

OLIVER LODGE AND THE FIRST MEDICAL USES OF X-RAYSDavid Edwards

On the 28th December, 1895, Wilhelm Conrad Rontgen (1845-1923) had a paper entitled 'On a new Kind of Rays' accepted by Wurzburg Society of Physics and Medicine for immediate publication. This was the only paper on the subject that year but, in 1896 there were over 1000 articles in the learned journals and several thousand in the popular press with the word X-rays in their title. The purpose of this paper is to examine this explosion of activity which excited the public imagination as nothing had since Darwin's *Origin of Species* nearly half a century earlier in 1859. The public flocked to have their hands X-rayed, there were songs written for the Music Halls and a host of cartoons and saucy post-cards depicted leering physicists outside bathing huts. One enterprising London clothier even advertised X-ray proof underwear for modest ladies but, unfortunately, none of the lead-lined nether-garments have survived.

My paper is not about X-rays in general nor indeed about precedence in the United Kingdom but considers the influence of Liverpool University's first professor, Oliver Lodge (1851-1940) on these events. In the *annus mirabilis* of 1896, he contributed twenty papers to the scientific journals and as many articles in newspapers and, by considering two of these I want to persuade you that his timely intervention led to both the University and the local hospitals quickly establishing themselves as world leaders in this new field.

For the sudden exploitation of a new discovery there have to be two ingredients, a pressing need and a widespread expertise. In medicine, the advent of a procedure which could locate foreign bodies (bullets and broken needles), and, within the year, provide pictures of soft organs within the body improved diagnoses and was quickly accepted by the profession. The Military was also quick to adopt the new technology; Kitchener's Army took a mobile X-ray unit up the Nile for the Battle of

Omdurman (April 1898). That there was so much latent expertise arose from the nature of Rontgen's work.

The study of the passage of electricity through gases at low pressure had been a major field of physics research for a generation. The various parameters - pressure, current and chemical composition of the residual gas - were all being investigated by perhaps 500 professionals and a few amateurs with the necessary apparatus, the Crookes tube. So, after Rontgen's discovery, there were 499 professional physicists and all the country parsons and school teachers who maintain the British Association raring to go. Some amateurs reported in the press in 1896 were:-

- a) Mr. H.S. Pyne, Science master at King William's College, Isle of Man, used school equipment to photograph a frog before June 1896.
- b) A schoolboy, Russell Reynolds, who later became a radiologist, took pictures of his hand.
- c) The Reverend Frederick Walter, a Congregationalist in Norfolk did the first X-rays for the local hospital.

They all had available Crookes tubes. William Crookes (1832-1919) had developed a piece of apparatus which consisted of a pair of electrodes in an evacuable glass vessel. Below a critical pressure, the residual gas glowed with a characteristic colour - the basis of modern advertising signs - but at even lower pressures the discharge stopped. The cause of the discharge had, correctly, been found by Lenard to be due to what he called 'cathode rays' which had a range in air of a few centimetres and which were eventually found, by J.J. Thomson (1856-1940) to be electrons.

In the autumn of 1895, Rontgen repeated the Lenard experiments and noticed that a barium platinocyanide screen continued to fluoresce when placed well beyond the range of the cathode rays, hence his title of a 'New sort of Ray'. He did a series of experiments to clarify their novelty and wrote his paper on the 15th December.

The opening of the floodgates is worth telling in a little detail. When Rontgen got copies of his paper early in January 1896, he sent some to a few colleagues and friends cautioning that, as there had not been a formal

reading because of the New Year's holiday, this report was preliminary and dissemination should await his reading to the Society. Two copies came to the U.K., one to Arthur Schuster (1851-1934), in Manchester and one to Lord Kelvin (1824-1907), in Glasgow. He also sent copies to Hamburg, Berlin and to Franz Exner in Vienna. Exner discussed the paper with his colleagues, one of whom could have stepped straight out of a Restoration Comedy, the splendidly named Ernst Lecher known to older physicists for his work on 'Lecher Wires', the transmission of waves along parallel conductors. Lecher's father happened to be editor of the *Neue Freie Presse* in Vienna and he, knowing a scoop when he smelt one, published an account the next day. It was picked up by the *Daily Chronicle* in London and a translation of Exner's article appeared on Monday 6th January. This was quickly followed by the rest of the Press.

