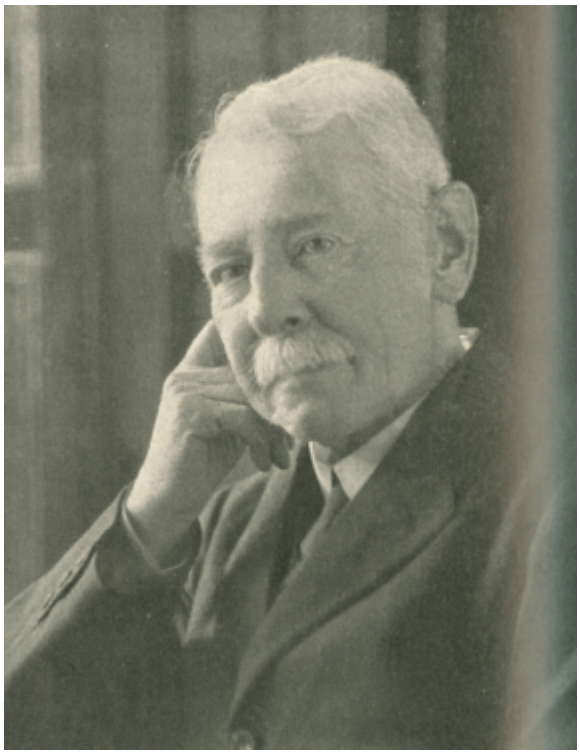
The Invisible Light



Feature: The Giffords of Chard

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The Invisible Light

Contents:

Editorial.

I hope that you enjoy this issue of *The Invisible Light*. We are now up to number 45, which seems astonishing, and many interesting articles have appeared over the years. I have included notes on books that will be of interest. Finding out about new books related to the history of the radiological sciences can be difficulty, and many journals have either none or only a few book reviews. If you come across any new books of interest then please could you let me know the details? If you care to write a few words about the book then that would be helpful.

I have been interested in James Gifford for many years, and presented a paper on James and Emma Gifford at the recent conference of the British Society for the History of Medicine (BSHM) held at the M shed in Bristol. I apologise in advance because of the considerable non-radiological content, however I wanted to give a full picture of the remarkable husband and wife team. As I was doing my research I saw how much more there was to James Gifford than his X-ray work, and I also became progressively more interested in his wife Emma who was a quite remarkable lady.

Finally do please send me material for publication. There is so much interesting material to present. The next BSHM congress will be held in Sheffield in 2021, and it would be good to see some more radiological presentations, either as posters or orally.

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Aunt Minnie Europe column:

Was Clarence Dally a radiology martyr or victim? (12 July 2019)
https://www.auntminnieeurope.com/index.aspx?sec=sup&sub=xra&pag=dis&ItemID=617593
Imaging mourns loss of MRI pioneer Ian Young. Graeme Bydder and Adrian Thomas (8 October 2019)
https://www.auntminnieeurope.com/index.aspx?sec=sup&sub=mri&pag=dis&ItemID=617916
Aunt Minnie Europe column: The remarkable life of Dr. Helmut Diefenthal. (24 October 2019)
https://www.auntminnieeurope.com/index.aspx?sec=sup&sub=ult&pag=dis&ItemID=617958

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Notes on Recent Books.

Professor Maxwell's Duplicitous Demon: The Life and Science of James Clerk Maxwell.
by Brian Clegg (Author)
Publisher: Icon Books Ltd (7 Feb. 2019)
ISBN-10: 1785784951 ISBN-1 3: 978-1785784958
This is a helpful book about James Clerk Maxwell. Maxwell deserves to be better remembered, and he made important contributions to physics. His life was somewhat uneventful, and he was blessed with a happy marriage. This is a good introduction to the work of an important figure in the development of modern physics.

Tesla: Inventor of the Modern.
by Richard Munson (Author)
Publisher: W. W. Norton & Company (22 Jun. 2018)
ISBN-10: 0393635449 ISBN-13: 978-0393635447
It's always difficult to assess Nikolai Tesla, and separating fact from fancy is not easy. You hear so much about Tesla these days. This book recounts Tesla's accomplishments, and also considers his character and motivations. The truth is not easy to determine, such as Tesla's claim to have developed a death ray. However we should remember that history is written by the victors and, in a time when the dominance of Einstein is being seriously questioned, it's surely time for a reassessment of many scientific figures such as Nikolai Tesla and Oliver Lodge. It's worth reading.

Tesla: Great Lives in Graphic Form (Biographic).
by Brian Clegg (Author)
Publisher: Ammonite Press (7 Oct. 2018)
ISBN-10: 1781453535 ISBN-13: 978-1781453537
I admit to have been somewhat skeptical when I first came across serious subjects presented in a graphic form, and yet when done well can be a good way of depicting information. The book uses timelines and dynamic maps, and presents biographical details alongside other significant events. Character traits of Tesla are covered using visual comparisons. I'm not sure what age this book is aimed at. It seems to be written for both adults and children, and the approach is graphic and simple, and will appeal to those brought up on comic books.

Chernobyl: History of a Tragedy.
by Serhii Plokhy (Author)
Publisher: Allen Lane (15 May 2018)
ISBN-10: 0241349028 ISBN-13: 978-0241349021
There can never be too many books about the accident at Chernobyl. I well remember the fears that were expressed at the time of the accident. There is a fascination with Chernobyl, both in serious studies, and also in horror films. This is an accessible account of the tragedy. It's interesting that the countryside around Chernobyl has recovered so rapidly, and would now seem to be a haven for wildlife. Just how dangerous is radiation?

Taming the Rays.
by Geoff Meggitt (Author)
Publisher: Pitchpole Books; 2nd Enlarged edition (5 Nov. 2018)
ISBN-10: 0957554982 ISBN-13: 978-0957554986

An excellent account of radiation and radiation protection by Geoff Meggitt. The book has a wealth of detail and is now essential reading. Many areas are covered including atomic weapons, measurement of radiation, development of standards, development of organisations, radiation safety, and is profusely referenced.

Women in Their Element: Selected Women's Contributions to the Periodic System.
by Annette Lykknes (Author, Editor), Brigitte Van Tiggelen (Author, Editor)
Publisher: World Scientific Publishing Company (28 Aug. 2019)
ISBN-10: 9811207682 ISBN-13: 978-9811207686
This book was produced for the celebration of the 150th anniversary of Mendeleev's first publication of the Periodic Table of Elements. It offers short illustrated papers on the contribution that women have made to our understanding of the Periodic Table and to our knowledge individual elements. The topics are well chosen. I particularly enjoyed the chapter on Margaret Tod who should be better known.

The Spectacle of Illusion: Magic, the paranormal & the complicity of the mind.
By Matthew L. Tompkins (author)
Publisher: Thames & Hudson Ltd; 01 edition (4 April 2019)
ISBN-10: 0500022429 ISBN-13: 978-0500022429
The book is written by a magician-turned-psychologist. He is online at www.matt-tompkins.com. Tompkins is said to be the first member of The Magic Circle to be admitted on the basis of a peer-reviewed scientific publication. The book considers the cognitive psychology of illusions, and also covers esoteric science. It's an important topic, and since it's one that fascinated both Sir William Crookes and Sir Oliver Lodge it must also interest those concerned with early radiology. The book is profusely illustrated, and accompanied an exhibition 'Smoke and Mirrors, The Psychology of Magic' that was held at the Wellcome Collection in Euston Road.

X-ray Contrast Agent Technology: A Revolutionary History.
by Christoph de Haën (Author)
Publisher: CRC Press; 1 edition (17 April 2019)
ISBN-10: 1138351644 ISBN-13: 978-1138351646
Christoph has written a brilliant book on the history of iodinated contrast media. It is well written, illustrated and referenced and will become the standard work on the subject. The story is an interesting and well-told one, and is an essential addition to a library on the history of radiology.

A Map of the Invisible: Journeys into Particle Physics.
by Jon Butterworth (Author)
Publisher: William Heinemann (5 Oct. 2017)
ISBN-10: 1785150936 ISBN-13: 978-d work.
Jon Butterworth is Professor of Physics at University College London, and a member of the ATLAS Collaboration at the CERN Large Hadron Collider. The topic of particle physics is interesting and complex and not easy to understand. It's easy for writers on the subject to slip into unverifiable mysticism and pseudoscience. This book is in a popular style and explores the extraordinary world of particle physics. The book is beautifully written, and compares well to George Gamov and his classic books about Mr. Thompson. We should remember that it was the discovery of X-rays that started the fall of classical physics and brought in modern physics. This book would make a good present for a young person interested in science.

X Ray Audio.
By Stephen Coates (Editor)
Publisher: Strange Attractor Press (1 Oct. 2015)
ISBN-10: 1907222383 ISBN-13: 978-1907222382
This is a brilliant book telling the fascinating story of the forbidden Western music that was recorded on to X-ray film in Communist Russia. The tale is told well, with many illustrations. These X-ray discs can be picked up on eBay quite easily and are a fun addition to any collection. It's strange to hold a radiograph that has been turned into a gramophone disc in one's hands.

