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Professor W. E. Ayrton, 1847–1908: the 'Never-resting, Keen-eyed chief'

IAN RUXTON

Professor W.E. Ayrton

> When I arrived in Japan in 1875, I found a marvellous laboratory, such as the world has not seen elsewhere. At Glasgow, at Cambridge and Berlin, there were three great personalities; the laboratories of [Lord] Kelvin, and of [James Clerk] Maxwell, and of [Hermann von] Helmholtz, however, were not to be mentioned in comparison with [that of] Ayrton. Fine buildings, splendid apparatus, well-chosen, a never-resting-keen-eyed chief of great originality: these are what I found in Japan.
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> J. Perry, untitled obituary ['Death of Professor Ayrton'], *Journal of the Institution of Electrical Engineers*, 1909, Vol. 42, 3–6 on pp. 3–4; and also in *Central*, Vol. 7, (1910), p. 708.[1]

AS THE ABOVE frequently quoted (but apparently somewhat misleading) observation[2] by his great research associate and Ulsterman colleague John Perry (1850–1920)[3] suggests, William Edward Ayrton was a British physicist and electrical engineer of

considerable verve and distinction. He was the first Professor of Electrical Engineering in Japan – and thus in the world[4] – at the ICE (The Imperial College of Engineering, from 1886 the Faculty of Engineering of the Tokyo Imperial University), and thereafter the first in Britain.

Born the son of a London-based lawyer, Ayrton studied at University College (part of London University) after his eminent Japan *senpai* (Sir) Ernest Satow, and was also taught in Glasgow by the above-mentioned Lord Kelvin of Largs (1824–1907, called Sir William Thomson 1866–92) who 'virtually single-handedly engineered the cables, galvanometers, and other electrical components for the first successful telegraph cable beneath the Atlantic Ocean in 1866.'[5] After working for the Indian Telegraph Co. Ayrton was in Japan from 1873 to 1879 at the ICE (the *Kōgakuryō* founded in August 1873, from 1877 known as the *Kōbu Daigakkō*) lecturing on Physics and Electrical Engineering (especially telegraphy).[6]

On 25 March 1878 the first carbon arc lamps in Japan were lit at the ICE under Ayrton's direction to celebrate the opening of the Tokyo Central Telegraph Station, and thereafter 25 March became 'Electricity (Commemoration) Day' in Japan, a clear measure of the very high regard in which his name was and is held up to the present day.[7] This paper focuses on Ayrton's Japan experience as a crucial formative stage in his development as a major pioneer in the study of, and teaching about, Electricity.

EARLY LIFE AND EDUCATION

In the 1901–11 Supplement to the *Dictionary of National Biography*[8] W. E. Ayrton was deemed to merit a substantial entry (pp. 72–75) by one 'P. J. H.' (Philip James Hartog, a family friend). He was born in London on 14 September 1847, the son of an able barrister Edward Nugent Ayrton, and had other eminent relatives.[9] 'Ayrton's father, a distinguished linguist ... tried, without much success, to enforce on his son the practice of speaking different languages (including Hebrew) on each day of the week.'[10]

Ayrton proceeded from University College School (1859–64)[11] to University College (founded 1826) in 1864, where in July of 1865 and the following year he won the Andrews mathematical scholarship. In 1867 he passed the first BA exam of the University of London with a second-class in mathematics and also passed the entrance exam for the Indian telegraph service. He was first sent to Glasgow to study electricity under Thomson, of which Hartog says he gave 'a vivid account' in *The Times* of 8 January 1908.

In 1868, after practical work at the Telegraph Construction and

Maintenance Company, Ayrton went to Bombay where, from 1 September, he was appointed assistant-superintendent (fourth grade). He received rapid promotion as a result of work with the Electrical Superintendent on 'developing a speedy method for locating the prevalent faults in the overland telegraph lines.'[12] This made it unnecessary to go to the trouble of laying costly submarine cables around the coast of India. On 21 December 1871, in London, Ayrton married a cousin, a practice apparently not uncommon in the Victorian era with its large families. She was Matilda Chaplin (1846–83), and was destined to teach midwifery to Japanese women.[13] On a second leave from India in 1872 Ayrton was elected a member of the Society of Telegraph Engineers (the STE, from 1888 the Institution of Electrical Engineers) and assisted Thomson in testing a new transatlantic cable.

