31. *Ibid.*
32. *Japan Weekly Mail*, 8 June 1889.
33. 'The Grand Hotel caters to First-Class Travel and is the best known hotel in the East … Wines and Cuisine (French Chef) the best the market affords. The Hotel Band plays each evening'. Advertisement, Murray's *Handbook to Japan* (1907). Kipling's view was more jaundiced: 'At the Grand … they don't always live up to their grandeur; unlimited electric bells, but no one in particular to answer 'em'. (Cortazzi, 1988, 129). Christopher Dresser also stayed there, and was surprised to find Crosse and Blackwell's potted meats, and Keiller's Dundee marmalade', on the table. (Dresser, 1882, 3).
34. *Japan Weekly Mail*, 29 June 1889.
35. See also Asiatic Society of Japan *Transactions* XIX 1891.
36. See Cortazzi's 'The Japan Society: A Hundred Year History', in Cortazzi & Daniels, Eds. *Britain and Japan 1859–1991: Themes and Personalities* (1991) 1–53. Also *The Japan Society: A History*. Hugh Cortazzi, edited Anne Kaneko, Japan Society 2001.
37. Japan Society *Transactions I* (1892–3) 213.
38. Japan Society *Transactions IV* (1898) 252.
39. Hayashi (1851–1906) was in Paris to organize the Japanese exhibit at the 1878 Exposition Universelle, and stayed on to become an influential dealer in Japanese art.
40. *Artistic Japan*, vi, 1891. With illustrations collected by S. Bing. *Le Japon Artistique*, published by Bing, was published for three years, 1888–91, in French, German and in English by Sampson Low, Marston & Company, London 1891.
41. Redesdale (Algernon Freeman-Mitford or A.B.Mitford) had been a diplomat in Japan. See Hugh Cortazzi, ed., *Mitford's Japan*, London 1985.
42. Memoir of George T. Ensworth, employed by Liberty's in 1878, one of a staff of twelve (*Liberty Lamp*, December 1925, 9).
43. *Cabinet Maker* V, 1885, 14, 181–3
44. *Liberty Lamp* VI, 4, 1925.
45. Dark and Grey, 1923, pages 97–101.
46. Thorstein Veblen (1857–1929) *The Theory of the Leisure Class*, 1899, chapter iv.
47. *Cabinet Maker* XII (1891) 120–131.

Chapter 15 IAN RUXTON *Professor W. E. Ayrton, 1847–1908: the 'Never-resting, Keen-eyed Chief'*

1. Quoted in Olive Checkland, 'Henry Dyer of the Imperial College of Engineering in Tokyo, and afterwards, in Glasgow' (in *Britain and Japan: Biographical Portraits*, Volume 3, Chapter 11, ed. J. E. Hoare, Japan Library for the Japan Society, 1999). Also in the same volume quoted by Neil Pedlar in 'James Alfred Ewing and his Circle of Pioneering Physicists in Meiji Tokyo'

(Chapter 8) and previously in O. Checkland, *Britain's Encounters with Meiji Japan* (Basingstoke, Macmillan, 1989) p. 85.

2. See Gooday & Low, 1998, footnote 39, p. 116: 'Some of Perry's obituaries of Ayrton ... elided the early [ill-equipped] laboratory of 1873 with that opened in 1877.' (But why would Perry have done this – to boost his old friend and colleague perhaps? Or was a failing memory to blame?)

3. See Graeme Gooday's entry for Perry in the forthcoming *New Dictionary of National Biography* (henceforth *New DNB*) from which the following is extracted:

John Perry (1850–1920), F.R.S., engineer and educator, was born on 14 Feb. 1850 at Garvagh, Ulster, the second son of Samuel Perry and a Scottish-born wife. He graduated B. Eng. with first class honours from Queens College, Belfast in 1870. He first taught at Clifton College, Bristol, from January 1871 where he wrote *An Elementary Treatise on Steam* and established the first physics laboratory and the second mechanics workshop in an English school. In 1874 he was Thomson's assistant in Glasgow for one year, and was recommended to Tokyo where he commenced a three-year contract as professor in civil engineering at the ICE from 8 September 1875.

He lectured on steam power, mechanical structures and hydrodynamics to Japanese student engineers while researching with Ayrton. He returned to London in 1879, and in 1882 was appointed to the chair of Mechanical Engineering at Finsbury Technical College where he was reunited with Ayrton until 1889. From 1896 to 1913 he was Professor of Mathematics and Mechanics at the Royal College of Science and School of Mines in London (part of Imperial College from 1907). He enjoyed a vigorous social life, was member of the Athenaeum Club and 'an affably disputatious man ... remembered fondly by both allies and one-time opponents.' Died Notting Hill, 4 August 1920.

4. Takahashi, 1991, p.1.

5. Robert Rosenberg, 'American physics and the origins of electrical engineering', *Physics Today*, October 1983, pp. 48–54) p. 48.

