Electrifying Women: Understanding the Long History of Women in Engineering

Women's Engineering Society visit to a power station, c.1938 Source: NAEST 092/07/01 Caroline Haslett papers, Institution of Engineering & Technology Archives

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@ElectrifyingWmn

#electrifyingwomen

Women's Engineering Society Centenary

- WES founded in the UK on June 23rd 1919
- The first women's engineering society in the world
- Why does Britain now have the lowest proportion in Europe (c.12%) of women in engineering?
- Can history help recruit more women to engineering?

WES Centenary Trail

2019 is the centenary of the Women's Engineering Society, founded with the intention of supporting women into employment and education in the varied fields of engineering. WES has had many notable members, yet the only member who features widely in the popular historical narrative is pilot Amy Johnson.

The WES Centenary Trail aims to redress this by creating an interactive online map recording and sharing the history of WES with a wider public, building an audience for local and women's history connected with WES from new and improved Wikipedia entries, based on research into the WES and other archives. The Wikipedia entries will be generated by volunteers, trained and engaged through Wikithons around the country and entries will be pulled through to populate the map with 200 pins to explore.

The project is sharing these new and improved histories through local events, displays, social media and a small PR programme.

HERITAGE FUND

Eminent Yorkshire(-born) female engineers in the 1920s/30s. All Presidents of W.E.S.

Plan for this evening

- Overview of ‘Electrifying Women’
- Women in engineering before WES
- WW1 and the founding of WES
- Early challenges for WES
- Eminent women in engineering
- What has kept WES going for a century?
- Audience discussion/questions

Arts & Humanities Research Council

AHRC project: Electrifying Women: Understanding the Long History of Women in Engineering

Public engagement work in partnership with WES, IET, Wikimedia & Science Museum:

Aims:

- To share stories of women's collaborative participation in engineering from 19th century
- To show where more research is needed, how it can be done & how shared
- To enhance Wikipedia pages on women in engineering history through wikithons
- To develop inclusive forms of participation e.g. creative writing and drama
- To support recruitment of women to engineering through heightened historical awareness

Project team

- **Graeme Gooday** (University of Leeds) PI - Domesticating Electricity
- **Elizabeth Bruton** (Science Museum) Co-I – Curator of Engineering
- **Emily Rees** (University of Leeds) Research and Engagement Assistant
- With much help received from Nina Baker, Patricia Fara, Sophie Forgan, Henrietta Heald, Sally Horrocks, Anne Locker, Alice White & many more
- Programme of lectures and events around the UK June-December 2019
- Funding to travel around the UK to anywhere willing to host us!
- Participation in events welcome – your ideas for new events welcome too

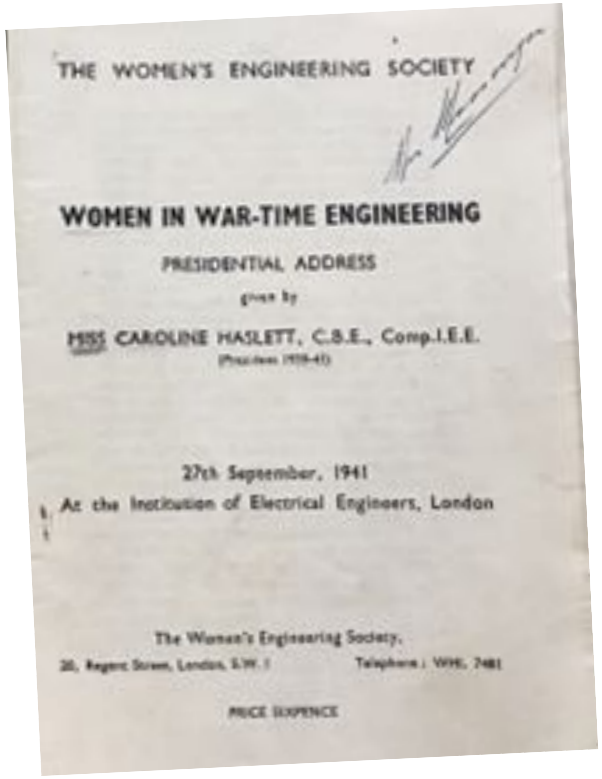
Where are the women in engineering history?

