Appendix 5: Constance Fligg Tipper

IC Women Standard Biographical Entry Template

Name and post nominals Constance Elam Fligg Tipper (1894-1995) DSc

Specialism: Metallurgy; Crystallography, Strength of Materials, Fractures in iron and steel, Developed new science of strength of metals

First to: Use scanning electron microscopy (SEM) in metallurgical research, developed the discipline of strength of materials

First woman: Full member University of Cambridge Faculty of Engineering, one of the first women to gain Natural Science Tripos at Cambridge

Career Roles Metallurgical Lab at the National Physical Laboratory 1910-1917; Research Assistant to Professor Sir Harold Carpenter 1917-1929 at Imperial College Royal School of Mines and Research Assistant concurrently at The Davy-Faraday Laboratory of The Royal Institution London, The Cavendish Laboratory Cambridge and with Professor Geoffrey Taylor at Cambridge University until 1929, moving to Cambridge permanently as a Researcher, Department of Mechanical Engineering undertook some teaching; Visiting Researcher Mechanical Division Naval Research Laboratory Washington DC 1940s; Reader and a full member of Cambridge University Faculty of Engineering 1949.

Career Awards Frecheville Fellowship 1921-1923; Royal Society Armourers and Braziers Fellowship 1924-1929; Newnham College Fellowship 1931-1932; Beilby Memorial Prize Institute of Metals 1933; Leverhulme Trust Research Fellowship 1936-1938; Associate Fellow Newnham College 1947-1949; Fellow Imperial College 1963. Sweet chestnut tree planted in the grounds of Newnham College on her 100th birthday

Awards in her name: Constance Fligg Tipper Centenary Memorial Prize Imperial College 2007;[i] ICF Constance Tipper Silver Medal 2013[ii]

Professional affiliations Institute of Metals 1917

Lectures Bakerian Lecture Royal Society 1923

Quote: ' I never expected any such honour to be conferred upon me as that of becoming a Fellow of Imperial College, or one that could be more appreciated'**.**[iii]

Born 16th February 1894 Constance Elam Fligg New Barnet Hertfordshire

Family Background Father William Henry Elam, Trained at Charing Cross Medical School General Surgeon and Medical Officer Barnet area; Mother Lydia Coombes; 1 brother, John later an orthopaedic surgeon

Marriage 1928 George Howlett Tipper (1881- 1947) (Born in Kendal, close to Penrith and Constance Tipper's home on her retirement.) Geologist Director Indian Geological Survey retired 1927 An expert on mica he undertook arduous war work for the Ministry of Supply and Mica Control (post war he became Director of this organisation and Consultant to the Board of Trade.) For the British Raw Materials Mission to Washington DC, crossing the Atlantic 4 times (ie 8 dangerous journeys

under war time conditions,) and flying to India, Australia, New Zealand and Brazil, which took a toll on his health, along with bouts of malaria contracted whilst in India. [iv]

Education
Schooling Felix School Southwold
University
Undergraduate Newnham College Cambridge
Degree BSc
Undergraduate Awards/scholarships
Postgraduate University of London; University of Cambridge
Degree DSc 1929; ScD 1949
Postgraduate Awards/scholarships

Text discussing career and other comments

Constance Fligg Elam Tipper made her career mark by establishing the reason for the breaking up of the so called Liberty ships in mid ocean in freezing conditions during WWII. This was not due to the system of welding that had been introduced to speed up the production of these essential supply ships, as would have seemed likely, but was due to a form of metal fatigue: brittle fracture. She established a test for the strength of metals, still in use, called the Tipper Test. Her expertise was well known in the engineering Department at Cambridge, hence Professor John Baker, who was working for the Admiralty Ship welding Committee, asking Constance to take on the investigations.

It was not until 1960 that she was finally persuaded by her long term Cambridge colleague, Professor Geoffrey Ingram Taylor, to write what is a very readable book on this period and the brittle fracture problem entitled: *The Brittle Fracture Story*[v] for whilst this is a report and full of technical detail, it is essentially a story, and demonstrates how practical science and discovery can be made interesting to non-technical readers without compromising the scientific information.

Constance was the first person to use scanning electron microscopy to investigate fractures in metals and she used only the second machine built, that of Charles Oatley[vi] in the 1950s, to investigate the crystal structure of fractured metals.