The Journals soon joined in; *Nature* of 16th January carried an English translation of Rontgen's article by Arthur Stanton, Schuster's assistant. The *British Medical Journal* announced on 8th February that Sydney Rowland (1872-1917) had been commissioned to investigate the phenomenon and he contributed a weekly report until mid-July, 1896. The *Lancet* of 22nd February carried the article by Lodge and Jones of the location of a bullet in a boy's wrist. The X-ray was taken on the 7th of February.<sup>1</sup>

Let us consider the *Lancet* article of 22nd February in some detail. The first observation is that it is two separate pieces, a medical bit by Robert Jones and a physics bit by Oliver Lodge. We normally remember these eminent gentlemen in their honour-laden old age - our medical colleagues will remember the portrait of Robert Jones in the uniform of a Major-general presented to him after the First World War - but they were both in 1896 just establishing their careers. Robert Jones (1857-1933) was born in Rhyl. His father was a journalist but his uncle was the legendary Liverpool bone-setter Hugh Owen Thomas who took him in hand and insisted he take Medicine at the Liverpool Medical School. By 1889 Robert Jones was honorary surgeon at the Royal Southern Hospital and he records that he was told about the new X-rays by a Frau Wimpfheimer, who had family still in Vienna, well before anything appeared in the English

press. Tracing her was not too difficult; the unique name and Gore's Directory for 1896 gave Augustus Wimpfheimer, Cotton Merchant, 22 Grove Park. That address rang a memory bell; at that time Oliver Lodge lived at no.2 Grove Park; could it be that the Frau's fore-knowledge had not been given to him?

Oliver Lodge (1851-1940) had been appointed professor of Physics (and Mathematics) in 1881 and had already done much work on early wireless and lightning conductors. He learned his photographic technique in June whilst trying to photograph sparks using a rapidly spinning plate. He was one of the 499 professionals, had several Crookes tubes and had been studying cathode rays off and on for some years. Robert Jones may have attended Lodge's lectures for medical students and must have been familiar with the improvements to medical instruments that Lodge and his assistants had introduced over the years. The approach for help certainly came from Jones.

Robert Jones ran a free clinic at the week-ends and was assisted by Charles Thurstan Holland (1863-1941) who, although not mentioned in the paper, was present on the occasion of the location of the bullet. The scene is vividly described in his valedictory paper to the *Liverpool Medico-Chirurgical Journal* in 1937. By May 1896, Holland had become, in all but salary, the first radiographer at the Royal Southern Hospital and in an address at the opening of the centenary celebrations of the Liverpool Medical School in 1934, Professor John Hay described him as 'the father of British radiology'. Also present in the Physics department on the afternoon of 7th February were the hospital surgeon, Mr. Houlgrave, Lodge's assistant, Edward Robinson, who had assembled the tube and probably Ben Davies who would have made the frame to restrain the hand for the hours of the exposure.

The Dr. Thomas Simpson (1836-1931) of Waterloo who made the referral, was a G.P. with political leanings; he was to become the first chairman of the Waterloo Urban District Council, but retired to Devon soon after the turn of the century. In the article the boy is, of course, professionally nameless as he is in the local newspapers, but the *Waterloo Herald* of 15th

February at least tells us that the gun-shot wound was self-inflicted, accidental and the bullet, now located, would be removed 'next Tuesday'. Unfortunately, there was no follow-up story.

The boy could still be alive; he would only by 105! I set out to try and trace the boy, not out of curiosity but because he would have been one of the first people to have had a massive dose of radiation. We might think that the primitive apparatus would have been very inefficient at producing X-rays but that is not so; each retarded electron produced the same amount of radiation in 1896 as it does today, all the inefficiency was in the insensitivity of the photographic plates - hence the long exposures. We know the voltage could produce '..a 1 inch spark..' so the X-rays were very soft but there were '..several preliminary exposures before the final picture which was exposed for about two hours'. The patient's anonymity was maintained throughout all the reports - except one. In his account to the *Liverpool Medico-Chirurgical Journal* in 1896 Lodge mentions 'George Henderson'. He would have lived within the catchment area of Dr. Simpson's house Tulliallan, on Liverpool Road, Waterloo; in those pony-and-trap days, say one mile. His house and surgery was the second house on the left as you enter Waterloo after the flyover so half the one mile circle was uninhabited.