- Lots of statues of Victorian engineers – all male
- Heroic histories of engineers – almost all about men
- After major opportunities during WW1 - 1919 legislative restrictions
- Engineering Trade Unions – women only fully included by 1945
- Engineering institutional membership criteria – very difficult for women to secure the relevant opportunities.

  BUT…

- Census data
- Patent records
- Biography/autobiography
- Archival papers – WES/Caroline Haslett
- Journals – *The Woman Engineer*

Recalling the 1841 Census in 1941



THE WOMEN'S ENGINEERING SOCIETY

WOMEN IN WAR-TIME ENGINEERING

PRESIDENTIAL ADDRESS

given by

MISS CAROLINE HASLETT, C.B.E., Comp.I.E.E.

(President 1939-41)

27th September, 1941

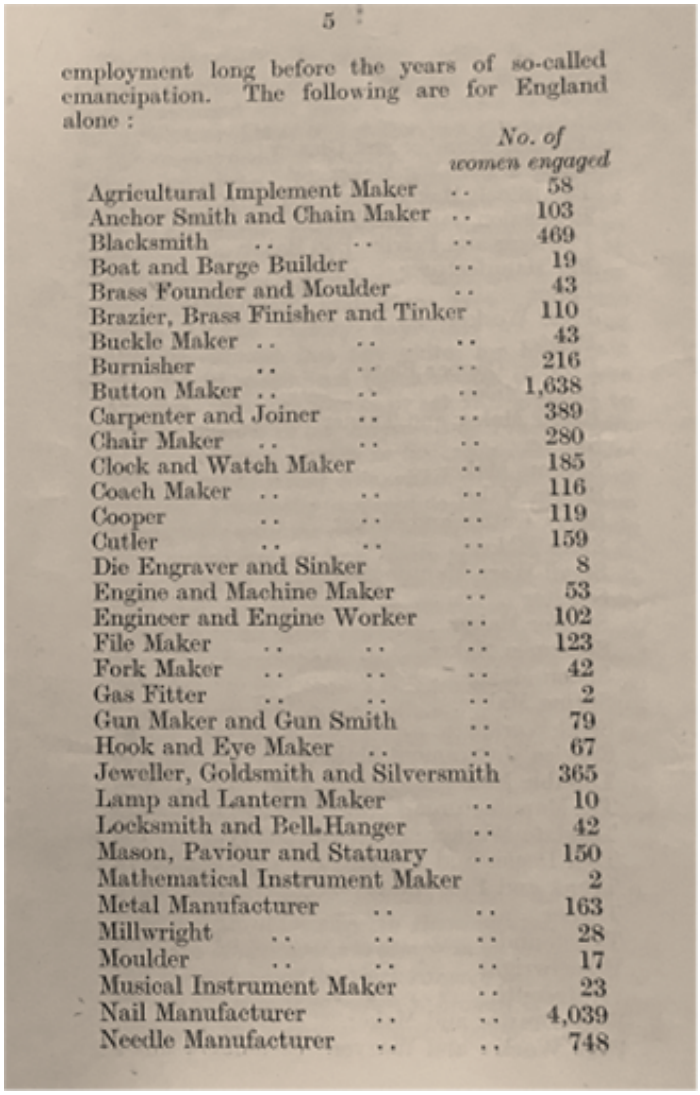
At the Institution of Electrical Engineers, London

The Women's Engineering Society,

PRICE SIXPENCE

Caroline Haslett's WES Presidential Address in September 1941

Haslett quoting appendix on 1841 census data in: Ivy Pinchbeck, *Women Workers and the Industrial Revolution* (1930)



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employment long before the years of so-called emancipation. The following are for England alone :