Zapped: From Infrared to X-rays, the Curious History of Invisible Light.
by Bob Berman (Author)
Publisher: Little, Brown US (26 Oct. 2017)
ISBN-10: 0316311308 ISBN-13: 978-0316311304
This is a popular and interesting unreferenced account of Röntgen and his X-rays, and including the various forms of radiation. Radiation in its many forms is all around us all of the time, including mobile 'phone towers, tanning salons, microwave ovens, CT scanners, mammogram machines, saunas, and nuclear power plants. All are emitting radiation in our general direction. This book would make a good present for a young person interested in science and the modern world

Soaking Up the Rays: Light Therapy and Visual Culture in Britain, 1890-1940.
by Tania Woloshyn (Author)
Publisher: Manchester University Press (3 Aug. 2017)
ISBN-10: 1784995126 ISBN-13: 978-1784995126
This is a very good book, and is now the definitive text on the subject. The subject of heliotherapy and actinotherapy is an important one, and many radiologists (such as Florence Stoney in Bournemouth) practiced light therapy in addition to radiotherapy. This book is now essential reading for anyone interested in the topic.

X-Ray: Art-Photography.
by Werner Schuster (Author), Rene Harather (Author)
Publisher: Hirmer Publishers; Bilingual edition (28 Feb. 2013)
ISBN-10: 9783777480817 ISBN-13: 978-3777480817 ASIN: 3777480819
Werner Schuster is a radiologist who is fascinated by photography and René Harather is a historian. His lovely book examiners and explores x-ray photography as art. There are many beautiful illustrations. The relationship between science and art is a fertile one, and this book does not disappoint.

Radium Girls
by Kate Moore (Author)
Publisher: Simon & Schuster UK (31 May 2018)
ISBN-10: 1471153886
ISBN-13: 978-1471153884
I recently went to a book reading of *Radium Girls* in Eltham Library and met the author Kate Moore. She read in an engaging manner and connected with her audience. The story of the radium dial painters is a sad and tragic one. The value of this book is that it is told from the perspective of the dial painters and their families, and the book is deservedly popular.

Is Medicine Still Good for Us? (The Big Idea)
by Julian Sheather (Author)
Publisher: Thames and Hudson Ltd; 1 edition (18 April 2019)
ISBN-10: 0500294585 ISBN-13: 978-0500294581
This is an important topic. It's all too easy to present the history of radiology as one of continuous improvements and advances, and to ignore the negative aspects. There is current concern about over diagnosis and over treatment and inappropriate or unwise use of radiology has contributed to the problem. Already by 1910 Bythell and Barclay, from Manchester, were commenting on the adverse effects of imaging when performed in isolation from history taking and physical examination. The book discusses MRI and its contribution to over diagnosis, and considers modern medicine generally. An important topic and well worth reading.

Wilhelm Conrad Röntgen: The Birth of Radiology (Springer Biographies)
by Gerd Rosenbusch (Author), de Knecht-van Eekelen, Annemarie (Author)
Publisher: Springer; 1st ed. 2019 edition (2 April 2019)
ISBN-10: 3319976605 ISBN-13: 978-3319976600
This is a lovely book and well i9llustrated. It sheds fresh light on the life and work of Wilhelm Conrad Röntgen, and demonstrating how his personality was formed by his youth in the Netherlands and by his teachers in Switzerland. The authors place Röntgen in a scientific and cultural context. There can never be too many books on Röntgen, and this book is warmly recommended.

Takis.
by Guy Brett (Author, Editor)
Publisher: Tate Publishing; 01 edition (3 July 2019)
ISBN-10: 1849766312 ISBN-13: 978-1849766319
I went along to the exhibition at Tate Modern in London having seen a review in *The Spectator*. The relationship between art and science is a fertile one, and Takis (1925-1919) was described as "One of the most playful, innovative and eccentric artists of Postwar Europe". Sadly he died during the exhibition. I was interested in his harnessing of invisible natural forces in his telemagnetic works, which were begun in the late 1950s and used everyday metallic objects that float effortlessly in space through the use of magnets. His work attracted the admiration of 'Beat' writers such as Allen Ginsberg and William Burroughs. This book is the first English language introduction to Takis. I found the general idea of creating three dimensional objects/sculpture using magnets and having objects floating in space fascinating, and the viewers specific response to individual pieces will depend upon their attitude to modern art.

Cold War Secret Nuclear Bunkers: The Passive Defence of the Western World During the Cold War (Pen & Sword Military Classics Book 80).
by Nick McCamley (Author)
Publisher: Pen & Sword Books Ltd (7 Mar. 2000)
ISBN-10: 0850527465 ISBN-13: 978-0850527469
This is a well-illustrated and informative account of the nuclear bunkers that were built during the Cold War. Fortunately they were never needed. As a child I was convinced that I would die in a nuclear war, and could not understand why my father chose to live in London, which was sure to be flattened. The first political event that I remember with clarity was the Cuban Missile Crisis of 1962 and I was convinced we were all going to die. A Nuclear Bunker may be visited in Essex at the Kelvedon Hatch Secret Nuclear

Bunker and the site is well displayed. www.secretnuclearbunker.com . One wonders how contemporary bunkers are constructed and where they are situated?

Handbook of X-ray Imaging: Physics and Technology (Series in Medical Physics and Biomedical Engineering)
By Paolo Russo (Editor)
Publisher: CRC Press; 1 edition (8 Nov. 2017)
ISBN-10: 1498741525 ISBN-13: 978-1498741521
This is a large textbook covering all aspects of X-ray imaging. It's good that there is a significant historical component, with several historical chapters in an otherwise technical book. The historical chapters include:

Rolf Behling: History of X-ray Tubes.
Uwe Busch: Wilhelm Conrad Röntgen: The Discovery of X-rays and the Creation of a New Medical Profession.
Adrian Thomas: History of Radiology.
Deutsches Röntgen-Museum: Historical Image Gallery.

The book covers the theory as well as the techniques and the devices routinely used in the various fields. Theories of image quality are fully illustrated. Historical, radioprotection, radiation dosimetry, quality assurance and educational aspects are also covered.

Edith and Florence Stoney, Sisters in Radiology (Springer Biographies)
by Adrian Thomas (Author), Francis Duck (Author)
Publisher: Springer; 1st ed. 2019 edition (15 July 2019)
ISBN-10: 3030165604 ISBN-13: 978-3030165604
"This book explores the lives and achievements of two Irish sisters, Edith and Florence Stoney, who pioneered the use of new electromedical technologies, especially X-rays but also ultraviolet radiation and diathermy. In addition, however, the narrative follows several intertwined themes as experienced by the sisters during their lifetimes. Their upbringing, influenced by their liberal-minded scientist father, set the tone for both their lives. Irish independence fractured their family heritage. Their professional experiences, fulfilling for Florence as a qualified doctor but often frustrating for Edith as a Cambridge-educated scientist, mirrored those of other aspiring women during this period, when the suffragist movement expanded and women's lobby groups were formed. World War I created an environment in which their unusual specialist knowledge was widely needed, and the sisters' war experiences are carefully examined in the book. But ultimately this is the extraordinary story of two independent but closely bonded sisters and their abiding love and support for one another." Taken from the blurb. Hopefully a more detailed review will follow.

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The Giffords of Chard

Lieut.-Colonel James William Gifford JP (1856-1930)
and
Mrs. Emma Rossiter Gifford MBE (1861-1936)

Adrian Thomas
Canterbury Christ Church University

Based on a presentation made to the 28th Biennial Congress of the British Society for the History of Medicine held in Bristol, UK from 11th -14th September 2019.

Abstract.

Colonel James William Gifford FRPS (1856-1930) of Chard in Somerset, was a lace manufacturer and scientist. Gifford had many scientific interests including astronomy, optics and photography. He was an amateur scientist, and had been a voluntary assistant to Sir William Crookes FRS. Gifford was interested in X-rays from the earliest days, and was one of the first members of the Röntgen Society. He presented his work at the first annual meeting of the Röntgen Society (the forerunner of the British Institute of Radiology) in 1897. Gifford had a home laboratory at his house "Oaklands" in Chard, and a contemporary photograph shows him surrounded by the apparatus needed to produce X-rays. Some of Gifford's other scientific interests are indicated by the presence of a spectroscope and a collection of chemicals pictured in the background. Gifford had a close scientific partnership with his wife Emma. The husband and wife team took a series of important radiographs in January 1896 shortly after the discovery by Röntgen. Gifford gave one of the earliest public demonstrations of X-rays in London at the Royal Photographic Society in 12 Hanover Square on 21 January 1896, and also published many articles on the subject in various journals. Emma Gifford was a mathematician and published an important book "Natural Sines to Every Second of Arc, and Eight Places of Decimals" in 1914 from Chard.

Introduction.

James Gifford is an important figure in the early history of radiology, and he also made significant contributions to optics. As a private scientist working with his wife Emma he illustrates the value of disinterested research. I have been interested in James Gifford for many years, and it's difficult to be interested in the history of radiology and not be interested in James and Emma Gifford. I remember discussions with the late Derek Guttery whose premature death was such a great loss to radiology history. Following his death, his son Simon Guttery copied his father's hard drive for me, and I have reproduced some of the writings in this journal. These include an interesting lecture on early radiology [i] and a long letter about James Gifford [ii].

