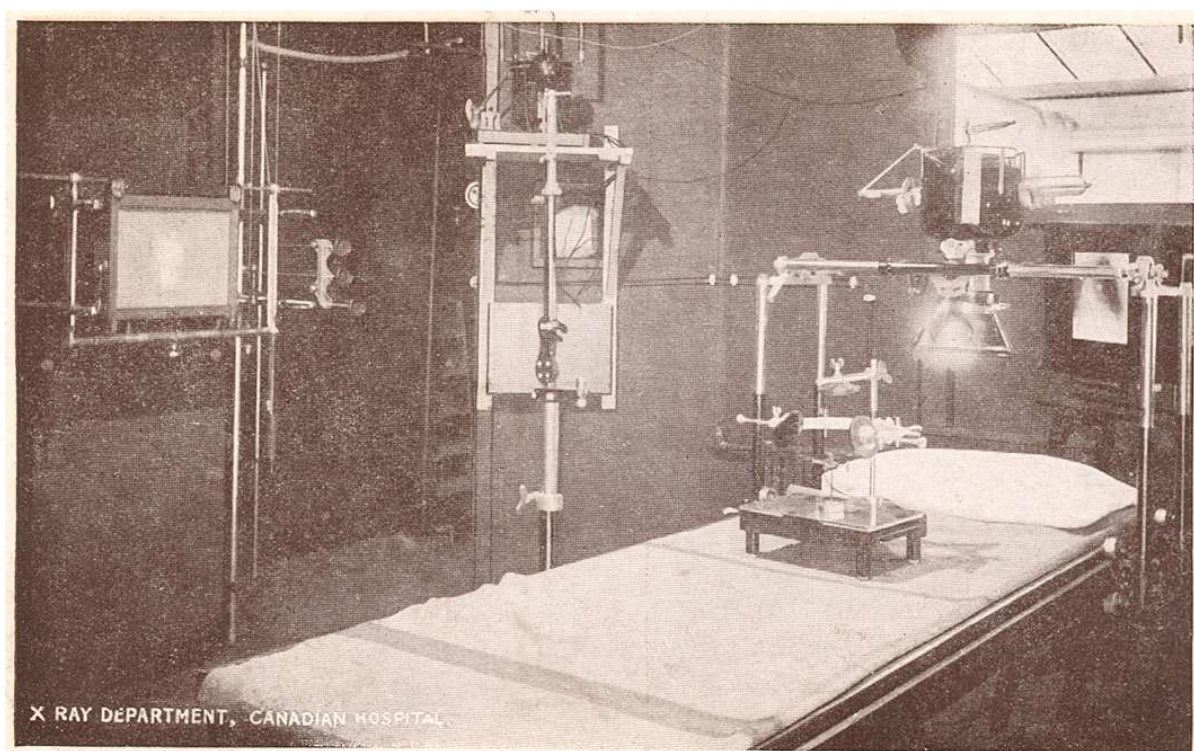


The Invisible Light

The Journal
of
The British Society for the History of Radiology



Number 30, November 2009

ISSN 1479-6945 (Print)

ISSN 1479-6953 (Online)

<http://www.bshr.org.uk>

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Editorial

The British Society for the History of Radiology (BSHR), formerly the Radiology History and Heritage Charitable Trust (RHHCT), continues to flourish as can be seen by this 30th issue of our Newsletter/Journal. Do visit our web site at www.bshr.org.uk. We hope to put different historical articles and items of interest on the site each month. We will also look at items and articles you wish to send in with a view to either publishing them in our journal or posting them on the web site.

This Journal "The Invisible Light" is published twice a year, and is free to members of the BSHR. For anyone interested in joining the Society a membership form is available in the contacts section on the web site, which you can download and send to us. This form also gives more details about the Society. We are affiliated to the British Society for the History of Medicine (BSHM). We are always looking for new members.

We organise a radiology history session at the annual UK Radiology Congress 'UKRC' www.ukrc.org.uk which this year was held in Manchester (UK Radiological Congress 2009, Manchester Central, Manchester UK). The History Special Focus Group at UKRC 2009 was well attended and our stand at the technical exhibition was very busy as always.

We will be present at UKRC 2010 (to be held in Birmingham) and again we will be having a history session and a stand in the technical exhibition. The history session at UKRC in 2010 will be well worth attending with a selection of interesting papers. We have two distinguished foreign visitors who will be speaking at the session. These are Prof. Dr. Alfredo Buzzi from the University of Buenos Aires in Argentina and who is now the President of the Argentinean

Society of Radiology. Prof. Buzzi continues to develop his links with the UK. The second foreign guest is Dr. Uwe Busch who is the Deputy Director of the Deutsches Röntgen-Museum in Remscheid (Lennep) in Germany who will be telling us about the exciting changes he is making to the museum. Dr. Arpan Banerjee from Birmingham Heartlands Hospital will be describing the life and work of the famous pioneer Birmingham radiologist James Brailsford. James Brailsford was one of the great characters of British radiology. Dr Pauline Reeves will tell us about her interesting work using professional journals to examine gender in radiography from 1935-1974. Prof. Richard Lawson, the Chief Physicist of Manchester Royal Infirmary, gives us a Nobel History of nuclear medicine. Nuclear medicine is often considered to be a relatively modern speciality, but in fact its foundations now go back over 100 years. His talk will describe the early scientific discoveries that led to the development of nuclear medicine and highlight the contribution of several Nobel Prize winners. Finally I will give a paper on the ultrasound pioneer Ian Donald in the centenary year of his birth.

Our Annual Lecture in 2010 will be held at the British Institute of Radiology on the 22nd February in the evening. The lecture is to be given by Prof. Peter Ell on the history of Nuclear Medicine.