	No. of women engaged
Agricultural Implement Maker ..	58
Anchor Smith and Chain Maker ..	103
Blacksmith	469
Boat and Barge Builder ..	19
Brass Founder and Moulder ..	43
Brazier, Brass Finisher and Tinker	110
Buckle Maker	43
Burnisher	216
Button Maker	1,638
Carpenter and Joiner	389
Chair Maker	280
Clock and Watch Maker ..	185
Coach Maker	116
Cooper	119
Cutler	159
Die Engraver and Sinker ..	8
Engine and Machine Maker ..	53
Engineer and Engine Worker ..	102
File Maker	123
Fork Maker	42
Gas Fitter	2
Gun Maker and Gun Smith ..	79
Hook and Eye Maker	67
Jeweller, Goldsmith and Silversmith	365
Lamp and Lantern Maker ..	10
Locksmith and Bell-Hanger ..	42
Mason, Paviour and Statuary ..	150
Mathematical Instrument Maker	2
Metal Manufacturer	163
Millwright	28
Moulder	17
Musical Instrument Maker ..	23
Nail Manufacturer	4,039
Needle Manufacturer	748

Alice (Mrs J.E.H.) Gordon working as an ‘engineer by marriage’

‘Some personal experiences’, 1891

DECORATIVE

ELECTRICITY

Alice M.
MRS. J. E. H. GORDON.

WITH

A CHAPTER ON FIRE RISKS

BY

J. E. H. GORDON, B.A., M. INST. C.E.,

DIRECTOR OF AND CONSULTING ENGINEER TO THE METROPOLITAN ELECTRIC SUPPLY COMPANY.

ILLUSTRATED BY HERBERT FELL.

LONDON:
SAMPSON LOW, MARSTON, SEARLE, & RIVINGTON,
LIMITED,
St. Dunstan's House,
FETTER LANE, FLEET STREET, E.C.
1891.

CONTENTS.

Alice Gordon, ‘Some Personal experiences’

Of the Gordon installation of an a.c. arc lighting system at Paddington Railway station in 1885-86:

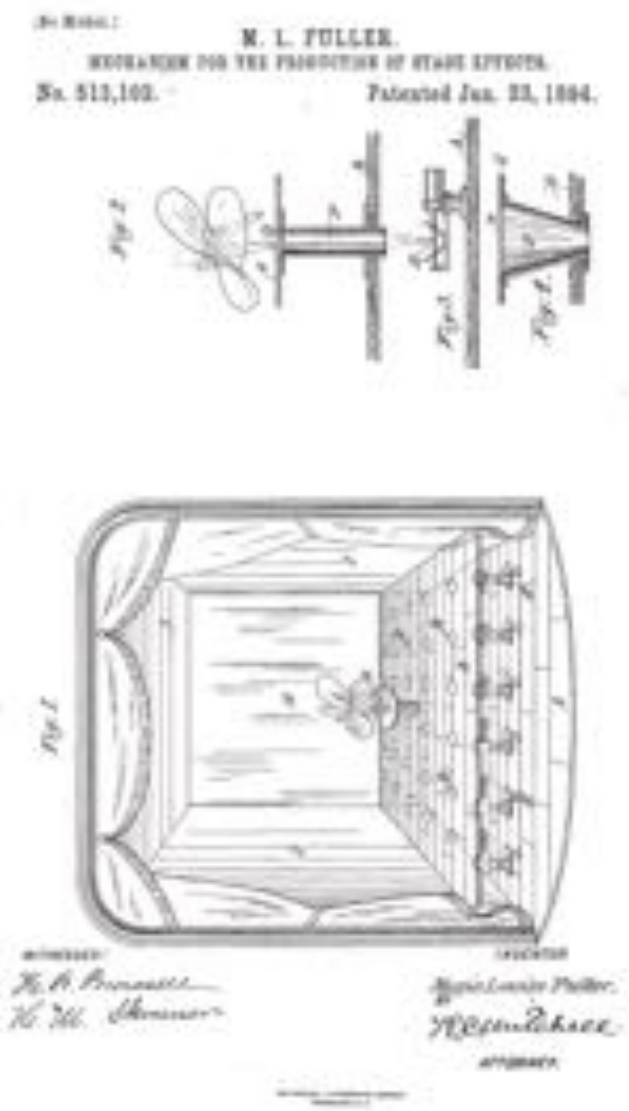
‘In spite of the anxiety, the details of the working of this station were of the greatest interest.

