The Invisible Light

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Editorial

There are two interesting articles in this issue. Firstly, Francis Duck has contributed a most interesting piece on X-ray ambulances in WW1.

The second piece is taken from the papers of the late Derek Guttery. Derek Guttery made significant practical contributions to radiology history, not lease in relation to his work at the library and archives of the British Institute of Radiology. Following Derek's untimely death his son copied the papers on his hard drive for me. There is much there of interest, and I reproduce a piece about James Gifford of Chard. I was able to visit Chard recently, and saw the old lace factory. I also visited Gifford's house 'Oaklands,' and it is reproduced on the front cover. It's a splendid building, however cannot be visited inside. Lieut-Colonel James William Gifford, of Oaklands, Chard, Somerset, was the managing director of Gifford, Fox & Co. Ltd., the well-known lace manufacturers. Gifford was a Fellow of the Royal Astronomical Society, and a pioneer of X-ray photography. He was elected a member of the Röntgen Society in 1897, and was an important figure in the earliest days of radiology.

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Museums and Places to Visit.

Benjamin Franklin House.

www.BenjaminFranklinHouse.org

Benjamin Franklin House is located in Central London (36 Craven Street, WC2N 5NF) and was the London base for Benjamin Franklin. The house was built in about 1730, and at one time also housed an anatomy school. The museum in an interesting example as to how you can have a museum when you possess no primary material. It's worth a visit.

Benjamin Franklin is important for radiology because of his work on electricity. As indicated, there is nothing remaining in the house related to Franklin, however there is an enjoyable illustrated tour with a guide in period costume. The tour needs to be booked beforehand.

Belgian Museum for Radiology.

http://www.radiology-museum.be/index.php/en/virtual-museums/virtual-museum-brussels

On November 18th 2017 the Belgian Minister Sven Gatz opened a new historical room at the Belgian Museum for Radiology. We congratulate our friend René Van Tiggelen, the Curator of the Belgian Museum for Radiology.

A short film about the room is to be found at: https://drive.google.com/open?id=1GtMb3EvpRnJIVeIsmshwkX3uOC81JOvi

and a photo-shoot at: https://photos.app.goo.gl/nNJ0a0nW5WMtsUl73

Photographs were taken during the ceremony and are found at: https://photos.app.goo.gl/RxEWNDllG85pRI9x2

A leaflet was distributed to the participants: https://drive.google.com/open?id=1o_u3FO252jMFzoOEym2HqPUppiB1IB6L

A video presentation of the Museum is at:

https://www.youtube.com/watch?v=cu6UXxyBIVE&feature=youtu.be

Interesting Books.

The Spark of Life.

Francis Ashcroft. Penguin Books (2012) 978-0-141-04653-1

This is a popular book on electricity and the human body. The book is an interesting read. There is nothing specific about radiology, however we should remember that radiology as a disciplined emerged from medical electricity and electrotherapy, and the book contains a small section on electrotherapy. The book is relatively reductionist in its view of humanity, and quotes with approval the words of Percy Bysshe Shelley (the brother of Mary Shelley the author of Frankenstein) 'Man is no more than electrified clay.'

Louis Harold Gray: A Founding Father of Radiobiology (Springer Biographies) 1st ed. 2017, Kindle Edition

by Sinclair Wynchank (Author)

ISBN-10: 3319433962

This book is a scientific biography of Louis Harold ("Hal") Gray, FRS (1905–65), a pioneer in radiobiology..

Prize Fight – The Race and the Rivalry to be the First in Science. (2012) Palgrave Macmillan Paperback Edition, 2013. ISBN 978-1-137-27842-5 By Morton A Myers.

This book is on its way to becoming a classic, and deals with rivalry in science. Morton Meyers is a very good writer, and as a junior I used his book on the Dynamic Radiology of the Abdomen. In this book the vexed question of priority in science is considered. Of particular interest to us is his consideration of priority in the application of NMR to medical imaging. The story of MRI is complex, and has resulted in considerable acrimony. This book is not the last word on the subject, but at least helps to clear the air.

Interesting Web Sites

An Interview with John F. Fowler, DSc, PhD, FASTRO https://www.astro.org/About-ASTRO/History/John-F-Fowler/

This is an interesting interview with Jack Fowler about his early story, and gives an account of the individuals and schools that resulted in his interest in physics, mathematics, and science.

Exhibition.

Radiologie im Nationalsozialismus. Eine Ausstellung der Deutschen Röntgengesellschaft
[Radiology under National Socialism.An Exhibition of the German Radiological Society]

German Museum of Medical History, Ingolstadt, Germany

Opening: 21st February 2018

www.dmm-ingolstadt.de/index.php?id=275

Ingolstadt is one of the many settings in Mary Shelley's novel 'Frankenstein'. Victor Frankenstein attended university in Ingolstadt.

Fit for Purpose? The two x-ray vans of the Scottish Women's Hospitals

By Francis Duck

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By the outbreak of WW1 in August 1914 there had been numerous prototype examples of x-ray equipment mounted in a variety of vehicles for use in the battlefield. Nevertheless, although the idea had currency, army medical corps had yet to include x-ray vans as a necessary part of medical planning. Nations, and their armies, had different official views on the value of such vehicles. The French were enthusiastic, and this was reflected in the efforts of Marie Curie, using her celebrity status as a woman Nobel Prize-winning scientist, to demonstrate the value of the x-ray van, raising funds to purchase eventually 20 of her 'little Curies". By 1915, a French guide to war radiology devoted a whole chapter to 'Les voitures radiologiques' [1]. Conversely, the United States Army X-Ray Manual contains not a single reference to x-ray vans, reflecting the lack of interest by the US Army in such vehicles [2]. When the US entered the war in 1917, any interest was limited to small vehicles without dark-rooms, equipped only for fluoroscopy [3]. Nor were they equipped with a separate electric generator, being intended only for brief visits to support rapid medical decisions in the evacuation areas. The British Army showed only muted interest in x-ray vans. By January 1915, there were only 2 vans operating in France. In due course, 10 more were sent [4].

