ibid.
25. The Genomics Working Group of the Science and Technology Task Force of the United Nations Millennium Project (2004), 'Genomics and Global Health', <http://belfercenter.ksg.harvard.edu/files/genomics.pdf>, date accessed 10 August 2010, p. 1.
26. Centre for Ecology & Hydrology (CEH) (2009), 'Bio-Linux Goes Global', 12 January, http://www.ceh.ac.uk/news/news_archive/2009_news_item_01.html, date accessed 10 August 2010.
27. Medicare Payment Advisory Commission (MedPAC) (2004), 'Report to the Congress: New Approaches in Medicare', June, <http://www.medpac.gov/publications>, date accessed 10 August 2010, p. 6.
28. Sir C. Davis (2008), 'Data and Technology Could Save Lives', *The Financial Times*, 16 May, <http://www.ft.com/cms/s/0/e7526326-16b0-11dd-bbfc-0000779fd2ac.html>, date accessed 10 August 2010.
29. WHO, 'Information Technology in Support of Health Care', <http://www.who.int/eht/en/InformationTech.pdf>, date accessed 10 August, p. 1.
30. L.M. Etheredge (2007), 'A Rapid-Learning Health System', *Health Affairs*, Vol. 26, No 2, 108.
31. National Cancer Institute (2010), 'About caBIG', <https://cabig.nci.nih.gov/overview/>, date accessed 10 August 2010.
32. Ibid.
33. D.L. Heymann (2005), 'Dealing with Global Infectious Disease Emergencies' in Gunn et al. (2005), *Understanding the Global Dimensions of Health*, p. 173.
34. Ibid.

35. 'Global Health Care Information Technology (2009–2014)', Markets and Markets Website, September, <http://www.marketsandmarkets.com/Market-Reports/healthcare-information-technology-market%20-136.html>, date accessed 10 August 2010.
36. M. Pearson (2010), 'E-ffective healthcare', *OECD Observer*, http://www.oecdobserver.org/news/fullstory.php/aid/3231/E-ffective_healthcare.html, date accessed 10 August 2010.
37. American Association for the Advancement of Science (AAAS) (2005), *Vision2033: Linking Science and Policy for Tomorrow's World* (Washington, D.C.: AAAS), p. 121.
38. Ibid.
39. Ibid.
40. 'Nanotechnology May Hold Promise for Health Care Design Materials' (2005), *Health Facilities Management*, Vol. 18, No. 9, 6.
41. F. Harvey (2004), 'Can We Overcome Nano-fear?' *The Financial Times*, 15 January, 12.
42. D.C. Rickerby (2006), 'Societal and Policy Aspects of the Introduction of Nanotechnology in Healthcare', *International Journal of Healthcare Technology & Management*, Vol. 7, No. 6, 463.
43. WHO (2009), 'About WHO', <http://www.who.int/about/en>, date accessed 10 August 2010.
44. WHO (2009), 'The WHO Agenda', <http://www.who.int/about/agenda/en/index.html>, date accessed 10 August 2010.
45. WHO (2009), 'Online Q&A', <http://www.who.int/features/qa/39/en/index.html>, date accessed 10 August 2010.
46. Ibid.
47. WHO (2008), *The World Health Report 2008, Primary Health Care* (Geneva: WHO).
48. P. Clevestig (2009), 'Pandemics and Bio-catastrophes' in N.R.F. Al-Rodhan (ed.) *Potential Global Strategic Catastrophes: Balancing Transnational Responsibilities and Burden-sharing with Sovereignty and Human Dignity* (Berlin: LIT), p. 85.
49. Ibid.
50. J.B. Tucker (2001), 'Contagious Fears: Infectious Disease and National Security', *Harvard International Review*, Vol. 23, No. 2, 82.
51. Ibid.
52. Ibid.
53. 'Sub Saharan Africa: HIV & AIDS Statistics' (2009), Avert Website, 7 July, <http://www.avert.org/subadults.htm>, date accessed 10 August 2010.
54. M. Manciaux and T.M. Flender (2005), 'World Health, A Mobilizing Utopia?' in Gunn et al. (2005), *Understanding the Global Dimensions of Health*, p. 77.
55. AAAS (2005), *Vision2033: Linking Science and Policy for Tomorrow's World*, p. 116.
56. Ibid, p. 117.
57. WHO 'Prevention of Health Care-Associated HIV Infection', <http://www.who.int/eht/en/HealthCareHIV.pdf>, date accessed 11 August 2010, p. 2.
58. Ibid.
59. D.P. Fidler (2003), 'Public Health and National Security in the Global Age: Infectious Diseases, Bioterrorism, and Realpolitik', *George Washington International Law Review*, Vol. 35, No. 4, 787.

60. S. Gay Stolberg (2009), 'Swine Flu Diary: Caught in a Beijing Dragnet', *The New York Times*, 27 July, http://www.nytimes.com/2009/07/28/health/28flu.html?_r=1, date accessed 11 August 2010.
61. D. Brown (2009), 'System Set Up After SARS Epidemic Was Slow to Alert Global Authorities', *The Washington Post*, 30 April, <http://www.washingtonpost.com/wp-dyn/content/article/2009/04/29/AR2009042904911.html>, date accessed 11 August 2010.
62. A. Buelva (2006), 'Technology Plays Key Role in Fight vs H1N1', *The Philippine Star*, 6 July, <http://www.philstar.com/Article.aspx?articleid=484115>, date accessed 10 July 2010.
63. S.S. Morse (2007), 'Global Infectious Disease Surveillance and Health Intelligence', *Health Affairs*, Vol. 26, No. 4, July/August, 1069.
64. 'Genomics and Biology Join Forces to Fight HIV' (2008), Swissinfo Website, 8 May, http://www.swissinfo.ch/eng/front/Genomics_and_biology_join_forces_to_fight_HIV.html?siteSect=105&sid=9062679&rss=true&ty=st, date accessed 19 August 2010.
65. Ibid.
66. 'The Global Fund to Fight AIDS, Tuberculosis, and Malaria' (2006), Avert Website, 16 July, <http://www.avert.org/global-fund.htm>, date accessed 11 August 2010.
67. The Global Fund to fight AIDS, Tuberculosis and Malaria 'Who We Are What Do We Do?', http://www.theglobalfund.org/documents/publications/brochures/whoware/gf_brochure_07_full_high_en.pdf, date accessed 11 August 2010, p. 6.
68. 'The Global Fund to Fight AIDS, Tuberculosis, and Malaria' (2009), Avert Website.
69. The Global Fund to fight AIDS, Tuberculosis and Malaria 'Who We Are What We Do?', p. 6.
70. Ibid.
71. 'The Global Fund to Fight AIDS, Tuberculosis, and Malaria', Avert Website.
72. Ibid.
73. Global Alliance for Vaccines and Immunisation (GAVI Alliance) 'Governance', <http://www.gavialliance.org/about/governance/index.php>, date accessed 11 August 2010.
74. J. Martens (2007), 'Multistakeholder Partnerships – Future Models of Multilateralism?' Dialogue on Globalization, Occasional Papers, Friedrich Ebert Stiftung Berlin, No. 29, <http://library.fes.de/pdf-files/iez/04244.pdf>, date accessed 10 August 2010, p. 26.
75. WHO (2009), 'Health Systems Development: GAVI Alliance – Health Systems Strengthening', <http://www.searo.who.int/en/Section1243/Section2448.htm>, date accessed 11 August 2010.
76. WHO (2010), 'EHT Advocacy folder', http://www.who.int/eht/advocacy_folder/en/index.html, date accessed 10 August 2010.
77. WHO (2010), 'Essential Health Technologies', http://www.who.int/eht/eht_intro/en/index.html, date accessed 10 August 2010.
78. 'Genomics and Biology Join Forces to Fight HIV' (2008), Swissinfo Website, 8 May, http://www.swissinfo.ch/eng/front/Genomics_and_biology_join_forces_to_fight_HIV.html?siteSect=105&sid=9062679&rss=true&ty=st, date accessed 11 August 2010.

79. Cf. World Economic Forum (WEF) (2002), *Global Health Initiative Resource Paper* (Geneva: WEF).
80. WEF 'The Global Health Initiative: A Catalyst for Partnership in Global Public Health', http://www.weforum.org/pdf/Initiatives/GHI_Brochure.pdf, date accessed 11 August 2010.
81. Helsinki Process on Globalization and Democracy (2005), *Empowering People at Risk: Human Security Priorities for the 21st Century* (Helsinki: Finish Ministry for Foreign Affairs), p. 15.
82. United Nations Children's Fund (UNICEF) (2009), *The State of the World's Children 2009: Maternal and Newborn Health*, <http://www.unicef.org/sowc09/docs/SOWC09-FullReport-EN.pdf>, date accessed 11 August 2010, p. 2.
83. WHO, 'Investing in Health: A Summary of Findings of the Commission on Macroeconomics and Health' (Geneva: WHO) <http://www.who.int/macrohealth/infocentre/advocacy/en/investinginhealth02052003.pdf>, date accessed 10 August 2010, p. 8.
84. Ibid.
85. Ibid., p. 10.
86. Ibid.
87. International Task Force on Global Public Goods (2006), *Meeting Global Challenges: International Cooperation in the National Interest*, p. 67.
88. J.H. Barton (2006), 'Scientific and Technical Information for Developing Nations' in Secretariat of the International Task Force on Global Public Goods (eds) *Expert Paper Series, Expert Paper Six: Knowledge* (Washington, D.C.: The Secretariat of the International Task Force on Global Public Goods), p. 26.
89. International Task Force on Global Public Goods (2006), *Meeting Global Challenges: International Cooperation in the National Interest*, p. 67.
90. Ibid.
91. D. Gardner (2009), "'There's No Reason Only Poor People Should Get Malaria": The Moment Bill Gates Released Jar of Mosquitoes at Packed Conference', *Daily Mail*, 6 February, <http://www.dailymail.co.uk/news/worldnews/article-1136463/Theres-reason-poor-people-malaria-The-moment-Bill-Gates-released-jar-mosquitoes-packed-conference.html>, date accessed 11 August 2010.
92. D. Sridhar (2006), 'Inequality in the United States Healthcare System', Human Development Report Office Occasional Paper (New York: UNDP), http://hdr.undp.org/en/reports/global/hdr2005/papers/hdr2005_sridhar_dev_i_36.pdf, date accessed 18 August 2010, pp. 1–2.
93. The White House, President Obama, 'Health Care', <http://www.whitehouse.gov/Issues/health-Care>, date accessed 29 July 2010.
94. J.H. Barton (2006), 'Knowledge' in Secretariat of the International Task Force on Global Public Goods (eds) *Expert Paper Series, Expert Paper Six: Knowledge* (Washington, D.C.: The Secretariat of the International Task Force on Global Public Goods), p. 11.
95. Barton (2006), 'Scientific and Technical Information for Developing Nations', p. 26.
96. Barton (2006), 'Knowledge', p. 11.
97. International Task Force on Global Public Goods (2006), *Meeting Global Challenges: International Cooperation in the National Interest*, p. 68.

98. Ibid.
99. Ibid., p. 69.
100. 'Goals', The Grand Challenges in Global Health Website, <http://www.grandchallenges.org/Pages/BrowseByGoal.aspx>, date accessed 29 August 2010.
101. Ibid.

5 Biotechnology

1. European Commission, 'Competitiveness in Biotechnology: Introduction', http://ec.europa.eu/enterprise/phabiocom/comp_biotech_intro.htm, date accessed 17 August 2010.
2. D. Steele (2004), 'Danger Lurks in a Biotech World', *The Aquarian*, Spring, http://www.aquarianonline.com/Sci-Tech/Steele_Biotech.html, date accessed 11 August 2010.
3. G.A. Koehler (1996), 'Bioindustry: A Description of California's Bioindustry and Summary of the Public Issues Affecting Its Development, An Overview of Biotechnology and Bioindustry', http://www.library.ca.gov/crb/96/07/BIOT_CH1.html, date accessed 11 August 2010.
4. Biotechnology Industry Organization (BIO) (2008), *Guide to Biotechnology 2008* (Washington, D.C.: BIO), <http://bio.org/speeches/pubs/er/BiotechGuide2008.pdf>, date accessed 17 August 2010, p. 1.
5. European Commission (2002), *Life Sciences and Biotechnology – A Strategy for Europe* (Luxembourg: Office for Official Publications of the European Communities), http://ec.europa.eu/biotechnology/pdf/com2002-27_en.pdf, date accessed 11 August 2010, p. 10.
6. 'Briefing: Genetically Modified Crops and Food' (2003), Friends of the Earth (FOE) Website, http://www.foe.co.uk/resource/briefings/gm_crops_food.pdf, date accessed 11 August 2010, p. 3.
7. Ibid.
8. Confederation of Indian Industry and the Department of Technology of the Ministry of Science and Technology of the Government of India, 'Facts about Biotechnology', <http://www.docstoc.com/docs/2308176/Facts-about-Biotechnology>, date accessed 11 August 2010.
9. 'Food vs. Fuel' (2007), *Business Week Online*, 5 February, http://www.businessweek.com/magazine/content/07_06/b4020093.htm?chan=search, date accessed 16 August 2010.
10. EuropaBio (2008), 'How Industrial Biotechnology Can Tackle Climate Change', p. 6.
11. BIO (2008), *Guide to Biotechnology 2008*, p. 69.
12. Katholieke Universiteit Leuven 'BioSCENTER – Context and Motivation', <http://homes.esat.kuleuven.be/~bioiuser/bioscenter/contextandmotivation.php#trends>, date accessed 11 August 2010.
13. T. Taylor (2010), 'Biotechnology Industry', Presentation at the Strategic Technologies and Our Global Future Course, Geneva Centre for Security Policy, Geneva, Switzerland, 15 April.
14. 'History of Biotechnology' (2010), Dupont Website, http://www2.dupont.com/Biotechnology/en_US/intro/history.html, date accessed 11 August 2010.