The X-ray Machine wins British Science Museum Award!

The X-ray Machine has won the Science Museum's Centenary Award. The Science Museum in London has its origins in the Great Exhibition of 1851, which is coincidentally the birth date of Silvanus Thompson, our first President. The modern Science Museum was founded in 1909 and as part of their Centenary celebrations held a public vote on the top ten icons in their museum. One of the icons is the Russell Reynolds X-ray apparatus which is on display in their 'Making of the Modern World' gallery. In January 1896, as a schoolboy, Russell Reynolds (1880-1964) used an early Watson tube mounted on a retort stand to demonstrate Röntgen's discovery (Fig 1. Early apparatus: gas tube on a wooden stand). Russell Reynolds went on to become our President in 1937-8 having become a member in 1901 whilst a medical student at Guy's Hospital. He was on the staff of Charing Cross Hospital and the National Hospital in Queen Square. Nearly 50,000 people voted and they voted overwhelmingly for the discoveries that transformed the way we look at our bodies and ourselves. The X-ray Machine took the top place, followed by Penicillin and then the DNA Double Helix <http://www.sciencemuseum.org.uk/Centenary.aspx>. We should also reflect that without X-ray crystallography the discovery of the Structure of DNA (in 3rd place) would not have taken place. If you have not been to the science museum recently then do make a visit. I particularly recommend the Science in the 18th Century gallery.

There are two deaths of significant radiological pioneers.

John Wild.

John Julian Cuttance Wild (1914-2009) was a pioneer of ultrasound in medicine and was born here in Beckenham, Bromley! He was an electrical engineer, biologist, inventor and doctor. In 1949, with John Reid, Wild found that pulse-echo ultrasound was reflected as echoes from body tissue. This pioneered the first real-time ultrasonic images in living tissue. The following is a link to The Times:

<http://www.timesonline.co.uk/tol/comment/obituaries/article6846357.ece>

Peter Langstone.

I am sorry to record the death of Peter Langstone on Thursday 24th September 2009. Peter Langstone worked at EMI with the late Sir Godfrey Hounsfield developing CT scanning (The EMI-scan). The team that was assembled under Godfrey Hounsfield included Stephen Bates (who worked on programming), Peter Langstone (working on electronics) and Mel King (working on mechanics), developed "Computerised Axial Tomography" (The CAT or CT scan). Peter Langstone had worked on designing and building a 1,000,000 bit computer memory in the early 1960's, before the invention of the silicon chip which revolutionized the computer industry. Peter Langstone made major contributions to modern medical imaging.

The British Society for the History of Medicine.

The BSHR is a member of the BSHM and our two representatives are Dr Arpan Banerjee and myself. I had a wonderful time in Belfast for the 23rd Congress of the BSHM. I attended the Officers and Representatives Meeting and if anyone wants a copy of the minutes then please contact me and I will e-mail them to you. Mrs Sue Weir took over as President and I was elected Vice-President. Sadly there was only one paper with a radiological theme and there will be no surprises as to the name on the author! The next and 24th Congress of the BSHM will be from the 31st August to the 3rd September 2011 and will be held at the University of Surrey, Guildford in association with the Faculty of the History and Philosophy of Medicine and Pharmacy of Medicine of the Society of Apothecaries. I would love to see more radiological papers so please start working. The next meeting of the BSHM is to be the Poynter Lecture which will be delivered by Dr Ruth Richardson who is Visiting Professor to Hong Kong University in Humanities and an Affiliated Scholar in the History and Philosophy of Science at the University of Cambridge. The talk will be given at the Wellcome Building Conference Centre on the Euston Road at 6pm on the 24th March 2010 and Ruth's subject is "Promiscuous and Inattentive Proceedings, The Ethics and Etiquette of Patient Care in the Georgian Era."

You Tube

I have been enjoying You Tube and looking at the huge variety of films available. I particularly liked "A Is For Atom" which is a Vintage Atomic Film from 1953 <http://www.youtube.com/watch?v=Gi-ltrJISQE&feature=fvw> . Although the "Atoms for Peace" campaign was formally launched in 1957, corporate America began to promote peaceful uses of atomic energy as early as the first few months after Hiroshima. Another interesting film is "Medical Aspects of Nuclear Radiation" from 1950. <http://www.youtube.com/watch?v=laW6qE8cDal&feature=SeriesPlaylist&p=C7BF5B17BC504A42> This film explains effects of radiation upon the human body, internal and external radiation hazards, and the relative gravity of the hazards of nuclear radiation, blast and heat. It contains charming animations as does "A is for Atom."

Adrian

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adrian.thomas@btinternet.com