*Gore's Directory* lists five 'Hendersons' within that radius; unfortunately, George would have been born after the 1881 census and the 1891 returns will not be made public for another two years. The household also had to be wealthy enough to possess a fire-arm or, at least, allow their 12-year old to go shooting. The prime candidate for father at the moment is Mr. William Henderson, a founder of Henderson and Glass, Steel Stock-holders still in business on the Dock Road. Surprisingly, no 'George' is listed amongst the mourners at William's funeral in 1913. Could it be that George had died before he was thirty? Another possible lead is provided by the fact that the second lecturer in Physics, Lodge's assistant, Dr. James Howard, lived within 50 metres of the Hendersons and both were active in the same church, St. John's, Waterloo. I am still searching archives.

Before we consider the second of Lodge's papers we should recall the events at the Liverpool Physical Society. This had been founded in 1889 by Lodge to bring Science to the masses and tap the local commercial gentry for research funds. Lodge's work on the Ether Drag, for example, was financed (£1000 = 7 years of lecturer salary) by the shipping magnate George Holt; his X-ray apparatus was paid for by the jam-and-jelly magnate William P. Hartley. The Liverpool Physical Society was not a student body - the total number of Honours Physicist in the 15 years up to our date was precisely - one, William Thornton in 1895. For the first 60 years of its existence, the major teaching in the department was service to medical students, engineers, vets etc.

From the Society Minute Book we find that the meeting on Monday 27th January 1896 had to be hastily rearranged so that Lodge could give a lecture-demonstration to a packed (about 300) audience on:-

...the new Photographic Discovery....photographs taken by Prof. Rontgen and by Prof. Lodge and Mr. Robinson were exhibited....

A report in the local press led to such interest that there was a repeat of the show in the Arts Theatre on the 3rd of February:

The attendance numbered nearly 1000 persons and large numbers were again unable to gain admission...At the close of the demonstration, Prof. Schuster of Owens College, Manchester...proposed a vote of thanks

[The Cash book shows stewards were hired to control the crowds.]

That Lodge arranged for his arch-rival Schuster to witness his triumph was a great piece of one-upmanship. In 1881 Lodge and J.J. Thomson had both been applicants, with Schuster, for the Chair of Physics at Manchester. Schuster got the job because, not only was he prepared to work without salary but would also pay for another lecturer and assistant out of his own pocket! That assistant was the translator of the Rontgen paper for *Nature*, Arthur Stanton.

At the next meeting, on 24th of February we read:-

Mr. E.E. Robinson exhibited photographs taken by means of Rontgen rays (Radiographs) by Prof Lodge and himself. They represented the wrist of a boy with a bullet lodged between the middle metacarpal and the corresponding carpal bones, and of a woman's hand with a broken needle in it...

The next meeting, on the 6th March has Lodge on some new designs of X-ray tubes. The meeting of the 23rd November, 1896 is a review of papers presented at the British Association for the Advancement of Science which, by good fortune, had arranged their Annual Meeting to be in Liverpool in September, 1896. This had been dominated by X-rays and the papers of, amongst others, Lenard, J.J. Thomson, Rutherford and S.P. Thompson, were reported on, the resulting discussion spilling over into the next meeting.

I now turn to Lodge's second paper on X-rays. It appeared in two versions, one destined for a learned journal and one published in the *Liverpool Daily Post* of 24th March, 1896 - not that Lodge was talking down to the general public, but the newspaper article has more background and a little less technology. I list some of the ideas floated in this conjoint:

- a) Listening to and smelling the tubes discharge then tuning by playing a bunsen burner on the glass.
- b) Need to train viewers of X-rays - he started a course.
- c) Comparison of available plates and developers.
- d) Design of a screening box.
- e) Compares excitation Induction Coil/Whimshurst Machine.
- f) Asks do the rays kill germs?
- g) Asks does the Sun emit X-rays; alpine tourists report fogging of plates. He plans a specific experiment. - Cosmic Rays were discovered a generation later.
- h) Speculates that the rays are light with wavelength comparable to the size of molecules: 'Such molecules would be made diffractionally visible' - discovered 1912.
- i) Recalled a certain Reverend Frederick Smith of Oxford who years before had warned that photographic plates had to be kept well clear of Crookes tubes or they would get fogged.
- j) Says '...last month J.J. Thomson showed that X-rays make insulators conduct...'

- k) He ridicules some reports of people claiming to have observed X-rays from Bunsen Burners etc.