15. BIO (2008), *Guide to Biotechnology 2008*, p. 2.
16. Massachusetts Institute of Technology (MIT) (1997), 'Inventor of the Week', <http://web.mit.edu/invent/iow/boyercohen.html>, date accessed 11 August 2010.
17. BIO (2008), *Guide to Biotechnology 2008*, p. 2.
18. Ibid.
19. National Research Council Committee on Advances in Technology and the Prevention of Their Application to Next Generation Biowarfare Threats (2006), *Globalization, Biosecurity, and the Future of the Life Sciences* (Washington, D.C.: The National Academies Press), p. 86.
20. S. Singh (2008), 'Biotech Growth Slows for the First Time in 5 Years', LiveMint.com, *The Wall Street Journal*, 15 July, <http://www.livemint.com/2008/07/15215237/Biotech-growth-slows-for-first.html>, date accessed 11 August 2010.
21. Ibid.
22. 'European Biotech Industry Shows Double Digit Revenue Growth' (2007), Ernst & Young Website, 16 April. <http://www.prnewswire.com/news-releases/global-biotechnology-makes-historic-advances-58331937.html>, date accessed 11 August 2011.
23. Ibid.
24. A. Pollack and D. Wilson (2010), 'Safety Rules Can't Keep Up with Biotech Industry', *The New York Times*, 27 May, <http://www.nytimes.com/2010/05/28/business/28hazard.html?ref=biotechnology>, date accessed 25 July 2010.
25. BIO (2007), *Milestones 2006–2007* (Washington, D.C.: BIO), <http://www.bio.org/speeches/pubs/milestone07/Milestones2007.pdf>, date accessed 26 August 2010, p. 23.
26. BIO (2010), 'Battelle / Bio State Bioscience Initiatives 2010', <http://www.bio.org/local/battelle2010/m>, date accessed 11 August 2010.
27. North Carolina State University 'What Is Bioprocess Engineering?' http://www.bae.ncsu.edu/undergrad/biopro_eng_info.htm, date accessed 11 August 2010.
28. BIO (2008), *Guide to Biotechnology 2008*, p. 18.
29. Ibid.
30. 'Recombinant DNA Technology', Encyclopedia Britannica Website, <http://www.britannica.com/EBchecked/topic/493667/recombinant-DNA-technology>, date accessed 11 August 2010.
31. BIO (2008), *Guide to Biotechnology 2008*, p. 18.
32. Ibid., p. 19.
33. Ibid.
34. Ibid., p. 20.
35. Ibid.
36. Ibid., p. 21.
37. Ibid.
38. Committee on Developing Biomarker-Based Tools for Cancer Screening, Diagnosis, and Treatment (2007), *Cancer Biomarkers: The Promises and Challenges of Improving Detection and Treatment* (Washington, D.C.: National Academies Press), p. 1.
39. 'Definition of Biomarker', Medicine.net Website, <http://www.medterms.com/script/main/art.asp?articlekey=6685>, date accessed 11 August 2010.

40. Committee on Developing Biomarker-Based Tools for Cancer Screening, Diagnosis, and Treatment (2007), *Cancer Biomarkers: The Promises and Challenges of Improving Detection and Treatment*, p. 1.
41. 'Biomarkers', Environmental Health Research Network Website, <http://www.rrse.ca/en/research/biomarkers-intro.htm>, date accessed 11 August 2010.
42. BIO (2008), *Guide to Biotechnology 2008*, p. 22.
43. D.F. Betsch (1994), 'DNA Fingerprinting in Human Health and Society', Access Excellence Resource Center Website, http://www.accessexcellence.org/RC/AB/BA/DNA_Fingerprinting_Basics.php, date accessed 11 August 2010.
44. Ibid.
45. K. Leutwyler (2001), 'New Micromachined Cantilever Quickly Detects Disease Markers', *Scientific American*, 4 September, <http://www.scientificamerican.com/article.cfm?id=new-micromachined-cantile>, date accessed 11 August 2010.
46. Ibid.
47. International Society for Stem Cell Research (ICCSR) (2008), *Stem-cell Facts: The Next Frontier?* (Deerfield, IL: ICCSR), http://www.isscr.org/public/ISSCR08_PubEdBroch.pdf, date accessed 11 August 2010, p. 2.
48. Ibid.
49. Ibid.
50. Ibid., p. 3.
51. Stanford University, 'Overview: Biomimicry', <http://www-cdr.stanford.edu/biomimetics/>, date accessed 11 August 2010.
52. Ibid.
53. 'Electrical Potential' (2009), *The Economist*, 10 December, <http://www.economist.com/node/15048719>, date accessed 11 August 2010.
54. Ibid.
55. The University of Melbourne, 'About Biomedicine', http://www.bbimed.unimelb.edu.au/bachelor_of_biomedicine/about_biomedicine, date accessed 17 August 2010.
56. Ibid.
57. Ibid.
58. European Commission (2005), *Synthetic Biology: Applying Engineering to Biology, Report of a NEST High-Level Expert Group* (Brussels: European Commission), p. 5.
59. N. Wade (2010), 'Researchers Say They Created a 'Synthetic Cell'', *The New York Times*, 20 May, <http://www.nytimes.com/2010/05/21/science/21cell.html>, date accessed 11 August 2010.
60. S. Benner (2010), 'Q&A: Life, Synthetic Biology and Risk', *BMC Biology*, Vol. 8, 78.
61. The White House (2010), 'Letter from President Obama', Bioethic.gov Website, 20 May, <http://www.bioethics.gov/documents/Letter-from-President-Obama-05.20.10.pdf>, date accessed 11 August 2010.
62. A.H. Cordesman (2005), *The Challenge of Biological Terrorism* (Washington, D.C.: CSIS Press), p. 91.
63. 'Follow-up of Deaths Among US Postal Service Workers Potentially Exposed to Bacillus Anthracis'(2003), Center for Disease Control (CDC) Website, 3

- October, <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5239a2.htm>, date accessed 11 August 2010.
64. Cordesman (2005), *The Challenge of Biological Terrorism*, pp. 12–17.
 65. The United Nations Office at Geneva (UNOG) ‘Disarmament: The Biological Weapons Convention’, <http://www.unog.ch/bwc>, date accessed 11 August 2010.
 66. ‘Syria Profile: Biological Overview’, The Nuclear Threat Initiative (NTI) Website, http://www.nti.org/e_research/profiles/index_4470.html, date accessed 18 August 2010.
 67. Cf. J. Parachini (2002), ‘Control Biological Weapons, but Defend Biotechnology’, *RAND Review*, Vol. 26, No. 2, 34–35.
 68. M.D. Kellerhals (2009), ‘United States Introduces New Biological Weapons Security System’, America.gov Website, 9 December, <http://www.america.gov/st/peacesec-english/2009/December/20091209130215dmslahrellek01077997.html>, date accessed 11 August 2010.
 69. Cordesman (2005), *The Challenge of Biological Terrorism*, p. 93.
 70. *Ibid.*, p. 185.
 71. United Nations Security Council (2004), ‘Resolution 1540, S/RES/1540’, April 28, <http://www.treas.gov/offices/enforcement/ofac/legal/unscrs/1540.pdf>, date accessed 11 August 2010.
 72. Committee on Research Standards and Practices to Prevent the Destructive Application of Biotechnology (2004), *Biotechnology Research in an Age of Terrorism* (Washington, DC: National Academies Press), p. 43.
 73. *Ibid.*, p. 44.
 74. European Union (EU) (2008), ‘European Union Legislation and Recommendations Related to Biosafety and Biosecurity, Working Paper submitted by Germany on behalf of the EU 2008 Meeting of Experts’, [http://www.unog.ch/80256EDD006B8954/\(httpAssets\)/C4BD641FF55084A1C12574A2004242B0/\\$file/Germany+EU+legislation+and+recommendations+to+implement+and+improve+biosafety+and+biosecurity+WP.pdf](http://www.unog.ch/80256EDD006B8954/(httpAssets)/C4BD641FF55084A1C12574A2004242B0/$file/Germany+EU+legislation+and+recommendations+to+implement+and+improve+biosafety+and+biosecurity+WP.pdf), date accessed 11 August 2010.
 75. Cordesman (2005), *The Challenge of Biological Terrorism*, p. 95.
 76. M. Stanley (2002), ‘Scientific Publishing: Knowledge is Power’, 30 September, <http://www.econ.ucsb.edu/~tedb/Journals/morganstanley.pdf>, date accessed 11 August 2010, p. 2.
 77. ‘Scientific Publishing: Access All Areas’ (2004), *The Economist*, 5 August, http://www.economist.com/science/displaystory.cfm?story_id=3061258, date accessed 11 August 2010.
 78. Cordesman (2005), *The Challenge of Biological Terrorism*, p. 96.
 79. Pollack and Wilson (2010), ‘Safety Rules Can’t Keep Up with Biotech Industry’.
 80. T. Taylor (2010), ‘Healthcare Industry’, Presentation at the Strategic Technologies and Our Global Future Course, Geneva Centre for Security Policy, Switzerland, 15 April.
 81. Committee on Research Standards and Practices to Prevent the Destructive Application of Biotechnology (2004), *Biotechnology Research in an Age of Terrorism*, p. 16.
 82. *Ibid.*
 83. Cf. J.D. Steinbruner, E.D. Harris, N. Galladher and S.M. Okutani (2005), *Controlling Dangerous Pathogens* (College Park, MD: Center for International

- and Security Studies at Maryland) http://www.cissm.umd.edu/papers/files/pathogens_project_monograph.pdf, date accessed 11 August 2010.
84. Committee on Advances in Technology and the Prevention of Their Application to Next Generation Biowarfare Threats, Development, Security, and Cooperation Policy and Global Affairs Division, Board on Global Health, Institute of Medicine and National Research Council of the National Academies (2006), *Globalization, Biosecurity, and the Future of the Life Sciences* (Washington, D.C.: The National Academies Press), pp. 246–250.
 85. N.R.F. Al-Rodhan, L. Nazaruk, M. Finaud and J. Mackby (2008), *Global Biosecurity: Towards a New Governance Paradigm* (Geneva: Éditions Slatkine), p. 225.
 86. A.H. Zakiri, S. Johnston and B. Tobin (2005), 'The Biodiplomacy Initiative: Informing Equitable and Ethical Decision-Making for Present and Future Generations', *Work in Progress*, Vol. 17, No. 2, Summer, <http://www.unu.edu/hq/ginfo/wip/wip17-2-summer2005.pdf>, date accessed 11 August 2010, 3.
 87. 'Stem Cell Research at the Crossroads of Religion and Politics' (2008), The Pew Forum on Religion & Public Life Website, 17 July, <http://pewforum.org/docs/?DocID=316>, date accessed 11 August 2010.
 88. T.F. Budinger and M.D. Budinger (2006), *Ethics of Emerging Strategic Technologies: Scientific Facts and Moral Challenges* (Hoboken, NJ: John Wiley & Sons), p. 342.
 89. B. Agnew (2001), 'The Politics of Stem Cells: Legislative Uncertainties Hinder Research in the US', Genome News Network Website, 21 February, http://www.genomenewsnetwork.org/articles/02_03/stem.shtml, date accessed 11 August 2010.
 90. R.S. Schwartz (2006), 'The Politics and Promise of Stem-Cell Research', *The New England Journal of Medicine*, Vol. 355, No. 12, 21 September, <http://content.nejm.org/cgi/content/full/355/12/1189>, date accessed 20 August 2010.
 91. 'Obama Ends Stem Cell Funding Ban' (2009), *BBC News*, 9 March, <http://news.bbc.co.uk/2/hi/americas/7929690.stm>, date accessed 10 August 2010.
 92. G. Harris (2010), 'U.S. Judge Rules against Obama's Stem Cell Policy', *The New York Times*, 23 August, <http://www.nytimes.com/2010/08/24/health/policy/24stem.html?ref=stemcells>, date accessed 27 August 2010.
 93. S.G. Stolberg and G. Harris (2010), 'Stem Cell Ruling Will Be Appealed', *The New York Times*, 24 August, <http://www.nytimes.com/2010/08/25/health/policy/25stem.html?ref=stemcells>, date accessed 27 August 2010.
 94. 'Stem Cell Research Around the World' (2008), The Pew Forum on Religion and Public Life Website, 17 July, <http://pewforum.org/docs/?DocID=318>, date accessed 18 August 2010.
 95. Ibid.
 96. A. Bonnicksen (2007), 'Therapeutic Cloning: Politics and Policy' in B. Steinbock (ed.) *The Oxford Handbook of Bioethics* (Oxford: Oxford University Press), p. 444.
 97. B. Agnew (2003), 'The Politics of Stem Cells: Legislative Uncertainties Hinder Research in the US', Genome News Network Website, 21 February, http://www.genomenewsnetwork.org/articles/02_03/stem.shtml, date accessed 10 August 2010.
 98. Bonnicksen (2007), 'Therapeutic Cloning: Politics and Policy', p. 444.

99. J. Kuzma (2004), 'Global Challenges and Biotechnology', *Economic Perspectives*, October, 4; K. Pawar, S. P. Pawar, V. A. Patel, H. V. Patel (2010), 'Promotion of Global Health through Oral Immunotherapy Using Edible Vaccines', *Pharmaceutical Reviews*, Vol. 8, No. 1, <http://www.pharmainfo.net/reviews/promotion-global-health-through-oral-immunotherapy-using-edible-vaccines>, date accessed 10 August 2010.
100. BIO (2008), *Guide to Biotechnology 2008*, p. 32.
101. Ibid.
102. Ibid.
103. Ibid., p. 35.
104. Ibid., p. 36.
105. Ibid., p. 37.
106. Committee on Advances in Technology and the Prevention of Their Application to Next Generation Biowarfare Threats et al. (2006), *Globalization, Biosecurity, and the Future of the Life Sciences*, p. 32.
107. Ibid., p. 49.
108. Ibid.
109. Ibid., p. 52.
110. The Central Intelligence Agency (CIA) (2003), 'The Darker Bioweapons Future', 3 November, <http://www.fas.org/irp/cia/product/bw1103.pdf>, date accessed 11 August 2010.
111. Ibid.
112. Ibid.
113. M.G. Kortepeter and G.W. Parker (1999), 'Potential Biological Weapons Threats', *Emerging Infectious Diseases*, 1 July, <http://www.cdc.gov/ncidod/eid/vol5no4/kortepeter.htm>, date accessed 11 August 2010.
114. 'Biological Warfare' (2004), *CBC News Online*, 18 February, <http://www.cbc.ca/news/background/bioweapons/>, date accessed 1 August 2010.
115. Ibid.
116. Kortepeter and Parker (1999), 'Potential Biological Weapons Threats'.
117. 'Biological Warfare' (2004), *CBC News Online*.

6 Genomics

1. 'T. Acharya, A.S. Daar, E. Dowdeswell, P.A. Singer and H. Thorsteinsdóttir (2004), *Genomics and Global Health: A Report of the Genomics Working Group of the Science and Technology Task Force of the United Nations Millennium Project* (Toronto: Joint Center for Bioethics) <http://belfercenter.ksg.harvard.edu/files/genomics.pdf>, date accessed 12 August 2010, p. 6.
2. US Department of Energy Human Genome Project (2001), 'Other Anticipated Benefits of Genetic Research', http://www.ornl.gov/sci/techresources/Human_Genome/publicat/primer2001/7.shtml, date accessed 12 August 2010.
3. Acharya et al. (2004), *Genomics and Global Health: A Report of the Genomics Working Group of the Science and Technology Task Force of the United Nations Millennium Project*, p. 9.
4. P. Baldi and G.W. Hatfield (2002), *DNA Microarrays and Gene Expression: From Experiments to Data Analysis and Modeling* (Cambridge: Cambridge University Press), p. 2.