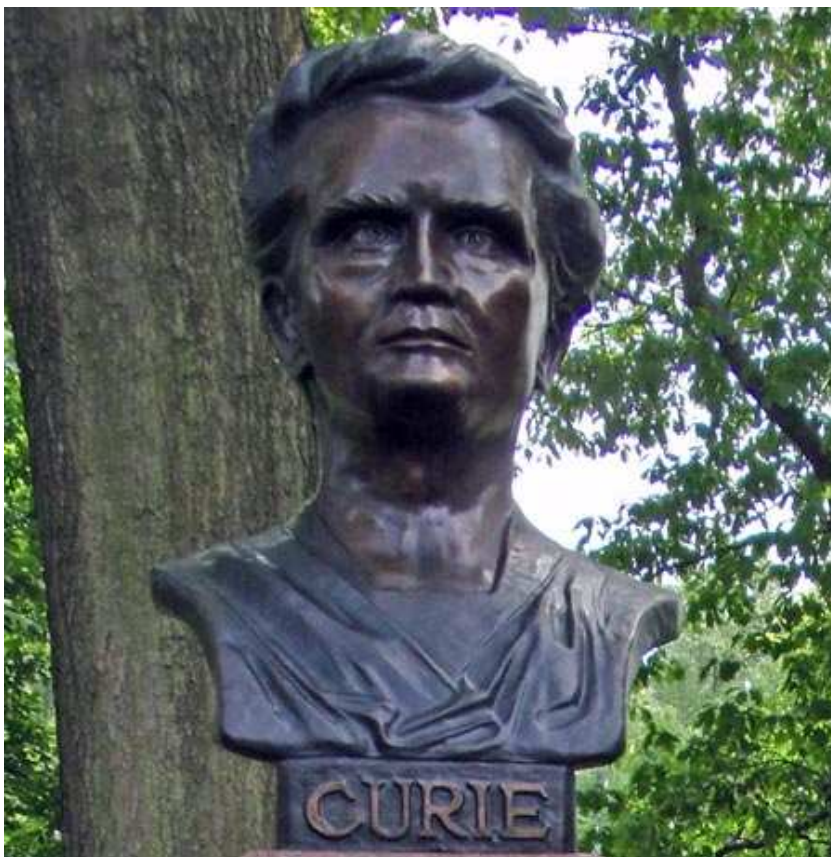
Department of Nuclear Medicine, Princess Royal University Hospital Orpington, Kent BR6 8ND, UK

Marie Curie

I am sure we all enjoyed the paper by Joel Lubenau on the atomic train in our last issue of *The Invisible Light* for February 2009. I have had many appreciative comments and I loved the way that the images were reproduced. Joel Lubenau wrote to me saying that he felt that the photographic reproduction was gorgeous. Also said that it was a nice coincidence (or was it?) the same issue included a review of Dick Mould's magnificent Radium History Mosaic.

I sent Joel some copies of the journal and he wrote that "Your package arrived while I was travelling researching my next writing project, the Flannery brothers' vanadium production enterprise that preceded their radium venture.

When alloyed with steel the product is much stronger than ordinary steel and better withstands shock and vibration. It's an international story – the ore came from a Peruvian mine located at nearly 16,000 feet elevation in the Andes and the secret to successfully alloy the metal with steel was solved by a British metallurgist, J. Kent Smith, and an Indian metallurgist, B. D. Saklatwalla from Calcutta. Henry Ford incorporated the new steel into his Model T auto.



Midway through my trip I attended the dedication of a replacement bust of Marie Curie in the Polish section of the Cleveland, Ohio Cultural Gardens. (The original was stolen for its scrap metal value.) Among the handouts was my article in *Pennsylvania Heritage* about the Standard Chemical Company and Marie Curie's visit. Ben Stefanski, President of the Polish Garden, was responsible for that. He is also a member to the Train Collectors Association and saw my article in that organization's journal. That led to his learning of the *Pennsylvania Heritage* article and he did the rest. Small, world, isn't it?

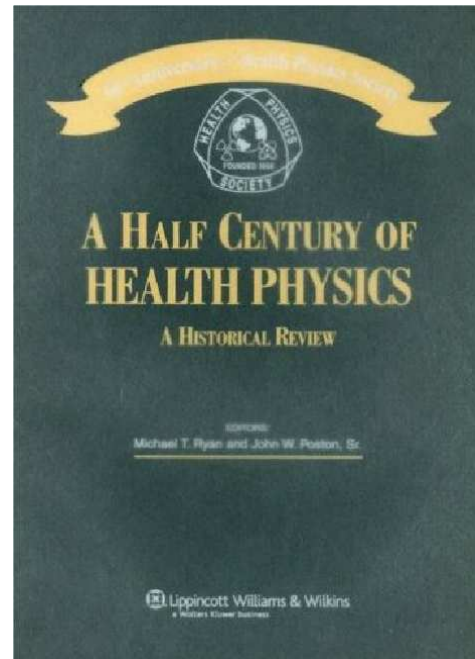
It was a lovely ceremony that ended with the traditional Polish patriotic melody, the Hejnal. You can view the story for the bust and photos and videos of the ceremony at www.clevelandpeople.com.

I hope the Joel will write us another article in the future.

New Books and Papers:

A Half Century of Health Physics (Hardcover)
by Michael T. Ryan (Author), John W. Poston (Author)
Publisher: Lippincott Williams & Wilkins, US; Rmst
edition (1 Mar 2006)
Language English ISBN-10: 0781769345
ISBN-13: 978-0781769341

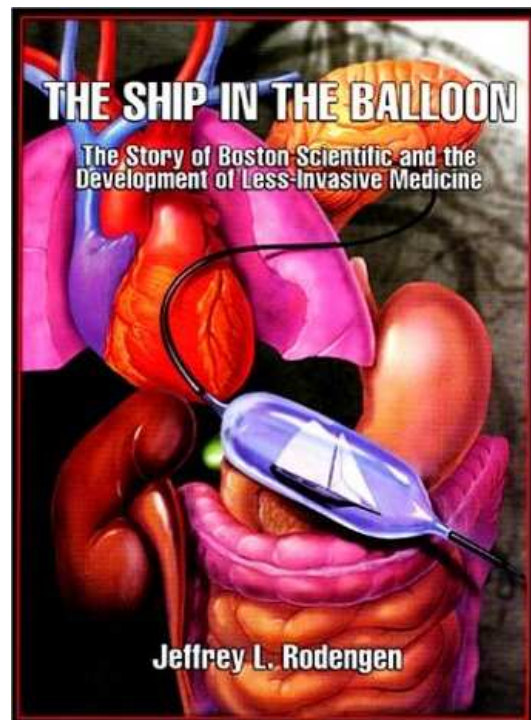
This book was written to commemorate the 50th year of the Health Physics Society in the USA and of the journal "Health Physics." This book consists of a series of review articles summarizing the first half-century of the Society. The topics covered range from fundamental physics to applied health physics in several areas of industry and medicine. There is also a history of the Health Physics Society.