This is the story about the procurement two x-ray vehicles on behalf of the Scottish Women's Hospitals, (SWH) one to operate in France, and the second in Serbia and Salonika. The story includes many aspects that are familiar to anyone who has been involved with the procurement of medical imaging equipment, particularly when the equipment is being installed for the first time during a time of rapid technological change. The clinical need had to be considered, partly on trust from the reports of others. Decisions had to be made on the technical specification, using external advice if necessary. Finance had to be raised and the publicity value exploited.

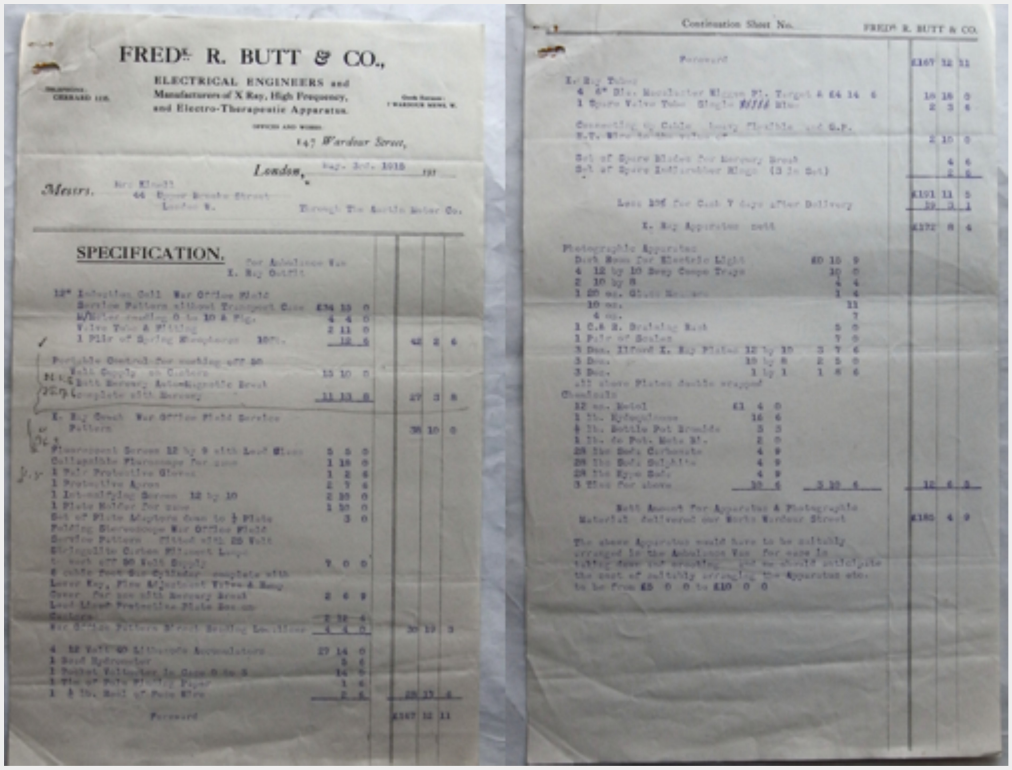
With offices in Edinburgh, the Scottish Women's Hospitals for Foreign Service (SWH) was arguably the most successful all-women hospital service to operate during WWI. Founded by Elsie Inglis, it operated hospitals in France, Serbia, Corsica Russia, Salonika and elsewhere, in which all the medical, nursing and administrative staff were women. The operation was supported by vigorous and successful fundraising, raising in total over £500,000.

The SWH London Unit X-ray van

By the beginning of 1915, when the SWH hospital at Royaumont, north of Paris, was being established, active planning commenced to equip this hospital with one or more x-ray vans. Funds were raised for the Royaumont unit by the London Branch of the National Union of

Women's Suffrage Societies, so it is often referred to as the London Unit. It was decided to channel some of the flow of money to the purchase of a first x-ray van.

No-one in the SWH had ever procured anything like this before, and it was the responsibility of Dr Agnes Savill, the Royaumont radiologist, to lead the project. On May 3rd 1915, a 2-page quotation for the x-ray equipment arrived from Fred R Butt & Co, Manufacturers of X-Ray, High Frequency and Electrotherapeutic Apparatus, 147 Wardour Street, London, at a total cost of £185 4s 9d. (Figure 1 a & b). The most expensive items were the coil (£34-15-0), the accumulators (£27–14-0), the 4 x-ray tubes (total £18-18-0) the control panel (£15-10-0) and the interrupter (£11-3-8).


FREDK R. BUTT & CO.,

ELECTRICAL ENGINEERS and Manufacturers of X Ray, High Frequency, and Electro-Therapeutic Apparatus.

147 Wardour Street,

London,

Messrs.

SPECIFICATION.

Figure 1 a and b. The quotation for the equipment to be installed in the SWH London Unit x-ray ambulance, ordered from Fred Butt and Co, May 3 1915. Women's Library, London School of Economics.

Much of the equipment is standard for the time. The imported Macalister Wiggin gas tubes had a reputation for reliability and high output and with the 12" coil should have been sufficient for abdominal as well as peripheral radiology. Both screening and film radiography was catered for. Safety had been considered, and one operator could have been protected using the lead gloves and lead apron. The controller was quoted as being on castors, although a later photograph suggests that it was fixed inside the ambulance. The order added that 'The above Apparatus would have to be suitably arranged in the Ambulance Van for ease in taking down and erecting".