5. Committee on Advances in Technology and the Prevention of Their Application to Next Generation Biowarfare Threats, Development, Security, and Cooperation Policy and Global Affairs Division, Board on Global Health, Institute of Medicine, Institute of Medicine and National Research Council of the National Academies (2006), *Globalization, Biosecurity, and the Future of the Life Sciences* (Washington, D.C.: The National Academies Press), p. 15.
6. '100 Greatest Discoveries', The Science Channel Website, <http://science.discovery.com/convergence/100discoveries/big100/genetics.html>, date accessed 12 August 2010.
7. G.J. Hannon (2002), 'RNA Interference', *Nature*, Vol. 418, July, <http://www.ncbi.nlm.nih.gov/pubmed/12110901>, date accessed 12 August 2010.
8. Cf. K. Nixdorff and W. Bender (2002), 'Biotechnology, Ethics of Research and Potential Military Spin-off', International Network of Engineers and Scientists Against Proliferation, *Information Bulletin*, No. 19, March.
9. Human Genome Project Information 'Frequently Asked Questions', http://www.ornl.gov/sci/techresources/Human_Genome/faq/faq1.shtml, date accessed 12 August 2010.
10. Human Genome Project Information 'Spinoff Projects Related to the Human Genome Project', http://www.ornl.gov/sci/techresources/Human_Genome/research/spinoffs.shtml, date accessed 12 August 2010.
11. A. Harmon (2008), 'Gene Map Becomes a Luxury Item', *International Herald Tribune*, 4 March, <http://www.iht.com/articles/2008/03/04/healthscience/04geno.php>, date accessed 12 August 2010.
12. Ibid.
13. 'The Genomics Revolution' (2000), *BCC Research*, <http://www.bccresearch.com/report/BIO026A.html>, date accessed 12 August 2010.
14. P. Ball (2010), 'Bursting the Genomics Bubble', *Nature News*, 31 March, <http://www.nature.com/news/2010/100324/full/news.2010.145.html>, date accessed 12 August 2010; N. Wade (2010), 'A Decade Later, Genetics Maps Yields Few New Cures', *The New York Times*, 13 June, <http://www.nytimes.com/2010/06/13/health/research/13genome.html>, date accessed 12 August 2010; A. Pollack (2010), 'The Genome at 10: Awaiting the Genome Payoff', *The New York Times*, 15 June, <http://www.nytimes.com/2010/06/15/business/15genome.html>, date accessed 12 August 2010.
15. B. Salter and N. Perez-Solorzano (2003), 'Civil Society and the Governance of Human Genetics: Report to the King Baudouin Foundation Regarding Its Project "Citizen Participation in the European Public Debate on the Issue of Human Genetics"', April, p. 6.
16. C.J. Henry, R. Phillips, F. Carpanini, J.C. Corton, K. Craig, K. Igarashi, R. Leboeuf, G. Marchant, K. Osborn, W.D. Pennie, L.L. Smith, M.J. Teta and V. Vu (2002), 'Use of Genomics in Toxicology and Epidemiology: Findings and Recommendations of a Workshop', *Environmental Health Perspectives*, Vol. 110, No. 10, October, 1047.
17. Biotechnology Industry Organization (BIO) (2008), *Guide to Biotechnology 2008* (Washington, D.C.: BIO), <http://bio.org/speeches/pubs/er/Biotech-Guide2008.pdf>, date accessed 17 August 2010, p. 27.
18. Ibid., p. 30.

19. 'The Mechanism of RNA Interference (RNAi)', Applied Biosystems Website, http://www.ambion.com/techlib/append/RNAi_mechanism.html, date accessed 12 August 2010.
20. B. Ashbridge (2008), 'RNA Interference Explained', Science Articles: The Naked Scientists Website, <http://www.thenakedscientists.com/HTML/articles/article/rna-interference-explained>, date accessed 12 August 2010.
21. Sixth Review Conference of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, Secretariat (2006), 'Background Information Document on New Scientific and Technological Developments Relevant to the Convention' BWC/CONF. VI/INF.4, Geneva, 28 September.
22. Ibid.
23. C. Cookson (2008), 'Research: Three Technologies That Could Transform Patient Care', *The Financial Times*, 3 July, http://www.ft.com/cms/s/0/668c7654-4898-11dd-a851000077b07658.html?nclick_check=1, date accessed 12 August 2010.
24. Ibid.
25. US Department of Health and Human Services, 'Genome-Wide Association Studies (GWAS)', <http://grants.nih.gov/grants/gwas/>, date accessed 19 August 2010.
26. 'Gene Mapping', Web Books 2.0 Website, <http://web-books.com/MoBio/Free/Ch10A.htm>, date accessed 12 August 2010.
27. The National Human Genome Research Institute (2009), 'Genetic Mapping', 28 January, <http://www.genome.gov/10000715>, date accessed 12 August 2010.
28. 'Gene Profiling Reveals the Essence of "Stemness"' (2002), Howard Hughes Medical Institute (HHMI) Website, 12 September, <http://www.hhmi.org/news/melton3.html>, date accessed 12 August 2010.
29. National Research Council of the National Academies (2003), *Biotechnology Research in an Age of Terrorism* (Washington, D.C.: The National Academies Press), p. 16.
30. S.G. Uzogara (2000), 'The Impact of Genetic Modification of Human Foods in the 21st Century: A Review', *Biotechnology Advances*, No. 18, 180.
31. T. Taylor (2010), 'Healthcare Industry', Presentation at the Strategic Technologies and Our Global Future Course, Geneva Centre for Security Policy, Switzerland, 15 April.
32. Uzogara (2000), 'The Impact of Genetic Modification of Human Foods in the 21st Century: A Review', p. 182.
33. 'Genetic Testing', MedlinePlus Website, <http://www.nlm.nih.gov/medlineplus/genetictesting.html>, date accessed 12 August 2010.
34. Ibid.
35. Genetic Science Learning Center at the University of Utah, <http://learn.genetics.utah.edu/content/tech/genetherapy/whatisgt/>, date accessed 12 August 2010.
36. Ibid.
37. Genetics Home Reference as a Service of the US National Library of Medicine (2009), 'What Is Gene Therapy?', 10 July, <http://ghr.nlm.nih.gov/handbook/therapy/genetherapy>, date accessed 12 August 2010.

38. Ibid.
39. The National Human Genome Research Institute (2010), 'Cloning', <http://www.genome.gov/25020028>, date accessed 12 August 2010.
40. Ibid.
41. Ibid.
42. Human Genome Project Information, 'Pharmacogenomics' http://www.ornl.gov/sci/techresources/Human_Genome/medicine/pharma.shtml, date accessed 12 August 2010.
43. Ibid.
44. National Center for Biotechnology Information Website (NCBI), 'Bioinformatics', <http://www.ncbi.nlm.nih.gov/About/primer/bioinformatics.html>, date accessed 12 August 2010.
45. Ibid.
46. University of Texas, 'Bioinformatics', <http://biotech.icmb.utexas.edu/pages/bioinfo.html>, date accessed 12 August 2010.
47. L. Gravitz (2009), 'TR10: \$100 Genome', *Technology Review*, March/April, http://www.technologyreview.com/read_article.aspx?ch=specialsections&sc=tr10&id=22112, date accessed 12 August 2010.
48. Ibid.
49. Ibid.
50. S. Hensley (2001), 'Proteins – Not Genes – Could Be Clue to Human Complexity, Disease', *The Wall Street Journal*, 13 February, B1.
51. Ibid.
52. BIO (2008), *Guide to Biotechnology 2008*, p. 27.
53. M. Wheelis (2002), 'Biotechnology and Biochemical Weapons', *The Nonproliferation Review*, Vol. IX, No. 1, 50.
54. P. Jenkins (2001), 'Map of Proteins Holds the Key to Disease', *The Financial Times*, 27 November, 6.
55. A. Kalia and R.P. Gupta (2005), 'Proteomics: A Paradigm Shift', *Critical Reviews in Biotechnology*, Vol. 25, 187.
56. US Department of Energy Human Genome Project (2001), 'Gene Testing, Pharmacogenomics, and Gene Therapy', http://www.ornl.gov/sci/techresources/Human_Genome/publicat/primer2001/6.shtml, date accessed 12 August 2010.
57. Kalia and Gupta (2005), 'Proteomics: A Paradigm Shift', p. 188.
58. Ibid., p. 194.
59. 'Proteomics' (2010), BIO Website, 16 July, <http://www.bio.org/speeches/pubs/er/biotechtools.asp>, date accessed 12 August 2010.
60. 'Metabolomics', The Human Genome Website, http://genome.wellcome.ac.uk/doc_WTD020768.html, date accessed 12 August 2010.
61. University of Wisconsin, Biological Magnetic Resonance Data Bank, 'Metabolomics/Metabonomics', <http://www.bmrb.wisc.edu/metabolomics/>, date accessed 12 August 2010.
62. 'Metabolomics', The Human Genome Website.
63. Ibid.
64. E. Harrell (2009), 'The Human Epigenome, Decoded', *Time Magazine*, 8 December, http://www.time.com/time/specials/packages/article/0,28804,1945379_1944416_1944420,00.html, date accessed 12 August 2010.

65. J. Cloud (2010), 'Why Your DNA Isn't Your Destiny', *Time Magazine*, 6 January, <http://www.time.com/time/printout/0,8816,1951968,00.html>, date accessed 12 August 2010.
66. Harrell (2009), 'The Human Epigenome, Decoded'.
67. Cloud (2010), 'Why Your DNA Isn't Your Destiny'.
68. Harrell (2009), 'The Human Epigenome, Decoded'.
69. Cloud (2010), 'Why Your DNA Isn't Your Destiny'.
70. Ibid.
71. Ibid.
72. C. Kuppaswamy (2007), *The International Legal Governance of the Human Genome* (New York: Routledge).
73. United Nations General Assembly (2005), 'United Nations Declaration on Human Cloning', A/RES/59/280, 23 March, <http://daccess-dds-ny.un.org/doc/UNDOC/GEN/N04/493/06/PDF/N0449306.pdf?OpenElement>, date accessed 12 August 2010.
74. United Nations General Assembly (1998), 'United Nations Universal Declaration on the Genome and Human Rights', A/RES 53/152, 9 December, <http://www2.ohchr.org/english/law/genome.htm>, date accessed 12 August 2010.
75. The National Human Genome Research Institute 'Welcome to the Genome Statute and Legislation Database', <http://www.genome.gov/PolicyEthics/LegDatabase/pubsearch.cfm>, accessed 2 August 2010.
76. Food and Agriculture Organization of the United Nations (FAO) (2009), *The State of Food Insecurity in the World 2009* (Rome: FAO), <ftp://ftp.fao.org/docrep/fao/012/i0876e/i0876e.pdf>, p. 11.
77. 'Biotechnology and the World Food Supply' (2009), Union of Concerned Scientists Website, 29 October, http://www.ucsusa.org/food_and_agriculture/science_and_impacts/impacts_genetic_engineering/biotechnology-and-the-world.html, date accessed 12 August 2010.
78. World Health Organisation (WHO) '20 Questions on Genetically Modified Foods', <http://www.who.int/foodsafety/publications/biotech/20questions/en/>, date accessed 12 August 2010.
79. Human Genome Project Information, 'Genetically Modified Foods and Organisms', http://www.ornl.gov/sci/techresources/Human_Genome/elsi/gmfood.shtml, date accessed 12 August 2010.
80. D.B. Whitman (2000), 'Genetically Modified Foods: Harmful or Helpful?', April, ProQuest Website, <http://www.csa.com/discoveryguides/gmfood/overview.php>, date accessed 12 August 2010.
81. Human Genome Project Information, 'Genetically Modified Foods and Organisms'.
82. K. Harmon (2009), 'Cracked Corn: Scientists Solve Maize's Genetic Maze: Boasting More Genes than Humans, the Corn Genome Proved Difficult to Decode', *Scientific American*, 19 November, <http://www.scientificamerican.com/article.cfm?id=corn-genome-cracked>, date accessed 12 August 2010.
83. Uzogara (2000), 'The Impact of Genetic Modification of Human Foods in the 21st Century: A Review', pp. 185–189.
84. 'Biotechnology and the World Food Supply' (2009), Union of Concerned Scientists Website.
85. Ibid.

86. P.S. Anton, R. Silbergliitt and J. Schneider (2001), *The Global Technology Revolution: Bio/Nano/Materials Trends and their Synergies with Information Technology by 2015* (Santa Monica, CA: RAND), p. 9.
87. WHO '20 Questions on Genetically Modified Foods'.
88. P. Collier (2003), 'The Politics of Hunger', *Foreign Affairs*, Vol. 87, No. 6, November/December, 67.
89. WHO, '20 Questions on Genetically Modified Foods'.
90. Ibid.
91. Anton et al. (2001), 'The Global Technology Revolution: Bio/Nano/Materials Trends and their Synergies with Information Technology by 2015', p. 10.
92. WHO '20 Questions on Genetically Modified Foods'.
93. J. Pohlhaus and R. Cook-Degan (2008), 'Genomics Research: World Survey of Public Funding', *BMC Genomics*, Vol. 9, 472.
94. 'Bridging the Genomics Divide' (2003), Ludwig Institute for Cancer Research Website, 29 January, http://www.licr.org/C_news/archive.php/2003/01/29/bridging-the-genomics-divide/, date accessed 12 August 2010.
95. A. Langlois (2006), 'The Governance of Genomic Information: Will It Come of Age?', *Genomics, Society and Policy*, Vol. 2, No. 3, December, <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2291236>, date accessed 4 September 2010.
96. Ibid.
97. WHO, 'GPG Aspects of Genomics', http://www.who.int/trade/distance_learning/gpgh/gpgh5/en/index5.html, date accessed 12 August 2010.
98. WHO, 'Genomics and the Global Health Divide', <http://www.who.int/genomics/healthdivide/en/index.html>, date accessed 18 August 2010.
99. E. Dowdeswell, A. Daar, and P. Singer (2003), 'Bridging the Genomics Divide', *Global Governance*, Vol. 9, No. 1, 1.
100. Ibid., p. 3.
101. D. Weisbrot (2009), 'Rethinking Privacy in the Genetic Age' in P. Atkinson, P. Glasner and M. Lock (2009), *Handbook of Genetics and Society: Mapping the New Genomic Era* (New York: Routledge), p. 324.
102. Anton et al. (2001), 'The Global Technology Revolution: Bio/Nano/Materials Trends and their Synergies with Information Technology by 2015', p. 9.
103. S. McLean (2009), 'Genetics: Law and Regulation' in Atkinson et al. (2009), *Handbook of Genetics and Society: Mapping the New Genomic Era*, p. 267.
104. Anton et al. (2001), *The Global Technology Revolution: Bio/Nano/Materials Trends and their Synergies with Information Technology by 2015*, p. 9.
105. WHO, 'Genomics and the Global Health Divide'.
106. Ibid.
107. Weisbrot (2009), 'Rethinking Privacy in the Genetic Age', p. 328.
108. B. Bogin (2003), 'The Evolution of Human Nutrition', *The Anthropology of Medicine*, December, <http://web.archive.org/web/20031203003838/http://citd.scar.utoronto.ca/ANTA01/Projects/Bogin.html>, date accessed 12 August 2010.
109. Ibid.
110. B. Balzer, 'Introduction to the Paleolithic Diet', Earth360 Website, http://www.earth360.com/diet_paleodiet_balzer.html, date accessed 12 August 2010.
111. Ibid.