The Ship in the Balloon: The Story of Boston Scientific and the Development of Less-Invasive Medicine (Hardcover)
by Jeffrey L. Rodengen (Author)

Hardcover: 224 pages
Publisher: Write Stuff Syndicate (Sep 2001)
Language English
ISBN-10: 0945903502
ISBN-13: 978-0945903505

This lovely book is warmly recommended to anyone interested in the history of interventional radiology. It shows the close cooperation between radiologists and the companies that manufacture the kit that we use in our daily work. The book well written with many illustrations.



I was not aware of this book when it came out and so I would be very grateful if anyone comes across any books and papers with a radiological history theme that they let me know so that I may include them in this publication.

Photography and the Invisible: 11th February – 24th May 2009

<http://www.albertina.at>

Albertinaplatz 1, 1010 Vienna, Austria

I spotted an announcement when I attended ECR in Vienna earlier this year. I was surprised that the exhibition with its significant radiological content was not recommended in the congress booklet. I visited the exhibition with Dr. Uwe Busch who is the Deputy Director of the Deutsches Röntgen-Museum in Remscheid (Lennepe).

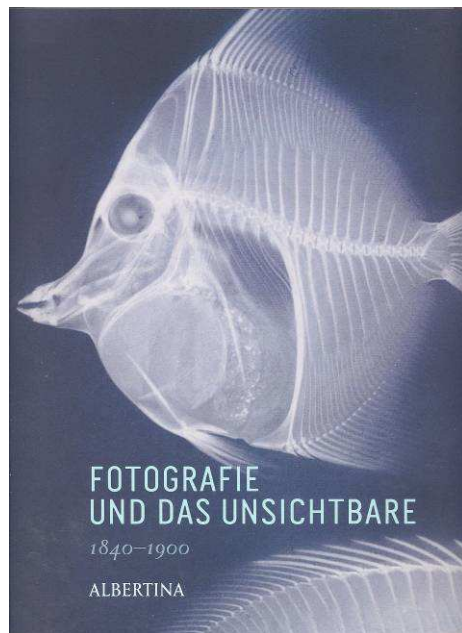
The exhibition looked at the use of photography as a tool in 19th-century science, with a special focus on images of phenomena that are unseen by the naked eye. The exhibition was organised by the San Francisco Museum of Modern Art (SFMOMA), and the exhibition was supplemented by works from the Albertina's own Photographic Collection.

"Modern science and photography both flowered in the first half of the 19th century. Photography was adopted as a scientific tool from the moment of its invention in 1839. As the century progressed, scientists used the microscope, the telescope and X-rays to capture images of previously hidden realms both infinitesimally small and unimaginably large. Through photography they analysed motion, peered into distant galaxies, and penetrated the human body.

Photography and the Invisible assembles 200 photographs and photographically illustrated books, most of which have never before been shown in Austria. Highlights of the exhibition include some of the earliest microscopic daguerreotypes; photographs by Henry Fox Talbot and Auguste-Adolphe Bertsch; Jules Janssen's chronograph of the transit of Venus in 1874 (on a circular daguerreotype plate); motion studies by Eadweard Muybridge and Étienne-Jules Marey; early X-ray photographs by Josef Maria Eder and Eduard Valenta; spirit photographs by Louis Darget; and photographs made using a process of colour photography based on interference that was developed by the physicist Gabriel Lippmann, who received a Nobel Prize for its invention."

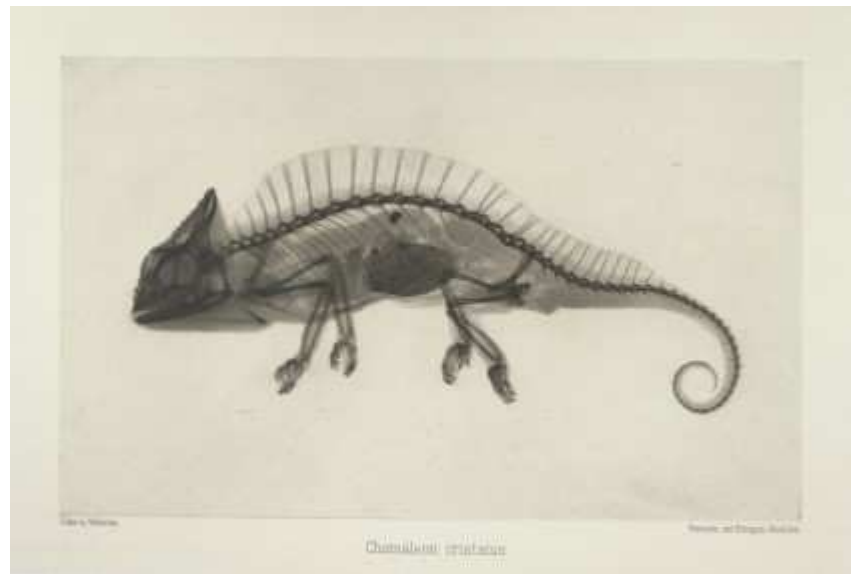
The exhibition catalogue, *Fotografie und das Unsichtbare 1840-1900* (Photography and the Invisible, 1840-1900), has essays by Corey Keller, Tom Gunning, Jennifer Tucker and Maren Gröning, and is available in both English and German. The beautifully reproduced plates are divided into six sections, each with a text describing important innovators of the period and the methods they used to produce their images. The English version is: *Brought to Light: Photography and the Invisible, 1840-1900* (San Francisco Museum of Modern Art) (Hardcover) by C Keller (Author) Publisher: Yale University Press (1 Jan 2009).