Agnes Savill, in overall charge of the specification, was a dermatologist whose main radiological experience had been with the therapeutic uses of x-rays to treat skin disorders. Whilst she would have been familiar with operating x-ray equipment, and with its component parts, she probably needed guidance in specifying complete diagnostic systems suitable both for the Royaumont hospital itself and for the van. Some advice would have come from the supplier, Frederick Butt and Co. In addition she would have probably had a chat to her more experienced colleagues. Included amongst them was the radiological pioneer Florence Stoney, with whom she was working before the war at the South London Hospital for Women. By this time Florence Stoney had over a decade of radiological experience, establishing the x-

ray systems for her own private practice, at the Royal Free Hospital and at the London Hospital for Women. She also was the only woman radiologist at that time to have had wartime experience, having been the chief medical officer and radiologist in the Women's Imperial Services League hospital expeditions to Antwerp and to Cherbourg. In addition, her elder sister, the physicist Edith Stoney, had by this time left her post as physics lecturer at the London School of Medicine for Women and had taken responsibility for the x-ray department at another SWH hospital which was being set up in Troyes in the Champagne region of France.

Each doctor had their own personal approach to radiological practice. Savill's preference, which she expressed in a later publication, was to use a small hard gas tube at low current [5]. This may have arisen from her experience with dermatological radiation therapy for which a harder beam was recommended. The Macalister Wiggin tubes specified for the van would not have been her first choice, so she must have been influenced by others in her equipment selection.

That left the specification for the vehicle itself. A quotation for £590 for a 20 HP Austin ambulance 'built to war office requirements', arrived at the beginning of May. The stretchers and fittings were to be removed to make room for the x-ray equipment and darkroom facilities. The superstructure was made of aluminium to be fully light-tight. There was no permanent roof over the driving seat, but the driver could be protected with a folding waterproof cover [6] (Figure 2).

Figure 2 The Scottish Women's Hospital London Unit x-ray ambulance at Royaumont showing the radiographic tent erected.

Guidance had been sought from Marie Curie when designing the SWH x-ray van. Her reply, in an undated transcription from a longer letter, and in its original French, gave some details of the specification she had used for her own x-ray vans [7]. She said (my own translation),

'The bodywork of the car is from a larger model, and the power of the motor should be 15-20 HP. It needs to be strong but robust in motion, carrying 100 kg of useful load in addition to the bodywork, with pneumatic tyres to cushion the shocks that might damage the equipment. The size of the superstructure we have used is: height 1.60 or 1.65 m: length 1.9 m: width 1.4 m. But these dimensions may be altered a bit. The frame is light, from wood or steel. It has a glass door at the back. The frame holds the furniture and the photographic equipment.'

The SWH van seems to have been slightly larger than this specification, although a later press report still observed that it was 'compact'. It is quite possible that this correspondence with Marie Curie was initiated by the Stoney sisters. Their father, G Johnstone Stoney, was a notable Irish physicist, known particularly for his naming of the electron, who would have been known to Madame Curie professionally and possibly personally. The extract suggests that there may have been personal material in the original letter, pointing towards a previous connection between the writer and Marie Curie. She went on to describe how her vans were being used:

'The car goes into the hospitals at the front-line and the doctor directs the examination of the wounded. I very often have carried them out myself, and they have been very successful, and saved many lives or prevented illness."

As advised by Marie Curie, the SWH plan was also to support the work of smaller French hospitals near to Royaumont, lacking their own x-ray facilities. Intended to be entirely independent, power for the Curie vans was supplied by a dynamo driven from the van engine itself. Marie Curie described a couple of alternative means by which this was achieved:

'I fixed a dynamo on the running board on the side of the chassis at the front. The dynamo is driven by a drive-belt passing over a pulley on the motor axis, so that when the car is stationary, the motor drives the dynamo. If the car is of the type of construction that has a free end of the axis under the feet of the driver, it is also possible to mount the dynamo at the front of the car, with a pulley 30 cm in diameter. The dynamo generates 2 kW or a bit less (110V at 15 A).'

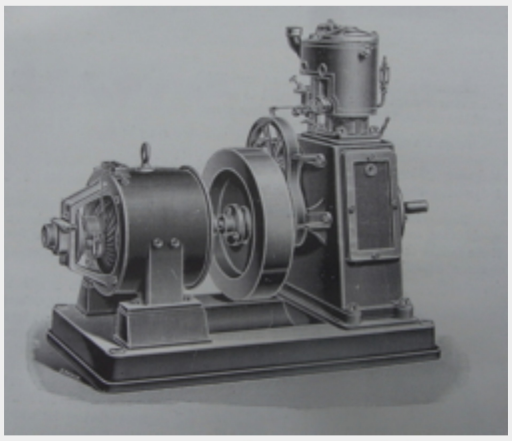
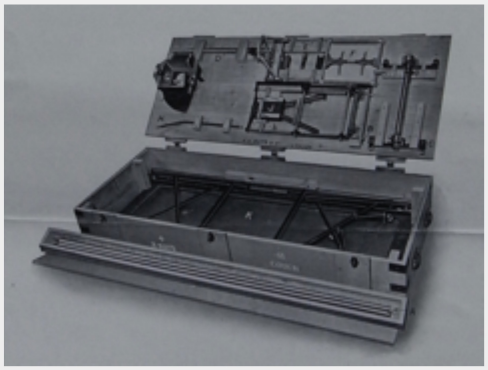


Figure 3. A generator for x-ray work, from the Cavendish Electrical Company catalogue of X-ray and Electro-Medical Apparatus, 1914.

Nevertheless, the specification from the Austin Motor Company did not include an integral generator. Whilst a 15A generator was included at delivery, it was probably independent from the vehicle, and would have been loaded into the back with the other equipment. Generators designed for x-ray work were widely available from several suppliers by this time (Figure 3).