112. N.R.F. Al-Rodhan (2009), 'Evolutionary Metabolism and Health Security', unpublished paper.
113. Bogin (2003), 'The Evolution of Human Nutrition'.
114. Balzer, 'Introduction to the Paleolithic Diet'.
115. Ibid.
116. Ibid.
117. Bogin (2003), 'The Evolution of Human Nutrition'.
118. National Diabetes Information Clearinghouse 'American Indians and Alaska Natives and Diabetes', <http://diabetes.niddk.nih.gov/dm/pubs/americanindian>, date accessed 12 August 2010.
119. R. Martorell (2005), 'Diabetes and Mexicans: Why the Two Are Linked', *Preventing Chronic Disease: Public Health Research, Practice, and Policy* 2, No. 1, <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1323307>, date accessed 12 August 2010.
120. Ibid.

7 Nanotechnology

1. M. Horton, A. Khan and S. Maddison (2006), 'Delivering Nanotechnology to the Healthcare, IT and Environmental Sectors', *BT Technology Journal*, Vol. 24, No. 3, 175.
2. W.S. Bainbridge (2007), *Nanoconvergence* (Upper Saddle River, NJ: Prentice Hall), p. 6.
3. T.F. Budinger and M.D. Budinger (2006), *Ethics of Emerging Technologies: Scientific Facts and Moral Challenges* (Hoboken, NJ: John Wiley & Sons), p. 444.
4. National Nanotechnology Initiative 'What is Nanotechnology?', <http://www.nano.gov/html/facts/whatIsNano.html>, date accessed 18 August 2010.
5. T. Shelley (2006), *Nanotechnology: New Promises, New Dangers* (London: Zed Books Ltd.), p. 14.
6. G. De Micheli (2009), 'Designing Nano Systems for a Safer Tomorrow' in N.R.F. Al-Rodhan (ed.) *Potential Global Strategic Catastrophes: Balancing Transnational Responsibilities and Burden-sharing with Sovereignty and Human Dignity* (Berlin: LIT), p. 149.
7. Budinger and Budinger (2006), *Ethics of Emerging Technologies: Scientific Facts and Moral Challenges*, p. 444.
8. M.C. Roco and W.S. Bainbridge (eds) (2001), *Societal Implications of Nanoscience and Nanotechnology* (Arlington, VA: National Science Foundation), p. 4.
9. P. Harris (2007), 'Carbon Nanotubes', Centre for Advanced Microscopy, University of Reading Website, 1 March, <http://www.personal.rdg.ac.uk/~scscharip/tubes.htm>, date accessed 12 August 2010.
10. K. Bullis (2008), 'The Year in Nanotech', *Technology Review*, 3 January, <http://www.technologyreview.com/Nanotech/19983/?a=f>, date accessed 12 August 2010.
11. 'The Project on Emerging Nanotechnologies' (2009), Nanotech Project Website, <http://www.nanotechproject.org>, date accessed 12 August 2010.

12. Roco and Bainbridge (2001), *Societal Implications of Nanoscience and Nanotechnology*, p. 2.
13. Bainbridge (2007), *Nanoconvergence*, p. 8.
14. S. Lenhart, 'A Brief History of Nanotechnology', Nanoword Website, <http://www.nanoword.net/pages/history.htm>, date accessed 12 August 2010.
15. 'There's Plenty of Room at the Bottom', EconomicExpert Website, <http://www.economicexpert.com/a/There:s:Plenty:of:Room:at:the:Bottom.htm>, date accessed 12 August 2010.
16. Office of Science and Technology, Executive Office of the President (2010), 'Independent Review finds Federal Nanotechnology Initiative Highly Effective; Recommends Changes to Assure =ngoing US dominance', 25 March, <http://www.whitehouse.gov/sites/default/files/microsites/ostp/nano-release.pdf>, date accessed 12 August 2010.
17. G. De Micheli (2009), 'Material and Nano Technology', Presentation at the 8th International Security Forum, Geneva, Switzerland, 19 May; G. De Micheli (2010), 'Nano-Technology', Presentation at the 'Strategic Technologies and Our Global Future Course' at the Geneva Centre for Security Policy, Geneva, Switzerland, 15 April.
18. M. Holman (2010), cited in 'Amid Nanotechnology's Dazzling Promise, Health Risks Grow', AOL News Website, 24 March, <http://www.aolnews.com/nanotech/article/amid-nanotechs-dazzling-promise-health-risks-grow/19401235>, date accessed 19 August 2010.
19. The White House (2003), 'President Bush Signs Nanotechnology Research and Development Act', 3 December, <http://georgewbush-whitehouse.archives.gov/news/releases/2003/12/20031203-7.html>, date accessed 18 August 2010.
20. 'NNI Amendmnt Act 2009 Introduced by Senator John Kerry' (2009), Nanotech Development Blog, July, <http://www.nanotechnologydevelopment.com/government/nni-amendment-act-2009-introduced-by-senator-john-kerry.html>, date accessed 12 August 2010.
21. De Micheli (2009), 'Material and Nano Technology'.
22. R.G. Lipsey, K.I. Carlaw and C.T. Bekar (2005), *Economic Transformations: General Purpose Technologies and Long-Term Economic Growth* (Oxford: Oxford University Press), p. 216.
23. Ibid.
24. 'The Wonders and Dangers of Nanotechnology' (2006), *Safety Compliance Letter*, Issue 2465, May, 1.
25. Ibid.
26. I. Amato (2004), 'Nano's Safety Checkup', *Technology Review*, Vol. 107, No. 1, February, 22.
27. 'The Risk in Nanotechnology' (2007), *The Economist*, 24 November, http://www.economist.com/node/10171212?story_id=10171212, date accessed 18 August 2010.
28. C. Phoenix and M. Treder (2008), 'Nanotechnology as Global Catastrophic Risks' in N. Bostrom and M.M. Ćircović (eds) *Global Catastrophic Risks* (Oxford: Oxford University Press), p. 483.
29. Ibid., p. 484.
30. R. Kurzweil (2006), *The Singularity Is Near* (London: Gerald Duckworth & Co., Ltd.), p. 247.

31. 'The Wonders and Dangers of Nanotechnology'(2006), *Safety Compliance Letter*, p. 1.
32. B.J. Feder (2002), 'New Economy; Nanotechnology Has Arrived; a Serious Opposition Is Forming', *The New York Times*, 19 August, <http://www.nytimes.com/2004/11/01/technology/01nano.html>, date accessed 12 August 2010.
33. 'The Wonders and Dangers of Nanotechnology' (2006), *Safety Compliance Letter*, p. 1.
34. G. Gonzalez (2007), 'Nanotechnology Poses Potential Risks to Environment, Health', *Business Insurance*, Vol. 41, No. 29, 3 December, 21.
35. 'Grey Goo Is a Small Issue' (2003), Center for Responsible Nanotechnology Website, 14 December, <http://crnano.org/BD-Goo.htm>, date accessed 12 August 2010.
36. Feder (2002), 'New Economy; Nanotechnology Has Arrived; a Serious Opposition Is Forming'.
37. C. Cookson(2008), 'Tight Regulation Urged on Nanotechnology', *The Financial Times*, 12 November, http://www.ft.com/cms/s/1bbac05a-b05c-11dd-a795-0000779fd18c,Authorised=false.html?_i_location=http%3A%2F%2Fwww.ft.com%2Fcms%2Fs%2F0%2F1bbac05a-b05c-11dd-a795-0000779fd18c.html&_i_referer=http%3A%2F%2Fsearch.ft.com%2Fsearch%3FqueryText%3Dnanotechnology, date accessed 19 August 2010, 4.
38. Shelley (2006), *Nanotechnology: New Promises, New Dangers*, p. 15.
39. Ibid.
40. G.A. Hodge, D. Bowman and K. Ludlow (eds) (2007), *New Global Frontiers in Regulation* (Cheltenham: Edward Elgar Publishing), p. 355.
41. International Organization for Standardization (ISO), 'Nanotechnologies', http://www.iso.org/iso/iso_technical_committee?commid=381983, date accessed 12 August 2010.
42. Organisation for Economic Co-operation and Development (OECD), 'OECD Working Party on Nanotechnology', http://www.oecd.org/document/36/0,3343,en_2649_34269_38829732_1_1_1_1,00.html, date accessed 12 August 2010.
43. Ibid.
44. De Micheli (2009), 'Designing Nanosystems for a Safer Tomorrow', p. 154.
45. Ibid., p. 155.
46. Ibid.
47. De Micheli (2010), 'Nano-Technology'.
48. J. Altmann and M.A. Gubrud (2004), 'Military, Arms Control, and Security Aspects of Nanotechnology' in D. Baird, A. Nordmann and J. Schummer (eds) *Discovering the Nanoscale* (Amsterdam: IOS Press), p. 275.
49. Ibid.
50. J. Altmann (2008), 'Military Uses of Nanotechnology – Too Much Complexity for International Security', *Complexity and Security*, Vol. 14, No. 1, 69.
51. Hodge et al. (2007), *New Global Frontiers in Regulation*, p. 361.
52. Ibid., p. 365.
53. Ibid., p. 364.
54. Ibid.
55. M.C. Roco and W.S. Bainbridge (2002), *Converging Technologies for Improving Human Performance: Nanotechnology, Biotechnology, Information Technology and Cognitive Science* (Arlington: National Science Foundation), p. ix.

56. Ibid., p. 2.
57. Roco and Bainbridge (2002), *Converging Technologies for Improving Human Performance: Nanotechnology, Biotechnology, Information Technology and Cognitive Science*, p. 4.
58. Biotechnology Industry Organization (BIO) (2008), *Guide to Biotechnology 2008* (Washington, D.C.: BIO), <http://bio.org/speeches/pubs/er/BiotechGuide2008.pdf>, date accessed 17 August 2010, p. 68.
59. Shelley (2006), *Nanotechnology: New Promises, New Dangers*, p. 91.
60. Roco and Bainbridge (2002), *Converging Technologies for Improving Human Performance: Nanotechnology, Biotechnology, Information Technology and Cognitive Science*, p. xi.
61. NASA (2002), 'Convergence of Biotechnology, Information Technology and Nanotechnology: A NASA Perspective', *Aerospace Technology Innovation*, Vol. 10, No. 4, July/August, 4.
62. Ibid.
63. S.L. Venneri (2001), 'Implications for Nanotechnology for Space Exploration' in Roco and Bainbridge (2001), *Societal Implications of Nanoscience and Nanotechnology*, p. 162.
64. 'Frequently Asked Questions – Molecular Manufacturing', Foresight Nanotech Institute Website, <http://www.foresight.org/nano/whatismm.html>, date accessed 12 August 2010.
65. Ibid.
66. Phoenix and Treder (2008), 'Nanotechnology as Global Catastrophic Risk', p. 489.
67. BIO (2008), *Guide to Biotechnology 2008*, p. 68.
68. Roco and Bainbridge (2002), *Converging Technologies for Improving Human Performance: Nanotechnology, Biotechnology, Information Technology and Cognitive Science*, p. xiii.
69. Ibid., p. x.
70. Ibid., p. xii.
71. Ibid.
72. Ibid.
73. Bainbridge (2007), *Nanoconvergence: The Unity of Nanoscience, Biotechnology, Information Technology, and Cognitive Science*, p. 11.
74. Budinger and Budinger (2006), *Ethics of Emerging Technologies: Scientific Facts and Moral Challenges*, p. 444.
75. Ibid.
76. Bainbridge (2007), *Nanoconvergence: The Unity of Nanoscience, Biotechnology, Information Technology, and Cognitive Science*, p. 92.
77. Budinger and Budinger (2006), *Ethics of Emerging Technologies: Scientific Facts and Moral Challenges*, p. 444.
78. 'Nanotechnology and Intellectual Property Issues' (2006), Nanowerk News Website, 26 December, <http://www.nanowerk.com/news/newsid=1187.php>, date accessed 12 August 2010.
79. Ibid.
80. Ibid.
81. B. Bastani and D. Fernandez (2002), *Intellectual Property Rights in Nanotechnology* (Menlo Park, CA: Fernandez & Associates), <http://www.iploft.com/Nanotechnology.pdf>, date accessed 12 August 2010, p. 5.

82. Ibid.
83. A.P. Alivisatos (2007), 'Less is More in Medicine', *Scientific American Reports*, Special Edition on Nanotechnology, 75.
84. Kurzweil (2006), *The Singularity Is Near*, p. 254.
85. Alivisatos (2007), 'Less is More in Medicine', p. 78.
86. Ibid.
87. Ibid.
88. Kurzweil (2006), *The Singularity Is Near*, p. 254.
89. De Micheli (2009), 'Material and Nano Technology'.
90. Bainbridge (2007), *Nanoconvergence: The Unity of Nanoscience, Biotechnology, Information Technology, and Cognitive Science*, p. 16.
91. F. Salamanca-Buentello, D.L. Persad, E.B. Court, D.K. Martin, A.S. Daar and P.A. Singer (2005), 'Nanotechnology and the Developing World', *PLoS Med*, Vol. 2, No. 5, <http://www.plosmedicine.org/article/info%3Adoi%2F10.1371%2Fjournal.pmed.0020097>, date accessed 18 August 2010.
92. C. Pellerin (2007), 'Nanotechnology Could Improve Health, Water in Developing Nations', America.gov Website, 5 March, <http://www.america.gov/st/washfile-english/2007/March/20070305134101lcnirellep0.9842035.html>, date accessed 12 August 2010.
93. Ibid.
94. De Micheli (2009), 'Material and Nano Technology'.
95. Kurzweil (2006), *The Singularity Is Near*, p. 246.
96. Deloitte Touche Tohmatsu, Technology, Media & Telecommunications (2008), *Technology Predictions: TMT Trends 2008* (United Kingdom: The Creative Studios), p. 9.
97. Cf. Salamanca-Buentello et al. (2005), 'Nanotechnology and the Developing World'.
98. Ibid.
99. De Micheli (2009), 'Material and Nano Technology'.
100. Ibid.
101. Ibid.
102. M. Scott (2008), 'Innovative Plans May be Key for Greener Future', *The Financial Times*, 18 April, <http://www.ft.com/cms/s/0/afa073fa-0b6b-11dd-8ccf-0000779fd2ac.html>, date accessed 12 August 2010.
103. R. Shapiro (2008), *Futurecast 2020: A Global Vision of Tomorrow* (New York: St. Martin's Press), p. 286.
104. Ibid., p. 305.
105. De Micheli (2009), 'Designing Nanosystems for a Safer Tomorrow', p. 146.
106. Ibid., p. 151.
107. Scott (2008), 'Business and the Environment: Innovative Plans May Be Key for Green Future'.
108. Shapiro (2008), 'Futurecast 2020: A Global Vision of Tomorrow', p. 306.
109. Ibid.
110. US Department of Defense (2007), *Defense Nanotechnology Research and Development Program*, 16 April, <http://www.fas.org/irp/agency/dod/nano2007.pdf>, date accessed 12 August 2010.
111. Shelley (2006), *Nanotechnology: New Promises, New Dangers*, p. 39.
112. Altmann (2008), 'Military Uses of Nanotechnology – Too Much Complexity for International Security', p. 64.

