



Electrifying Women: Understanding the Long History of Women in Engineering



Elizabeth Bruton
& Graeme Gooday

@ElectrifyingWmn

Caroline Haslett, First WES Secretary

WES visit to a Birmingham power station,
c.1938 Image source: NAEST 092/07/01
Caroline Haslett papers, IET Archives



Women's Engineering Society Centenary 2019

W.E.S. 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?



W.E.S. annual conference 1924. Image courtesy of W.E.S.

Plan of the evening

- WES Presentation on its Heritage Centenary Trail project, Helen Close
- Overview of the 'Electrifying Women' AHRC project
- Women in engineering before WES
- WW1, the founding of WES and early challenges
- What has kept WES going for a century - when other bodies did not?
- Audience discussion and questions
- Opportunities for future participation.
- Reception and networking

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.



Centenary map



Snapshot of the
WES Centenary Trail map
in draft beta testing form
earlier this week



WES Centenary Trail



We are organising a Lottie Doll tour as part of the WES Centenary Trail, aimed at encouraging families to think of engineering and its heritage as subjects just as interesting for girls as for boys.

Follow the hashtag [#WESLottieTour](#) or if you would like to borrow a Lottie Doll to take part in the 2019 Lottie Tour please do sign up.

As part of the WES Centenary Trail, we are posting daily stories of women engineers who belonged to or were connected with WES on [@WESCentenary](#) on Twitter or [@wes_centenary](#) on Instagram #WES100

The WES Centenary Trail is funded by a grant from the National Lottery Heritage Fund, and supported by some brilliant partners including Heritage Open Days and Wellcome Collection
Our lovely hosts today are the LSE Library.



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

Resources:

- WES archive & Caroline Haslett papers, Archives of Institution of Engineering & Technology
- *The Woman Engineer* (1919-) at <https://www.wes.org.uk/content/journal-archive>

Project team

- **Graeme Gooday** (University of Leeds) PI - [Domesticating Electricity](#)
- **Elizabeth Bruton** (Science Museum) Co-I – Curator of Engineering
- Research and Engagement Assistant – recruiting (University of Leeds Jobs)

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

Twitter: [@ElectrifyingWmn](#)

Email: electrifyingwomen@gmail.com

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

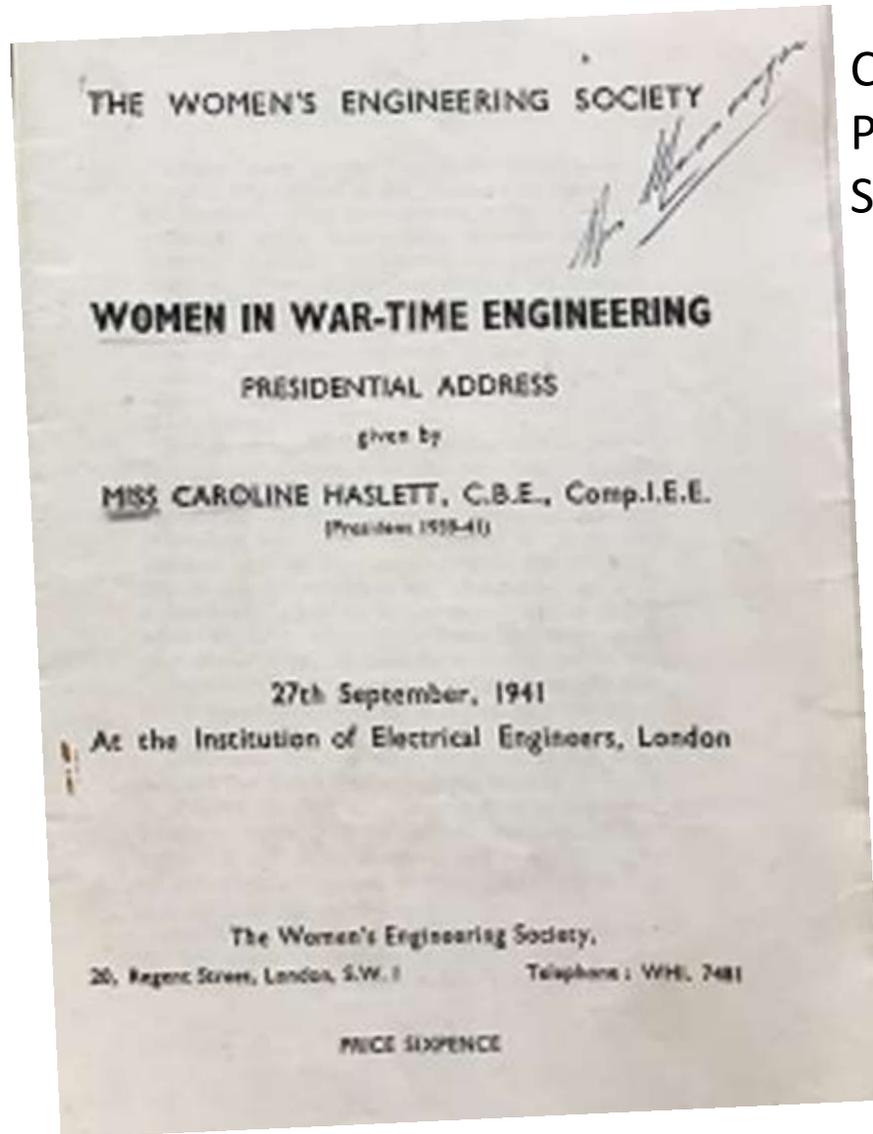
Engineering Trade Unions – women only fully included by 1945