"Brought to Light" invites readers to step back to a time when photography, X-rays, and movies were new, when forays into the world beneath the skin or the realm beyond our everyday vision captivated scientists and the public alike. In this book, accounts of scientific experimentation blend with stories of showmanship to reveal how developments in nineteenth-century technology could enlighten as well as frighten and amaze. Through a series of 200 vintage images, produced by photographers, scientists, and amateur inventors, this book ultimately traces the rise of popular science. The images demonstrate early experiments with microscopes, telescopes, electricity and magnetism, motion studies, X-rays and radiation, and spirit photography. We learn how these pictures circulated among the public, whether through the press, world's fairs, or theatres. What started out as scientific progress, however, often took on the trappings of magic and superstition, as photography



was enlisted to offer visual evidence of clairvoyance, spirits, and other occult influences. With beautifully reproduced plates and engaging narratives, this book embodies the aesthetic pleasures and excitement of the tale it tells.”

Josef Maria Eder and Eduard Valenta
Chamaeleon Cristatus, 1896
Photogravure

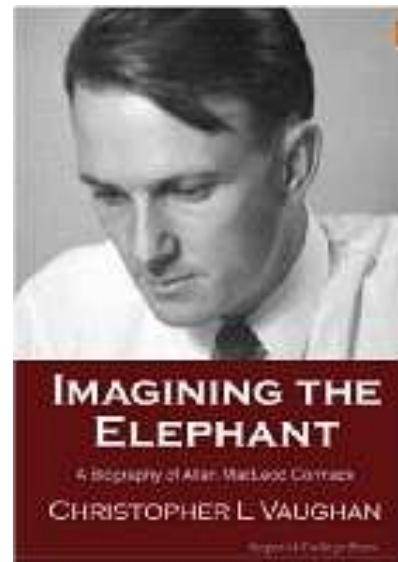


Imagining the Elephant: A Biography of Allan MacLeod Cormack

Author(s): Vaughan, Christopher, L
Publisher: University of Cape Town, South Africa
ISBN: 978-1-91989-508-6
Publisher: Imperial College Press; illustrated edition (2 Aug 2008)
Language English
ISBN-10: 1860949886
ISBN-13: 978-1860949883

The book “Imagining the Elephant” is a biography of Allan MacLeod Cormack. The book is well produced and attractive to hold and has a photograph of the young Allan Cormack on the cover.

Alan Cormack is a major figure in both African and world science and medicine. Allan MacLeod Cormack (February 23, 1924 – May 7, 1998) was born in Johannesburg in South Africa and won the 1979 Nobel Prize in Physiology or Medicine sharing the prize with the late Sir Godfrey Hounsfield for his work on x-ray computed tomography. The work of Allan Cormack and Godfrey Hounsfield has transformed investigative medicine and Christopher Vaughan has done us all a great service in writing this unique biography of Allan Cormack. The field of Radiology can be divided into the period before the work of Hounsfield and Cormack and that afterwards. The result of their work is profound and Dr James Bull stated that the development of the CT scanner was the most important development in radiology following the discovery of x-rays in 1895.



The personal and professional life of Cormack is described in an interesting and thoughtful manner. The story of his family and its move from Scotland to South Africa is described well, as is the young life of Cormack. The level of detail is excellent and I liked the way that background is given to the work that he was undertaking with clear explanations and illustrations. There is detailed information about the scientists with whom he worked and the level of detail makes this book of use to the interested non-specialist as well as to those with a more detailed knowledge of the subject. It is not easy to write a biography of a scientist and to get the balance between the personal life right and to explain the technical aspects that will make to book interesting to the specialist and avoiding patronising the more general reader.

What I liked about the book is that it is both a biography and a resource for further study. I enjoyed reading the book and learnt much. There is an excellent set of appendices. Appendix A is a helpful list of his publications and appendix B is his 1979 Nobel Lecture. Of great fun is appendix E "A Teenager's Odyssey" which was written in 1991 for a magazine for Japanese teenagers and is beautifully illustrated and written and deserves to be widely read.

The book is served well by the helpful illustrations and figures which are inserted within the text. There is a useful table of the sources and provenance of the figures. The resolution of some of the illustrations suffers from being on matt paper however the images can be seen adequately.

The notes to the text are helpful and will assist further study. The index seems accurate and well done.

I can warmly recommend this book as a significant and unique contribution to the history of radiology. I hope that this book gets the world-wide recognition that it surely deserves and it is worthy to receive The Noma Award. I will certainly be recommending it in "The Invisible light," which the journal of the British Society for the History of Radiology.

Taming the Rays

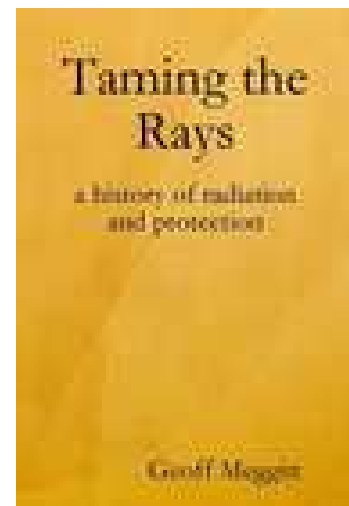
<http://www.tamingtherays.com/>

by Geoff Meggitt

Published by Lulu.com 2008

ISBN: 978-1-4092-4667-1

Taming the Rays is a history of the use of X-rays and nuclear radiation and of the understanding and management of the dangers they pose. Soon after Röntgen and Becquerel made their discoveries in the final years of the 19th century physicians adopted the technology and scientists have since found many new applications, most significantly those connected with nuclear fission. The book traces how the risks associated with these technologies – and with the naturally-occurring sources of radiation - have been understood, expressed and assessed. It has often been a controversial enterprise and certainly one of the more complex of intellectual endeavours undertaken on an international scale. It has not been a strictly scientific one since the physics, chemistry and biology have necessarily been translated into concepts and standards that can be communicated and used to set standards. The book explores these themes and traces how they have evolved through reference to original research and the thinking of national and international organisations with responsibilities for advising on protection.