The SWH vehicle had two functions, transport and dark room. In transit, the x-ray equipment was carried in the back. On arrival, some equipment, such as the couch, would be unpacked and set up in a tent for the examination (Figure 4), with the main van used as the dark room with its own water supply. The 10-foot spring rheophores linked the van to couch and tube in the tent. The heavier equipment, such as the control panel, coil and generator (Figures 5, 6) would have usually stayed inside the van, and operated from outside. There is no suggestion that radiography was carried out inside the van itself.



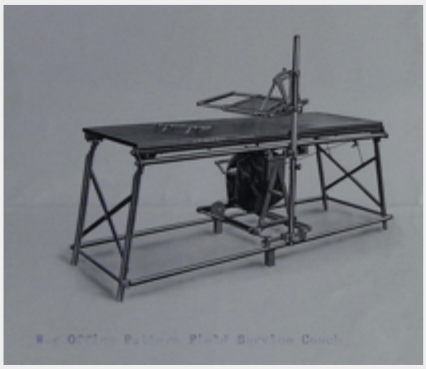


Figure 4. The War Office Pattern Field Service Couch, (a) folded and (b) erected. (Source for figures 3, 4 and 5. SWH archive, Women's Library, London School of Economics)

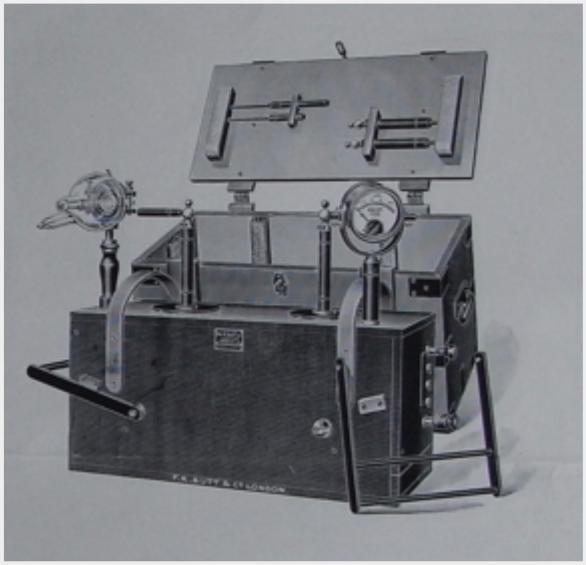


Figure 5. Boxed x-ray equipment, including the induction coil, for war radiography as specified by the War and supplied by Fred Butt and Co. The coil for the Royaumont van was ordered without the box, to be mounted in the van.

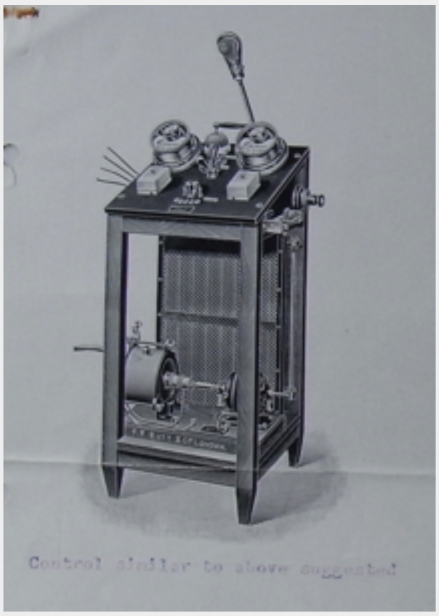


Figure 6. The illustration supplied by Butt for the controller, labeled 'Control similar to above suggested'. The mounted control panel supplied can be seen in figure .

Public demonstration.

By the end of July the ambulance was sufficiently complete to be shown to the pubic. On Wednesday 28th July notices appeared in the press that the SWH x-ray ambulance would be on view at Bedford College for Women, Regent's Park, on next two days, during the afternoon and early evening. Tickets were free: this was not to be a separate fund-raising event. Photos appeared in Thursday's papers (Figure 7). Dignitaries arrived to view the ambulance. It was inspected by the French Ambassador, M. Paul Carabon, accompanied by his wife and daughter-in-law. It was draped in the Italian colours for the visit of the Marchesa Imperiali, the wife of the Italian Ambassador, who was pictured with other prominent ladies alongside the x-ray equipment (Figure 8). The press described the ambulance as 'the finest and most up to date ever constructed, and that 'many prominent advocates of the women's movement' visited. One report remarked that the van was called the "Ambulance Flottante", and had cost a total of more than £1000, which presumably included the additional cost for the generator and the tent. The publicity value of this high-tech unit, run entirely by women, was exploited to the full.

Figure 7. The rear of the London Unit x-ray ambulance, on display to the public on 30th July 1915 at Bedford College. (Daily Record July 29 1915: British Newspaper Archive).


GIFT OF X RAY AMBULANCE TO FRENCH ARMY.

Figure 8. The screen holder and x-ray control system with eminent visitors to the London Unit Ambulance. L to R: Baroness Barnekow from Sweden, Lady Muir-Mackenzie and the Marchesa Imperiali. (Sunday Mirror August 1 1915: British Newspaper Archive)

This initiative of the SWH was also being monitored with considerable interest by the War Office, even though the purchasers were nominally a civilian organisation. The War-Office X-Ray Committee had been established in 1914 under the chairmanship of Dr (later Sir) Archibald Reid, with responsibility for the planning, equipping and organising of x-ray services at home and on the battlefield. This included the specification of the 'War Office Field Service Pattern' for equipment, and three of the items in the SWH van, the folding couch (Figure 4), the induction coil (Figure 5) and the folding stereoscope, were identified by the supplier as conforming to this standard. This suggests both a close liaison between Fred Butt and the War Office and also that Savill and the SWH purchasers were being guided by the supplier. The Austin ambulance also conformed to war office requirements. Furthermore, the British army had only a couple of x-ray vans in Europe by the beginning of 1915, and the War Office X-ray Committee would have been particularly interested in testing the performance of a new prototype, evaluating whether the Austin ambulances, which the army was already using, would be appropriate to transport x-ray equipment.