Gifford Fox & Co.

In 1842 James Benjamin Gifford started manufacturing lace at Forton in Lancashire[1]. He moved to Chard in 1856 founding the company Messrs. Gifford, Fox & Co. of Nottingham and Chard, and based in Holyrood Mill [iii]. Chard is an old town with a rich history. England was having considerable economic difficulties during the period following the Napoleonic Wars, and technological developments whilst increasing overall wealth were causing significant suffering to working people as manufacturing and farming mechanised. This may be compared to the concerns of today with the introduction of robotics and artificial intelligence and the fear that numbers employed will fall. There were riots as a consequence of the fears, the so-called 'Luddite Riots', with the destruction either of farm equipment or of weaving looms. It might be imagined that the company was based in Chard to avoid the Luddite riots in the Midlands, however Chard was already a well-known centre of lace making and had already had its own share of troubles with the notorious lace riots of 1842 with workers protesting a fall in wages.

The firm was successful and became a major local employer. Although James was described as a 'hard' employer the town benefitted from the prosperity of his company, and wages were good. The Gifford's were described as being a 'blend of the progressive and the cautious' [iv], and so when the pioneer of unmanned powered flight John Stringfellow asked the older Gifford for financial help he was told in no uncertain terms 'Now Mr. Stringfellow, give up this nonsense; God never meant a man to fly and we shall never fly'! [2] The son James Gifford knew Stringfellow when he was an old man who was then earning his living by making brass bobbins and carriages for the bobbin net lace machine. However in 1866 when some of Gifford's workers wanted to form a 'Co-op' he made them a loan of £15 and allowed them to use part of the mill. The senior partner of the firm was William Francis Fox JP of East Bridgford Hall in Nottinghamshire. William was the son of the Charles Fox, of Wellington in Somerset where he had been born on March 11th, 1837. Chard is close to Wellington, and the Fox family were one of the most important local families in Wellington.

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[1] Lace as a product was first developed in Europe during the sixteenth century. Lace was traditionally a luxury item for the rich, and making it by hand was a painstaking and time-consuming production. The introduction of automation facilitated the production of complex designs that were now available to more people and at a lower cost. The bobbin net machine was invented by John Heathcoat (1783 - 1861). John Heathcoat and Samuel Caldwell (son of William Caldwell) were granted their first patent in 1804 'for a new apparatus to be attached to warp frames, whereby all kinds of thread lace and mitts of a lacy description may be made'. It was four years later in 1808 that John Heathcoat patented his bobbin net machine, with a second patent in 1809 for an improved machine. John Heathcoat became partners with Charles Lacy who was a point net lace manufacturer. By 1816 their partnership had 55 frames working at their factory in Loughborough.

[2] John Stringfellow first constructed an aeroplane that would fly in 1847. It was improved in 1868 when a machine flew across the Crystal Palace at the Exhibition of the Aeronautical Society of Great Britain, and Stringfellow won £100 prize. The aeroplane was powered by a steam engine, and apart from being unmanned, its principles of operation were the same as the early manned aircraft.

James Benjamin Gifford took an active part in the affairs of Chard, as did his son after him, and as an example in May 1857 he was elected to the newly-elected Board of Guardians of the Chard Union Workhouse. James Benjamin attended the first meeting of the new board and it is recorded that 'At the conclusion of the business the old and new boards dined together at the George Inn; other gentlemen joined the party by invitation, and the catering of Mr. and Mrs. Corner gave great satisfaction' [v]. Certainly the catering at the George Inn would have been rather different from the scant fare received by the inmates of the workhouse.

James William Gifford was born in Chard to James Benjamin Gifford and his wife Mary Jane Gifford on the 29 February 1856. In later life James was to become one of Chard's most honoured and prominent townsmen. James attended a school for boys located in the High Street of Chard, and run by a Monsieur Delfraisse, where he became fluent in French. James was then educated at Chard Grammar School [3] and he maintained his links with the school throughout his life. Following Chard School James attended Amersham Hall. Amersham Hall was described as a 'school for the sons of dignified gentlemen' and had relocated in 1861 to its Caversham site in the north of Reading. There were a number of notable alumni including the economist John Neville Keynes (1852-1949) and the neurophysiologist Francis Gotch (1853-1913). James would have received an excellent education at both Chard Grammar School and Amersham Hall.

James is recorded as spending six months in Lyon before entering his father's lace making firm. This cannot have been without a good reason for the son of a lace manufacturing family. This was a time of technological advances in lace making and textile manufacturing, and Lyon was an important centre in the French lace making industry [vi]. The lace made in Lyon was called the 'Dentelle de Lyon' (Lace of Lyon) and made by the Dognin Company which was the original firm to whom Lyon's lace making history is indebted. In 1805 Jean-Claude Dognin (1785-1848) had opened his silk tulle business in Lyon (La Maison Dognin/Dognin & Cie) entering into partnership with the English businessman Augustin Isaac, who had patented a Jacquard loom, allowing him to produce lace on a tulle bobbin machine. The Jacquard machine [4] is a piece of apparatus fitted to a power loom that dramatically simplified the process of manufacturing textiles that had complex patterns including brocade, damask and matelassé. In 1851 J B Gifford's Blackland Mill is recorded as possessing twelve plain net machines and one Jacquard machine [vii] .

James William Gifford spent his working life in the lace making business, becoming the Chairman of the Board of Directors. The firm of Gifford, Fox & Co. prospered under his management and a 'remarkably advanced' factory was erected in Holyrood

[3] The building that became Chard School dates from 1583 (however James Gifford held that this date on the rain-water pipe was misleading) and the house was donated to Chard as a Grammar School in 1671. There has been a school on the site ever since. The school remained the grammar school until 1890, when it became a public boarding school. In 1972 the present Chard School was configured as an independent and co-educational preparatory school (http://chardschool.co.uk).

[4] The Jacquard machine was invented by the Frenchman Joseph Marie Jacquard (1752-1834) in 1804. The device used a series of replaceable punched cards which controlled the working of the loom. As such this may be seen as a step towards the development of computer hardware and certainly influenced Charles Babbage.

Street. The factory was technologically advanced for its time, and the building still exists and currently houses the town's library and council offices.

James had many interests apart from the sciences. He was a musician playing the piano, organ and violin. He spoke many languages being fluent French, German and Italian. He could also read Greek and Latin, and knew a little of Modern Greek, Hebrew and Chaldean.

In 1883 James married Emma Rossiter. The couple were married on the 1 May at Holy Trinity Church in Weston-Super-Mare. James was then aged 27, and Emma was 21. Emma had been born on 19 November 1861 at Taunton in Somerset. Her father Ernest Rossiter was a solicitor in Taunton, and her mother was Laura Rossiter (Her maiden name was Laura Mare). Emma was educated at Dover and at Bedford College in London [5]. It is significant that Emma was educated outside the home since during this period there was a significant concern about the low standard of education of many girls who had only received a home-based education by a governess [viii]. The time of Emma's childhood was a period of general improvement in the education of girls, and the Girls Public Day School College (Later Trust) had been founded in 1873. There were insufficient numbers of schools for girls and this is why so many were educated at home. When Emma attended Bedford College it was located in York Place, which was located off Baker Street in London having moved there in 1874. It is now the Sherlock Holmes Hotel. In 1878 there was a major advance for women when the University of London admitted women to its degrees. When Emma was at Bedford College the Head of the Mathematics Department was Percy John Harding (1845 - 1943)[ix]. Harding became the Head in 1870 and was associated with Bedford College for over 50 years. He was a stimulating teacher and would have had made a profound impression on Emma. On 1 March 1906 he gave a talk at Bedford College on 'The History and Human Side of Mathematics' and is remembered in the Harding Prize in Mathematics. Harding was prestigious enough to have been an invited speaker at the International Congress of Mathematicians held at Cambridge in 1912 speaking on 'The history and evolution of arithmetic division.'

The young couple established their family home at Oaklands on the Crewkerne Road in Chard. James and Emma were obviously a good team and shared many interests. Emma gave assistance to James in his scientific work and he pays grateful tribute in many of his papers. They had five children, four daughters and a son. The children

[5] Bedford College was an important institution. It was founded by the social reformer Elizabeth Jesser Reid (1789-1866) in 1849 as the first women's university in the United Kingdom, and was initially located at 47 Bedford Square in London. In 1900 Bedford College became a constituent school of the University of London. In 1985 Bedford College merged with the Royal Holloway College and the name Bedford has been lost. The purpose of the college was to provide a liberal and non-sectarian education for women and Reid was a convinced Unitarian and anti-slavery activist. In the 1880s Bedford College was raising its educational standards and an entrance examination had been introduced. The College introduced an internal diploma in 1880 for students who were not wanting to undertake a degree course. Bedford College played a major role in the advancement of women in higher education, and in public life, and its values would have strongly influenced Emma's later life and work in Chard.

were Dorothy Edith (b 1884), Ralph Eric (b 1885) [6] , Sylvia Constance (b1889), Winifred Mary (b 1897), and Gwendoline Maud (b1900). The children's governess Evelyn Maud Sanford Bayliss lived with them for many years, and they had between three and four servants. On 22 May 1897 Emma advertised in the Chard and Ilminster News for an experienced house parlour-maid to work at Oaklands and to assist with the working of the house.