113. J. Altmann and M.A. Gubrud (2004), 'Military, Arms Control, and Security Aspects of Nanotechnology' in D. Baird, A. Nordmann and J. Schummer (eds) *Discovering the Nanoscale* (Amsterdam: IOS Press), p. 273.
114. *Ibid.*, p. 272.
115. *Ibid.*, p. 273.
116. *Ibid.*, p. 274.
117. De Micheli (2009), 'Material and Nano Technology'.
118. *Ibid.*
119. *Ibid.*

8 Materials Science

1. Committee on Materials Science and Engineering, Solid State Sciences Committee, Board on Physics and Astronomy, Commission on Physical Sciences, Mathematics, and Resources, National Materials Advisory Board, Commission on Engineering and Technical Systems, National Research Council (1989), *Materials Science and Engineering for the 1990s: Maintaining Competitiveness in the Age of Materials* (Washington, D.C.: National Academies Press), p. 19.
2. Massachusetts Institute for Technology (MIT) Department of Materials Science and Engineering 'What Is Materials Science and Engineering?', <http://dmse.mit.edu/about/whatis.html>, date accessed 16 August 2010.
3. L.J. Pellack (2002), 'Introduction to Materials Science', Materials Science Resources on the Web, <http://www.istl.org/02-spring/internet.html>, date accessed 16 August 2010.
4. P. Patel (2008), 'Self-Assembled Organic Circuits', *MIT Technology Review*, 17 October, <http://www.technologyreview.com/computing/21575/?a=f>, date accessed 16 August 2010.
5. *Ibid.*
6. 'Organic Electronics as a Two-Way Street, Thanks to New Plastic Semiconductor' (2009), *Science Daily*, 7 September, <http://www.sciencedaily.com/releases/2009/08/090817143606.htm>, date accessed 16 August 2010.
7. K. Bullis (2008), 'Mass Production of Plastic Solar Cells' (2008), *MIT Technology Review*, 17 October, <http://www.technologyreview.com/energy/21574/pagel>, date accessed 16 August 2010.
8. D.R. Howell and R. Silbergliitt (2006), 'Appendix C: Materials Science and Engineering Trends to 2020' in R. Silbergliitt, P. Anton, D. Howell, A. Wong, N. Gassman, B.A. Jackson, E. Landree, S. L. Pfleeger, E.M. Newton and F. Wu (eds) *The Global Technology Revolution 2020, In-Depth Analyses: Bio/Nano/Materials/Information Trends, Drivers, Barriers, and Social Implications* (Santa Monica, CA: RAND), p. 177.
9. Biotechnology Industry Organization (BIO) (2008), *Guide to Biotechnology 2008* (Washington, DC: BIO), <http://bio.org/speeches/pubs/er/BiotechGuide2008.pdf>, date accessed 17 August 2010, p. 67.
10. 'How Green Are Green Plastics?' (2008), Mindfully Website, <http://www.mindfully.org/Plastic/Biodegrade/Green-PlasticsAug00.htm>, date accessed 16 August 2010.

11. T.A. Adams II (2000), 'Physical Properties of Carbon Nanotubes', Michigan State University Website, <http://www.pa.msu.edu/cmp/csc/ntproperties/>, date accessed 16 August 2010.
12. Ibid.
13. M. Dresselhaus and G. Dresselhaus (1998), 'Carbon Nanotubes', PhysicsWorld Website, 1 January, <http://physicsworld.com/cws/article/print/1761>, date accessed 16 August 2010.
14. J. Savage (2008), 'Silicon Nanowires Turn Heat to Electricity', IEEE Spectrum Website, January, <http://www.spectrum.ieee.org/energy/renewables/silicon-nanowires-turn-heat-to-electricity>, date accessed 16 August 2010.
15. J.R. Heath and M.A. Ratner (2003), 'Molecular Electronics', *Physics Today*, May, 43.
16. 'It's an Advanced Material World' (2006), Nova: Science in the News, Australian Academy of Science, <http://www.science.org.au/nova/093/093glo.htm>, date accessed 16 August 2010.
17. 'Spintronics' (2008), Nanotechnology Now Website, 29 March, <http://www.nanotech-now.com/spintronics.htm>, date accessed 16 August 2010.
18. Ibid.
19. Ibid.
20. 'Wide Bandgap Semiconductors' (2005), Information Society Technology (IST) World Website, <http://www.ist-world.org/ProjectDetails.aspx?ProjectId=875e48af26924964ac9f294efa7dd914>, date accessed 16 August 2010.
21. 'Wide Band Gap Semiconductors' (2005), European Space Components Information Exchange System Website, 1 November, <https://escies.org/ReadArticle?docId=220>, date accessed 16 August 2010.
22. Ibid.
23. 'It's an Advanced Material World' (2006), Nova: Science in the News, Australian Academy of Science.
24. 'Smart Materials', Discovery Channel Website, http://www.discoverychannel.co.uk/technology/basic_materials/smart/index.shtml, date accessed 16 August 2010.
25. 'It's an Advanced Material World' (2006), Nova: Science in the News, Australian Academy of Science.
26. Howell and Silberglitt (2006), 'Appendix C: Materials Science and Engineering Trends to 2020', p. 170.
27. Ibid.
28. Ibid.
29. R. Miller (2009), 'Scientists Develop Piezoelectric Motor for Medical Microbots', Engadget Website, 20 January, <http://www.engadget.com/2009/01/20/scientists-develop-piezoelectric-motor-for-medical-microbots>, date accessed 16 August 2010.
30. C. Johnson (2004), "'Smart" Textiles Emerge from Nanotech Labs', MSNBC.com Website, 15 December, <http://www.msnbc.msn.com/id/6713188/>, date accessed 16 August 2010.
31. Howell and Silberglitt (2006), 'Appendix C: Materials Science and Engineering Trends to 2020', p. 172.
32. 'On the Path to Sophisticated Fibers that Can Hear and Sing' (2010), *R&D Magazine*, 12 July, <http://www.rdmag.com/News/2010/07/Materials-Material-Science-On-The-Path-To-Sophisticated-Fibers-That-Can-Hear-And-Sing/>, date accessed 16 August 2010.

33. Howell and Silberglitt (2006), 'Appendix C: Materials Science and Engineering Trends to 2020', p. 172.
34. G.P. McKnight, 'Magnetostrictive Materials Background', University of California Website, <http://aml.seas.ucla.edu/research/areas/magnetostrictive/overview.htm>, date accessed 16 August 2010.
35. Howell and Silberglitt (2006), 'Appendix C: Materials Science and Engineering Trends to 2020', p. 171.
36. McKnight, 'Magnetostrictive Materials Background'.
37. 'Shape Changing Smart Material', Inventables Website, <https://technology.inventables.com/technologies/terfenol-d-smart-material>, date accessed 16 August 2010.
38. Ibid.
39. Howell and Silberglitt (2006), 'Appendix C: Materials Science and Engineering Trends to 2020', p. 171.
40. Ibid.
41. Ibid.
42. Ibid., pp. 171–172.
43. Ibid., p. 172.
44. J. Elliot and B. Hancock (2006), 'Pharmaceutical Materials Science: An Active New Frontier in Materials Research', *MRS Bulletin*, Vol. 31, 869.
45. Ibid., p. 873.
46. University of Cambridge 'The Pfizer Institute for Pharmaceutical Materials Science', <http://www.msm.cam.ac.uk/pfizer/>, date accessed 16 August 2010.
47. Elliot and Hancock (2006), 'Pharmaceutical Materials Science: An Active New Frontier in Materials Research', p. 873.
48. 'What Are Composites?' Society of Manufacturing Engineers Website, http://www.sme.org/cgi-bin/communities.pl?communities/ema/what_is_pcc.htm&&SME&, date accessed 16 August 2010.
49. Ibid.
50. US Department of Energy: Industrial Technologies Program (2006), 'Advanced Composite Coatings for Industries of the Future', http://www1.eere.energy.gov/industry/imf/pdfs/1791_advanced_compositecoatings.pdf, date accessed 16 August 2010, p. 1.
51. 'Metal, Heal Thyself' (2010), *The Economist*, 10 June, <http://www.economist.com/node/16295654>, date accessed 16 August 2010.
52. K.C. Jones (2008), 'Metamaterials Hold Promise for Invisibility Cloaks', *Information Week*, 11 August, <http://www.informationweek.com/news/hardware/peripherals/showArticle.jhtml?articleID=210001982>, date accessed 16 August 2010.
53. S. Markey (2006), 'First Invisibility Cloak Tested Successfully, Scientists Say', *National Geographic News*, 19 October, <http://news.nationalgeographic.com/news/2006/10/061019-invisible-cloak.html>, date accessed 16 August 2010.
54. 'Invisibility Cloak One Step Closer: New Metamaterials Bend Light Backwards' (2008), *Science Daily*, 11 August, <http://www.sciencedaily.com/releases/2008/08/080811092450.htm>, date accessed 16 August 2010.
55. Ibid.
56. Ibid.
57. Ibid.
58. Foundation for Fundamental Research on Matter (FOM Institute AMOLF) (2010), 'Optical Metamaterial with Negative Refractive Index for Visible

- Light', 18 April, http://www.amolf.nl/news/detailpage/back_to/news/article/optical-metamaterial-with-negative-refractive-index-for-visible-light//chash/7df92703a2/, date accessed 16 August 2010.
59. 'Invisibility Cloak One Step Closer: New Metamaterials Bend Light Backwards' (2008), *Science Daily*.
 60. K. Bourzac (2009), 'TR10: Nanopiezoelectronics', *MIT Technology Review*, March/April, http://www.technologyreview.com/printer_friendly_article.aspx?id=22118&channel=specialsections§ion=tr10, date accessed 16 August 2010.
 61. Ibid.
 62. Ibid.
 63. National Research Council (2005), *Globalization of Materials R&D: Time for a National Strategy*, (Washington, D.C.: National Academies Press), p. 120.
 64. Ibid.
 65. 'Army Selects MIT for \$50 Million Institute to Use Nanomaterials to Clothe, Equip Soldiers' (2002), MIT News Website, 13 March, <http://web.mit.edu/newsoffice/2002/isn.html>, date accessed 16 August 2010.
 66. 'Center for Computational Materials Website', Naval Research Laboratories Website, <http://cst-www.nrl.navy.mil/>, date accessed 16 August 2010.
 67. Committee on Materials Research for Defense After Next, National Research Council (2003), *Materials Research to Meet 21st Century Defense Needs* (Washington, D.C.: National Academies Press), p. 13.
 68. Ibid., p. 12.
 69. 'Liquid Body Armor: Rheologists Apply Shear-Thickening Fluids to Protective Gear' (2006), *Science Daily*, 1 August, http://www.sciencedaily.com/videos/2006/0803-liquid_body_armor.htm, date accessed 16 August 2010.
 70. M. Brant (2003), 'Sci-fi War Uniforms?', *Newsweek*, Vol. 141, No. 8, p. E2.
 71. Committee on Materials Research for Defense After Next, National Research Council (2003), *Materials Research to Meet 21st Century Defense Needs*, p. 15.
 72. 'Intelligent Structures: Structural Healing' (2005), *The Engineer*, 11 July, 24.
 73. 'Span of Control' (2009), *The Economist*, 3 September, http://www.economist.com/sciencetechnology/tq/displaystory.cfm?story_id=E1_TQNJJGVQ, date accessed 16 August 2010.
 74. Ibid.
 75. Committee on Materials Research for Defense After Next, National Research Council (2003), *Materials Research to Meet 21st Century Defense Needs*, p. 22.
 76. G. De Micheli (2009), 'Material and Nano Technology', Presentation at the 8th International Security Forum, Geneva, Switzerland, 19 May.
 77. Ibid.
 78. Ibid.
 79. A. Kahära (2006), 'Smart Cold Protective Clothing for Military Use', Tampere University of Technology Website, <http://www.tut.fi/index.cfm?MainSel=1&Sel=6106&Show=5600&Siteid=54>, date accessed 16 August 2010.
 80. Committee on Materials Research for Defense After Next, National Research Council (2003), *Materials Research to Meet 21st Century Defense Needs*, p. 22.
 81. Ibid.
 82. European Space Agency (ESA) Materials Science in Space 'What is Gravity?', <http://www.spaceflight.esa.int/users/materials/introduction/gravity/>

- gravity.html, date accessed 20 August 2010; Committee on Materials Research for Defense After Next, National Research Council (2003), *Materials Research to Meet 21st Century Defense Needs*, p. 22.
83. Madrid Institute of Material Science 'Nanostructured Materials for Space Applications: Sensors and Coatings', http://www.icmm.csic.es/solgel/sol-gel_space_applications.html, date accessed 16 August 2010.
 84. R.W. Bruce, 'NASA 2004 SBIR Phase 1 Solicitation', National Aeronautics and Space Administration (NASA) Website, <http://sbir.nasa.gov/SBIR/abstracts/04-1.html>, date accessed 16 August 2010.
 85. De Micheli (2009), 'Material and Nano Technology'.
 86. Ibid.
 87. G. De Micheli (2009), 'Designing Nano Systems for a Safer Tomorrow' in N.R.F. Al-Rodhan (ed.) *Potential Global Strategic Catastrophes: Balancing Transnational Responsibilities and Burden-sharing with Sovereignty and Human Dignity*, (Berlin: LIT), p. 152.
 88. De Micheli (2009), 'Material and Nano Technology'.
 89. Kahära (2006), 'Smart Cold Protective Clothing for Military Use'.
 90. 'Trappings of Waste' (2009), *The Economist*, 3 September, http://www.economist.com/sciencetechnology/tq/displaystory.cfm?story_id=E1_TQNJJGGQ, date accessed 16 August 2010.
 91. Ibid.
 92. Ibid.

9 Artificial Intelligence

1. R. Kurzweil (2006), *The Singularity Is Near* (London: Gerald Duckworth & Co., Ltd.), p. 7.
2. University of Michigan 'Intelligence and Artificial Intelligence', <http://ai.eecs.umich.edu/cogarch0/common/theory/ai.html>, date accessed 16 August 2010.
3. R. Kurzweil (2006), 'Reinventing Humanity: The Future of Machine-Human Intelligence', *The Futurist*, Vol. 40, No. 2, March/April, 39.
4. Ibid.
5. P. Domingos (2009), 'Solving AI', *Technology Review*, Vol. 112, No. 2, March/April, 10.
6. Ibid.
7. C. Goldberg (2007), 'Beyond AI: Creating the Conscience of the Machine', *Science News*, Vol. 172, No. 11, 15 September, 175.
8. P.W. Singer (2009), *Wired for War: The Robotics Revolution and Conflict in the 21st Century* (New York: Penguin Press), p. 75.
9. 'What Is the Singularity?' The Singularity Institute for Artificial Intelligence Website, <http://singinst.org/overview/whatisthesingularity>, date accessed 16 August 2010.
10. Ibid.
11. Ibid.
12. D.L. Waltz (1996), 'Artificial Intelligence: Realizing the Ultimate Promises of Computing', NEC Research Institute Website, <http://www.cs.washington.edu/homes/lazowska/cra/ai.html>, date accessed 16 August 2010.