Ayrton, whose notepaper (according to Perry) was fittingly embossed with his motto 'Energy', was appointed to a five-year contract as Professor of Physics and Telegraphy at the ICE through the patronage of Thomson and W. J. M. Rankine, both of Glasgow University. He arrived in Japan with his wife in September 1873, a rising star in a new academic field, aged just 26. But the Scottish principal of the ICE Henry Dyer (1848–1918), who had arrived in June 1873 after appointment the previous year, was almost a year younger. The pioneering new college, suggested by Rankine to Itō Hirobumi during the Iwakura Mission's visit to Scotland in October 1872,[14] and the creation of Dyer and then Vice Minister of Public Works Yamao Yōzō (a member, with Itō, of the Chōshū Five who had himself worked and studied in Glasgow, 1866–68) would clearly lack for nothing in terms of youthful dynamism and energy!

AYRTON IN JAPAN

The ground breaking and key research, which Ayrton did in Japan, was mainly conducted with John Perry, who at the age of 25 took up the Chair of Mechanical Engineering at the ICE in 1875. Together they published many papers in British and Japanese journals between 1877 and 1880.[15] Topics were wide-ranging and included earthquakes (i.e. seismology, in which John Milne,[16] professor of mining and geology at the ICE from March 1876, was to specialise from 1880 onwards and ultimately make his name), and Japanese 'magic mirrors'.[17]

The main focus of Ayrton and Perry's research was, however, the exciting and still relatively unknown properties of the new energy source, electricity. They wrote on: 'telegraph tests, the ratio of electrostatic and electromagnetic units, electrolytic polarization, atmospheric electricity, the resistance of galvanometers and the electric arc, the viscosity of dielectrics, and the theory of voltaic action in the electric

cell [i.e. battery]'.[18] To a layman some of these words may be obscure, but that the research was cutting-edge in the Victorian age seems obvious.

The leading Japanese academic researcher on Ayrton is Dr Yūzō Takahashi of the Faculty of Engineering at Tokyo University of Agriculture and Technology. His seminal 1991 article '*Ayrton to sono shūhen*' (Ayrton and his circumstances) provides much useful and detailed material. He explains that the Telegraphy course at the ICE was the first independent course of electrical engineering in the world, and that Ayrton and this course were crucially important for the institutionalization (*seidoka*) of electrical engineering education worldwide. In other words, the ICE itself was one vast (and hugely successful) experiment!

What did Ayrton think of Japan and its seemingly sudden passion for Western technology? Perhaps the clearest answer is the one he gave shortly after his return to England, near the end of his lengthy inaugural lecture at the new City Guilds Institute (funded by the City of London), of which he was the first professor, on 1 November 1879. In the address, entitled 'The Improvements Science can effect in our Trades and in the condition of our workmen', he spoke in glowing terms of his admiration for the country:

> And yet another nation, small and apart from the world, a people like the Swiss, dwelling in a mountainous country, and like them too dearly loving their pine-clad hills – *the Japanese – have set us an example that our ambition should lead us to emulate*. [My italics, not in original text.] Much have we heard of Japanese art, much have we seen of Japanese lacquer, Japanese fans, but only a few of us are acquainted with the Japanese modern technical education.

Ayrton went on to describe the Meiji Restoration, and the drive to catch up with the West which had created the new ICE:

> Ten years ago a feudal country, tyranised [*sic*] over by barons with power of life and death in their hands, distracted by the conflict between the rightful sovereign and their hereditary military usurper, that nation whom we regarded as barbarous, that nation of whose manners we were comparatively ignorant, whose very modes of thought are so different from our own that we can hardly be said to understand them now, that people had but three years emerged from a state of almost slavery, when up grew, in its very midst, *a technical college, with its staff of carefully-chosen English professors, with its laboratories, its class-rooms, museums, libraries, and workshops, costing Japan, a poor country be it remembered, at least twelve thousand pounds a year to support, and many many thousands to build*. [My italics]