Oaklands, the home of James and Emma Gifford, on the Crewkerne Road in Chard

Gifford had a modern and well-equipped private laboratory and an observatory in his home at Oaklands in Chard where he was assisted by Emma. There was a telescope on the balcony of the house, and a larger instrument was located in the grounds, and these delighted their many guests. James was a Fellow of the Royal Astronomical Society (FRAS)(elected Jan 8, 1909) because of the improvements that he had made to telescope lenses. He was also made a Fellow of the Royal Microscopical Society (FRMS) following his visualisation of the previously unobserved diatom *pleurosigma quadratum* [7]. Both of these events give testimony to his practical skills and ability.

X-Ray Studies.

The astonishing discovery by Wilhelm Conrad Röntgen of the X-rays on 8 November 1895 created a sensation and astonished both the public and the scientific community [x]. The newspapers and scientific journals described the discovery, and reassurances that this was a real discovery were necessary since the visualisation of the skeleton in the living body would seem so unlikely [xi].

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[6] Ralph Eric Gifford was born on 11th December 1885 at Chard. He attended school at Marlborough College (1898-1902), and was an undergraduate at Clare College, Cambridge. He was an active athlete and was a member of the Clifton Rugby Football Club joining in 1902/03. He became director of the family business Messrs. Gifford and Fox, Lace Manufacturers. In 1912 he married Mildred P Ostrehan. He followed his father into the army, and served in the Great War. Ralph died on 13th January 1955 at Paintmoor House in Chard, and is buried at St. Mary's Church.

[7] *Pleurosigma quadratum* is a species of diatom in the family Pleurosigmataceae. In the 1870s there were few microscopic objects that were so frequently or critically examined than the siliceous valves of these beautiful diatoms. This was to both determine the exact nature of the markings on diatoms, as well as to test the function of the microscope.

Snowdon Ward recorded that the first public announcement of X-rays had been made on January 13, 1896 by James Gifford in a communication he made to the Royal Photographic Society for its 14 January meeting. Gifford's initial efforts were met with a failure to repeat Röntgen's results even though he had a set of Crookes' globular tubes that were needed for the experiment. On the 16th of the same month James made another communication describing his success and he enclose a series of his results [xii]. On the 18 January he was able to 'electrograph' (as he termed radiography) his son's hand through cardboard, with an exposure time of 10 to 15 minutes. Emma Gifford noted in a letter to *The Times* of 27 February 1932 that "…my husband took his (radiograph) at the request of my son, a boy of 10, on Saturday afternoon. I well remember the excitement when my husband came out of the dark room with the dripping negative in his hand and said 'You can see the bones' " James presented one on the first demonstrations of the new X-rays at 12 Hanover Square in London to the Royal Photographic Society on the 21 January 1896 and this was recorded in *The Photographic Journal* [xiii]. He communicated again to the Royal Photographic Society on the 29 January 1896 [xiv] on what was being called 'The New Photography' and introduced his theory that the nature of X-rays could be likened to the vibrations that were produced by tuning forks, a theory that he was to repeat in his lecture in Bath in February. However he made an error when he claimed that the new rays could be refracted by an aluminium plate.

James Gifford experimenting in his laboratory at Chard, from The Windsor Magazine of April 1896

In early February 1896 James Gifford gave a presentation on 'The New Photography' to a packed meeting of the Bath Photographic Society held at the Literary Society [xv]. The chairman remarked that what was shown would have been thought improbable only a few years ago. Gifford was described as showing a great enthusiasm and great powers of patience and concentration. He said that he had pursued his studies and researches without the least object of personal advantage to himself and only for the pure love of science. He had brought a large induction coil to the lecture and commented that it was taking one's life in one's hands to deal with it at all carelessly. In his room at Chard his induction coil was kept high up and out of reach. Early in the evening at Bath James took a photograph with the remarkable rays 'to which few if any substances are obsoletely opaque'. A child with a malformed hand who was attending the Royal United Hospital in Bath was examined. The photographic plate was shielded from the gaslight in the room and covered with a sheet of celluloid.

Gifford said that Lenard had discovered the 'mysterious penetrative rays some years ago and which Rontgen rediscovered more thoroughly quite recently. Lenard, as Mr. Gifford put it, did not get hold of the journalist, and it was left for Rontgen to arouse public interest.' Others apart from James would repeat the assertion. Gifford used a Crookes' tube held at a foot above the boy's hand. The tube gave off a greenish glow and the exposure lasted a full 15 minutes. Gifford had found that a lead diaphragm (that is a sheet of lead with a hole in it) increased the sharpness of the image, but also increased to exposure time. Whilst the exposure was being made he described the various objects that he had examined. He showed many lantern slides of hands, feet and arms that he had photographed, and also stated that he had been unable to focus the rays with a lens. The photograph of the boy's hand was developed and handed around the audience, and a further photograph of the foot of a man in the audience was made. Gifford discussed to possible nature of the new rays but 'guarded himself against the suspicion of dogmatism'.

The nature of the new rays was not known and there was considerable contemporary scientific speculation. Wilhelm Conrad Röntgen discovered X-rays on 8 November 1895 and nothing was to be the same again. Röntgen did not know what the new rays were and so he called them "X" as the unknown quantity. In his famous First Communication of 1895 Röntgen wrote:

> "May not the new rays be due to longitudinal vibrations in the ether? I must admit that I have put more and more faith in this idea in the course of my research, and in now behooves me therefore to announce my suspicion, although I know well that this explanation requites further corroboration."

In the May 1896 number of Popular Science Monthly [xvi] is said that 'A rather ingenious explanation of the X rays is offered by Mr. J. W. Gifford'. At the meeting in Bath he had said that he did not believed that X-rays were ultra-violet rays, and that he doubted if they were light at all, saying that the new rays are like the vibrations in a tuning fork setting up vibrations in a second tuning fork. In the Popular Science article we are told that 'He (Gifford) likens the Crookes tube to a vibrating tuning fork, which, if sounding simple A, would set an A violin string vibrating not only A but its octave and the fifth to its octave, and quite a host of other overtones or harmonics of rapidly decreasing wave length which would seem to have no theoretical limit. The waves of long period from a Crookes tube would pass through wood, paper, or the human body, without much resistance, but would be absorbed or reflected by the denser metals. But if objects capable of taking up their vibrations lay in the path of these long rays they would set them vibrating like the violin string, and might in the same way produce overtones which did not before exist. These overtones may include waves of such short lengths as to cause the objects themselves to become luminous. If so, the light waves in question, although they are distinctly instrumental in darkening a photographic plate exposed to them, have nevertheless not passed through, and could never pass through the obstacles easily traversed by the electric waves which gave them origin'.

It was not until many years later in May 1912 that Max von Laue passed a fine pencil beam of X-rays through a copper sulphate crystal and recorded the diffraction pattern on a photographic plate. The work of Max von Laue on diffraction gave solid evidence that X-rays were waves of electromagnetic radiation; however X-rays also

behave like particles because they can ionise gasses. Indeed it was this property of X-rays to ionising gasses that caused William Henry Bragg to argue in 1907 that X-rays were not electromagnetic radiation at all, a view that seems rather curious to us now. We now know that X-rays consist of photons and as such show characteristics of both particles and waves. The idea of the photon had been proposed by Albert Einstein in 1905, however it was not until 1922, and to the work of Arthur Compton that the theory was completely accepted.

A most interesting article by H Snowden Ward entitled 'Marvels of the New Light, Notes on the Röntgen Rays' was published in the April 1896 issue of Windsor Magazine [xvii]. The article gives a fascinating account of the earliest days of radiology, and was illustrated by electrographs (as they called radiographs) that were especially taken by James and Emma Gifford and also by Alan A Campbell-Swinton. In order to show the readers the nature of the apparatus needed there was an interesting picture of James Gifford experimenting with a vacuum tube in his workshop in Chard in April 1896. Snowden Ward recorded his indebtedness to Gifford, not only for supplying illustrations for his article, but also for allowing him to use the Gifford's laboratory at Chard and for assisting him in repeating Röntgen's experiments. In May 1896 Gifford described a new X-ray tube that he had made especially to his own design[xviii]. This tube resembled many of the early X-ray ion or gas tubes. In 1897 we find Gifford writing about the X-ray fluorescent screens that were used to enhance the photographic action of the X-rays [xix].