Geoff worked as a health physicist for the United Kingdom Atomic Energy Authority and its later commercial offshoots for 25 years with particular interests in risk assessment, internal dosimetry, waste management, nuclear criticality and accident response. For five years in the 1990s he was Honorary Editor of the Journal of Radiological Protection.

Since retiring in 2002 he has spent some of his time researching the history of nuclear technology and radiation protection. The results so far are a short history of nuclear criticality safety (Fission, critical mass and safety - a historical review, J Radiol Prot 26 (2006) 141-159) and this book.

This book is full of a wealth of detail and is warmly recommended.

Head & neck X-ray images: a selection from 1896-1904

R. F. Mould

<http://www.nowotwory.edu.pl/content.php>

NOWOTWORY Journal of Oncology • 2009 • volume 59
Number 3 • 108e115e

Historia medicinae

Head & neck X-ray images: a selection from 1896-1904

Richard F. Mould

This article illustrates the type and quality of head and neck images which were published in books, journals and catalogues in the nine years after the discovery of X-rays. This period included not only plain radiography but also stereoscopy and ventriculography.

Working Radium Spinthariscopes Microscope Slide

E-bay Item number: 120390640847

The radium spinthariscopes slide was the original form of a spinthariscopes, invented by Sir William Crookes in 1903. The slide contains zinc sulphide powder mixed with a tiny quantity of radium bromide. Each alpha particle emitted produces a flash of light. The combined effect gives a luminous glow that is bright enough to be seen in the dark with the naked eye and a huge storm of light flashes when viewed under magnification. A simple 10X lens is sufficient to see the detail and a microscope is not needed.

This YouTube movie gives an impression of what it looks like, although the movie is of a pocket instrument spinthariscopes with the radium on a watch hand and not the microscope variety. The slide is in good condition and has been kept in the dark to preserve the luminosity of the zinc sulphide. It is signed H J Gray who I believe was an early 20th century slide maker. The winning bid was £103.00.

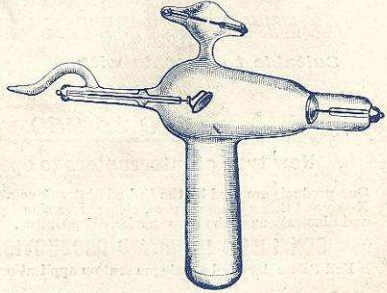
Advertisement: Archives of the Roentgen Ray, September 1904 (on next page)



A. C. COSSOR, 54, FARRINGDON ROAD, E.C.

"X" RAY TUBE FOR THERAPEUTIC WORK,
AND FOR THE RADIOGRAPHY OF SMALL AREAS.

Tubes with window of 1 inch diameter or less, 20s. each.
 Tubes with window of 2 or 3 inches diameter, 25s. each.





Patent No. 5611.

SPINTHARISCOPES
 As devised by SIR WILLIAM CROOKES.

Showing the Scintillations of Radium.

PRICE WITH LENS, £1 1s. FOR MICROSCOPE, 10s. 6d.

PURE RADIUM BROMIDE.

Physics-Related Stamps

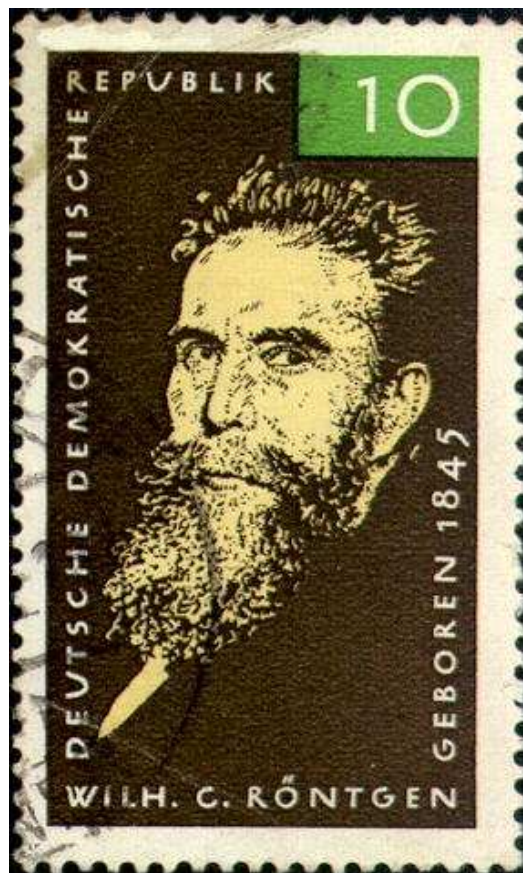
This may be of interest:

<http://th.physik.uni-frankfurt.de/~jr/physstamps.html>

This page exhibits stamps displaying physicists and a few mathematicians and engineers important for physics. The stamps are combined in 'albums' according to the people who contributed to the collection. There is a large collection of thematic radiological stamps.

Hint: Use the search function of your browser if you look for a particular name.