13. 'Predicting AI's Future' (2001), *BBC News*, 21 September, http://news.bbc.co.uk/1/hi/in_depth/sci_tech/2001/artificial_intelligence/1555742.stm, date accessed 16 August 2010.
14. Singer (2009), *Wired for War: The Robotics Revolution and Conflict in the 21st Century*, p. 78.
15. Waltz (1996), 'Artificial Intelligence: Realizing the Ultimate Promises of Computing'.
16. G. Anthes (2009), 'AI Comes of Age', *Computerworld*, Vol. 43, No. 4, 16.
17. R.A. Palmquist (1996), 'AI and Expert Systems', The University of Texas at Austin Website, <http://www.ischool.utexas.edu/~palmquis/courses/ai96.htm>, date accessed 16 August 2010.
18. Anthes (2009), 'AI Comes of Age', p. 16.
19. Waltz (1996), 'Artificial Intelligence: Realizing the Ultimate Promises of Computing'.
20. 'Artificial Intelligence', British Computer Society Website, <http://www.bcs.org>, date accessed 16 August 2010.
21. Kurzweil (2006), *The Singularity Is Near*, p. 261.
22. Ibid.
23. 'AI', MSN Encarta Website, <http://encarta.msn.com/encnet/features/dictionary/dictionaryhome.aspx>, date accessed 16 August 2010.
24. University of Toronto 'Symbolic AI', <http://www.psych.utoronto.ca/users/reingold/courses/ai/symbolic.html>, date accessed 16 August 2010.
25. 'AI', MSN Encarta Website.
26. University of Toronto 'Symbolic AI'.
27. University of Toronto 'The Common Sense Knowledge Problem', <http://www.psych.utoronto.ca/users/reingold/courses/ai/commonsense.html>, date accessed 16 August 2010.
28. 'University of Toronto 'Symbolic AI'.
29. 'AI', MSN Encarta Website.
30. 'Artificial Intelligence (AI)', Encyclopedia Britannica Website, <http://www.britannica.com/EBchecked/topic/37146/artificial-intelligence>, date accessed 16 August 2010.
31. Kurzweil (2006), *The Singularity Is Near*, p. 269.
32. Ibid.
33. 'AI', MSN Encarta Website.
34. 'Artificial Intelligence (AI)', Encyclopedia Britannica Website.
35. B. Faltings (2009), Personal Email Communication with Author, 3 August.
36. 'Kernel Machines' (2007), Kernel Machines Website, 1 February, <http://www.kernel-machines.org/>, date accessed 20 August 2010.
37. Faltings (2009), Personal email communication, 3 August.
38. 'Evolutionary AI', Herself's Artificial Intelligence Website, <http://www.herselfsai.com/2007/02/evolutionary-ai.html>, date accessed 16 August 2010.
39. 'AI', MSN Encarta Website.
40. Ames Research Center (2004), 'NASA Evolutionary Software Automatically Designs Antenna', 15 June, http://www.nasa.gov/mission_pages/st-5/main/04-55AR.html, date accessed 16 August 2010.
41. Ibid.
42. Kurzweil (2006), *The Singularity Is Near*, p. 271.

43. B.J. Copeland (2000), 'What Is Artificial Intelligence?' AlanTuring Website, http://www.alanturing.net/turing_archive/pages/Reference%20Articles/what_is_AI/What%20is%20AI14.html, date accessed 16 August 2010.
44. 'Strong and Weak AI', PhilosophyOnline Website, http://www.philosophyonline.co.uk/pom/pom_functionalism_AI.htm, date accessed 16 August 2010.
45. University of Texas 'Philosophical Arguments Against "Strong" AI', <http://www.cs.utexas.edu/users/mooney/cs343/slide-handouts/philosophy.4.pdf>, date accessed 20 August 2010.
46. Copeland (2000), 'What Is Artificial Intelligence?'.
47. E. Naone (2009), 'TR: 10: Intelligent Software Assistant', *MIT Technology Review*, March/April, http://www.technologyreview.com/printer_friendly_article.aspx?id=22117&channel=specialsections§ion=tr10, date accessed 16 August 2010.
48. Ibid.
49. Ibid.
50. C. Thompson (2010), 'What Is I.B.M.'s Watson?' *The New York Times*, 14 June, <http://www.nytimes.com/2010/06/20/magazine/20Computer-t.html>, date accessed 17 August 2010.
51. E. Harrell (2009), 'A Robot Performs Science', *Time Magazine*, 8 December, http://www.time.com/time/specials/packages/article/0,28804,1945379_1944416_1944423,00.html, date accessed 17 August 2010.
52. Ibid.
53. B. Hibbard (2006), 'The Singularity Summit and Regulation of AI', Email communication, 10 May, http://www.ssec.wisc.edu/~billh/g/singularity_summit.html, date accessed 16 August 2010.
54. Ibid.
55. J. Hughes (2007), 'Hughes on Regulating AI at the Singularity Summit', Singularity Institute for Artificial Intelligence Website, 21 September, <http://ieet.org/index.php/IEET/more/2021/>, date accessed 17 August 2010.
56. B. Joy (2004), 'Why the Future Doesn't Need Us', *Wired*, August, http://www.wired.com/wired/archive/8.04/joy_pr.html, date accessed 17 August 2010.
57. Ibid.
58. Ibid.
59. Faltings (2009), Personal email communication, 3 August.
60. Ibid; P.W. Singer (2010), 'War of the Machines', *Scientific American*, Vol. 303, No. 1, 59.
61. Singer (2009), *Wired for War: The Robotics Revolution and Conflict in the 21st Century*, p. 398.
62. Ibid., p. 399.
63. 'Terminate the Terminators' (2010), *Scientific American*, July, <http://www.scientificamerican.com/article.cfm?id=terminate-the-terminators&page=2>, date accessed 17 August 2010.
64. Singer (2009), *Wired for War: The Robotics Revolution and Conflict in the 21st Century*, p. 403.
65. Ibid.
66. Singer (2010), 'War of the Machines', p. 56.
67. 'Military Applications of AI', Oracle ThinkQuest Library Website, http://library.thinkquest.org/18242/app_military.shtml, date accessed 16 August 2010.

68. Kurzweil (2006), *The Singularity Is Near*, p. 280.
69. Singer (2009), *Wired for War: The Robotics Revolution and Conflict in the 21st Century*, pp. 36–37.
70. Singer (2010), 'War of the Machines', p. 56.
71. W.S. Weed (2002), 'This Year in Ideas: Robotic Warfare', *The New York Times*, 15 December, <http://www.nytimes.com/2002/12/15/magazine/the-year-in-ideas-robotic-warfare.html>, date accessed 17 August 2010.
72. S. Ackerman (2010), 'Air Force Wants Drones to Sense Other Planes's Intent', *Wired*, 23 July, <http://www.wired.com/dangerroom/2010/07/air-force-wants-drones-to-sense-other-planes-intent/>, date accessed 17 August 2010.
73. Weed (2002), 'This Year in Ideas: Robotic Warfare'.
74. 'AI Topics: Military' (2008), Association for the Advancement of Artificial Intelligence Website, <http://www.aaai.org/aitopics/pmwiki/pmwiki.php/AITopics/Military>, date accessed 17 August 2010.
75. Singer (2010), 'War of the Machines', p. 57.
76. F. Reed (2005), 'Robotic Warfare Drawing Nearer', GlobalSecurity Website, 10 February, <http://www.globalsecurity.org/org/news/2005/050210-robotic-warfare.htm>, date accessed 17 August 2010.
77. Ibid.
78. L. Greenemeier (2009), 'Researchers Turn to Artificial Intelligence and Real Data to Improve War Games', *Scientific American*, 26 November, <http://www.scientificamerican.com/article.cfm?id=virtual-war-games>, date accessed 17 August 2010.
79. Ibid.
80. W. Warner (1993), 'Send in the Machines: War in the Age of Intelligent Machine', *MIT Technology Review*, Vol. 96, No. 3, 75.
81. Kurzweil (2006), *The Singularity Is Near*, p. 330.
82. Ibid., p. 332.
83. Singer (2009), *Wired for War: The Robotics Revolution and Conflict in the 21st Century*, p. 398.
84. Reed (2005), 'Robotic Warfare Drawing Nearer'.
85. R. Finkelstein (2009), 'Robotics in Future Warfare', Presentation at the U.S. Army War College Strategic Studies Institute, 14–16 April.
86. Kurzweil (2006), *The Singularity Is Near*, p. 421.
87. Weed (2002), 'This Year in Ideas: Robotic Warfare'.
88. Singer (2009), *Wired for War: The Robotics Revolution and Conflict in the 21st Century*, p. 212.
89. Ibid., p. 213.
90. C.D. Walton (2007), *Geopolitics and the Great Powers in the 21st Century* (New York: Routledge), p. 94.
91. Kurzweil (2006), *The Singularity Is Near*, p. 280.
92. Ibid., p. 281.
93. NASA: Jet Propulsion Laboratory, California Institute of Technology 'Current Projects', <http://ai.jpl.nasa.gov/public/projects/current.html>, date accessed 17 August 2010.
94. Kurzweil (2006), *The Singularity Is Near*, p. 282.
95. 'AI in Medicine: An Introduction', Open Clinical Website, <http://www.openclinical.org/aiinmedicine.html>, date accessed 17 August 2010.

96. W.H.W. Ishak and F. Siraj (2002), 'Artificial Intelligence in Medical Applications: An Exploration', *Health Informatics Europe Journal*, 30 June, http://74.125.155.132/scholar?q=cache:O4B5JcShRjMJ:scholar.google.com/+%E2%80%98Artificial+Intelligence+in+Medical+Applications:+An+Exploration%E2%80%99,+Health+Informatics+Europe+Journal,&hl=de&as_sdt=2000&as_vis=1, date accessed 17 August 2010.
97. 'Doctors Team Up with Computers' (2000), *The Futurist*, Vol. 34, No. 5, September/October, 13.
98. T. Horowitz (2010), 'Cyber Care: Will Robots Help the Elderly Live at Home Longer?', *Scientific American*, 21 June, <http://www.scientificamerican.com/article.cfm?id=robot-elder-care>, date accessed 17 August 2010.
99. A. Harmon (2010), 'A Soft Spot for Circuitry', *The New York Times*, 4 July, <http://www.nytimes.com/2010/07/05/science/05robot.html>, date accessed 17 August 2010.
100. 'Artificial Intelligence in Medicine', Cedars-Sinai Website, <http://www.csmc.edu/5835.html>, date accessed 17 August 2010.
101. C. Whelan (2010), 'The Doctor is Out, But New Patient Monitoring and Robotics Technology is In', *Scientific American*, 25 March, <http://www.scientificamerican.com/article.cfm?id=patient-monitoring-tech>, date accessed 17 August 2010.
102. Ishak and Siraj (2002)'Artificial Intelligence in Medical Applications: An Exploration'.
103. Faltings (2009), Personal email communication, 3 August.
104. Ibid.
105. O. Port, M. Arndt, and J. Carey (2003), 'Smart Tools: Companies in Health Care, Finance, and Retailing are Using Artificial Intelligence Systems to Filter Huge Amounts of Data and Identify Suspicious Transactions', *Business Week*, Issue 3826A, 25 March, 154.
106. A. Anshum and P. Siddharth (2009), 'Applications of AI in Finance', Indian Institute of Technology Bombay, <http://www.cse.iitb.ac.in/~cs344/2009/seminars/>, date accessed 17 August 2010.
107. Ibid.
108. Ibid.
109. Ibid.
110. Faltings (2009), Personal email communication, 3 August.
111. Kurzweil (2006), *The Singularity Is Near*, p. 286.
112. Ibid.
113. R. Wray (2006), 'Google Users Promised Artificial Intelligence', *The Guardian*, 23 May, <http://www.guardian.co.uk/technology/2006/may/23/searchengines.news>, date accessed 17 August 2010.
114. H. Green (2005), 'Building a Smarter Search Engine', *Business Week*, 11 January, http://www.businessweek.com/technology/content/jan2005/tc2005014_2937.htm, date accessed 17 August 2010.
115. 'Search Engine Privacy Tips', World Privacy Forum Website, <http://www.worldprivacyforum.org/searchengineprivacytips.html>, date accessed 17 August 2010.
116. Ibid.
117. Kurzweil (2006), *The Singularity Is Near*, p. 420.

118. D.M. Ewalt (2001), 'Stephen Hawking Warns of 'Terminator'-Style Menace', *Information Week*, 5 September.
119. Kurzweil (2006), *The Singularity Is Near*, p. 420.
120. J. Markoff (2010), 'Scientists Worry Machines May Outsmart Man', *The New York Times*, 25 July, <http://www.nytimes.com/2009/07/26/science/26robot.html>, date accessed 17 August 2010.

11 Introduction: Definitions, Terms and Concepts

1. N.R.F. Al-Rodhan (2008), *'Emotional Amoral Egoism': A Neurophilosophical Theory of Human Nature and its Universal Security Implications* (Berlin: LT), p. 65.
2. 'Transhumanist FAQ', Extropy Institute Website, <http://www.extropy.org/faq.htm#1.1>, date accessed 17 August 2010.
3. Ibid.
4. N. Bostrom (2010), 'Transhumanist FAQ', Humanity+ Website, <http://humanityplus.org/learn/transhumanist-faq/>, accessed 29 July 2010.
5. J.J. Hughes and N. Bostrom, 'What Is Transhumanism?' World Transhumanist Association Website, <http://www.transhumanism.org/resources/PressIntro.ppt#3>, date accessed 17 August 2010.
6. A. Sandberg, 'Introduction to Transhumanism', Transhumanist Resources Website, <http://www.aleph.se/Trans/>, date accessed 17 August 2010.
7. 'Transhumanist FAQ', Extropy Institute Website.
8. Bostrom (2010), 'Transhumanist FAQ'.
9. M. More (1994), 'On Becoming Posthuman', Max More Website, <http://www.maxmore.com/becoming.htm>, date accessed 17 August 2010.
10. 'Transhumanist FAQ', Extropy Institute Website.
11. Ibid.
12. D. Ust (2001), 'What Is Posthumanism?' Daniel Ust Website, <http://mars.superlink.net/~neptune/Posthuman.html>, date accessed 17 August 2010.
13. Bostrom (2010), 'Transhumanist FAQ'.
14. More (1994), 'On Becoming Posthuman'.
15. 'Definition of Eugenics' (2001), MedicineNet Website, 5 August, <http://www.medterms.com/script/main/art.asp?articlekey=3335>, date accessed 17 August 2010.
16. Bostrom (2010), 'Transhumanist FAQ'.
17. F. Galton (2009), quoted by L. Koch, 'Eugenics' in P. Atkinson, P. Glasner and M. Lock (eds) (2009), *Handbook of Genetics and Society: Mapping the New Genomic Era* (New York: Routledge), p. 437.
18. L. Koch (2009), 'Eugenics' in Atkinson et al. (2009), *Handbook of Genetics and Society: Mapping the New Genomic Era*, p. 437.
19. Ibid., p. 438.
20. 'Definition of Eugenics' (2001), MedicineNet Website.
21. D.B. Resnik (2006), 'The Moral Significance of the Therapy-Enhancement Distinction in Human Genetics' in H. Kuhse and P. Singer (eds) *Bioethics* (Malden, Oxford and Victoria: Blackwell Publishing Ltd), p. 216.
22. Bostrom (2010), 'Transhumanist FAQ'.
23. M. Foucault (1990), *The History of Sexuality: An Introduction* (New York: Random House), p. 138.