A cat's paw, after four minutes exposure – an electrograph by Emma Gifford, from The Windsor Magazine of April 1896

James Gifford was obviously well known to the early radiological community since his name is used as a recommendation in an advertisement in the first Archives of Clinical Skiagraphy that was edited by Sidney Rowland. The advertisement was inserted by C. Baker, Optical and Surgical Instrument Makers of 244 High Holborn in London. The advertisement was for a 30/- (£1.50) Radiant Matter Focus Tubes (guaranteed), and for a 21/- (£1.05p) Fluorescent Screen, 6½ by 4 ¾ inches (in dark box), and both "as supplied to Mr. Gifford". Of particular interest is that C Baker is selling "A Series of 42 Lantern Slides from Mr. J. W. Gifford's negatives". These retailed at 1/6 (7.5p) for a single slide, or 2/- (10p) for a print. These lantern slides illustrating the work of an acknowledged expert would have been invaluable for anyone who wanted to give an illustrated talk on the new subject.

The Röntgen Society (which was founded in 1897) became the British Institute of Radiology. This Society had a broad membership and included many amateur experimenters. James Gifford was one of the 127 members that were recorded at the end of its first year. The first meeting was a *conversazione* and was held on 15 November 1897 at St Martin's Town Hall in Marylebone. There was a large exhibition of radiographs, an 'Exhibition of Photographs', which was organized by Snowdon Ward. As part of this exhibition James Gifford presented examples of his early work. In the brochure for this meeting James is mentioned on page 2 and is recorded as: 97 Gifford, J. W., F.R.A.S., F.R.M.S., Chard, and Somerset.

The early manufacturer of gas tubes A C Cossor [xx] was a founder member of Röntgen Society and also demonstrated at the *conversazione* of the Röntgen Society in November 1897. Cossor's workshop was located at 54 Farrington Street in London, and he is recorded as supplying tubes to Colonel Gifford of Chard. The photograph of Cossor's workshop is on page 4 of the Snowdon Ward's Windsor Magazine article. James obviously thought highly of Cossor's vacuum tubes and in an advertisement in the October 1896 volume of the *Process Photogram* is quoted as saying: 'All the tubes you have sent me latterly have been unmatched by any other maker.' That the other authority used in the advertisement was the Birmingham pioneer radiologist John Hall-Edwards, who was a major figure in British radiology, gives an indication as to the esteem in which Gifford was held in these early days of the new subject.

James Gifford published extensively in relation to his X-ray work in the early years of the subject before he turned his attention to optics, and papers appeared in *The Photographic Journal*, in *the British Journal of Photography*, in *Knowledge*, and in the prestigious journal *Nature*. His paper in *Knowledge* [xxi] is worth quoting illustrating the necessary technique used in that period:

> "The subject to be operated on is taken into the darkroom. A sheet of celluloid or mica is laid over the film of a sensitive plate; the hand, if that is the part to be electrographed, is laid on the celluloid, and the whole enclosed in a black cloth bag, tied tightly round the wrist so that no light may get at the plate. The plate may then be taken into broad daylight - not bright sunshine - and laid with the patient's hand upon it, on a table over which the bulb [Crookes tube] is hung. ... In some experiments no celluloid was used, and in more than one

> case the warm moisture of the hand partially melted the gelatine. In others a paper bag made of grocer's paper was slipped over the plate to prevent contact. The paper meant is the greased paper used for wrapping up butter; ... but in some cases the grease melted, and the last of that plate was worse than the first..."

There is no record of James Gifford having experienced any of the harmful effects of ionizing radiation that were so commonly seen in the first generation of X-ray workers. This is presumably because he stopped most of his X-ray work in favour of his studies of optics. Optical researches would have been significantly easier for an independent scientist to pursue, and more advanced X-ray research would require more resources than an independent scientist could muster. However the achievements of James and Emma Gifford are quite remarkable.

In 1910 Alexander Cambridge (1874-1957), Prince of Teck and 1st Earl of Athlone, and who was chairman of the Weekly Board of the Middlesex Hospital, received a letter from James in which he announced his intention of presenting 40 milligrams of radium to the Cancer Research Laboratories of the Middlesex Hospital for the prosecution of their investigations [xxii]. At current rates (for 1910) this quantity of radium, weighing approximately one seven-hundredth of an ounce, is worth about £600 (or £70,000 in 2019). When he learnt that the radium was of less quality that expected, he gave additional monies so as not to disappoint Prince Alexander and the governors. It was stated in the *Archives of the Roentgen Ray* that 'It is to be hoped that this generous gift will encourage other possessors of Radium to give or lend their specimens to one or other of the Hospitals which are in urgent need of it. It seems a pity that so much Radium is hoarded by people, who would be the first to devote it to the benefit of the sick if they could only realise the virtual Radium famine that now exists, and the uses to which it may be put for treatment and research'.

Optics.

James Gifford's main contributions were in the field of optics, and as an example he was the author of many important papers dealing with both the construction and improvement of telescopic lenses. He was active in the Royal Astronomical Society, the Optical, Microscopical, and other kindred Societies, and communicated numerous 'The Refractive Indices of Fluorite, Quartz, and Calcite', 'The Refractive Indices of Water and Sea Water', 'The Refractive Indices of Benzene and Cyclo-hexane', and 'The Existing Limits of Uniformity in producing Optical Glass'. Gifford worked with William Ashwell Shenstone FRS (1850-1908) senior science master at Clifton College in Bristol and close to Chard. Shenstone was an excellent chemist and collaborated with James with many publications including 'The Optical Properties of Vitreous Silica' in 1904 [xxiii]. James also collaborated with Thomas Martin Lowry CBE FRS (1874-1936) who was a physical chemist and who from 1920 held the Chair in Physical Chemistry at the University of Cambridge. Lowry shared an interest in optics with James and was particularly interested in optical rotation. One of their collaborations resulted in a paper on 'Some refractive indices of benzene and cyclohexane' published in 1923 and they noted that it has been possible in certain classes of compounds to draw important distinctions between substances which exhibit "simple" and those which exhibit "complex" rotatory dispersion [xxiv]. James Gifford was working at a high level and this makes the comment of Fletcher *et al* in

1962 that James' optical work was a 'great hobby' seem more than a little patronising [xxv].

In September 1920 James visited the USA and he was accompanied by a Miss Gifford, presumably one of his daughters. The visit was being made by British glass experts and manufacturers, and the party of 35 included representatives from Sheffield University, from prominent glass companies of the British Isles, and members of the British Society of Glass Technology. The purpose of the visit was to view modern glass production [xxvi] as guests, and under the guidance, of the American Ceramic Society. On the morning of Wednesday, 9 September, the group visited the Libbey-Owens Sheet Glass Company at Kanawha City in Charleston in West Virginia. The plant at Charleston was the largest in the world, and the visitors wanted to view the Libbey-Owens window glass machine which could automatically make window glass of any desired thickness. The group went to various locations including Pittsburgh to see their glass industry, and to Fairmont and Clarksburg and finishing at Columbus, Ohio. James and his daughter would have found the visits interesting, viewing modern and innovative glass production methods.

James worked with the London firm of Adam Hilger Ltd. Adam Hilger were located at 75a Camden Road, London, NW1 and were makers of optical instruments used in the control of industrial processes [xxvii]. With Adam Hilger James developed fluorite prisms in about 1902, and in 1928 developed fluoro-quartz lenses for ultra-violet photography. A collection of prisms used by James Gifford and made by Adam Hilger Ltd. are held by the Science Museum in London [8] [xxviii]. The reputation of James Gifford was obviously well known to potential customers of Adam Hilger since in their March 1920 product catalogue in their section on wavelength spectrometers they state that 'We can now supply for these Spectrometers apochromatic triple object glasses. The calculations for these lenses and the measurements of the refractive indices of the glasses used have been made by J. W. Gifford, Esq'.

In 1927 James' book *Lens Computing by Trigonometrical Trace* was published [xxix]. The foreword to the book was written by Prof. F. Cheshire, who was formerly the Director of the Technical Optics Department of the Imperial College of Science and Technology in London. Cheshire pointed out that 'Colonel Gifford is one of that very select band ….. of successful optical designers and computers (note: that is mathematicians) inspired by love of the work only', and that he 'never relied upon the glass-makers' catalogue for the optical constants of the glasses, but determined these data for himself, and the excellency of the systems that he produced was undoubtedly due to this fact'. Personal experimental verification was always important for James. His optical researches were never simply theoretical, and his lenses were both made and tested. His aim in the book was to produce a handbook of trigonometrical trace as applied to Optics and said that it was at the 'request of some of my friends, in a very humble spirit, and painfully conscious of my many shortcomings, I have set out an attempt to supply this need'. The book is very practical and full of advice. He pays

[8] The collection of prisms comprises: Left-handed quartz prism, c. 1902., Fused Silica Prism (compound - 4 segments), c. 1902., Fused Silica Prism, c. 1902, Fluorite Prism, c.1902., Hollow Prism of natural quartz with mounting lug on base, and three quartz windows for same, c.1902.

tribute to his friend E M Nelson [9] who gave him his early training in optics, and quotes from him in the book. As has been shown, James and Emma worked as a team and her mathematical expertise in trigonometry supported James' work and her assistance is acknowledged in this book.