The Japanese egalitarian and meritocratic pursuit of academic excellence clearly appealed to Ayrton as 'an example to emulate' in his new post, for he continued and concluded:

> And to enter and study at this college, neither cash, nor position, nor any qualification is necessary but ability and desire to study; so that working at the lathe, or conning over their books in the class-room, or experimenting in the laboratory, may now be seen, side by side, the young noble and the young artisan.[19]

AYRTON AND PERRY'S JAPANESE STUDENTS

In imitation of Thomson's practice, of which Ayrton later wrote enthusiastically,[20] Ayrton and Perry made use of their Japanese students as 'research assistants' in their laboratories. This turned the whole educational process into a highly positive and mutually beneficial exchange: the bright and knowledge-hungry young students, fiercely patriotic and determined to acquire engineering knowledge for Japan, learned the practical skills of experimentation by doing, and the canny professors used the results of these experiments in their research papers. The trust which Ayrton, unlike other European colleagues, was ready to place in his students as independent researchers paid handsome dividends.

This convenient two-way symbiotic mechanism (which, incidentally, continues to flourish in little-modified form in many Japanese technological universities and faculties to this day[21]) was specifically and properly acknowledged by Ayrton and Perry. For example, in a paper on the gravitational acceleration for Tokyo, published three years later in England, they wrote:

> We have to thank several of our late [i.e. former] students, and especially Messrs. Honda, Kikkawa, A. Kasai, J. Nakabara, and H. Nobechi for assistance rendered … And it may be here mentioned that this investigation, like the many others we have been enabled to carry out during the last few years, has resulted from the plan we have followed of teaching the laboratory students not … to repeat well-known experiments, but to endeavour … to advance, in some small degree at any rate, the bounds of existing knowledge.[22]

The authors went on to claim, no doubt with some justification, that this approach of spurning the received wisdom of the few text books available and harnessing the curiosity of the young created 'an enthusiasm in experimental work otherwise unreproducible'.

Ayrton had clear ideas about good and bad teaching. In his 1908

Times tribute to Thomson, who died on 17 December 1907 ('Kelvin in the Sixties'), he wrote with scorn of 'the stereotyped teacher … the talking text-book, who instructs his students what it will pay them to read, payment being made in examination marks …' and with contrasting reverence of great teachers such as Thomson, 'the inspired teacher, he who soars above scientific fashion, whose doxy becomes scientific orthodoxy, who produces thinkers, not mere successful examinees'. Judged by these standards, Ayrton was indeed a worthy successor to his distinguished Scottish mentor, whom he recognized as the inspiration of his professional life.[23]

While at the ICE Ayrton taught about twenty students,[24] but supervised only one through his thesis to graduation. Like Ayrton before him, Shida Rinzaburo (1856–92) was in 1879 ordered to study at Glasgow (by the Japanese government) where as the first of several Japanese pupils of Thomson[25] he became an outstanding student. On his return to Japan in 1883 Shida became the first Japanese to teach in the telegraphy department at his alma mater, and in the same year he founded the Institute of Electrical Engineers of Japan. Three others who graduated in 1881, Fujioka Ichisuke (1857–1918), Nakano Hatsune and Asano Osuke, stayed on to become Shida's research and teaching assistants, in the pattern established by Ayrton and Perry which persists today.[26]

In their subsequent careers Nakano was a professor at the ICE, while in 1886 Fujioka became chief engineer at Tokyo Electric Lighting, Japan's first electricity supply company (established 1883) and made significant contributions in electric-powered rail transport and incandescent light production.

Dr Asano was the first director of the government-funded Electric Experimental Station (the *Denki Shiken-jo*, founded 1891), which led research on the wireless telegraph. He 'played a leading role as a technical adviser and senior researcher on telegraphy, telephone communication and electricity supply, as well as improving government administration in these fields'.[27]

In 1924 Asano wrote a brief memorial tribute to Ayrton in which he mentioned that he routinely worked through public holidays and weekends, and even researched on the morning of his final day in Japan before catching the boat at 3 pm with barely time to spare, telegraphing the results back to London from Suez on the way home! On arrival in London Ayrton went directly to the Royal Society to give a lecture. Such was the passion of the man for his lifework.[28]

Ayrton also taught students sent by the government from the Telegraph Operators' Training School; many of these later made their mark in Japanese electrical engineering.