Engineering institutional membership criteria – used to exclude women.

BUT...

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

Recalling the 1841 Census in 1941



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)

5

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, Pavioir 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

Women as inventors/patentees

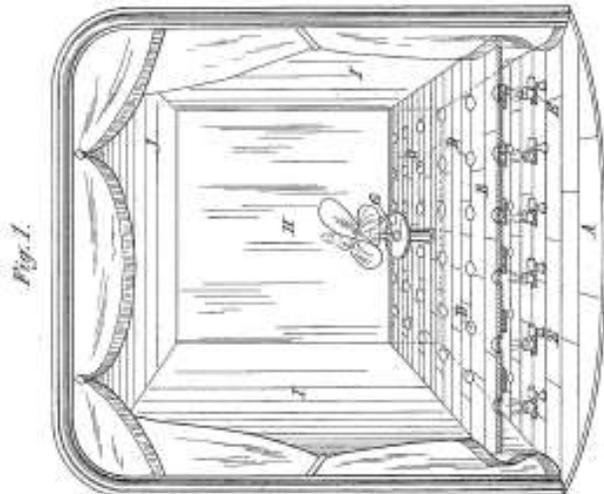
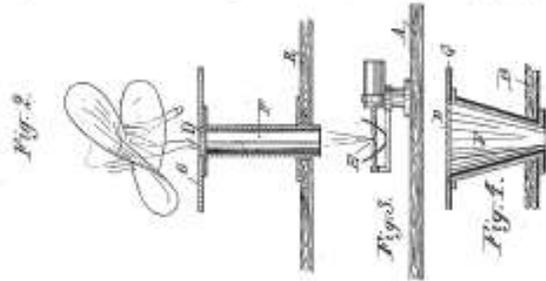
(No Model.)

M. L. FULLER.

MECHANISM FOR THE PRODUCTION OF STAGE EFFECTS.

No. 513,102.

Patented Jan. 23, 1894.



WITNESSES:

H. A. Pisonell
H. W. Skinner

INVENTOR

Marie Louise Fuller.

BY *Resmitchee.*

ATTORNEY.