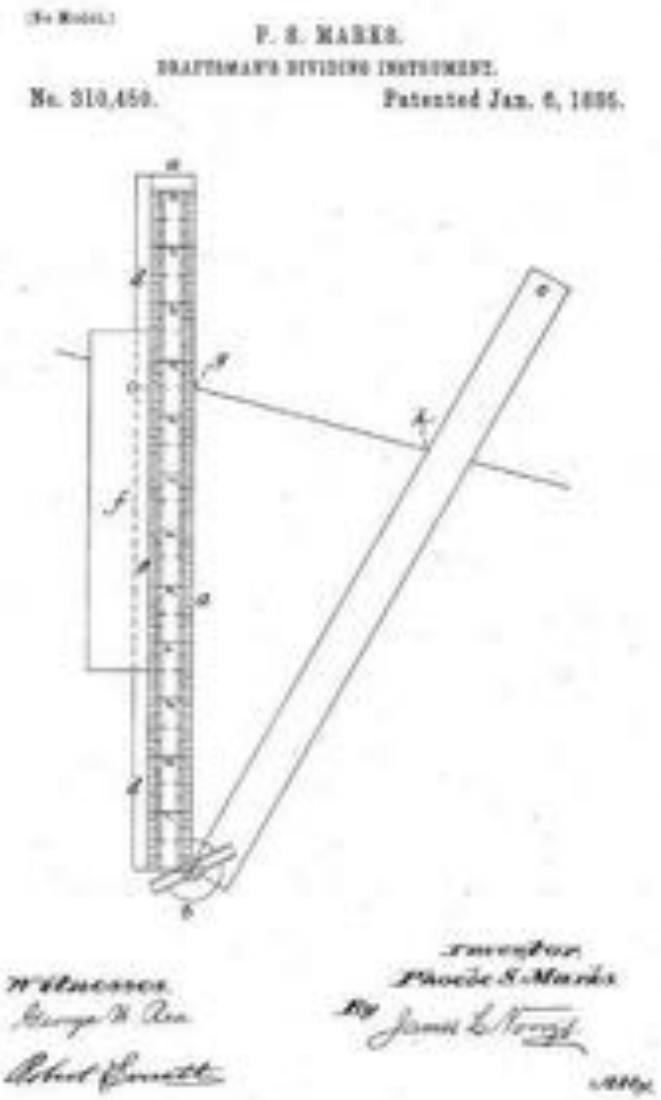
I always felt as if the dynamos were sentient beings, and they all had characteristics of their own.

No. 1 was not quite dependable, for her shaft, which was eight inches in diameter, and eleven feet long, had been sprung a sixty-fourth of an inch out of truth in transport, and required incessant nursing for the first few months, and consumed enormous quantities of castor oil.

However, with care, her constitution recovered, and she is now working as steadily as her sisters.’

Women as inventors/patentees


M. L. FULLER.
No. 513,102. Patented Jan. 23, 1894.


P. S. MARKS.
No. 310,450. Patented Jan. 6, 1885.

Hertha Ayrton (1854-1923)

- **1899:** Hertha Ayrton elected first female member of the Institution of Electrical Engineers (now IET)
- Feminist, mathematician, inventor, patent holder physicist, electrical engineer, and suffragist.
- **1854:** Born Phoebe Sarah Marks to impoverished Jewish-Polish migrant family
- **1876-1881:** Studied Mathematic at University of Cambridge and London (BSc)
- **1884:** Granted first patent for line divider

Right: Portrait of Hertha Ayrton, painted by Héléna Arsène Darmesteter, supplied by The Public Catalogue Foundation

Hertha Ayrton: Physicist & Electrical Engineer

1884: Studies Physics at Finsbury Technical College, mee
Professor William Ayrton

Early 1890s: Begins researching electrical arcs – powerfu
outdoor and indoor lighting

1899: Elected first female member of Institution of Electrical Engineers for her arc light research

1902: *The Electric Arc* wins wide praise and secures her the Royal Society Hughes Medal.

1916: Ayrton anti-gas fan used in WW1 trenches – over 100,000 issued to British Army in France.