Stamp illustrated: Wilhelm Conrad Röntgen (1845-1923), GDR, 1965



A Great Rap on Radioactivity

www.planet-scicast.com/view_clip.cfm?cit_id=2810

Winner: Institute of Physics Best Physics Film 2009

Winner: Flipside Most Entertaining Film 2009

Winner: Best Original Score 2009

Nominee: Best Film - Secondary 2009

Team Let's Get Physical writes:

"The original idea for this film came from a school trip to the Hadron Collider in Switzerland. We watched a rap about CERN and we thought we could do something similar about radioactivity as it is a subject where people know the terminology but often don't understand the science.

We had already done radioactivity as a subject for our GCSE course so we were quite familiar with it. We worked out how to explain the science first and made sure we covered all the main facts. Natania wrote the words and music which I then storyboarded to create the film. We were able to shoot the film in a couple of hours - it would have been shorter but we kept getting the giggles, especially at Thembi as the mad professor! It was all done on location at Sydenham High School in London <http://www.sydenhamhighschool.gdst.net/>. The editing and sound recording took the longest time as it was important to make sure it was cut to reflect the rap.

We're really lucky that our school encourages us to do things like this. It's an independent, all girls' school where we are encouraged to explore all our different interests. We are able to combine physics for instance with other subjects and skills like film-making and sound recording which makes it a brilliant school."

My son is home from college (he is currently a physics undergraduate) and knew the Hadron rap <http://www.youtube.com/watch?v=j50ZssEojtM> which is on You Tube. He is currently trying to understand Hamilton's principle. He visited CERN as a school visit which was the only one of his school trips that I was jealous of!

WLB Lecture 1968 Nobel Laureates Meeting in Lindau

William Bragg 1890-1970 Nobel Prize for Physics in 1915 together with his father for the determination of crystalline structures using X-rays.

Prof. Dr. William Lawrence Bragg, 1968 - 18th Meeting of Nobel Prize Winners

History of the Determination of Protein Structure

I was unaware of this audio recording of WHB from 1968 from the Nobel Prize website - fascinating.

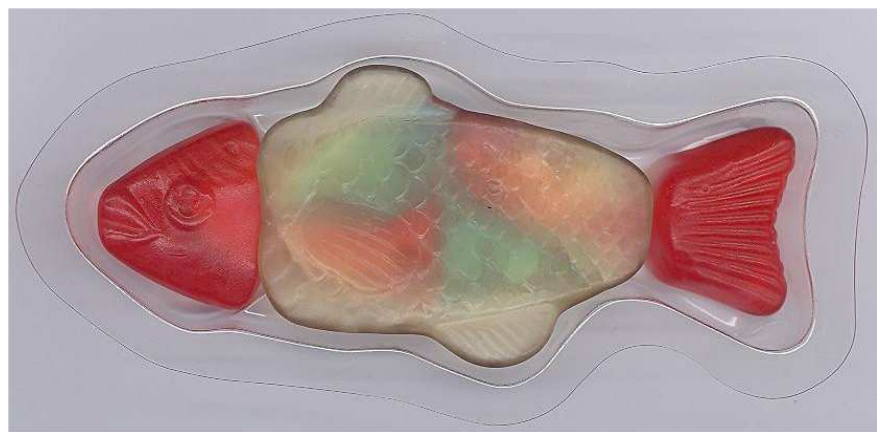
<http://lindau-nobel.de/MediaContainer.AxCMS?type=lectures&LaureateID=10792>

X-Ray Fish Sweet!



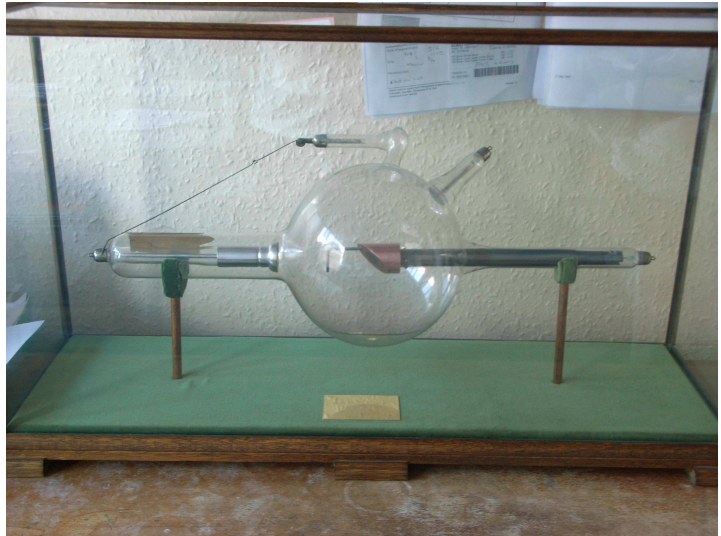
This is not really historical but is quite fun. I love the relationships between science and popular culture.

They are described as peanut free and 99% fat free! This is a jelly shaped sweet with a transparent body.