Chard Volunteer Battalion Somerset Light Infantry

In the mid-nineteenth century there were continual concerns about the possibility of a French invasion. The Napoleonic Wars were within the memory of many. Many Rifle Volunteer Corps were set up, and in 1882 James was commissioned into the newly formed 2nd Volunteer Battalion Somerset Light Infantry. James was active with the Corps which became part of the Territorial Army. His son Ralph Eric Gifford kept up the family tradition joining 2nd Volunteer Battalion in Chard in 1905. In 1910 as Lieutenant Colonel James became the Commanding Officer of the 5th Battalion, Prince Albert's (Somerset Light Infantry), retaining the post until he resigned his commission in 1913. James was allowed to retain his rank and to wear the prescribed uniform [xxx]. In 1925 James was appointed Honorary Colonel of the 5th Battalion and he took the position seriously and was concerned for the welfare of the battalion. At the annual camp of 1929 the Duke of York, as Colonel of the Regiment, visited the battalion and was welcomed by James and the other officers. James was awarded the VD (Volunteer Decoration) for his long service.

The Great War.

During the First World War Emma was commandant of the Red Cross Hospital which was located in Monmouth House in Chard (And as published in the Supplement to the London Gazette of 30 March 1920). Her service as recorded on her Voluntary Aid Detachment (VAD) service card [xxxi] was from 30 December 1915 to 2 April 1919 at VAD Monmouth House Hospital in Chard. She held the 5 years' Service Badge BRCS (British Red Cross Society), FA (Field Ambulance) Proficiency Badge, HS (possibly Home Service) Proficiency Badge, and 2 stripes. The Chard VAD was registered in 1911. Monmouth House was modified for use as a hospital and by the end of 1915 38 wounded soldiers had been admitted. Emma put all of her efforts into the hospital so as to ensure that the patients would be cared for as well as possible. The medical staff consisted of Drs Sunderland and Jupp, and the sister-in-Charge was Nurse Fletcher who was paid for by James Gifford. By 2 May 1919 there were 52 beds and 1162 patients had been treated. To orgnaise a 52 bed hospital required considerable organisational skills and the success of the hospital was largely due to the work of Emma. The Red Cross Society had only provided an initial funding of £10, and the staff eventually numbered 30. The government provided funding of 3s (15p) per patient per day, although this amount was only received towards the end of the hospital's existence. Fundraising was therefore needed for the hospital and Emma spoke of the generosity of her husband, and also noted that she when she walked up

[9] Edward Milles Nelson (1851-1938) was a microscopist (and interested in the development of microscopy), and was deeply interested in mathematical optics. He studied at Corpus Christi College in Cambridge, and worked in telegraphy laying submarine cables off the coast of South America and from the Shetlands. His main interest was in testing the performance and optical performance of optical instruments such as sextants and telescopes, and as such shared this interest with James Gifford. Nelson was a deeply respected President of the Royal Microscopical Society and played a major role in developing modern microscopy.

the High Street in Chard that bank notes and money would be thrust into her hand. The hospital had an excellent reputation with the authorities. The Chard VAD hospital was the only one authorised to treat amputees and this was due to the work of Messrs. J Gillingham & Sons and 245 patients were so treated [10]. The Gifford's home Oaklands House was also pressed into war service. The wounded soldiers were very appreciative of Chard VAD and its Commandant and compared it very favourably to other hospitals. Emma's financial management was impeccable and when the hospital finally closed there was a surplus of funds which were donated to the Chard and District War Memorial Hospital. Most VAD hospitals showed a deficit.

For her Red Cross work service Emma was awarded the Freedom of the Borough on February 4, 1920, and the MBE in 1920. Emma was the first woman to be awarded the honorary Freedom of the Borough of Chard, which was the highest honour that the town could offer. The Scroll of the Freedom was contained in a tortoiseshell casket that was inlaid with ivory and silver, and bore the arms of the Borough in silver.

James was deeply patriotic and, although unable to serve when war broke out in 1914 because of medical reasons, he helped as much as he could and assisted with the recruiting of soldiers by addressing meetings in Chard and its neighbourhood. His work with lenses did not escape the attention of the Admiralty, according to the Chard and Ilminster News of August 2, 1919, when they reported that he had designed periscopes and telescopes, including a submarine telescope following, 'valuable investigations into the transparency of sea water'.

His health did not prevent him from going to France, and he was sent to the front by the War Office to report upon the use of giant periscopes by the Germans in the trenches, as the Government was considering using them. On his return to England James advised against them as they only served 'to draw fire, and shortly after the Germans removed their instruments, thus proving the value of his advice.' How the Germans discovered this report was unknown and a mystery.

Later in the war James designed and produced a short and convenient high-power telescope to be used by officers. His work on telescopes was also noted in the obituary written by Harold St George Gray in the 1930 Proceedings of the Somerset Archaeological and Natural History Society: 'As a valuable contribution to the Great War, Colonel Gifford had made at his own expense and from his own calculations many hundreds of telescopes for the troops during the war, and they were admittedly the best sent out.' It is estimated that he personally spent over £4,000 (worth approximately £350,000 in 2019 prices). An officer from Chard who was serving in Salonica and Palestine was shown an excellent telescope that had been presented to a neighbouring company in the field. The officer was surprised to read on the telescope 'Computed and presented by Col J. W. Gifford of Chard'. When this incident was reported to James he gave a similar telescope to the officer for his company's use.

[10] James Gillingham (1839-1924) made boot and shoes in Chard calling his business the 'Golden Boot'. He met a man called Will Singleton who was about to have his arm amputated and taking pity on him promised to make him a new arm. The result was so successful that by word of mouth his business increased, His success was based on the fact that he moulded the prosthesis to the client's limb before the leather was hardened. The firm Messrs. J Gillingham & Sons only closed in the 1960s.

James was an active supporter of the Chard Veterans Association and the Royal British Legion.

Emma and Mathematics.

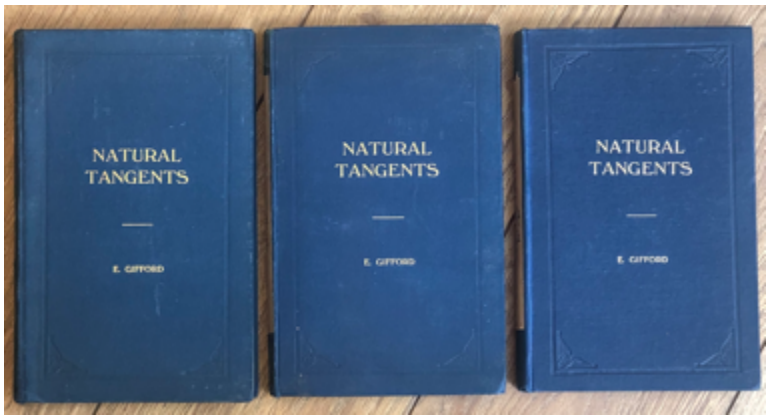
During and before the Great War Emma was active in her mathematical work. She published a series of significant books of mathematical tables which makes the comment by Fletcher *et al* that Emma was 'an extremely cultured lady but by no means a mathematician' seem rather odd [xxxii]. Fletcher further noted that Emma was 'married to a well-to-do lace manufacturer, whose great hobby was the manufacture of lenses, a field in which he established a good reputation for himself'. If we are charitable we might see Fletcher's view as based on ignorance, however I suspect that his is the progressive reading of history that was popular in the 1960s and he cannot imagine that an upper middle class husband and wife from a privileged background would have anything useful to contribute to society. In Fletcher's words we can feel the distain of the professional academic for the private individual. Although Emma was writing mathematical books that required a considerable mathematical expertise she was 'not a mathematician'. Presumably to be a mathematician a university qualification or position is essential. Fletcher even rather condescendingly dismisses James' work on Optics as a 'hobby'. The optical work required mathematical calculations and the Gifford's had three mechanical calculating machines of the Thomas' arithmometer type [11]. Ray tracing required the use of natural sines and, and again with what sounds highly condescending, Fletcher exclaims that 'Mrs. Gifford bravely began to construct a table'.

In 1914 *Natural Sines* was published with a second edition appearing in 1926 [xxxiii]. Emma was obviously well known enough to have been asked to present her work at the John Napier Tercentenary [12] Celebration that was held at the Royal Society in Edinburgh on July 24-28, 1914 [xxxiv]. Emma spoke on Monday, July 27 taking as a title 'On a recent table of sines'. In her talk she described her method of both computing and checking her recent table of natural sines, which gives the sine for every second of the quadrant. Between 1920 and 1927 there was published the three volumes of *Natural Tangents* [xxxv] and a *Table of Primes and Factors* appeared in 1931 [xxxvi]. Whilst these tables might seem quaint to us today when modern computing power is available so readily, it should be remembered that at the time Emma's work was cutting edge. Even Fletcher *et al* could say that 'Although this meritorious single-handed enterprise is somewhat marred by an inconvenient arrangement, nevertheless its appearance, in the in the very year when the tercentenary of Napier's invention of logarithms was celebrated in Edinburgh, helped to sound the death-knell of common logarithms, and marked an epoch in the approach of the era of calculating machines'.

[11] The Thomas arithmometer was invented by Thomas de Colmar in 1820. This was the first commercially manufactured mechanical calculator and was the preferred choice in the second half of the 19th century.