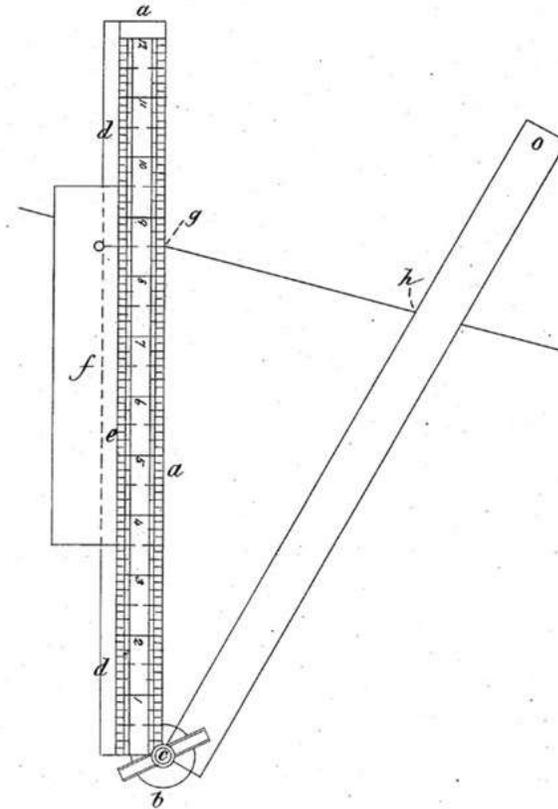
(No Model.)

P. S. MARKS.

DRAFTSMAN'S DIVIDING INSTRUMENT.

No. 310,450.

Patented Jan. 6, 1885.



Witnesses.

George W. Rea

Robert Everett.

Inventor.

Phoebe S. Marks.

By *James L. Norris.*

Atty.

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.

Right: Portrait of Hertha Ayrton, Girton College, University of Cambridge painted by H el ena Ars ene Darmesteter (nee Hartog) [Ayrton's first cousin once removed]; supplied by The Public Catalogue Foundation



Early Life

1854: Born Phoebe Sarah Marks

1863: Invited by aunt Marion Hartog to live with cousins and to be educated with them

1870: Working independently as governess

1876: Began studying at Girton College, University of Cambridge

1881: Receives University of London BSc

1884: Granted first patent for line divider



Girton College archive GPCH 10/2/41 Girton College Fire Brigade 1878 featuring Hertha Ayrton

Hertha Ayrton: Physicist & Electrical Engineer

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

Early 1890s: Begins researching electrical arcs – powerful outdoor and indoor lighting FEQ 492

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

1902: *The Electric Arc* wins wide praise and secure 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...

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

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.

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

'Some personal
experiences', 1891

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.

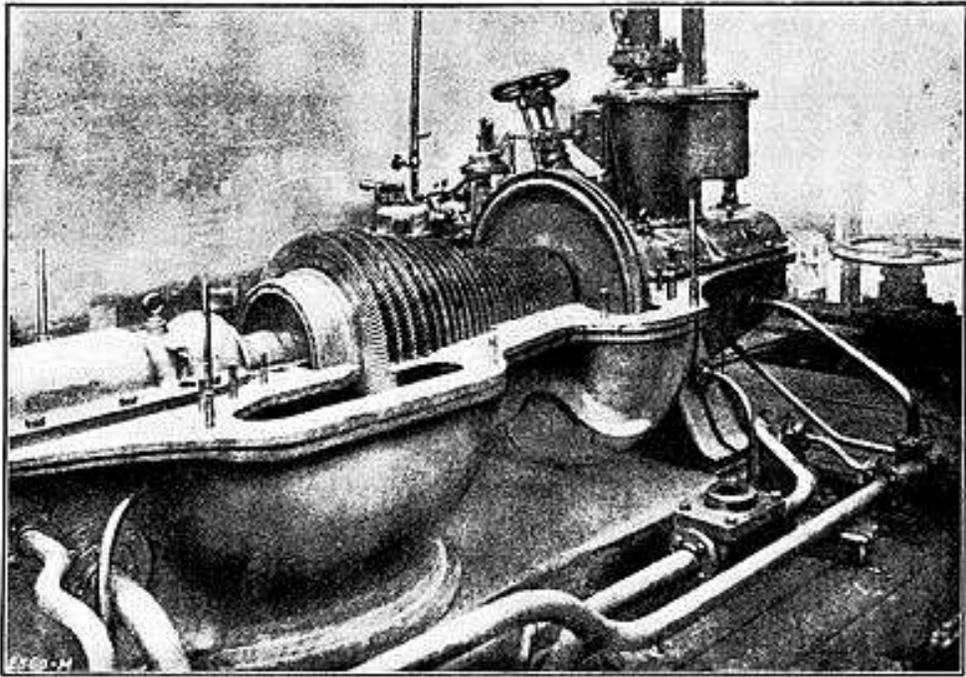
I always felt as if the dynamos were sentient beings, and they all had characteristics of their own.