One notable visitor to the demonstration at Bedford College was the radiologist Florence Stoney [8]. The reporter for the Scotsman described her as the 'Chief Radiographer to the War Office', which suggests an official position by which she reported back to Reid and his Committee. Whatever was the true situation, with the ambulance now apparently ready for dispatch to France, it seems that the War Office actively intervened, and subsequently got the blame from Royaumont for causing a further delay during August [9]. Perhaps the War Office and Austin wished to carry out further tests on this prototype vehicle to assist in the design of any future x-ray vans for the Army. Then, in September, further difficulties were encountered when the departure to France of two military radiological personnel was delayed. Major Barratt and Captain Humphries had been assigned to advise the Royaumont staff on setting up and using the van, and quite likely to assess its utility to advise the army's own plans also. This again supports the view that this whole SWH enterprise was not at all independent of War Office control. Eventually, in late September, the van finally arrived in France and started to be used.

Later developments

Towards the end of the war, in a paper on the design of mobile x-ray vans [10], Howard Head included a comment that strongly suggests that the SWH x-ray van was the prototype on which the design of x-ray vans for the British Army was subsequently based. Describing the design of a van using an Austin ambulance chassis, he said 'One of the first equipments produced with this type of chassis was built in July 1915, and has since been in use near Paris'. He went on to identify those design aspects that particularly resulted in its success. He noted specifically the loading line which, being quite low, made it much easier to load and unload the back of the van. He also noted that the low loading line made it possible to reach the induction coil and control equipment from outside the vehicle, so only the x-ray stand and

couch needed to be moved into the tented x-ray area. He also noted that the low centre of gravity helped with stability.

Whilst many design features were derived from the earlier model, this was a much larger vehicle. Head described how the interior of the van was divided into 2 compartments, one to be used as the photographic darkroom, and the other to carry the x-ray apparatus. The dividing wall was partially lead-lined. Water was carried in a 30 gallon tank, from which it was hand-pumped to smaller tank above the sink. The darkroom was fitted with a safelight, light-tight compartments, and an extractor fan to remove toxic fumes.

The x-ray compartment was 9 x 7 ft. (approximately 2.7 x 2.1 m approx.), and the separate dark room was 3 ft. 4 in x 7 ft. (approximately 1.0 x 2.1 m). It included therefore about 3 times the floor area than Marie Curie' Renault van and was considerably larger than the SWH van. Each item of equipment was secured by clamps, straps and turn buttons. The equipment could be used to x-ray extremities without moving it outside, but it was thought to be too small to use with a couch. Usually a large 3-ply canvas tent, 12 ft. 9 in long by 10 ft. 6 in wide (approximately 3.9 x 3.2 m) was erected on a frame, with a further light fly-sheet for tropical conditions. When closed, the tent was completely lightproof and lit by an electric lamp. Also described was a method of use where extended special cabling linked the van to a room in the hospital, in which the x-ray tube, small control board, couch and induction coil were taken.

In the design described by Head, a specially designed generator was driven through a removable chain from the engine drive shaft. Rated at 3 kW at 1700 rpm, it was considerably more powerful than the generator that powered SWH ambulance equipment. There were three alternative modes of operation: 30 A at 150 V for 5 minutes from the accumulator batteries alone: 20 A at 150 V from the generator alone: or 50 A at 150 V when running both in parallel. A switchboard allowed change between these modes of operation.

Head also described the x-ray equipment. This was primarily of the standard War Office design, with an induction coil capable of generating a 16-in spark. 6 tungsten tubes were included, as was a Coolidge tube and its associated auxiliary battery and circuit. There was a choice of 3 interrupters: a dipper mercury interrupter, a centrifugal mercury interrupter, and an electrolytic interrupter. There were aprons, gloves and masks for protection.

Such were the details of this later van, of considerably higher specification than that purchased for the London Unit of the SWH. By 1918, much had been learned about the effective design of a vehicle to bring x-rays to remote medical facilities under war conditions. Nevertheless, many important design decisions made for the Royaumont x-ray van, for example the Austin chassis with its low loading, its relative stability on rough terrain, the provision of an x-ray tent for radiography, the use of part of the van for photographic development, and a cable to allow remote operation from the van, ensured that this prototype was able to serve the radiography needs of SWH London Unit in Royaumont for much of the war.

The SWH Girton and Newnham Unit X-ray van

Unlike the x-ray van for the SWH London Unit, the one for the Girton and Newnham Unit was not successful. There were a number of contributory factors for this, and in this section I will describe what went wrong.

During the heady early days of 1915, when the Austin x-ray van was being arranged for the London Unit, it was discussed in the committees of the SWH whether more than one van might be procured, either for Royaumont or to support the second unit to be placed in France, known as the Girton and Newnham Unit, from its Cambridge college sponsors. This latter unit was posted to Troyes in June 1915, and was placed under French military authority. The person responsible for equipping and running the x-ray service in this unit was Florence Stoney's older sister, the physicist Edith Stoney. However, whilst she had initially expressed enthusiasm for the principle of an x-ray van, she was uncertain that it would actually be of great value in Troyes, perhaps because there was no lack of x-ray equipment in the other French hospitals in that area when they arrived. There was no point in bringing equipment that would not be used.