IWM FEQ 492 Ayrton Anti-Gas Fan. Courtesy of Imperial War Museums (IWM)

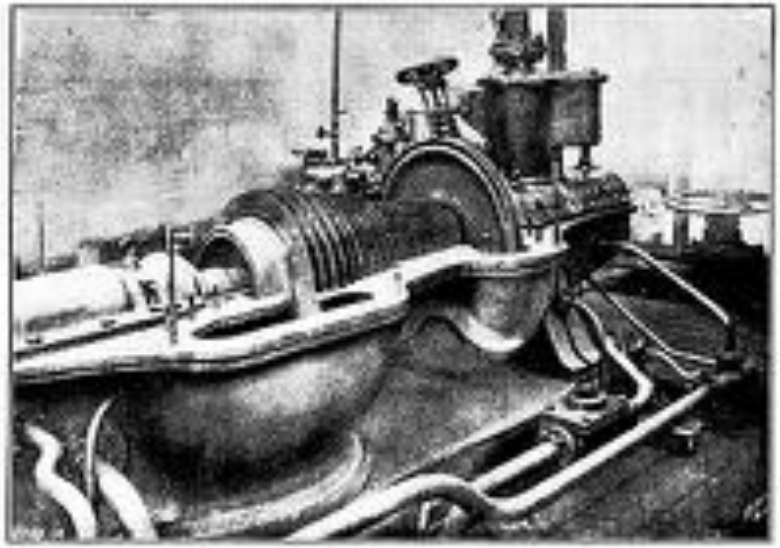
Mrs Hertha Ayrton was I think the first member of the fair, but no longer frail sex, to distinguish herself in the engineering world,

…though perhaps the woman engineer would not have arrived yet, had not the war, which upset so many masculine traditions, proved that woman was capable of doing many things which had hitherto been considered strictly within the provenance of the more assertive male…

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

Hon. Charles Parsons & Katharine Parsons

The steam turbine engine and ‘Turbinia’ c.1894



Lady Parsons documented in the *Transactions of the North East Coast Institution of Engineers and Shipbuilders*

Lecture: 'Women's Work in Engineering and Shipbuilding during the War' July 1919

'It has a been a strange perversion of women's sphere – to make them work at producing the implements of war and destruction and to deny them the privilege of fashioning the munitions of peace'

Obituary 'The Hon. Lady Parsons (Hon.Fellow)' published in 1933

'She was always at [Sir Charles Parson's] side, always there to help him when he needed her, always supporting him with her really powerful mind and ready tact, and perfect understanding.

'Lady Parsons was the possessor of a remarkable character, she was almost fiercely independent... She had in many ways a very masculine brain - and a love of business organization and leadership.'

The Women's Engineering Society 1919

- Launched on 23rd June 1919 by six eminent/wealthy women:
- Lady EG Shelley-Rolls, Monmouth; Rachel Parsons, London; Lady Katharine Parsons, Newcastle; Janetta Mary Ormsby, Newcastle; Margaret Rowbotham, Kirkcudbright; Margaret Moir, SW London; Laura Annie Willson, Halifax
- To promote the study and practice of engineering among women; and…
- To enable technical women to meet and to facilitate the exchange of ideas respecting the interests, training, and employment of technical women and the publications and communication on such subjects
- Rachel Parsons (Univ Cambridge Mech Sciences) as first W.E.S. president
- Lady Parsons as W.E.S.'s chief financial sponsor, paying Secretary's wages
- Caroline Haslett as Secretary 1919-1929, editor of *The Woman Engineer*

Caroline Haslett: campaigner, organiser, Secretary.

- Suffragette in 1913, in WW1 Haslett trains for secretarial work
- Join Cochran Boiler Co. as junior clerk drawing up specifications
- Manages London office in 1918, supplying boilers to the War Office
- Moves to Cochran's Scottish factory to learn practical boiler making: designed and sold some using genderless name 'C.Haslett'
- After WW1 Haslett kept on, while many women forced out in 1919
- Engineering journals advertise February 1919:
  'Required: Lady with some experience in Engineering Works an Organizing Secretary for a Women's Engineering Society'
- Lady Parsons hires Haslett: experience of shorthand & running an engineering works

Laura Willson
Halifax house builder

Caroline Haslett
W.E.S. Secretary

Margaret Partridge
Consulting engineer

Margaret Partridge among dozens of women recruited by Haslett in early days of WES

Early patrons and Presidents: Rachel Parsons (above)

Lady Margaret Moir
'engineer by marriage'

Common themes
WW1, suffrage, cars…

The Women's Engineering Society

President—MISS R. M. PARSONS.
Secretary—MISS C. HASLETT.