6. See Silvana de Maio, 'Engineering Education in Japan after the Iwakura Mission', Chapter 9 of *The Iwakura Mission in America & Europe* (ed. Ian Nish, Japan Library, 1998) pp. 162–9. Ayrton is described as a professor of 'natural philosphy' (p. 166). This is the older term for what we now call Physics. Strictly speaking, Ayrton was Professor of Natural Philosophy and Telegraphy (see Gooday, 1991, pp. 85–6).

7. From the website of the Illuminating Engineering Institute of Japan (IEI-J) at http: //wwwsoc.nacsis.ac.jp/ieij/englsh/history.html

See also *Britain & Japan: Biographical Portraits*, Vol. 3 p. 92. 'In Japan, at a banquet given at the Hall of the College of Engineering on the evening of 25 March 1878 to celebrate the opening of the Central Telegraphic Communication Office, three of Ayrton's students lit a large arc-light to illuminate proceedings. Unfortunately, after the dark banqueting hall was lit up

... for a few seconds, the arc broke with a hissing sound and darkness ensued again.' (J. Perry, *ibid.*).

8. Founded in 1882 by George Smith. (Oxford University Press, ed. Sidney Lee)

9. Acton Smee Ayrton (his uncle), Edmund Ayrton and William Ayrton. For more about 'the dark angel of retrenchment' A. S. Ayrton (1816–1886) MP 1857–84, see Roy M. Macleod, 'The Ayrton Incident: A commentary on the relations of science and government in England, 1870–1873', in *Science and Values: patterns of tradition and change* (ed. A. Thackray and E. Mendelsohn; Humanities Press, 1974) pp. 45–78.

10. Ernest Satow's Nonconformist father was also keen on strict home schooling, though more oriented towards religion. (See *The Family Chronicle of the English Satows* by E. Satow, privately printed, Oxford, 1925).

11. University College School was founded in Gower Street in 1828 as part of University College, London and moved to Hampstead in 1907. A public school with day pupils only, it had a particularly strong teaching record in mathematics, with many pupils going on to Cambridge. One of its most distinguished former pupils was the Cambridge mathematician Kikuchi Dairoku, later President of Tokyo University (1898–1901) and Minister of Education in Japan (1901–3). He attended the opening ceremony on the new Hampstead site in 1907. (See *Hatenkō: 'Meiji Ryūgakusei' Retsuden* by Koyama Noboru, Kodansha Sensho Metier, 1999.)

12. See Graeme Gooday's entry for Ayrton in the forthcoming *New DNB*.

13. See Takahashi (1991) pp. 29–30. See also Gooday & Low, 1998 pp.114–5: Matilda Ayrton was 'a refugee from Edinburgh University's expulsion of women medical students, forced to qualify at the Sorbonne and retrain as a midwife in London ... Matilda exercised her medical skills in teaching European midwifery techniques ... to Japanese women, but she also took the opportunity to study the physical anthropology of the Japanese. This work would become the basis of her MD thesis at the Sorbonne.' She also wrote a storybook, *Child Life in Japan* (London, 1879). She left Japan with the couple's daughter Edith in early 1877, one year before Ayrton. (She has a separate entry in the *DNB*.)

14. See O. Checkland, '"Working at their Profession": Japanese Engineers in Britain before 1914', Chapter 4, p.45, *Britain and Japan: Biographical Portraits*, Vol. 1, ed. Ian Nish (1994). But Yamao had already submitted a proposal to open a technical college in the name of the Public Works ministry to the *Dajōkan*, the Grand Council of State, in April 1872. (p. 127, *A-nesuto Satō no Shūhen*, by Shozo Nagaoka, published by Lieb Co. Ltd., Tokyo, 2000)

15. For a list see Takahashi (1991), p. 19. He lists seven papers by Ayrton as sole author and 14 by Ayrton jointly with Perry.

16. On Milne, (1850–1913; resident in Japan 1876–1895) see Chapter 3, pp. 136–141 of *Westerners in the Modernization of Japan* (henceforth *Westerners*) by Teijiro Muramatsu, professor emeritus of Tokyo University and sometime

director of the Meiji Mura Museum at Inuyama city near Nagoya (Originally *Nihon no Kindaika to o-Yatoi Gaikokujin*, translated by Lynne E. Riggs and Manabu Takechi, English and Japanese versions both published by Hitachi Ltd., Tokyo in 1995). The same volume contains brief portraits of Dyer and Ayrton (Chapter 5, pp. 194–206 in the English version) and some good illustrations of the ICE building and workshops, arc lamps and a generator used with arc lamps.

See also Gooday & Low, pp. 121–127. For his first three years in Japan the man later known as 'Earthquake Milne' (sometimes 'Earthquake Jonny'), who had been educated at King's College, London and trained as a mining engineer at the Royal School of Mines in the 1860s before gaining practical experience in a career path resembling Ayrton's, concentrated on teaching mining, architecture, chemistry and crystallography at the ICE. It was only after a severe earthquake struck Yokohama on 22 February 1880 that Milne with two colleagues (Thomas Gray and W. S. Chaplin) and some interested Japanese founded the Seismological Society of Japan on 16 April 1880 (disbanded 1892).