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.'

Hon. Charles Parsons & Katherine/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'

Discussion: James Driver (Technical College, Loughborough) agreed: 'during the latter part of the war, women had demonstrated in a most remarkable manner their ability to enter the engineering profession successfully.'

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.



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...



Caroline Haslett & the Cochran boiler company 1914-19

- Suffragette in 1913, WW1: Caroline 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 is kept on, while many women obliged to leave
- Engineering journals advertise February 1919:
 'Required: Lady with some experience in Engineering Works a
 Organizing Secretary for a Women's Engineering Society'
- Lady Parsons hires Haslett: experience of shorthand & running an engineering works

The Women's Engineering Society 1919

- Launched on 23rd June 1919 by six eminent and wealthy women:
- Lady EG Shelley-Rolls, Monmouth; Rachel Parsons, London; Lady Katharine Parsons, Newcastle-on-Tyne; Janetta Mary Ormsby, Newcastle-on-Tyne; 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 Sci) as the first W.E.S. president
- Lady Parsons as W.E.S.'s chief financial sponsor, paying Haslett's wages
- Caroline Haslett as Secretary 1919-1929 and editor of *The Woman Engineer*

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 5,000 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 considerably 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 apprentice 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 main 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 hotter—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 break 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

Haslett & the Electrical Association for Women, 1924

- Haslett meets US time & motion specialist, Dr Lillian Gilbreth at Power conference
- Paper on women's domestic uses of electricity offered by WES member Mrs M.L. Matthews: proposed an Electrical Association for Women
- Haslett enthusiastic for an E.A.W. – Lady Parsons is not.
- Explicit aim to reduce drudgery for women at home via electricity, and thus have their own independent careers
- First President of EAW: Lady Nancy Astor, Conservative MP: amused to see that women were 'expecting to be emancipated by electricity':
-the 'most difficult thing in a house was a man', and electrical equipment 'would not get rid of that...'
- EAW promotes all-electric homes installed by women, for solo 'lady bachelors'