The Women's Engineering Society is established in the Interests of Women engaged in Engineering and Allied Trades. The Aims and Objects of the Society are as follows:—

1. To promote the training and employment of women in Engineering and Allied Trades.

2. To work for the admission of women to all Schools of Engineering and Technical Colleges.

3. To give special attention to the future of women who have attained some degree of skill in the Engineering and Allied Trades and Professions, and who wish to continue their work.

4. To work for the admission of women:

   To membership of all suitable Institutes of Engineers.

5. To enable technical women to meet and to correspond, and to facilitate the interchange of ideas respecting openings in the various branches of technical and mechanical science by the circulating of information on such subjects.

The Woman Engineer

Volume 1
1919-24

First issue
December
1919

3rd issue
June 1920

course she will need a great deal of determination and perseverance and must not mind how dirty she gets.

In spite of all this the work is most fascinating and absorbing and one becomes so interested in everything that one forgets to be tired and the time goes extraordinarily quickly and happily.

I see no reason at all why girls should not be as successful in Engineering as they have been in other trades which have hitherto been considered unsuitable for them.

After all, pioneers always meet with difficulties and discouragement and we cannot hope to be an exception to the rule, but I firmly believe that we shall succeed in the end.

The Direct Current Machine.

NOTES ON ITS CONSTRUCTION AND HABITS.

By MARGARET M. PARTRIDGE, B.Sc., *Graduate I.E.E.*

THE standard Direct Current Machine consists of a rotating armature, described by some genius as "a bundle of wires tied up with tape" encased in a stationary magnetic yoke, or field. Electric current runs through the wires of the armature, and through the coils of wire wound round the poles of the field.

It is easy to run a current through stationary coils, like the field coils; but how send a current through a wire which is racing round the main shaft at the rate of 500 or 3,000 times a minute?

At one end of the armature is the commutator, a ring of copper bars or strips—each insulated from the main shaft, and from its neighbour by mica. Every wire is soldered at each end to one of these bars. Pressing on to the commutator are two or more brushes which sweep over it as it revolves, and pick up or distribute the electric current. These brushes are usually composed of some preparation of carbon.

This is, very roughly, the construction of every Direct Current Machine, though its individual characteristics vary according to the different systems of winding the coils.

If we put an electric current through the armature and the field coils, we get mechanical energy from the rotation of the armature. The machine is then called a motor. Inversely, if we impart mechanical energy to the same machine we get electrical energy generated. We then call the machine a dynamo.

The theory of the Direct Current Machine is very simple, and when it is properly and considerately treated, it is an honest and straightforward creature, but no machine resents ill-treatment, either in construction or use, more quickly and violently.

* * *

Suppose you take an inspection tour round our test bed.

The first apparatus we come to, a girl, wears a worried look, and a pair of alternatives (as we are perfect ladies we do not call them trousers!). She is running two machines coupled together, and is providing current for the motor from the mains supply, and is using up the current produced by the dynamo to heat a radiator—at least that is what she wants to do—but as soon as she starts the motor the commutator becomes a ring of sparks. This will not do. First she tests the field circuit. Yes. Current there all right.—Then she tests the separate coils with a compass needle to see if the polarity of the magnetic poles is correct. Nothing wrong there.—She examines the commutator. Blackened, but otherwise O.K.—The winding of the armature appears all right and all the connections to the brushes.—What about the spacing of the brushes round the commutator? No trouble there.—Oh! now we are home—the spring, which should hold the brush firmly on the commutator, has moved out of place. She adjusts that and all is well.

It is no fallacy that the slightest faults take the longest to find.