Things changed when the unit was posted, in October 1915, first to Serbia and then to Salonika. The conditions were much more challenging there, and more chaotic than in France. The terrain, too, was much more difficult, the roads unmade, the mountainous tracks often impassable. The provision of x-ray equipment was limited to the few large hospitals in Salonika. Out of this main centre, closer to the fighting in Serbia, it seemed to Edith that there was a real need for a rugged mobile x-ray unit that could negotiate the difficult travelling conditions to reach remote hospitals where there were few or no modern facilities. It would be a risk, but with the right equipment and planning she knew that radiology could reach otherwise unsupported hospitals.

At the beginning of 1916, soon after Edith had arrived in Salonika, her sister Florence began lobbying the SWH head office on her behalf that they should provide another x-ray van, this one for the Girton and Newnham Unit [11]. This first met with resistance, and in a letter in July she noted with regret that the x-ray car could not be secured [12]. The reason was almost certainly that the SWH had no obvious way to fund such an enterprise, comparable to the special appeal that was set up in London for the other van. In fact, her requests had not fallen on entirely deaf ears. It had been realised in Scotland that the purchase of an x-ray van would provide an extremely effective focus for fund raising. An appeal was launched in Glasgow, in memory of the nurse Edith Cavell who had been executed for treason by a German firing squad on 12 October 1915, convicted of aiding allied soldiers to escape from German-occupied Belgium. This appeal was hugely successful. It is at this point that the initiative started to unravel. Edith, and the head of the Salonika Unit Louise McIlroy, were too far away to make clear what was the actual operational need. In Scotland, the publicity value of a high-tech item designed and built north of the border was too good to miss. Glasgow believed they had the engineering expertise to execute the project. The chair of the SWH equipment committee, Marion Erskine, was a radiologist who had purchased x-ray equipment before. What could go wrong?

Edith Stoney's criticism

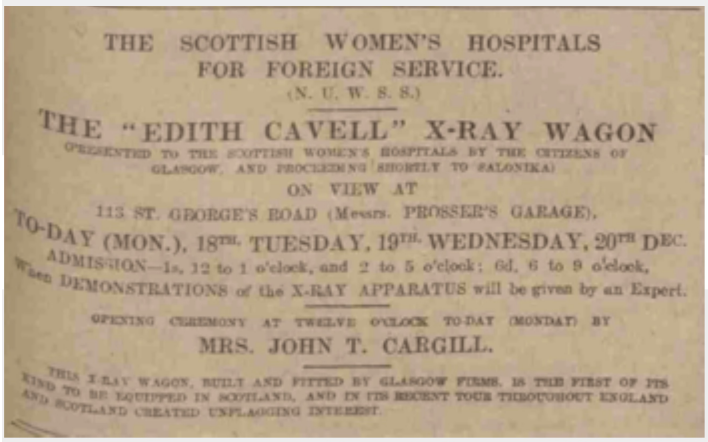
By the time Edith returned from Salonika to Britain in the late summer of 1916, work was well underway on the new van. She was invited to inspect it in Glasgow, with the assumption that it would be approved and would quickly be dispatched. Edith had very firm views of the specification that she expected [13] and this included a sufficiently powerful x-ray set installed in a sufficiently rugged lorry. She had seen the design of the Fiat x-ray vans used by the Radiographic Units of the British Red Cross in Italy, whose high clearance (14½ inches) and double wheels allowed access over the worst of rough mountain roads. Having such high standards, she was shocked and embarrassed to see the small low-slung Wolseley lorry when she arrived at the premises of H. Prosser, the Glasgow Wolseley agent, to inspect the vehicle. Whilst some aspects were much better than she had expected, she knew immediately that several aspects of its design and construction were going give real problems once it was deployed.

Edith documented her criticisms [14], giving her views both on design problems with the vehicle and also the design problems with the x-ray equipment. She later commented on operational problems after the van was delivered. The most serious problem with the vehicle was that it was too small, and in particular the clearance of 5½ inches would be insufficient to travel over the rough country Serbian roads. It might be useful in the Serbian towns but only if it could be transported there by rail. This Wolseley lorry had a mounted dynamo, but only rated at 12 A at 100 V, less than the 15 A available with the Austin. But she was also aware of a changing attitude to the use of mounted dynamos. Some x-ray vans were now being supplied with a separate generator that would work outside the van, so removing the requirement to keep the van engine running during the x-ray procedures.

There was a further practical issue. Unlike the Royaumont Austin van, the Wolseley had no electric self-starter. Edith knew that women drivers would find it difficult to operate this vehicle in the absence of such a facility, especially during the cold Serbian winter. Furthermore, she felt that the 20 HP van was underpowered, carrying about 4 tons of equipment when fully loaded. Perhaps the load was greater than the Royaumont 20 HP Austin, or perhaps she was thinking that the hills of Serbia were steeper than those in France.

Broadly, the x-ray equipment, largely supplied again by Fred Butt, was suitable. However, the maximum tube current she could generate was 2.5 mA, only sufficient for peripheral radiography. Edith Stoney would certainly have preferred the water-cooled Macalister Wiggin tubes, capable of operating with a higher tube current. There was no plumb line, essential for foreign body localisation. And finally, she was fairly certain that she would not be able to find a source of coal gas in the villages of Serbia: the mercury jet-break interrupter supplied was designed to work with coal gas¬ instead of the more practical paraffin or alcohol dielectric.