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



E.A.W.'s growth under Haslett's leadership

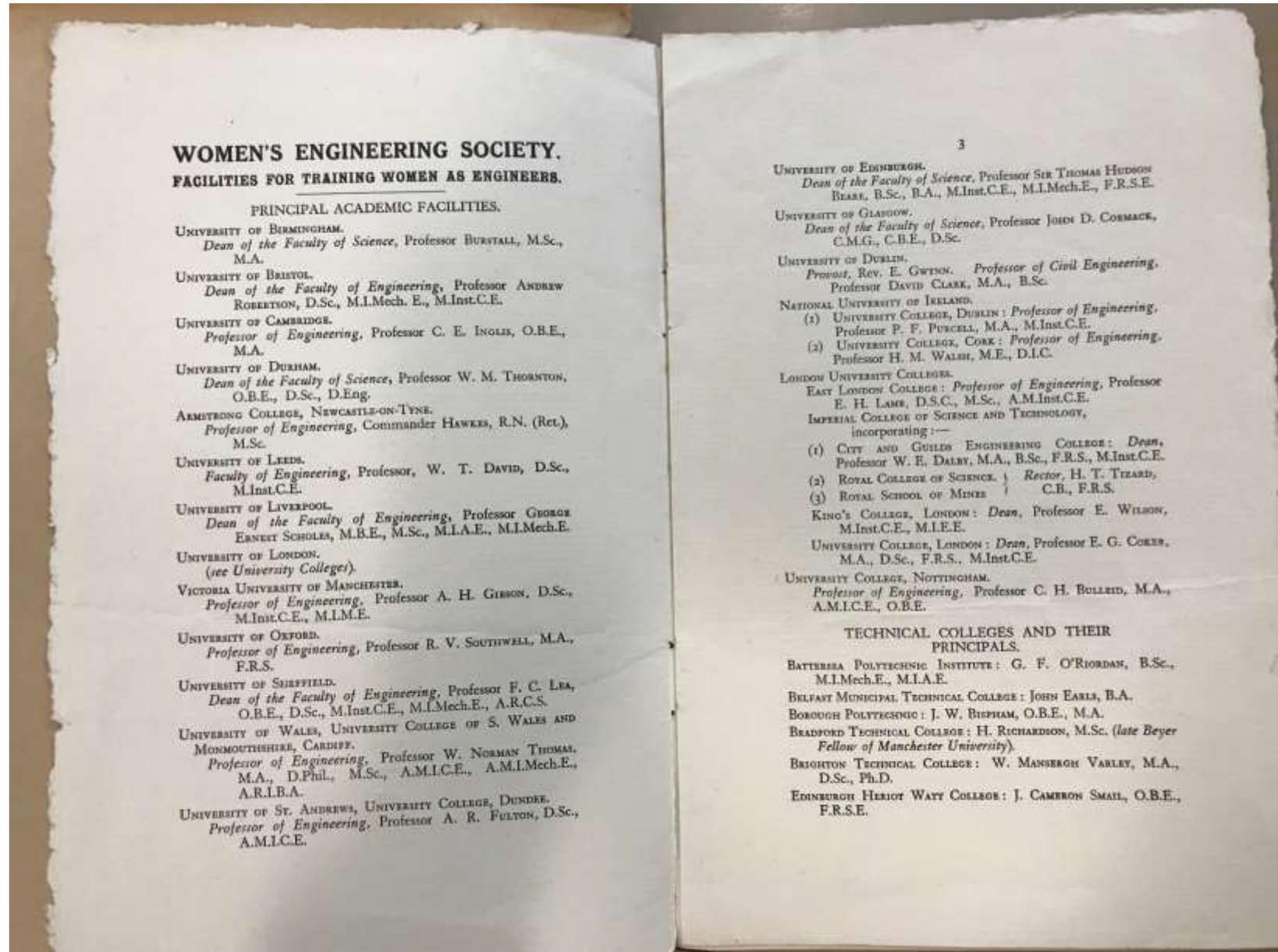
- After 1925 lecture Haslett asked to visit power stations, electrical depots
- Rapid EAW expansion with branches opening across the nation.
- Financial support from the electrical industry – to secure more customers.
- Promises WES membership emancipation by participation:
 - ‘I do not think that the women's world has yet realised that the machine has really given women complete emancipation. With the touch of a switch she can have five or six horsepower at her disposal; in an aeroplane she has the same power as a man’.
- Large career infrastructure of women as EAW lecturers & demonstrators
- Easier to recruit those to create opportunities for women as engineers

The Women's Engineering Society continues

Engineering
training
opportunities
published

First edition 1921

This edition 1930



W.E.S. Register of Women Engineers

1935

Editors' preface asks readers for more information to be complete

Haslett

Miss Caroline H., C.B.E., Companion I.E.E. Educated at Haywards Heath High School. Director, Electrical Association for Women; Hon. Secretary and Council, Women's Engineering Society. Editor, "The Woman Engineer" and "The Electrical Age." Publications: Electrical Handbook for Women, etc. Recreations: Golf, Motoring. Address: 20, Regent Street, S.W.1. Telephone: Whitehall 7481. Clubs: Forum, Lyceum, Soroptomist, Women's Automobile and Sports Association.

Havelock

Miss Marjorie Annie, B.Sc., M.W.E.S. Daughter of A. H. Havelock and Annie L. Havelock (deceased). Educated at Queenswood, Hatfield; Bedford College, London. Training and experience: B.Sc., Chemistry and Zoology; Psychology, London School of Economics, 1929; Post-Graduate Certificate, Social Science; with M.V. Elec. Co., Ltd., Manchester; Hoover, Ltd., Middlesex. Present position: Women's Employment Manager, M.V. Elec. Co., Ltd. Recreations: Boating, Golf, Cinematography. Address: Walford Lodge, Dunham Road, Altrincham. Telephone: Altrincham 2828. Clubs: B.F.U.W., Institute of Labour Management, Cavendish, Buxton.

Heywood

Mrs. Harold (Frances D.), B.Sc. (Hons.), Ph.D. Chem., M.Inst.Met., M.W.E.S. (Council). Daughter of Rev. B. Weaver. Married Dr. Harold Heywood, August, 1932. Educated at Bradford Girls' Grammar School, Sheffield High School, G.P.D.S.T., Bedford College, London University. Research work, Sir John Cass Technical Institute, London University; Assistant Metallurgist, Monotype Corporation, Ltd. Present position: International Tin Research and Development Council. Publications: Papers for the Journal of the Institute of Metals, March, 1933; Research Worker, International Tin Research Council, 1934. Recreation: Sketching. Address: 78a, Eltham Road, Lee, S.E.12. Telephone: Lee Green 4587.