AYRTON IN ENGLAND

This portrait focuses on Ayrton in Japan and I cannot comment here in detail on Ayrton's illustrious career after Japan, which has been described elsewhere. He played a leading role in England in electrical engineering and technical education, becoming a Fellow of the Royal Society in 1881 and winning a Royal Medal, awarded by the Royal Society in 1901, in recognition of his achievements in physics and engineering. His time in Japan had certainly laid the foundations for his subsequent success and fame.

In 1882 Perry rejoined Ayrton at Finsbury Technical College where 'the reunited pair translated their unique Japanese experience of laboratory-based technical education into a rather more frugal English form'.[29] The renewed partnership lasted till 1889–90. After Matilda died of tuberculosis in July 1883, William (known as 'Will') Ayrton married Sarah 'Hertha' Marks – a Cambridge-educated mathematician – on 6 May 1885. They shared research interests, and in 1899 Ayrton, a public champion of womens' rights, helped Hertha to become the first woman to read a paper at the Institution of Electrical Engineers (IEE), now based in Savoy Place, central London, of which Ayrton himself was briefly President (1892–93). Continuing the Ayrton family's political traditions, their daughter Barbara Gould (née Ayrton) became a Labour MP in 1945.

CONCLUSION

William Edward Ayrton was a most industrious, dedicated and brilliant academic, who led and taught his Japanese students by his example rather than kindness. (The phrase 'live wire' seems peculiarly apt to describe him!) Bearded and handsome, he was enormously influential at the ICE despite his relatively short period of employment there, and effectively used it as a stepping-stone to international recognition, which he had certainly achieved by 1890 when *The Electrical World* commented:

> The name of Professor Ayrton is a familiar one in every corner of the world where electrical apparatus is used today, for by his long connection with the development of practical electricity and his valuable additions to the theoretical part of the science, he is singularly well known to practical men.[30]

Ayrton's Japanese employers clearly respected his obvious abilities as a researcher and teacher, even if they did not particularly appreciate his unrestrained frankness. When his contract expired in 1878 it was

not renewed, it has been suggested, because of his insistence that foreign supervision was necessary for the operation of the national telegraph system, and his 'tactlessly neo-colonialist conduct towards the officials of the Japanese telegraph service'.[31] This resembled his previous treatment of subordinates in India (1868–72), and perhaps also echoed the treatment of some of his students at the ICE.

In short, and in clear contrast to the diplomatic Dr Dyer and other colleagues, the electrifying Professor Ayrton was probably perceived as rather rude and arrogant, trading too heavily on his god-like (and self-assumed) reputation for omniscience. Yet Ayrton himself was probably not inclined to stay in Japan longer than the five years needed to make his name: although he admired Japan and was for a while treasurer of the Asiatic Society of Japan in Tokyo,[32] his self-investment in the country was not enough to make him desire permanent residence, and he followed Matilda and their daughter Edith home.

Nevertheless, the work Ayrton did in Japan was to serve both him and his students, to say nothing of the Japanese nation, in remarkably good stead in their respective future careers: it is the 'phenomenally energetic' and 'often fearlessly critical'[33] W. E. Ayrton who deserves the credit for first sowing the seed that subsequently blossomed in the field of Japanese electrical engineering, which in its modern corporate form (Sony, Toshiba, Sanyo et al.) has been envied and admired around the world.

PRINCIPAL SOURCES

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I am most grateful to Dr Gyōichi Nogami, Professor of Electrical Engineering at the Kyushu Institute of Technology (KIT, or *Kyūshū Kōgyō Daigaku*), for first suggesting W. E. Ayrton as a subject for a portrait in February 2001, and providing many materials in Japanese about him. Thanks are also due to Dr Graeme Gooday of the Division of History and Philosophy of Science, University of Leeds, Leeds LS2 9JT for much help with articles and advice, and to Ms Kazue Akagawa, librarian of KIT.