24. Ibid., p. 141.
25. Ibid., p. 138.
26. Ibid., p. 140.
27. Ibid., p. 137.
28. Ibid.
29. T. Ellis-Christensen, 'What Is Biopower?' Wisegeek Website, <http://www.wisegeek.com/what-is-biopower.htm>, date accessed 17 August 2010.
30. Foucault (1990), *The History of Sexuality: An Introduction*, p. 143.
31. Ibid., p. 146.
32. Ibid., p. 148.
33. N.R.F. Al-Rodhan (2008), 'Emotional Amoral Egoism': A Neurophilosophical Theory of Human Nature and its Universal Security Implications' (Berlin: LIT), p. 67.
34. Ibid., pp. 85–92.
35. Ibid., p. 104.
36. Ibid.
37. Ibid., p. 65.
38. Ibid.
39. Ibid., p. 73.
40. N.R.F. Al-Rodhan (2009), *Sustainable History and the Dignity of Man: A Philosophy of History and Civilisational Triumph* (Berlin: LIT), p. 86.
41. Ibid., p. 97.
42. Ibid.
43. United National General Assembly (1948), *Universal Declaration of Human Rights*, 217 A (III), 10 December, <http://daccess-dds-ny.un.org/doc/RESOLUTION/GEN/NR0/043/88/IMG/NR004388.pdf?OpenElement>, date accessed 20 August 2010.
44. Ibid.
45. N.R.F. Al-Rodhan (2009), *Sustainable History and the Dignity of Man: A Philosophy of History and Civilisational Triumph*, p. 185.
46. Ibid.
47. Ibid., p. 186.
48. Ibid.
49. Ibid., pp. 186–187.
50. Ibid., p. 181.
51. Ibid., p. 183.
52. Ibid.
53. Al-Rodhan (2008), 'Emotional Amoral Egoism': A Neurophilosophical Theory of Human Nature and its Universal Security Implications, p. 65.
54. Ibid., pp. 81–82.
55. Al-Rodhan (2009), *Sustainable History and the Dignity of Man: A Philosophy of History and Civilisational Triumph*, p. 437.
56. Ibid., p. 187.
57. Ibid., p. 188.
58. Ibid.
59. Ibid., p. 190.
60. Ibid., p. 191.
61. Ibid., p. 194.
62. Ibid., p. 13.

63. Ibid.
64. Ibid., p. 14.
65. Ibid., p. 27.
66. Ibid., pp. 39–40.
67. Ibid., p. 424.
68. Ibid., p. 419.
69. Ibid.
70. Ibid.
71. Ibid., p. 420.
72. Ibid., p. 39.
73. Ibid., p. 34.
74. Ibid., pp. 96–99.

12 Human Enhancement: The Nature of the Debate

1. Cf. The President's Council on Bioethics (2003), *Beyond Therapy: Biotechnology and the Pursuit of Happiness* (Washington, D.C.), http://bioethics.georgetown.edu/pcbe/reports/beyondtherapy/beyond_therapy_final_webcorrected.pdf, date accessed 26 August 2010.
2. M. Anissimov, 'What Is Bioconservatism?' Wise Geek Website, <http://www.wisegeek.com/what-is-bioconservatism.htm>, date accessed 17 August 2010.
3. Ibid.
4. Ibid.
5. 'Bioconservative', Institute for Ethics and & Emerging Technologies (IET) Technoprogressive Wiki Website, <http://ieet.org/index.php/tpwiki/Bioconservative/>, date accessed 17 August 2010.
6. Ibid.
7. Ibid.
8. Ibid.
9. 'Bioconservatism', StateMaster Website, <http://www.statemaster.com/encyclopedia/Bioconservatism>, date accessed 17 August 2010.
10. 'Bioconservative', IET Technoprogressive Wiki.
11. F. Fukuyama (2002), *Our Posthuman Future: Consequences of the Biotechnology Revolution* (New York: Farrar, Straus and Giroux), p. 159.
12. Ibid.
13. Cf. The President's Council on Bioethics (2003), *Beyond Therapy: Biotechnology and the Pursuit of Happiness*.
14. Ibid.
15. F. Allhoff, P. Lin and J. Steinberg (2009), 'Ethics of Human Enhancement: An Executive Summary', December, *Science and Engineering Ethics*, Vol. 16, No. 2, 1–12.
16. M.J. Sandel (2009), 'The Case Against Perfection: What's Wrong with Designer Children, Bionic Athletes, and Genetic Engineering' in N. Bostrom and J. Savulescu (eds) *Human Enhancement* (Oxford: Oxford University Press), p. 78.
17. Ibid.
18. T. Assenheuer and J. Jessen (2002), 'Interview: Auf schiefer Ebene', *Zeit Online*, May, http://www.zeit.de/2002/05/200205_habermasint..xml, date accessed 17 August 2010.

19. P. Brey (2009), 'Human Enhancement and Personal Identity' in J.K.B Olsen, E. Selinger and S. Riis (eds) *New Waves in Philosophy of Technology* (New York: Palgrave Macmillan), p. 170.
20. *Ibid.*, p. 181.
21. R. van Est, P. Klaassen, M. Schuijff and M. Smits (2008), *Future Man – No Future Man* (The Hague: The Rathenau Institute), p. 17.
22. C.A.J. Coady (2009), 'Playing God' in Bostrom and Savulescu (2009), *Human Enhancement*, p. 179.
23. Cf. The President's Council on Bioethics (2003), *Beyond Therapy: Biotechnology and the Pursuit of Happiness*.
24. Fukuyama (2002), *Our Posthuman Future: Consequences of the Biotechnology Revolution*, p. 149.
25. F. Fukuyama (2004), 'Transhumanism', *Foreign Policy*, September/October, <http://www.foreignpolicy.com/articles/2004/09/01/transhumanism>, date accessed 17 August 2010.
26. N. Bostrom (2005), 'In Defense of Posthuman Dignity', *Bioethics*, Vol. 19, No. 3, 202–214.
27. N. Bostrom (2008), 'Smart Policy: Cognitive Enhancement in the Public Interest' in L. Zonneveld, H. Dijkstra and D. Ringoir (eds) *Reshaping the Human Condition: Exploring Human Enhancement* (The Hague: Rathenau Institute), p. 29.
28. *Ibid.*, p. 30.
29. Allhoff et al. (2009), 'Ethics of Human Enhancement: An Executive Summary'.
30. S. Cave (2001), 'The Most Dangerous Idea on Earth', *The Financial Times*, 28 May; J. Harris (2007), *Enhancing Evolution: The Ethical Case for Making Better People* (Princeton, NJ: Princeton University Press).
31. 'Who's Afraid of Human Enhancement?' (2006), Reason Website, January, <http://www.reason.com/news/show/33064.html>, date accessed 17 August 2010.
32. P. Lin and F. Allhoff (2006), 'Nanoethics and Human Enhancement: A Critical Evaluation of Recent Arguments', *Nanotechnology Perceptions*, Vol. 2, 47.
33. Bostrom (2005), 'In Defense of Posthuman Dignity'.
34. Lin and Allhoff (2006), 'Nanoethics and Human Enhancement: A Critical Evaluation of Recent Arguments', p. 47.
35. *Ibid.*
36. Cf. R. Persaud (2006), 'Does Smarter Mean Happier?' in J. Wilsdon and P. Miller (eds) *Better Humans? The Politics of Human Enhancement and Life Extension* (London: Demos).
37. F. Allhoff, J. Moor, P. Lin and J. Weckert (2009), 'Ethics of Human Enhancement: 25 Questions and Answers', submitted to *Studies in Ethics, Law and Technology*, Manuscript 1110 (Berkeley, CA: The Berkeley Electronic Press), http://files.allhoff.org/research/Ethics_of_Human_Enhancement_SELT.pdf, accessed 30 July 2010, 22.
38. *Ibid.*
39. N. Bostrom and R. Roache (2007), 'Ethical Issues in Human Enhancement', Personal website, <http://www.nickbostrom.com/ethics/human-enhancement.pdf>, date accessed 17 August 2010, p. 20.

40. N. Bostrom (2003), 'Human Genetic Enhancements: A Transhumanist Perspective', *Journal of Value Inquiry*, Vol. 37, No. 4, 493–506.
41. Bostrom (2005), 'In Defense of Posthuman Dignity'.
42. N. Daniels (2009), 'Can Anyone Really Be Talking About Ethically Modifying Human Nature?' in Bostrom and Savulescu (2009), *Human Enhancement*, p. 31.
43. Ibid.
44. Ibid.
45. A. Caplan (2009), 'Good, Better, or Best?' in Bostrom and Savulescu (2009), *Human Enhancement*, p. 204.
46. Ibid., p. 205.
47. P. Hagoort interviewed by L. Zonneveld and M. Slob (2008), 'Cognitive Perfection is not the Optimal Condition' in Zonneveld et al. (2008), *Reshaping the Human Condition: Exploring Human Enhancement* (The Hague: Rathenau Institute), p. 92.
48. R. Roache and S. Clarke (2009), 'Bioconservatism, Bioliberalism, and the Wisdom of Reflecting on Repugnance', *Monash Bioethics Review*, Vol. 28, No. 1, 1–21.
49. Ibid.
50. J. Hughes (2006), 'Human Enhancement and the Emergent Technopolitics of the 21st Century', IJET Website, 19 May, <http://ieet.org/index.php/IEET/more/hughes20060519/>, date accessed 17 August 2010.
51. Ibid.
52. D. Carrico (2006), 'Technoprogressivism: Beyond Technophilia and Technophobia', IJET Website, 12 August, <http://ieet.org/index.php/IEET/more/carrico20060812/>, date accessed 17 August 2010.
53. F. Baylis and J.S. Robert (2004), 'The Inevitability of Genetic Enhancement Technologies', *Bioethics*, Vol. 18, No. 1, 1.
54. Cf. N.R.F. Al-Rodhan (2008), *Emotional Amoral Egoism: A Neurophilosophical Theory of Human Nature and its Universal Security Implications* (Berlin: LIT).
55. 'Overview of Biopolitics', IJET Website, <http://ieet.org/index.php/IEET/biopolitics>, date accessed 17 August 2010.
56. Ibid.
57. Ibid.
58. Ibid.
59. Ibid.
60. Ibid.
61. Ibid.
62. Ibid.
63. Ibid.

13 The Science and Technology of Human Enhancement

1. E.A. Williams (2006), 'Good, Better, Best: The Human Quest for Enhancement', Summary Report of an Invitational Workshop Convened by the Scientific Freedom, Responsibility and Law Program, American Association for the Advancement of Science, 1–2 June, http://www.aaas.org/spp/sfrrl/projects/human_enhancement/pdfs/HESummaryReport.pdf, date accessed 17 August 2010.

2. Ibid.
3. N. Bostrom and R. Roache (2007), 'Ethical Issues in Human Enhancement', Nick Bostrom Website, <http://www.nickbostrom.com/ethics/human-enhancement.pdf>, date accessed 17 August 2010, p. 7.
4. Mayo Clinic 'Performance-enhancing Drugs: Are They a Risk to Your Health?' <http://www.mayoclinic.com/health/performance-enhancing-drugs/hq01105>, date accessed 17 August 2010.
5. Ibid.
6. Ibid.
7. Ibid.; 'Human Enhancement: Making People Better or Making Better People?', The Irish Council for Bioethics Website, <http://www.bioethics.ie/uploads/docs/Humanenh.pdf>, date accessed 17 August 2010.
8. A. Bhargava (2010), 'All's Fair in Botox and Evolution', Institute for Ethics and Emerging Technologies (IEET) Website, 20 July, <http://ieet.org/index.php/IEET/more/bhargava20100720/>, date accessed 17 August 2010.
9. Bostrom and Roache (2007), 'Ethical Issues in Human Enhancement', p. 3.
10. R. Kurzweil and T. Grossman, 'What Is Longevity?' Ray Kurzweil and Terry Grossman's Longevity Products Website, http://www.rayandterry.com/wellness_information.asp?section=Resources&question=142, date accessed 17 August 2010.
11. Ibid.
12. Ibid.
13. US Department of Energy Office of Science 'Artificial Retina Project: Restoring Sight Through Science', Artificial Retina Project Website, <http://artificialretina.energy.gov/about.shtml>, date accessed 17 August 2010.
14. Ibid.
15. P. Belluck (2009), 'Burst of Technology Helps to See', *The New York Times*, 26 September, <http://www.nytimes.com/2009/09/27/health/research/27eye.html?pagewanted=1>, date accessed 17 August 2010.
16. F. Allhoff, P. Lin and J. Steinberg (2009), 'Ethics of Human Enhancement: An Executive Summary', December, *Science and Engineering Ethics*, Vol. 16, No. 2, 2.
17. A. Sandberg, 'Physical Improvements of Humans', Anders Sandberg Personal Website, <http://www.aleph.se/Trans/Individual/Body/improvements.html#Eyes>, date accessed 17 August 2010.
18. R. Radebaugh (2002), 'About Cryogenics', Cryogenics Technologies Group Website, <http://cryogenics.nist.gov/>, date accessed 17 August 2010.
19. 'Cryonics', Cryonics Institute Website, www.cryonics.org, date accessed 17 August 2010.
20. Ibid.
21. 'Cryonics; A Basic Introduction', Cryonics Institute Website, <http://cryonics.org/prod.html>, date accessed 27 July 2010.
22. Ibid.
23. J. Altmann (2008), 'Military Uses of Nanotechnology – Too Much Complexity for International Security', *Complexity and Security*, Vol. 14, No. 1, 64.
24. Centre for Disease Control and Prevention (CDC) (2007), '2007 Art Report Section 5- ART Trends 1998 – 2007, Figure 49' <http://www.cdc.gov/ART/ART2007/section5.htm>, date accessed 27 July 2010.
25. C. Stolba (2002/03) 'Overcoming Motherhood', *Policy Review*, Vol. 116, December/January, 31.