The year 1896 had been a very exciting one but what of the future? The future for medical X-rays in Liverpool was in the safe hands of C. Thurstan Holland at the Royal Southern Hospital; apparatus to the value of £30 had been purchased from Messers Newton & Co, Fleet Street, and was installed by the end of May 1896 - spare Crookes tubes cost 18/6 each. During the rest of 1896, Holland took 251 X-rays of a great variety of subjects:

Congenital deformities, Rheumatoid arthritis, Osteitis,  
Tuberculosis, Foetuses, Rickets, Enchondromata,  
Metataralagia, Strumous dacylitis and many other conditions.  
A series of childrens hands to show bone growth.  
Showed a wealthy woman her diamond ring was fake, and....  
October 22nd - a mummified bird  
November 2nd - a suspected case of swallowing false teeth  
September - Sir Joseph Lister's hand

Sir Joseph Lister (1827-1912) was the President of the British Association and was attending the 1896 meeting in Liverpool. He visited the Southern Hospital specifically to view the new radiology department. Much of the program for the B.A. had had to be redrafted after the discovery of X-rays and two whole sessions were devoted to technique and to speculation about their origin in those pre-electron days.

The Royal Infirmary quickly got involved with radiology due to the enthusiasm of their pharmacist, Prosper H. Marsden, with active help from Lodge. Charles Woods, who had been a technician in the Physics Department from 1891 went to the Royal in 1903 at about the time Thurstan Holland got a permanent post there. Charles Woods was one of the first victims of radiation losing progressively fingers, hands and then, fore-arms before dying of facial cancer in 1938. He is named on the so-called Martyrs' Memorial, Hamburg. The title is a dreadful misnomer to quote Ernest Wilson just before he succumbed in 1911:-

I am not a martyr to science but a victim - a martyr knows what to expect

Nathan Raw was taking X-rays at Mill Road Infirmary by December 1896 and the Stanley Hospital had a set by early 1900. The David Lewis Northern and St. Pauls were equipped by 1902.

I do not want to suggest that rapid developments were entirely local. Duos of physicist-medics sprang up around many Universities:

Lord Kelvin & John Macintyre in Glasgow  
 John Poynting & John Hall-Edwards in Birmingham  
 Prof Stroud and G.E. Williamson in Newcastle  
 Prof Hicks and Christopher Addison in Sheffield  
 Arthur Schuster & Leopold Larmuth in Manchester  
 Silvanus P. Thompson and Arthur Blacker in London

By 1900, X-rays were routinely available in about 55 hospitals in the United Kingdom.

The physicist half of these teams quickly withdrew from diagnostic work and concentrated on investigating the nature of X-rays. The discovery of the electron by J.J. Thomson in 1897 showed the distinction between cathode rays and X-rays thus enabling more specific experiments to be devised. Oliver Lodge with his assistants and students continued to work in the field after the George Henderson photograph. Ben Davies made novel X-ray tubes; two of his 1896 tubes with focusing cathodes and aluminium anodes were presented to the Rontgen Society and are in the Victoria & Albert Museum, London. One of Lodge's students, Charles Glover Barkla (1877-1944), was sent after graduation in 1899 to the Cavendish Laboratory to work with J.J. Thomson on the nature of X-rays. He returned to Liverpool in 1901 and in a series of experiments over the next few years showed that X-rays were small wavelength, polarisable electro-magnetic waves. For this work he was awarded the Nobel Prize in 1917 - but, the very first Nobel Prize of all went, quite rightly, to Wilhelm Conrad Rontgen in 1900.

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NOTES

- <sup>1</sup> My sources include E.H. Burrows' *History of British Radiology*, which has the limitations imposed by the title. I had also anticipated using the Lodge note-books in the University Archives. Lodge left 26 volumes of laboratory workings but, it emerged, nothing on X-rays. I suspect that as he gave his Liverpool course 'Physics for Radiology and Medicine' when he went to Birmingham, the 'lost' note-books were taken with him. My main sources of archival information are the minute books of the Physical Society and the petty cash books of the department. [The cash books show a considerable spending on photographic materials in the first quarter of 1896]

We can learn a lot from the spending of money; for example, we find an entry....

"3/6 to have the professors balls gold plated"

My other sources are the local newspapers, particularly the *Liverpool Daily Post*, the *Waterloo and Crosby Herald* and the *Southport Visitor*.

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