Next we come to two boys who are giving a break load to a series motor. They have made the break themselves. It is a long wooden lever covered with ferodo brake compound, which one presses down on to the pulley of the machine, while the other takes readings of the speed and electric pressure and current (volts and amps). One Boy thinks he is being as strong as two horses because the motor shows that it is doing 2 h.p. Yes, but he forgets that his break lever is a long one, though he would remember quickly enough if you were to suggest that he should shorten it.

Here is another girl, very busy. Her machine appears to be running perfectly—pleasant hum—not too hot—everything in the garden is beautiful. "Please, my machine is running ever so much faster than it ought to." Whose fault is that? It may be that you have some extra unnoticed resistance in the field circuit, or the voltage of

Why did the UK have the first Women's Engineering Society?

- Compare UK – WES founded 1919
- Germany - Verein Deutsche Ingenieure (1856) women's section 1933
- USA - Society of Women Engineers, founded 1950

- Germany & USA: formal professional education requirements in engineering
- UK: unlike Medicine, no legally-required engineering qualifications

- WES Focus on engineering (vs. engineers)
- More inclusive of experience (vs. training)
- Financial support from wealthy philanthropic women

The First International Conference of Women in Science, Industry and Commerce, Wembley, 1925

Henrietta Heald –
Magnificent Women and their Revolutionary Machines (2019)

The early decades of the Women's Engineering Society

Expanding areas of innovation were most welcoming to women

Aeroplanes, automobiles and electrical engineering.

Laura Annie Willson, WES President 1926-28

From Halifax textile worker to suffragette and union activist

From engineering spouse to independent builder

First woman member of the Federation of House Builders

MRS. L. A. WILLSON, M.B.E.

Amy Johnson/Mrs Mollison WES President, 1935-37

- Sheffield Economics graduate
- Promoted aeronautics to women
- 1935: Mr & Mrs Mollison debate

The series of debates and discussions on subjects of aeronautical interest, arranged throughout this Spring, is of course the direct result of our having Mrs. Mollison as our President. Not only was the original idea hers, but she is herself taking part in as many of the meetings as her other engagements will permit.

The first Debate, held on Tuesday, January 22nd, was a discussion between Mr. and Mrs. Mollison on the value of record-breaking flights, Mrs. Mollison proposing the motion "That record-breaking flights no longer serve a useful purpose," and her husband opposing. The Viscountess Elibank, J.P., was in the chair.

Divorce in 1938. Amy Johnson
- dies on ATA service 1941

Miss Johnson shortly after her return from her first flight.

Mrs. J. A. Mollison, C.B.E.

Amy Mollison, be re-elected for the coming year.

WES and the new generation of graduate women in engineering

- **Margaret Partridge** - University of London, BSc Mathematics, 1914
- **Hilda Lyon** - University of Cambridge Mathematics, 1918
- **Gertrude Entwisle** - Manchester College of Technology… engineering evening class
- **Verena Holmes** - Loughborough Engineering College, BSc Engineering 1922
- **Beatrice Shilling** - University of Manchester, Electrical Engineering 1932
  MSc Mechanical Engineering 1933

Hilda Lyon (1896 –1946)