[12] John Napier (1550-1617), the 8th Laird of Merchiston, was a physicist, astronomer and mathematician. His great work on natural logarithms *Mirifici Logarithmorum Canonis Descriptio* was published in 1614.

The book *Natural Sines* was reviewed indicating that Emma had started her work from scratch, and that when she began her work on a table of natural sines to every second of arc she did not have any access to the work of Georg Joachim de Porris or Rheticus (1514-1574) [xxxvii]. By the expenditure of an amount of time and work which might be seen as out of all proportion to the results obtained she computed two hundred and forty sines. Emma then obtained a copy of the *Opus Palatinum* and proceeded to find the sines by interpolation [13]. Gottfried Leibniz (1646-1716) had recognized a number of major mathematical table projects, had commented that his newly invented calculating machine "has not been made for those who sell vegetables or little fish, but for observatories or halls of computers (or mathematicians)" [xxxviii] .



The three volumes of *Natural Tangents* (1920-1927) by Emma Gifford.

In 2012 Denis Roegel published a reconstruction of Emma's table of primes and factors of 1931 [xxxix] . Roegel again repeats the old assertion of Fletcher *et al* that Emma was 'by no means a mathematician'. Gifford's table was one of those used by Peters *et al* in their table published in 1935 [xl]. Roegel recorded that in 1932, it was suggested that the British Association Tables Committee prepare a table of the factors of all numbers less than 100000. Emma offered to prepare the manuscript, based on her table of primes and factors, and Mary Croarken noted that the British Association Mathematical Tables Committee did make use of small calculating teams as well as solitary workers [xli].

Life in Chard and Post War Life.

James was active in local affairs and supported many local causes. Indeed it would be difficult to find good local causes that he did not support. On the 6 April 1907 James was appointed as a Commissioner for Land Tax for Somerset and the Division of Ilminster. The Land Tax was initiated in 1693 and was for many years the only form

[13] In 1551 Rheticus produced a tract titled *Canon of the Science of Triangles*, or *Canon doctrinae triangulorum* the first publication of six-function trigonometric tables (although the word trigonometry was not yet coined). At his death, the *Science of Triangles* was still unfinished. However, paralleling his own relationship with Copernicus, Rheticus had acquired a student who devoted himself to completing his teacher's work. Valentinus Otho oversaw the hand computation of approximately 100,000 ratios to at least ten decimal places. When completed in 1596, the volume, *Opus palatinum de triangulis*, filled nearly 1,500 pages. Its tables were accurate enough to be used in astronomical computation into the early twentieth century. The *Opus Palatinum* of Rheticus published in 1596 (and the source book for Gifford's Natural sines) was said to be the work of eight computers (that is eight mathematicians). .

of direct taxation that was imposed on a regular basis. The commissioners had to have an income from land of £100 per year or more. The tax was finally abolished in 1963 [xlii].

In 1909 James gave money for a beautiful new East Window at St Brannock's Church in Braunton. The window commemorated the patron saints of Braunton. The window was dedicated by Robert Trefusis, the Bishop of Crediton, in April 1909 in memory of James' mother Mary. James, accompanied by Emma, unveiled the window, which was inscribed: 'In loving memory of my mother, Mary Jane, a native of Braunton, and wife of James Benjamin Gifford, of Chard'.

In 1909 James qualified as a Magistrate, otherwise known as a Justice of the Peace (JP), for the county of Somerset at the Michaelmas Quarter Sessions that were held in Wells. The position was unpaid [14]. In 1923 James is recorded as being a JP for the Ilminster Petty Sessional Division. He was also an active member of the Chard Literary and Scientific Society, sadly no longer in existence. In 1893 James had been persuaded to put himself forward for the Chard Town Council and he was duly elected, and again in 1896. He could not be persuaded to be nominated as Mayor, however he gave money for a link and a medallion for the Mayoral chain. He was an active member of St Mary's Parish Church and gave generously, whilst also supporting local Nonconformist chapels,

James was a chairman of the Board of Governors at Chard School, of which he was an old boy or Old Cerdic. He was a Trustee of the school for over 30 years. His support enabled the school to continue its activities and he did a great deal behind the scenes with no concern for self-aggrandizement, He was the first president of the Old Cerdics Association.

For thirty years he maintained at his own expense a nurse for the Chard and district. When he started this work with his sister Mrs. Loader Brown there were no health visitors, infant clinics or school doctors. The nurse was therefore of major importance for the town and the work of Nurse Henrietta Fischer was deeply appreciated. With Henry Bloden he provide a 50 guinea cup for the Chard Hospital Charity Football Competition which raised considerable sums of money for the local hospital. James also did X-ray studies for the local doctors until a short time before his death.

In the 1927/1928 session James was President of the Somerset Archaeological and Natural History Society. He had joined the society in 1884 and was particularly interested in the Natural History Section which was founded in the 20th century. In 1920 he was vice-president of the Ornithological Section and their visits to Chard Reservoir were always appreciated. He was President of the Microscopical Section in 1925. The 79th Annual Meeting of the Society was held at Chard on July 12 to 14 1927, and James was elected President at a meeting held at the Town Hall. There was an extensive programme of lectures and visits, and James was chairman of the local committee. The new President gave his address on the first day of the meeting on the subject of 'Old Chard' which is still interesting to read today. He described his boyhood exploration of an underground passage from the Chard caves to Crimchard

[14] Magistrates are not paid, and are not legally qualified. They receive training and have a legal advisor present in court. They deal with over 90% of all criminal cases, and also a range of civil offences.

House. It would seem that subsequent localization of this passage has proven problematic. On the afternoon of the 14th James and Emma entertained the members of the Society to afternoon tea. After tea members could either visit Chard Reservoir or there was an invitation to 'see Colonel Gifford's scientific instruments, etc.'

James died in Chard on the 27th October 1930. His health had been failing for several years, and two weeks before he died he had attended as JP the Chard Petty Sessions, and it was felt that he had overtaxed his strength. Following his four hours in Court he had caught a severe cold and had taken to his bed. He was attended by Dr. M W Maidlow and died peacefully.

James left an estate valued at £148,942 18s 10p (worth about £10 million in 2019). He gave £4,000 to the vicar of Chard and 'the medical men practicing on their own account in Chard', in a trust called 'The Gifford Nursing Trust' for supporting a qualified nurse for the benefit of residents in Chard. His X-ray apparatus was bequeathed to Taunton & Somerset Hospital and his spectroscopic apparatus to the Imperial College of Science and Technology in South Kensington. The rest of the estate was left to the family. Notable he gave his son his King Charles (the Second) snuff box, and his 'Breeches' Bible. He bequeathed to Emma his optical apparatus and scientific papers and other apparatus including 10mg of radium bromide. He presumably expected his wife to continue with scientific investigations.

The late Dr Ted Burrows describes James Gifford as one of a body of amateur experimenters wholly without self-interest [xliii]. This point was also made by Gardiner in the *Nature* obituary of 29 November 1930 when Gifford is described as one of the 'men who, in addition to their ordinary occupations, found time and opportunity to follow the pursuit of pure science for the love of it' [xliv]. Gardiner tells the charming story illustrating the practical experimental approach that so characterised the man. The story related to the so-called musical properties of some sands that are found on the coasts of Scotland and elsewhere; these sands, when trodden upon, emit a musical note or squeak which becomes fainter and is soon lost altogether if the same specimen is used repeatedly. Col. Gifford found, by the simple operation of rolling the sand down an inclined board several times, that the musical property was re- stored, evidently by the removal of the fine dust of silica that was produced by the rubbing together of the grains of quartz.

Emma remained active following the death of James. In 1931 an incident was reported in two local newspapers of a theft from Oaklands [xlv]. A 31 year old labourer James Monaghan appeared in court in Taunton charged with breaking and entering Emma's house and stealing two legs of chicken and a wax candle with a value of 3 shillings (15p, and worth about £7 in 2019). Monaghan had gone upstairs in Oaklands and had opened a bedroom door, however seeing someone asleep had gone away. Whilst having an intruder in the house would have been frightening to Emma, the sentence of six months hard labour seems excessive, however Monaghan had a previous and similar offence.

In September 1934, the Egyptologist Ernest A Wallis Budge (1857-1934) wrote to *The Times*, outlining the mummy wheat story which he described as a fraud inflicted on tourists. Budge had found wheat grains in an old model of a granary removed by robbers from a 3,000 year old tomb, and in 1897 William Thiselton-Dyer from the

Royal Botanic Gardens had tried unsuccessfully to germinate a sample of the grains. Budge cited a distinguished group of Egyptologists who had all failed to cultivate mummy wheat [xlvi]. This 'Mummy wheat' allegedly grown from seeds found in the tombs or wrappings of Egyptian mummies had become a scientific marvel in the 1840s in Great Britain. Despite a growing skepticism amongst plant biologists and professional Egyptologists, a belief in mummy wheat had endured well into the twentieth century. In his letter to *The Times* Budge said that he was very glad to be able to say that he could supply the wheat, and was prepared to devote a generous handful for experiment by any responsible authority. He said that he should be glad to see some of it used by responsible people with the view of settling for everybody once and for all the question, 'Will mummy wheat grow?' Emma wrote to Budge and tried to reassure Budge of her bona fides, informing him in her letter of 7 September 1934 that 'My gardener is a member of the Horticultural Society, my son is a Cambridge M.A., I am M.B.E. so that we are reputable people whose word would be believed.' Although Budge recorded and reproduced Emma's letter there is no record of any response.

