Where are the Women in Engineering? A century-old story

Lady Parsons

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Why talk now about the history of women in engineering? Isn't the arrival of the female engineer too recent to write a history of, we hear some say? In fact the story of women's involvement in engineering - not only as engineers per se - goes back a long way. To be precise on the 23rd June 1919, a group of seven women that included Lady Katharine Parsons and Lady Margaret Moir came together in London to create an organisation that was to be the first of its kind in the world: The Women's Engineering Society (WES). A century later, having been sustained by many talented and persevering women – not least its dynamic first Secretary Caroline Haslett - WES continues to promote and support women engineers, although its hundred years still seem remarkably little-known to the wider public.

Despite WES's vigorous early start, women remain woefully underrepresented in the British engineering profession, constituting only 12% of the workforce – one of the lowest participation rates in Europe. This anomaly is one of several reasons why WES and the Electrifying Women project (electrifyingwomen.org) supported by the Arts and Humanities Research Council, are working to promote greater awareness of the breadth and depth of women's historical role in engineering. Most distinctly, the Electrifying Women project highlights women's work in engineering before WES's founding and even before engineering opportunities arose for women in the First World War.

One of the challenges of finding women in engineering remains their apparent invisibility: few people on the high street will know the accomplishments of, for example, Hertha Ayrton, Verena Holmes, Margaret Partridge, Beatrice Shilling or Hilda Lyon. While the achievements of male engineers have been widely celebrated in statues and heroic biographies, such is not the case for those women. Even while the First World War saw many women employed to cover for engineers departing to the battlefront, most women were forced to relinquish such work under the terms of the 1919 Restoration of Pre-War Practices Act. While that exclusion has often left the impression that opportunities gained for women engineers during World War 1 were completely lost, it was nevertheless in fact important in triggering WES's founding in 1919.

Our Electrifying Women project highlights how we can find out about the women who were active in engineering whether or not they were members of WES. Patent records, census data, and archival papers can help to reveal the different roles that women had. A particularly revealing source is the WES journal, The Woman Engineer, initially edited by Haslett and published continually since 1919. One of the many fascinating revelations of this journal is that women's participation in engineering often came through kinship connections since there a numerous tales of fathers, uncles or brothers involved in engineering encouraged (respectively) their female relatives to take part, often in the context of a family business. Less common in the interwar era, but strikingly the case for five of WES's seven founders was the marital route into engineering via a spouse; indeed one of those WES founders, Lady Margaret Moir, memorably described herself an 'engineer-by- marriage'.

But for women entering engineering by either of these routes before the First World War, there were many barriers to surpass in securing recognition as an independently operating engineer. In fact the pre-eminent Victorian example of this is Hertha Ayrton (1854-1923). She was born Phoebe Sarah Marks to an impoverished Jewish-Polish migrant family and went on to study Mathematics at Cambridge University, before becoming an inventor and patent holder in her own right. Not only this, she was also a campaigner for the suffrage movement for women to gain the vote. Her first patent was for a line divider in 1884, but her most celebrated achievement was her research into electricals arc lighting. It was her superior expertise in this area that prompted her electrical engineering spouse, William Ayrton, to agree that this should be Hertha's solo area of expertise, avoiding spousal collaboration to pre-empt questions about who should be credited for her work. Her achievement in explaining

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the oxidation mechanism which caused the roaring and hissing of arc lights led to her being elected first female member of the Institution of Electrical Engineers in 1899 and won her the Royal Society's Hughes Medal in 1906 (the first woman to win such a medal). Her specially designed anti-gas fan was used in the trenches in World War One, 100,000 models being issued to the British army in France alone. An article in The Woman Engineer in 1923 said of Ayrton that she was 'the first member of the fair, but no longer frail sex, to distinguish herself in the engineering world'. Yet it also emphasised that, had it not been for the opportunities opened up by the First World War, Hertha Ayrton might have been the only (British) woman to secure

independent recognition.[1]

While Hertha Ayrton thus remains an exceptional example of a Victorian woman who succeeded in engineering practice, the 20th century saw more women pursue higher education opportunities that enabled them to enter technical professions. Among the generation of women with formal qualifications emerged were electrical engineer and businesswoman Margaret Partridge (1891-1967) who graduated with a Mathematics degree from Bedford College, London in 1914; aerodynamics engineer Hilda Lyon (1896-1946) who completed a Mathematics degree course at Cambridge in 1918, as well as securing an Masters qualification from MIT in the USA, while mechanical engineer Beatrice Shilling (1909-1990) received her BA in Electrical Engineering from the University of Manchester in 1932, and a Masters in Mechanical Engineering a year later. Others, such as Verena Holmes (1889-1964), took a less formal route and used evening classes to acquire a degree in engineering Holmes received a BSc in Engineering in 1922 from the Loughborough Technical College. She swiftly became skilled in marine and locomotive engineering, inventing and often patenting technologies as diverse as engine valves and medical support devices.