1918 Air Ministry course in aeroplane stress-analysis & technical assistant.

1925 Royal Airship Works: R101 rigid airship

1930 Royal Aeronautical Society prize "The Strength of Transverse Frames of Rigid Airships'

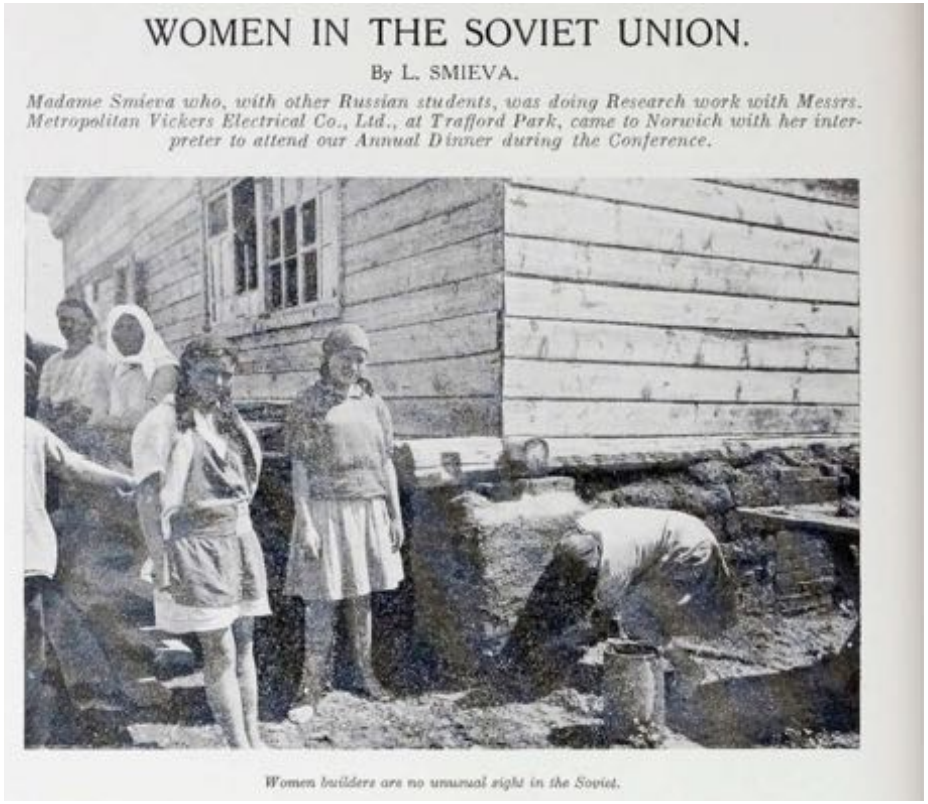
1932, MIT Master thesis on ;The Effect of Turbulence on the Drag of Airship Models'

Hilda Lyon and the ‘Lyon Shape’

- 1930s Principal Scientific Officer at Royal Aircraft Establishment
- Worked on wind tunnels, boundary layers suction and stability
- Joins the Aeronautical Research Council
- Posthumously in USA the ‘Lyon shape’ adapted from airships to submarines

USS *Albacore* launched in 1955

Internationalism in WES



WOMEN IN THE SOVIET UNION.

By L. SMIEVA.

Madame Smieva who, with other Russian students, was doing Research work with Messrs. Metropolitan Vickers Electrical Co., Ltd., at Trafford Park, came to Norwich with her interpreter to attend our Annual Dinner during the Conference.

Women builders are no unusual sight in the Soviet.

Chinese Student, ‘Miss Y.H. Yuan’ 1943
Civil Engineering, University of Liverpool

Longer term view of WES

- World War 2 brings only short-term opportunities for women to take leading role in engineering
- Post World war 2 Britain gave less prestige to engineers than scientists
- Secrecy over Bletchley Park decryption obscures much women's work

- Caroline Haslett drawn in to many other roles, moving away from WES
- Several famous WES figures die young - notably Johnson and Lyon

- BUT Collegial support essential for dispersed WES membership
- Can this be a useful message to encourage women into engineering?

Discussion and looking ahead

- What are your questions about WES's history?
- What will you do with what you have learned today?
- What could you do to support this project and WES's aims?

Sign up for more by emailing electrifyingwomen@gmail.com


THE WOMAN ENGINEER

THE ORGAN OF THE WOMEN'S ENGINEERING SOCIETY (Incorporated 1920).

MARCH, 1941

MRS. CARLA A. WESTCOTT
THE FIRST AMERICAN WOMAN MARINE ENGINEER

THE "WOMAN ENGINEER" IS ISSUED QUARTERLY—PRICE 6d.

Further research

- The Woman Engineer (digitised from 1919-2014)
- The IET archives (Savoy Place, London)
  - WES archives
  - Caroline Haslett papers

Hannah Stone – creative writing specialist

- Poet and academic writer Hannah Stone
- Will be facilitating creative writing responses to the project
- Events in London (5th October) and Leeds
- Drawing on primary source materials on women engineers

Keep in touch

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https://electrifyingwomen.org/

Twitter: @ElectrifyingWmn