Emma died at the age of 75 in Chard on 16 October 1936 leaving an estate of £5,822 1s 2d. She was remembered in Chard as a philanthropist, a friend of the hospitals, and also for her ideals in education.

Their Legacy Today.

The charitable work of James Gifford continues today in the work of the James William Gifford Charity [xlvii]. This is a Trust fund in Chard that aims to help sick, poor and needy people in the town. The James William Gifford Charitable Trust was set up in 1931 by James Gifford's will, and the charity is managed by a group of trustees. The Trust makes grants to those in Chard with a financial need or who need assistance with their day to day living.
James and Emma are both remembered in the Chard Museum. A collection of personal items related to James and Emma Gifford are displayed. The history of Chard is presented in the Museum and the "Chard Famous five" are celebrated [15].

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[15] The Chard Famous Five are: John Stringfellow (pioneer of powered flight), James Gillingham (pioneer of artificial limbs), Margaret Bondfield (first woman Cabinet Member), Arthur Hull (founder of Chard and District Museum), and James Gifford (pioneer of X-rays and optics).

[i] Guttery, D. *Radiographs - 1896-1897: Notes by the late Derek Guttery*. The Invisible Light Number 30, November 2009 p.16-19.
[ii] Guttery, D. *James William Gifford, 1856-1930.* The Invisible Light. Number 42, December 2017 pp14-16
[iii] https://historicengland.org.uk/listing/the-list/list-entry/1197481 Accessed 26-Aug-19
[iv] Hoskins, L., & Chard History Group. *The History of Chard*. 2nd Ed. Chard History Group, 2016.
[v] Chard: New Board of Guardians. Dorset County Chronicle, Thursday 7 May 1857.
[vi] https://www.malishenderson.com/all-about-lace Accessed 27 Aug 2019
[vii] Chard History Group. *Chard in 1851*. Chard History Group, publication 5. Revised reprint, 2003.
[viii] Bedford College Papers https://archiveshub.jisc.ac.uk/search/archives/ea72edbf-ccfd-3a04-8a64-021e9779134f (accessed 13 September 2019)
[ix] Cohn, PM. *Mathematics*, in Crook, J Mordaunt (Ed). Bedford College (University of London) Memories of 150 Years. Royal Holloway and Bedford New College, 2001, 243-252.
[x] Thomas, AMK. and Banerjee, AK. *The History of Radiology*. Oxford: Oxford University Press, 2013.
[xi] Guy, JM. and Thomas AMK. *The Early Reception of Röntgens Discovery in the United Kingdom*. In The Invisible Light. 100 Years of Medical Radiology. Ed. AMK Thomas, assisted by I Isherwood & PNT Wells. Blackwell Science (1995) 7-12
[xii] Ward, H Snowden. *Marvels of the New Light, Notes on the Röntgen Rays*. The Windsor Magazine, Vol. 3, April 1896, p372-384.
[xiii] Gifford, JW. *Professor Röntgen's Experiments: Photography through opaque substances*. The Photographic Journal, Jan 31 1896, p127-128.
[xiv] Gifford, JW. *Professor Röntgen's Experiments: Photography through opaque substances*. The Photographic Journal, Jan 31 1896, p128-129.
[xv] Anon. *The New Photography*. Bath Chronicle and Weekly Gazette Feb 13 1896
[xvi] Popular Science Monthly/Volume 49/May 1896/Recent Work on X Rays https://en.wikisource.org/w/index.php?title=Popular_Science_Monthly/Volume_49/May_1896/Recent_Work_on_X_Rays&oldid=9530801
[xvii] Ward, H Snowden. *Marvels of the New Light, Notes on the Röntgen Rays*. The Windsor Magazine, Vol. 3, April 1896, p372-384.
[xviii] Gifford, JW. *Tubes for the X Rays*. The Photographic Journal, March 21 1896, p209.
[xix] Gifford, JW. *Fluorescent Screens*. The Photographic Annual, 1897, p213-2156.v
[xx] Guttery, D. *X-Ray Tube Maker – A C Cossor, 1861-1922*. The Invisible Light. Number 30, November 2009 p20
[xxi] Gifford, JW. *Electrography or the New Photography*. Knowledge (Lond), 19, 73 (April 1896)
[xxii] Archives of The Roentgen Ray 15 (7) pp- 266 (1910)
[xxiii] Gifford, JW and Shenstone, WA. *The Optical Properties of Vitreous Silica* Proceedings of the Royal Society 73 488-496 1904 https://doi.org/10.1098/rspl.1904.0031
[xxiv] Gifford, JW, and Lowry, TM. *Some refractive indices of benzene and cyclohexane*. Proceedings of the Royal Society A. 1 October 1923 Volume 104 Issue 726 https://doi.org/10.1098/rspa.1923.0118
[xxv] Fletcher, A., Miller JCP., Rosehead L and Comrie LJ., *An Index of Mathematical Tables*, 2nd ed, Oxford: Blackwell, 1962. Vol 2, p v818.
[xxvi] https://sites.google.com/site/molwebbhistory/Home/history/9---duncan-webb-junior-and-the-company-liquidation (accessed 4 September 2019)
[xxvii] Adam Hilger https://www.gracesguide.co.uk/Adam_Hilger (accessed 4 September 2019)
[xxviii] https://collection.sciencemuseum.org.uk/people/cp52814/col-j-william-gifford (accessed 4 September 2019)
[xxix] Gifford, J and Cheshire, F. *Lens Computing by Trigonometrical Trace*. Macmillan and Co. Limited, 1927.
[xxx] The London Gazette, 3 January 1913, p45.

[xxxi] British Red Cross https://vad.redcross.org.uk/Card?hosp=chard&page=4&id=83901 accessed August 24, 2019
[xxxii] Fletcher, A., Miller, JCP., Rosehead, L, and Comrie, LJ. *An Index of Mathematical Tables*, 2nd ed, Oxford: Blackwell, 1962
[xxxiii] Gifford, E. *Natural Sines, to every second of arc, and eight places of decimals*, 2nd Ed. Manchester: Haywood, 1926. Note: *Natural Sines to every second of arc, and eight places of decimals.* First edition, 1914 (Third edition [photographic] 1940. London, Scientific Computing Service.)
[xxxiv] Smith DE. *The Napier tercentenary celebration*. Bull. Amer. Math. Soc. Volume 21, Number 3 (1914), 123-127.
[xxxv] Gifford E. *Natural Tangents, to every second of arc, and eight places of decimals*, (3 vols) Manchester: Heywood, 0°-45° 1920, 45°-70°, 70°-90° 1927 .
[xxxvi] Gifford E. *Primes and Factors*. Printed Manchester, Heywood. Obtainable from Scientific Computing Service, London. 1931
[xxxvii] Smith, D E. Bull. Amer. Math. Soc., Volume 21, Number 5 (1915), 254-255.
[xxxviii] Campbell-Kelly, M., Croarken, R., Flood, R. and Robson, E (Eds). Introduction, in *The History of Mathematical Tables from Sumer to Spreadsheets*. Oxford University Press Reprinted 2007
[xxxix] Roegel, D. *A reconstruction of Gifford's table of primes and factors (1931)* 3 September 2012 This document is part of the LOCOMAT project: http://locomat.loria.fr
[xl] Roegel, D. *A reconstruction of the table of factors of Peters, Lodge, Ternouth, and Gifford (1935*) 31 August 2012 This document is part of the LOCOMAT project: http://locomat.loria.fr
[xli] Croarken, M. Table making by committee: British table makers 1871-1965. In Campbell-Kelly, M., Croarken, R., Flood, R. and Robson, E (Eds). *The History of Mathematical Tables from Sumer to Spreadsheets*. Oxford University Press Reprinted 2007, p235-264
[xlii] The Land Tax and role of commissioners. https://www.parliament.uk/about/living-heritage/transformingsociety/private-lives/taxation/case-study/introduction1/land-tax-commissioners/ (Accessed 4 November 2019)
[xliii] Burrows, E H. *Pioneers and Early Years*. Alderney: Colophon, 1986.
[xliv] Gardiner, JH. *Col. J. W. Gifford*. Nature volume 126, p 851–852 (1930)
[xlv] Stole Legs of Cooked Chicken, Wells Journal. Friday 16 October 1931 & Breaking and Entering Charges from Chard and Yeovil, Western Daily Press, Thursday 15 October 1931.
[xlvi] Moshenska, G. 2017. *Esoteric Egyptology, Seed Science and the Myth of Mummy Wheat*. Open Library of Humanities, 3(1), p.1. DOI: http://doi.org/10.16995/olh.83
[xlvii] c/o The Parish Office, St Mary's Church Centre, Holyrood Street, Chard, Somerset, TA20 2DN https://beta.charitycommission.gov.uk/charity-details/?regid=243267&subid=0 Accessed 26/08/2019