The SWH Committee did not allow Edith's concerns to interfere with the publicity value of the new x-ray van. On 17th October 1916 the 'magnificently-equipped x-ray motor ambulance' was formally handed over by Lady Dunlop in the quadrangle of Glasgow City Chambers [15]. They were in no hurry to ship it on. As reported in the same newspaper article 'Prior to proceeding to the Front the car will be placed on exhibition in various Scottish towns, and demonstrations of the working of the X-Ray apparatus will be given.' Two months later the 'Edith Cavell X-Ray Wagon' was still in Glasgow, where the general public were invited to inspect it at Messrs. Prosser's Garage, for an admission fee of 1s during the day and sixpence in the evening [16]. (Figure 9)


THE SCOTTISH WOMEN'S HOSPITALS
FOR FOREIGN SERVICE.
(N. U. W. S. S.)

THE "EDITH CAVELL" X-RAY WAGON

PRESENTED TO THE SCOTTISH WOMEN'S HOSPITALS BY THE CITIZENS OF GLASGOW, AND PROCEEDING SHORTLY TO SALONIKA)

ON VIEW AT

113 ST. GEORGE'S ROAD (Messrs. PROSSER'S GARAGE),

TO-DAY (MON.), 18TH. TUESDAY, 19TH. WEDNESDAY, 20TH DEC.

ADMISSION—1s, 12 to 1 o'clock, and 2 to 5 o'clock; 6d, 6 to 9 o'clock,

When DEMONSTRATIONS of the X-RAY APPARATUS will be given by an Expert.

OPENING CEREMONY AT TWELVE O'CLOCK TO-DAY (MONDAY) BY

MRS. JOHN T. CARGILL.

THIS X-RAY WAGON, BUILT AND FITTED BY GLASGOW FIRMS, IS THE FIRST OF ITS KIND TO BE EQUIPPED IN SCOTLAND, AND IN ITS RECENT TOUR THROUGHOUT ENGLAND AND SCOTLAND CREATED UNFLAGGING INTEREST.

Figure 9. Advertisement to publicize the "Edith Cavell" X-ray Wagon in Glasgow. (Daily Record Dec 18 1916. British Newspaper Archive).

Delivery and outcome.

The x-ray van finally arrived in Salonika over 6 months later, in late May 1917. When it did so, further problems became apparent. By the time of the Glasgow inspection the tent had not been supplied, and was probably purchased later, following Edith's strong recommendation that it needed to be absolutely lightproof. What arrived was made of canvas that was so thick, and so large, that it

almost too heavy to manage. Furthermore, in addition to the problems with the vibration caused by the dynamo, the space inside the van was cramped, hot and noisy. In Edith's view the van would have so little use that the equipment should be stripped out and used elsewhere, and that the van itself should be used as a general-purpose vehicle in Salonika.

It is easy to understand why, back in Scotland, Dr Erskine was angry. The x-ray van was a costly, public, high-tech, prestige project for the SWH. What she wanted from Edith was a glowing report that demonstrated how their women were at the vanguard of medical care for casualties in the mountains of Serbia, if possible supported by photographs with grand scenery and grateful wounded. What she had received was a scathing criticism of a mismanaged project, which supplied badly conceived and constructed equipment, too late, to an inappropriate location.

Nevertheless, those pioneers from the Scottish Women's Hospitals may be forgiven for some errors of judgment. Certainly the fund-raising publicity value which presented the organization as being at the cutting edge of new technology, taking the best possible medical care to the soldiers in the battlefield, would have been a very powerful one, and impossible to resist. Within the organization they had technical and radiological experience and competence, and contacts that could have given appropriate advice. But both the technology and the operational requirements were changing rapidly, with no general consensus on the specific medical needs for x-ray vans close to the battle. If the US Army was correct, all serious radiology would be carried out in the main hospitals alongside the operating theatres. The only need for a mobile unit would be in a front-line casualty unit, possibly only then to help to decide on which soldiers might be saved. Edith Stoney expressed doubt whether this approach had been effective, noting reports that numerous US vehicles lay unused on French ports. As the front stabilized in France and the military hospitals were better established and better equipped, even the argument that a van might help to support the smaller hospitals became weaker. It is fairly clear that the Royaumont van was used less and less as the war progressed. As the war continued, the strongest argument for mobile radiology arose not from France, but from the more remote areas of conflict, where field hospitals were more primitive, and radiology could indeed support surgeons trying their best in very difficult conditions. But this could only have worked with a high specification van, with both a rugged design of the vehicle, and having high performing, reliable x-ray equipment installed in it. Sadly, the SWH van supplied for work in Salonika and Serbia simply did not meet this need.

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[13] Edith Stoney to Mrs Laurie. 6 October 1916. Scottish Women's Hospitals archive, Mitchell Library Glasgow

[14] Edith Stoney to Mrs Laurie 16 and 17 October 1916. Scottish Women's Hospitals archive, Mitchell Library Glasgow

[15] Edith Cavell memorial. Presentation of X-Ray Motor Ambulance. Daily Record October 18 1916.

[16] Daily Record Dec 18 1916.

James William GIFFORD, 1856-1930

A letter by the late Derek Guttery from 1996 addressed to Mr. Leonard W. Hoskins.

The letter is of considerable interest and I thought it appropriate to reproduce it in an unedited form. Derek was an expert on the technical aspects of radiography, and was also interested in the philately of radiology, and in paper ephemera.

His untimely death was a great loss to the radiology history community.

You may recall that I spoke to you on the telephone on 12 January *(1996: ed.)* concerning J.W.Gifford's involvement with X-rays immediately following the announcement of their discovery and my interest in establishing whether or not any historical material or personal knowledge relating to Gifford still survive in Chard. I also promised to send you a photograph showing Gifford working in his private laboratory together with a few notes about his involvement with X-rays.

The enquiries that I have made so far show that apart from his direction of the family business of lace-making, Gifford was also a keen amateur scientist, astronomer, skilled photographer and one-time voluntary assistant to Sir William Crookes.