In a letter from Tangier to his friend F. V. Dickins dated 8 March 1894 Ernest Satow wrote that he agreed with Dickins that Milne was the best man to be *The Times* correspondent in Japan. 'He is independent, has plenty of brains and can write well enough' (See *The Diaries and Letters of Sir Ernest Mason Satow (1843–1929): A Scholar-Diplomat in East Asia*, ed. I. Ruxton, Edwin Mellen Press, Lampeter, Wales, 1998, p. 185). Satow was clearly unaware that Milne was soon to return to England with his Japanese wife Tone, the daughter of a Buddhist temple priest from Hakodate. (Tone returned to Japan in 1919, six years after Milne's death. She passed away in Hakodate in 1925.)

17. Japanese 'magic mirrors' revealed images embossed on their metallic rear when viewed at specific angles. Ayrton interpreted this phenomenon as resulting from Japanese metalworking techniques. See W. E. Ayrton, 'The Mirror of Japan and Its Magic Quality,' *Nature*, 1879, 19: 539–542, quoted in Gooday & Low, 1998, p. 118.
18. Gooday & Low, 1998, p. 118.
19. Inaugural lecture at Cowper-street Schools in connection with 'The City Guilds Institute' from *The Electrician*, Volume 3, November 8 and 15, 1879.
20. See the Engineering Supplement of the London *Times*, 8 January 1908. 'Among Thomson's discoveries was the fact that it was good for students to do laboratory work.'
21. The research of the lowly and modestly remunerated *joshu* (research assistants), who also have a teaching/tutorial load and the prospect of promotion to lecturer grade and above, is generally treated as the property of the whole laboratory which operates as a kind of hierarchical family, with the professor whose name the laboratory bears in a paternal role. This little-

studied structure might interest trained anthropologists as an example of group interaction. (Note: As a rule the research of all subordinates is acknowledged in some way by the professor and associate professors though of course there are occasionally unscrupulous exceptions !)
22. W. E. Ayrton and J. Perry, 'Determination of the Acceleration of Gravity for Tokio, Japan,' *Proceedings of the Physical Society of London*, 1880, 3: 265–76, on p. 276. Quoted in Gooday & Low, 1998, p. 121.
23. Ayrton in *Popular Science Monthly*, 1908, p. 268.
24. See Takahashi (1991) p. 15. All 21 theses (1879–84) were in English, presumably because Ayrton could not read Japanese. Shida's thesis was on the history of electricity and telegraphy. Fujioka wrote on galvanometers; Nakano on telegraphic communication; and Asano on the speed of signalling.
25. See Checkland, (ibid.) vol. 1, p. 53. Six Japanese students of Kelvin (Thomson) sent him a birthday greetings telegram in 1904, which is in the Kelvin papers, University Library, Cambridge, NB 168, 25 June 1904.
26. *Westerners*, pp. 205–6.
27. *Westerners*, p. 206.
28. *Meiji Bunka Hasshō Kinenshi*, 1924, pp. 40–1.
29. From Graeme Gooday's entry for Perry in the forthcoming *New DNB*.
30. 'Prof. W. E. Ayrton, F.R.S', Electrical World Portraits, no XIX, *The Electrical World: a weekly review of current progress in electricity and its practical applications*, Vol. XVI, no. 25, p. 432.
31. Gooday & Low, 1998, 13: 118–9.
32. Ayrton had three scientific papers published in the Transactions of the Asiatic Society of Japan, first series, volume 5: *The Importance of a General System of Simultaneous Observations of Atmospheric Electricity; The Specific Inductive Capacity of Gases; A Neglected Principle that may be Employed in Earthquake Measurement.*
33. Gooday, July 1997, entry for Ayrton in the forthcoming *New DNB*.

Chapter 16 OLIVE CHECKLAND *W. K. Burton, 1856–99: 'Engineer Extraordinaire'*

* This essay is a gift for Tsurumi Sachiko, W.K. Burton's great granddaughter in Kyoto.
1. It was Max Inanaga, formerly of Glasgow, Scotland, now of Fujisawa, Japan, who first introduced me to Tsurumi Sachiko and W. K. Burton. With thanks for all his help.
2. The University of Glasgow *Senatus acedemicus*, deeply conservative, resisted the imposition of Engineering as a University subject. Certificate of Engineering (CE) was a grudging acknowledgement.
3. For Henry Dyer see http;//www.cs.strath.ac.uk/-rbh/hd/index.html.
4. The degree of Bachelor of Science, (B.Sc) was introduced in the University of Glasgow in 1872. Henry Dyer and Thomas Urquhart were the first to hold this distinction.