26. P. Singer (2009), 'Parental Choice and Human Improvement' in N. Bostrom and J. Savulescu (eds) *Human Enhancement* (Oxford: Oxford University Press), p. 279.
27. 'Trying to Conceive: Artificial Insemination', WebMD Website, <http://www.webmd.com/infertility-and-reproduction/guide/artificial-insemination>, date accessed 17 August 2010.
28. Ibid.
29. Ibid.
30. 'In Vitro Fertilization', eMedicineHealth Website, http://www.emedicine-health.com/in_vitro_fertilization/article_em.htm, date accessed 17 August 2010.
31. 'IVF', Shared Journey Website, <http://www.sharedjourney.com/ivf.html>, date accessed 17 August 2010.
32. University of California Los Angeles, Earth and Space Sciences 'Germline Gene Therapy', <http://www.ess.ucla.edu/>, date accessed 17 August 2010.
33. N. Bostrom (2003), 'Human Genetic Enhancements: A Transhumanist Perspective', *Journal of Value Inquiry*, Vol. 37, No. 4.
34. University of California Los Angeles, Earth and Space Sciences 'Germline Gene Therapy'.
35. D.W. Brock (2009), 'Is Selection of Children Wrong?' in Bostrom and Savulescu (2009), *Human Enhancement*, p. 252.
36. M.D. Lemonick, D. Bjerklie and A. Park (1999), 'Designer Babies', *Time Magazine*, 11 January, <http://www.time.com/time/magazine/article/0,9171,989987,00.html>, date accessed 17 August 2010.
37. T. Assenheuer and J. Jessen (2002), 'Interview: Auf schiefer Ebene', *Zeit Online*, May, http://www.zeit.de/2002/05/200205_habermasint.xml, date accessed 17 August 2010.
38. M. Henderson (2010), 'Demand for 'Designer Babies To Grow Dramatically'', *The Times of London*, 7 January, <http://www.timesonline.co.uk/tol/news/science/genetics/article6978400.ece#cid=OTC-RSS&attr=1515793>, date accessed 17 August 2010.
39. Ibid.
40. N. Bostrom and A. Sandberg (2009), 'Cognitive Enhancement: Methods, Ethics, Regulatory Challenges', *Science and Engineering Ethics*, Preprint, 2.
41. M.C. Roco and W.S. Bainbridge (2002), *Converging Technologies for Improving Human Performance: Nanotechnology, Biotechnology, Information Technology and Cognitive Science* (Arlington: National Science Foundation), p. 97.
42. W.J. Riedel (2008), 'Psychopharmaceutical Cognition Enhancement' in L. Zonneveld, H. Dijkstra and D. Ringoir (eds) *Reshaping the Human Condition: Exploring Human Enhancement* (The Hague: Rathenau Institute), p. 115.
43. Ibid., p. 116.
44. Ibid., p. 120.
45. Roco and Bainbridge (2002), 'Converging Technologies for Improving Human Performance', p. 154.
46. T. Sejnowski (2010), 'When Will We Be Able to Build Brains Like Ours?' *Scientific American*, 27 April, <http://www.scientificamerican.com/article.cfm?id=when-build-brains-like-ours>, date accessed 17 August 2010.

47. Roco and Bainbridge (2002) 'Converging Technologies for Improving Human Performance', 54
48. Ibid.
49. Cf. U. Lee, H.J. Lee, S. Kim and H.C. Shin (2006), 'Development of Interacranial Brain-Computer Interface System Using Non-Motor Brain Area for Series of Motor Functions', *Electronics Letters*, Vol. 42, No. 4, 98–200.
50. Roco and Bainbridge (2002), 'Converging Technologies for Improving Human Performance', p. 99.
51. Ibid., p. 155.
52. Bostrom and Sandberg (2009), 'Cognitive Enhancement: Methods, Ethics, Regulatory Challenges', p. 6.
53. Columbia University 'History of Neuroscience', <http://www.columbia.edu/cu/psychology/courses/1010/mangels/neuro/history/history.html>, date accessed 17 August 2010.
54. E.H. Chudler, 'The Hows Whats and Whos of Neuroscience', University of Washington Website, <http://faculty.washington.edu/chudler/what.html>, date accessed 17 August 2010.
55. 'What Is Neuroscience?' Society for Neuroscience Website, <http://www.sfn.org/index.cfm?pagename=whatIsNeuroscience>, date accessed 17 August 2010.
56. Ibid.
57. Columbia University 'History of Neuroscience'.
58. Ibid.
59. 'What Is Neuroscience?' Society for Neuroscience Website.
60. C. Dackis and C. O'Brien (2005), 'Neurobiology of Addiction: Treatment and Public Policy Ramifications', *Nature*, November, 1436.
61. 'Principles of Drug Addiction Treatment: A Research Based Guide', National Institute on Drug Abuse Website, <http://www.nida.nih.gov/podat/faqs.html#faq2>, date accessed 17 August 2010.
62. 'Neural Engineering', Weldon School of Biomedical Engineering at Purdue University Website, <https://engineering.purdue.edu/BME/Research/NE>, date accessed 17 August 2010.
63. 'Neural Engineering', University of Florida College of Engineering Website, <http://www.bme.ufl.edu>, date accessed 17 August 2010.
64. K.W. Horch and G.S. Dhillon (eds) (2004), 'Neuroprosthetics: Theory and Practice', *Series on Bioengineering and Biomedical Engineering*, Vol. 2, February, <http://www.worldscibooks.com/engineering/4987.html>, date accessed 17 August 2010.
65. Siao (2007), 'Neuroprosthetics: Restoring Function in the Bionic Human', Harvard Science Review, Spring, <http://www.hcs.harvard.edu/~hsr/pdf-sspring2007/SiaoGE.pdf>, date accessed 5 September 2010, p. 46.
66. S.L. Nasr (2008), 'How Brain Mapping Works', HowStuffWorks Website, <http://health.howstuffworks.com/brain-mapping.htm>, date accessed 17 August 2010.
67. M. Brain (2007), 'How Uploading Works', *Journal of Geoethical Nanotechnology*, Vol. 1, No. 2, Spring, <http://ieet.org/index.php/IEET/more/brain20070409/>, date accessed 17 August 2010.
68. Ibid.
69. Ibid.

70. Ibid.
71. 'Mind Transfer', EconomicExpert Website, <http://www.economicexpert.com/a/Mind:transfer.htm>, date accessed 17 August 2010.

14 The Geopolitics of Human Enhancement: Applying the 'Multi-Sum Security Principle'

1. Cf. N.R.F. Al-Rodhan (2007), *The Five Dimensions of Global Security: Proposal for a Multi-sum Security Principle* (Berlin: LIT).
2. Ibid., p. 16.
3. 'New Dimensions of Human Security', Human Development Report Office Website, <http://hdr.undp.org/en/reports/global/hdr1994/>, date accessed 20 August 2010; United Nations Development Programme (UNDP) (1994), *Human Development Report 1994: New Dimensions of Human Security* (New York: Oxford University Press).
4. UNDP (2005), *The Human Security Report 2005: War and Peace in the 21st Century* (New York: Oxford University Press).
5. Ibid.
6. 'What Is Environmental Security?', Institute for Environmental Security Website, http://www.envirosecurity.org/activities/What_is_Environmental_Security.pdf, date accessed 17 August 2010, p. 1.
7. P. Collier (2004), 'Development and Conflict', Centre for the Study of African Economies, Department of Economics, Oxford University, 1 October, <http://www.un.org/esa/documents/Development.and.Conflict2.pdf>, date accessed 17 August 2010, p. 3.
8. Al-Rodhan (2007), *The Five Dimensions of Global Security: Proposal for a Multi-sum Security Principle*, p. 73.
9. Ibid.
10. N.R.F. Al-Rodhan (2009), 'Multi-sum Security: Five Distinct Dimensions', International Relations and Security Network (ISN) Website, <http://www.isn.ethz.ch/isn/Current-Affairs/Special-Reports/Safeguarding-Security-in-Turbulent-Times/Overview>, date accessed 17 August 2010.
11. Al-Rodhan (2007), *The Five Dimensions of Global Security: Proposal for a Multi-sum Security Principle*, p. 79.
12. Al-Rodhan (2009)'Multi-sum Security: Five Distinct Dimensions'.
13. N. Bostrom (2005), 'In Defense of Posthuman Dignity', *Bioethics*, Vol. 19, No. 3, 202–214.
14. J. Hughes (2006), 'Human Enhancement and the Emergent Technopolitics of the 21st Century', Institute for Ethics and Emerging Technologies (IEET) Website, 19 May, <http://ieet.org/index.php/IEET/more/hughes20060519/>, date accessed 17 August 2010.
15. Ibid.
16. Ibid.
17. Bostrom (2005), 'In Defense of Posthuman Dignity', pp. 202–214.
18. 'Human Cloning and Human Dignity: An Ethical Inquiry' (2002), *Atlantic Monthly*, Vol. 290, No. 3, 42.
19. N. Bostrom (2010), 'Transhumanist FAQ', Humanity+ Website, <http://humanityplus.org/learn/transhumanist-faq/>, accessed 29 July 2010.

20. I.A. Colquhoun (2008), 'Life Expectancy in Prehistory: How Long Did Our Prehistoric Ancestors Live?', Suite101 Website, 24 October, http://archaeology.suite101.com/article.cfm/prehistoric_population, date accessed 17 August 2010.
21. World Health Organisation (WHO) 'Global Life Expectancy Reaches New Heights but 21 Million Face Premature Death This Year, Warns WHO', http://www.who.int/whr/1998/media_centre/press_release/en/index.html, date accessed 17 August 2010.
22. R.G. Lipsey, K.I. Carlaw, and C.T. Bekar (2005), *Economic Transformations: General Purpose Technologies and Long-Term Economic Growth* (Oxford: Oxford University Press), p. 213.
23. Bostrom, 'Transhumanist FAQ'.
24. Ibid.
25. M. More (1994), 'On Becoming Posthuman', Max More Website, <http://www.maxmore.com/becoming.htm>, date accessed 17 August 2010.
26. M. Shindikar, S. Jadhav, R. Karpe, M. Lale, P. Tetali and V.R. Gunale, 'Quantification Studies on the Accumulation of Non-Biodegradable Solid Waste Material in the Mangroves of Thane Creek', University of Pune Website, <http://wgbis.ces.iisc.ernet.in/energy/water/proceed/section4/paper1/section4paper1.htm>, date accessed 18 August 2010.
27. N. Shachtman (2007), 'Be More Than You Can Be', *Wired*, Issue 15, 3 March, <http://www.wired.com/wired/archive/15.03/bemore.html>, date accessed 17 August 2010.
28. Ibid.
29. N. Shachtman (2008), 'Top Pentagon Scientists Fear Brain-Modified Foes', *Wired*, 9 June, <http://blog.wired.com/defense/2008/06/jason-warns-of.html>, date accessed 17 August 2010.
30. Ibid.
31. W. Evans (2007), 'Singularity Warfare: A Bibliometric Survey of Militarized Transhumanism', *Journal of Evolution and Technology*, Vol. 16, No. 1, 2.
32. Ibid.
33. The President's Council on Bioethics (2003), *Beyond Therapy: Biotechnology and the Pursuit of Happiness* (Washington, D.C.).
34. Ibid.
35. P.W. Singer (2009), *Wired for War: The Robotics Revolution and Conflict in the 21st Century* (New York: Penguin Books), pp. 416–417.
36. T. Kirkwood (2008), 'Changing Expectations of Life' in L. Zonneveld, H. Dijkstra and D. Ringoir (eds) *Reshaping the Human Condition: Exploring Human Enhancement* (The Hague: Rathenau Institute), p. 98.
37. Ibid., p. 97.

15 Criteria for a Regulatory Framework of Human Enhancement

1. United National General Assembly (1948), *Universal Declaration of Human Rights*, 217 A (III), 10 December, <http://daccess-dds-ny.un.org/doc/RESOLUTION/GEN/NR0/043/88/IMG/NR004388.pdf?OpenElement>, date accessed 20 August 2010.

2. N.R.F. Al-Rodhan (2009), *Sustainable History and the Dignity of Man: A Philosophy of History and Civilisational Triumph* (Berlin: LIT), p. 180.
3. R. Bailey (2006), 'Human Rights and Human Enhancement: Is Genetic Modification of People Moral?', *Reason Online*, 29 May, <http://www.reason.com/news/show/117339.html>, date accessed 18 August 2010.
4. Ibid.
5. M. Brockman (2009), 'A Limited View of the Future', *Nature*, 459.7246, 28 May, 511.
6. The White House (2009), 'Executive Order 13521: Establishing the Presidential Commission for the Study of Bioethical Issues, November 24, Bioethics.gov Website, <http://www.bioethics.gov/documents/Executive-Order-Establishing-the-Bioethics-Commission-11.24.09.pdf>, date accessed 17 August 2010.
7. P. Shanks (2010), 'President Obama's Bioethics Commission', *Biopolitical Times*, Center for Genetics and Society Website, 13 April, <http://www.biopoliticaltimes.org/article.php?id=5154>, date accessed 17 August 2010.
8. Bioethics.gov (2010), 'The Presidential Commission for the Study of Bioethical Issues', <http://www.bioethics.gov/>, date accessed 30 July 2010.
9. M. Smits (2009), *STOA Workshop in the European Parliament: A European Approach to Human Enhancement* (Den Haag: Rathenau Institute).
10. Ibid.
11. Ibid.
12. The President's Council on Bioethics (2003), *Beyond Therapy: Biotechnology and the Pursuit of Happiness* (Washington, D.C.).
13. The European Group on Ethics in Science and New Technologies (EGE) (2007), 'The European Group on Ethics in Science and New Technologies Adopted on 17 January 2007 Opinion No. 21 on the Ethical Aspects of Nanomedicine and Presented It Today to President Barroso', 24 January, http://ec.europa.eu/european_group_ethics/activities/docs/press_release_op_nano_en.pdf, date accessed 17 August 2010.
14. F. Allhoff, P. Lin, and J. Steinberg (2009), 'Ethics of Human Enhancement: An Executive Summary', December, *Science and Engineering Ethics*, Vol. 16, No. 2, 3.
15. M. A. Rorty (2003), 'The Future of Human Nature', *Notre Dame Philosophical Reviews*, 2 December, <http://ndpr.nd.edu/review.cfm?id=1291>, date accessed 30 July 2010.
16. Cf. Allhoff et al. (2009), 'Ethics of Human Enhancement: An Executive Summary'; P. Lin and F. Allhoff (2008) 'Against Unrestricted Human Enhancement', *Journal of Evolution & Technology*, Vol. 18, No. 1, 35–41.
17. Ibid., p. 185.
18. Ibid., p. 210.
19. Ibid., pp. 187–191.
20. G. Dvorsky and J. Hughes (2008), 'Postgenderism: Beyond the Gender Binary', Institute for Ethics and Emerging Strategic Technologies (Hartford, CT: IEET), <http://ieet.org/archive/IEET-03-PostGender.pdf>, date accessed 18 August 2010, p. 2.
21. Ibid.
22. Cf. Smits (2009), *STOA Workshop in the European Parliament: A European Approach to Human Enhancement*.

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