With these qualifications, these women were able to find their way into a variety of employment opportunities. Although Gertrude Entwisle (1892-1961) did not graduate from her degree in Physics from the University of Manchester, she was employed as an electrical engineer by British Westinghouse (later known as Metropolitan Vickers) and became the first woman to retire from a complete career in industry as a professional engineer, mostly spent designing electrical machinery, especially direct current motors and engine exciters. By remaining unmarried throughout her whole career, she avoided the widespread employers' marriage bar that hindered many women from continuing to work after marrying until the 1960s. One exception to this was protégé of Margaret Partridge, Beatrice Shilling, who even after marriage to an RAF pilot in 1938, worked continuously until her retirement in 1969, latterly in research work at the Royal Aircraft Establishment.

Partridge herself had been a significant trailblazer in electrical engineering during the interwar period, used her engineering knowledge to establish her own electrical supply company (M. Partridge and co.), which employed a large female workforce in installing and running power stations in the Southwest and East Anglia. Similarly, Holmes set up an engineering firm in 1946, which again predominantly employed women. As well-established independent engineers, Partridge and Holmes used their platforms as inclusive employers to encourage other women to pursue careers in engineering. Most notably Partridge encouraged Shilling, whom she had employed at her firm, to study engineering at university. Partridge further supported women's working life by campaigning alongside WES for the removal of the ban on women working at night, after Shilling had been found contravening these laws. Women in a supervisory role were exempted from the ban in 1934 following a major international debate that year concerning the special case of women with managerial responsibilities.

In fact, the support of other women, especially through WES networks, is a common thread in these women's stories. They managed to break down barriers by becoming some of the first female members of key engineering institutions. In 1924, Holmes was the first woman to become an associate member of the Institution of Mechanical Engineers. Entwisle joined the Institution of Electrical Engineers in 1916 as a student member and in 1920 became an associate member, the first woman at both these membership levels. All of these women were early members of WES, some were founding members and all served as WES presidents Holmes in 1931-32 (the first practising engineer in the role); Gertrude Entwisle in1942-43 and Margaret Partridge in 1944-45.

As working engineers, these women produced significant publications, patents and inventions. Holmes has 12 or more patents under her name for medical and safety devices, as well as internal combustion engine improvements. Lyon became the first woman to be awarded the R38 Memorial Prize by the Royal Aeronautical Society for her paper on the strength of transverse frames of rigid airships (1930). The 'Lyon Shape', which she devised, was incorporated into the American submarine USS Albacore. Shilling invented the R.A.E restriction (informally dubbed by RAF men as 'Miss Shilling's orifice), which solved a serious problem with fuel flow in the early versions of Merlin engines used in Spitfires in World War Two. Her device was successfully used until the introduction of the pressure carburettor to Spitfires in 1943.

To ensure that the legacy of these women lives on, the Women's Engineering Society has launched a centenary trail to identify their working and birth locations. In some cases, plaques have been put up to celebrate the women in the places they lived and worked. Beatrice Shilling even has a Wetherspoons pub named in her honour. Moreover, the Electrifying Women project has been supporting the WES centenary in a series of Wikithons in which members of the public can (learn to) create and edit Wikipedia pages focused for these women's work in engineering.

There are, however, many examples of women who participated in engineering but who were not necessarily qualified engineers. One factor which enabled British women to participate in engineering more than in other countries is that Britain has traditionally not formally required a professional qualification to participate, as has long been required in Germany and France. In fact the Electrifying Women project promotes a more inclusive awareness of engineering as a form of teamwork, looking not just at the women who identified individually as professional engineers. Thus we also highlight the work of early WES leaders Lady Katharine Parsons and Caroline Haslett who, after some direct experience of mechanical engineering, mostly campaigned for women's participation in engineering. Their stories as role-models show that women have a well-precedented place in engineering of all kinds.

Much research remains to be done to find out how many women in WES's first century actually took part in engineering. The extensive collection of Caroline Haslett papers and WES collections housed in the Archives of the Institution of Engineering and Technology look likely to reveal many more stories. There may even be archives yet to be discovered that would help extend this history.

So, we look to volunteers to help us find the missing stories of women engineers, using for example the marvellous resource that is the digitized version of the Woman Engineer available from 1919 onwards via the IET website at: www.theiet.org/publishing/library-archives/the-iet-archives/the-woman-engineer-journal

Anyone who has records of women engineers in their family, or who wants to volunteer to help our project is welcome to contact us on electrifyingwomen@gmail.com

1 Andrew Stewart, 'On Making the Best of It' *The Woman Engineer 1*(1923), pp. 284-286