Her work on what was to be a new science of strength of metals began with Professor Harold Carpenter at Imperial, where she worked as his Research Assistant from 1916 to 1929. Together they investigated crystals in metals, it was to be a field in which Constance led. She even turned her attention to archaeological applications in 1933, investigating coins and objects[vii] By this time, she had a full time career in the Engineering Department at Cambridge. She was mainly a researcher, but took on teaching and during WWII ran the Heat Treatment Laboratory.

Despite working with eminent men who highly valued her work, such as Harold Carpenter at Imperial and Geoffrey Taylor at Cambridge, and being sought out by John Baker to investigate the cause of the Liberty ships breaking up, it took Constance 32 years to be awarded a professional academic title, that of Reader, which was in 1949. At the same time she was made a full Fellow of the Engineering Faculty of Cambridge University, a first for a woman.

She wrote many research papers, both collaboratively and independently, signing them C.F. Tipper, which androgynous method very nearly caused an upset to the Royal Society's Dining Club. Constance was to give a Bakerian Lecture[viii] jointly with her co-author, Professor Geoffrey Taylor, and attend the Society's Dining Club dinner always given in the speakers honour afterwards, except that women were not allowed to attend Club dinners at that time! It was therefore fortunate that she realised the Society's mistake and pointed out she was a woman, thus saving embarrassment at the prestigious meeting, and so her invitation was withdrawn and her consolation prize was only a box of chocolates.[ix] This showing how professional bodies can be very out of step with their professional worlds. But, amends were made in 1973, when a commemorative Bakerian Lecture dinner was held by the Dining Club and Constance did attend.[x]

Constance retired in 1960, but undertook consultancy work, mainly in the north-west of England, the Lake District, particularly for the Vickers shipyard in Barrow in Furness, advising on metallurgy in their submarine construction.[xi] She had retired to nearby Penrith , living with her brother at Langwathby. She was an accomplished organist, pianist and artist, and enjoyed gardening.

It was highly appropriate that her long productive life was recognised by Imperial College awarding her a Fellowship. After the ceremony she wrote to Lady Linstead, the then Rector's wife, thanking her for her kindness and turning 'an ordeal into a very pleasant experience'.[xii] Lastly, her Cambridge College, Newnham recognised her life and work, by the planting of a tree in the grounds to mark her 100th birthday in 1994. She died in 1995 aged 101.

End Notes

[i] See Imperial College Centenary prizes
[ii] See entry for Professor Dame Julia King. Awarded the International Fatigue Congress (ICF) Inaugural Constance Tipper Silver Medal 2013, Forum for Engineering Structural Integrity FESI Bulletin Vol 7: 2 Autumn 2013.
[iii] Letter: CF Tipper to SIr Patrick Linstead Rector Imperial College 26th October 1963 Imperial College Archives
[iv] Nature v. 159 June 21st 1947
[v] *The Brittle Fracture Story* by C.F.Tipper 1962 Cambridge University press
[vi] Professor Sir Charles William Oatley (1904-1996) Physicist and Electrical Engineer Cambridge University Developed the Scanning Electron Microscope with his PhD students in Cambridge from 1948
[vii] Journal Institute of Metals and Metallurgical Abstracts Vol LIII part 7 July 1933 http://delibra.bg.polsl.pl/Content/9117/P-99_VolLIII_Part7_1933_AS.pdf Accessed 20150426
[viii] Henry Baker left funds in 1775 to the Royal Society for an annual lecture in physical sciences, hence Bakerian Lecture, which in 1923 was given by Geoffrey Ingram Taylor and Constance F. Elam on The Distortion of an Aluminium Crystal during a Tensile Test
[ix] Brian Cathcart *No dinner, but a nice box of chocs Observations on science and sexism* New Statesman Published 16 February, 2004
x. Catalogue of the papers and correspondence of Sir Geoffrey Ingram Taylor OM FRS (1886-1975) D.83 1924,1927, 1961-1975 Tipper Constance F. (Nèe Elam) Trinity College Cambridge
xiDavid Aris http://www.cachalots.org.uk/wp-content/uploads/2011/01/History-of-the-Liberty-Ship-SS-Jeremiah-OBrien.pdf Accessed 20150424 Every effort has been made to contact the author http://www.cachalots.org.uk
xii C.F. Tipper letter to Lady Linstead 27th December 1963 Archives Imperial College