Gifford was very well equipped with all the apparatus needed to generate X rays when he read an account of Röntgen's discovery in the EVENING STANDARD for 7 and 8 January. He had recently purchased a hand-driven dynamo and a powerful [Apps] induction coil for research into "spectrum photography" and also possessed a set of Crookes tubes acquired about fifteen years earlier including one with a saucer-shaped "focused" cathode and platinum-foil anti cathode.

His first attempt to produce X-rays was unsuccessful leading him to suppose that the newspaper accounts were either a hoax or a misconception and on this basis he addressed a letter to the Royal Photographic Society for its 14 January meeting detailing his experiments and their failure. However, more detailed information in later press reports caused him to make a fresh attempt and on Saturday, 18 January, 1896 he succeeded in "electrographing" his young son's hand. The exposure time was 10-15 minutes. Gifford describes the technique used in an article "Electrography; or the New Photography" published in the April 1, 1896 issue of KNOWLEDGE:

. . . on Saturday the 18th, to my great delight, I succeeded in electrographing a child's hand through cardboard. This was shown at the Photographic Meeting on the following Tuesday. In this early experiment, and in fact in all the earlier ones, the plate was enclosed in a cardboard box, such as photographic plates are packed in, and the hand laid on the lid of the box about two inches below the glass bulb – for, as far as appearance goes, tube is a misnomer – with the result that a child's hand appeared on the plate after development. In the earlier attempts five minutes' exposure was given, and in the first successful one the nails appeared, but little or no bone. Never since the first experiment have the nails appeared – why is not known. Probably the bones did not appear partly because it was a child's hand and the ossification imperfect, and partly because the exposure was too short for the power used . . ..

Gifford's wife, Emma, writing from "Oaklands", Chard, recalled the event in a letter to the TIMES nearly forty years later (27 February, 1932, p.6d):

. . . 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!"

Gifford soon discovered that he could achieve a considerable improvement in image definition by increasing the "bulb"-to-plate distance from 2 inches to 6 inches.

Further on in the article in KNOWLEDGE, Gifford explains in considerable detail the preparatory work prior to the actual exposure:

. . . 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 [of the photographic emulsion]. 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 . . .

Without question, Gifford's first successful radiograph of 18 January, 1896 was one of the very first taken in this country and only preceded in terms of priority by the very faint X-ray image of a coin exposed through a sheet of aluminum produced by the London electrical engineer A.A.Campbell Swinton on 7 January and the same experimenter's radiographs of various metal objects on 8 January and of a human hand on 13 January.

Gifford gave one of the earliest public demonstrations of X-rays in London on 21 January at the Royal Photographic Society, 12 Hanover Square and also published many articles on the subject in Nature, Knowledge and various contemporary photographic journals. Some of the radiographs illustrating his articles are the joint efforts of Mrs. Gifford and a Miss Baylis. Apart from human extremities of hands, feet and the hand and forearm of "Sylvia Gifford, aged 6", typical subjects included a coiled adder, a sparrow, a mouse and a cat's paw. Other radiographs illustrating his articles are credited to Mr. C [harles] Baker, the optician and microscope maker of High Holborn, and F.Higgins, the Chard photographer. I have no doubt that all of these names are familiar to you.

The enclosed photograph (in three copies) was taken in February 1896 by

F. Higgins of Chard to accompany an article by H. Snowden Ward entitled "Marvels of the New Light: Notes on the Röntgen Rays" published in the April issue of the Windsor Magazine. It shows Gifford in his spacious home laboratory surrounded by a plethora of the apparatus needed to generate X-rays including a Crookes tube, two induction coils, a collection of Leyden jars and a hand-operated vacuum pump. Some of Gifford's other scientific interests are indicated by a "state of the art" spectroscope and a collection of bottled chemicals clearly visible in the background.

After about 1898-99, Gifford's name disappears from the X ray scene and it is assumed that he had become bored with practical aspects of the subject and moved on to other fields of science. However, he continued his association with the [London] Röntgen Society – to which he had been elected one of the earliest members in 1897 – until at least as late as 1918. His range of interests outside the business of lace-making is shown by his Fellowship of the Royal Photographic Society (1895), Royal Astronomical Society and Royal

Microscopical Society. I assume that his rank of Lieut-Colonel came from involvement with the Territorial rather than regular army.

When Gifford died in 1930 at the age of 74, his estate amounted to £148,942. He gave £4,000 in trust to the vicar of Chard and general medical practitioners of the town to support a qualified nurse for the benefit of residents. The rest of the estate was left to his family. In 1910, he had presented his personal hoard of 40 mg. of radium – then worth about £600 – to the Cancer Research Laboratories of the Middlesex Hospital.

From the many things that you mentioned during our telephone conversation, I particularly remember that the Gifford lace factory closed in about 1960 and that the building may be taken over by the local council (it now houses the local library, ed.); and that you suspect that Gifford's father, "J.B." was one of the founders of the Y.M.C.A. I was also intrigued to learn that as young schoolboy, you either attended or witnessed Gifford's funeral procession. During our conversation, I also mentioned Sir William Crookes and his long-time personal assistant, C.H. ("Charlie") Gillingham. After 'ringing-off, I thought it unusual that you seemed so familiar with both names and wondered if either or both of them also had some connection with Chard.

If you feel that there is any relevant Gifford material still surviving in Chard – or in Chard Museum – I would very much appreciate hearing about it. I would also value any comments or additions that you might wish make to the notes contained in this letter. However, if you prefer not to get involved, I shall fully understand.

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“We are duly bound to preserve that which cannot be replaced.

We are what we are today because of those who come before us.

What we have here are precious treasures – gifts from those who preceded us.

These are a trust – to be guarded, cherished and enriched.

Then proudly passed on to those who come after us.”

William H Shehadi, New York Medical College, 1991.
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