Hirst

Doris Mona, M.A., A.F.R.Ae.S., M.W.E.S. Daughter of G. W. Hirst. Married to R. A. Fairthorne, B.Sc. Educated at Birmingham University; 1st Class Hons. in Maths., 1924; M.A. 1925. Technical Assistant to Messrs. Boulton & Paul, Ltd., Norwich (Aeronautical Dept.); Assistant in Maths., Queen's University, Belfast; Junior Scientific Officer (Aerodynamics and Airworthiness Dept.) at Royal Aircraft Establishment, South Farnborough, Hants. Present position: Aeronautical Consultant (for aerodynamics and stress calculations). Publications: Papers in Reports and Memoranda Series of Aeronautical Research Committee, Proceedings of London

11 ABCT 33/1/5/1

Mathematical Society and Philosophical Magazine. Address: Kirk Michael, Hillfield Road, Farnborough, Hants. Clubs: London Mathematical Society, Royal Aeronautical Society.

Hollands

Miss Hilda Constance, A.M.W.E.S. (Council). Daughter of Henry and Martha Hollands. Educated at Streatham Hill High School (G.P.D.S.T.), and Clark's College. Training at Borough Polytechnic for Machine Drawing and Construction; Secretary to Robt. Bruce & Sons, Consulting Engineers. Hon. Treasurer, Women's Engineering Society, since 1932. Recreations: Music and Reading. Address: 187, Mountview Road, N.4. Telephone: Mountview 5187.

Holmes

Miss Verena W., M.W.E.S. (Council), B.Sc. (Lond.), A.M.I.Mech.E., M.I.Loco.E., M.Inst.Met., A.M.I.Mar.E. Address: 127, Highbury New Park, London, N.W.5.

Hoskins

Miss Harriet Rachel, M.W.E.S. Daughter of George Gale and Mary Jane Hoskins. Educated at Southlands College. Apprenticed five years J. I. Thornycroft, Chiswick and Southampton; three years with Coventry Ordnance Works, London and Coventry; four years with Babcock & Wilcox, Ltd., London. Present position: Head of Tracing Dept., Sturtevant Engineering Co., Ltd., 147, Queen Victoria Street, E.C.4. Address: 1, Canford Road, Clapham Common, S.W.11. Clubs: City Women's Club.

How

Miss D. A., M.W.E.S., 16, Salisbury Road, Walthamstow, E.17.

Jeans

Miss Norah M., M.W.E.S. Trained under Ministry of Munitions as Engineer's Draughtsman and at Regent Street Polytechnic in Mechanical Engineering; Draughtsman with Kennedy Aeroplanes, Ltd., from 1917 to 1920; Assistant Research Worker from 1920 to 1924; Assistant Engineer to the Infinitely Variable Gear Syndicate, Ltd., from 1923 to 1931. From 1931: Technical Publicity Manager to Evershed & Vignoles, Ltd. Address: 3, Eastern Road, Brockley, S.E.4. Clubs: Forum, Women's Automobile.

Jerome

Miss E. Wells, A.M.W.E.S., 130, Franklin Road, Gillingham Kent.

Internationalism in W.E.S.

- American members join W.E.S. during 1920s
- Chinese Student
'Miss Y.H. Yuan' 1943
Civil Engineering
University of Liverpool



Longer term view of W.E.S.

- World War 2 brings only short-term opportunities for women to take leading role in engineering.
- Post-war Britain gave less prestige to engineers than scientists
- Less British establishment support for WES in 1945 than in 1925
- Caroline Haslett drawn in to many other roles away from W.E.S.

- But: collegiality and warm mutual support very sustaining for WES
- Outlived indirect rival EAW by continuing to adapt to new challenges

Discussion and looking ahead

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

Sign up for more by emailing electrifyingwomen@gmail.com

Hannah Stone – creative writing specialist

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