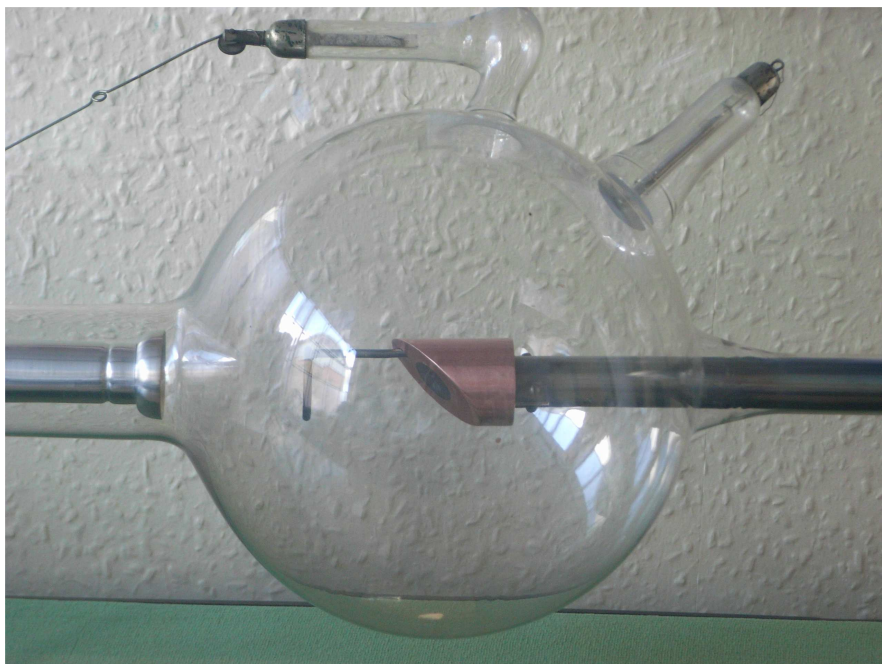
An interesting X-ray Tube

Mike Haddaway wrote to me saying that his hospital has been given an old x-ray tube, by the family of a former radiologist, whose wife sadly died earlier this year. They have requested that it goes on display at the Robert Jones & Agnes Hunt Orthopaedic Hospital in Oswestry. The plaque states it was made by F. Butt & Co of Old Kent Road, and is dated 1909.



The tube is a cold cathode or ion X-ray tube. The cathode is the shallow dish on the left of the picture. There is no filament in these early X-ray tubes. There was a small quantity of

gas in the tube, which allowed it to function. As the tube was used the vacuum increased and it became progressively more difficult to operate. In these ionic tubes gas was introduced by a variety of means to lower the vacuum and in this case a current was passed across the upper left electrode to liberate gas. Opposite the cathode is the large copper anticathode with a tungsten target inset. The circular device coming off it was to help in focusing the stream of electrons – and this was also why the cathode was dish shaped. The anode is in the right upper side branch and was connected to the anticathode so they were at the same potential. There are a number of explanations as to why both an anticathode



and an anode were needed. It obviously worked and this 3-electrode set-up was commonly employed. The anticathode in this tube is of a different shape from the fixed anode of the classic Coolidge tube. Neither of them employed the principle of line focus seen in later tubes. The long heavy metal arm to hold the anticathode and the size of the copper was to help with heat dissipation.

It's a lovely tube and as Mike says is much more interesting than the black boxes we use today!

RADIOGRAPHS — 1896-1897: Notes by the late Derek Guttery.
(Note: sadly I do not have the slides)

As virtually no original radiographs from the pre-1900 period have survived (apart from two small collections at the British Institute of Radiology and a few individual plates in teaching hospitals and at the Science Museum) it could be claimed that positive lantern slides copy reduced from the original negatives remain the best surviving evidence of the level of technical picture quality achieved by the early experimenters. The only other remaining pictorial evidence is in the form of contact or reduced positive prints on silver-chloride paper (often gold toned to a pleasing sepia colour) and screened half-tone positive reproductions in books and journals. Neither reveal as much information as a transparency; however, their frequent reproduction in print form led to the public's perception of an "X-ray" as a positive image whereas the radiographer always saw a negative image apart from when he was using a fluorescent screen.

During Röntgen's investigations following his initial discovery of X-rays by fluorescence, he soon established that the rays could also influence traditional silver-based photo sensitive material. In *Eine Neue Art von Strahlen* — "First Communication" he observes (Arthur Stanton's translation in *NATURE*):

"Of special interest ...is the fact that photographic dry plates are sensitive to the X-rays. It is thus possible to exhibit the phenomena so as to exclude the danger of error. I have thus confirmed many observations originally made by eye observation with the fluorescent screen. Here the power of the X-rays to pass through wood or cardboard becomes useful. The photographic plate can be exposed to the action without removal of the shutter of the dark slide or other protecting case, so that the experiment need not be conducted in darkness. Manifestly, unexposed plates must not be left in their box near the vacuum tube."

The only recording media available to the early X-ray experimenters were standard photographic plates with an emulsion coated on one side of the glass. The sensitivity to X-rays was low because of poor absorption in the thin emulsion resulting in low density, poor contrast and extended exposure times. Experimenters tried various methods to increase the film sensitivity ranging from sensitisation of the plates before exposure and chemical intensification after development to impregnation of the emulsion with fluorescent salts. A commercial example of the latter idea was the Cathodal Plate introduced in May 1896 by the English manufacture B.J. Edwards & Company incorporating a fluorescent salt recommended by Sir Oliver Lodge. Another commonly used method was to expose the plate in intimate contact with a barium platino-cyanide - or, after March, 1896 - calcium tungstate fluorescent screen — a technique which has persisted until today. Plate manufactures soon introduced thicker emulsions specifically for X-ray use but were still limited to applying the coating on one side only because of the interposed thickness of glass. Duplex coating was not feasible until thin "film" bases became available many years later.

Development was carried out in a standard horizontal dish in the same way as a photographic plate. Hydroquinone - often in a highly diluted concentration - was a popular developer and typical development times were in the range 10-30 minutes. It was not unusual for safelamps to be illuminated by oil or gas as many darkrooms lacked electricity. Small hospitals and doctors in private practice without darkroom facilities were obliged to send their plates to a local photographer or chemist for processing.

Glass plates were heavy and extremely fragile and in the larger sizes of 12 x 10", 15 x 12" and 17 x 14" (2 lb.), quite unsuited to referral between different locations. For this reason, it was not uncommon to produce contact or reduced-size positive prints for independent viewing purposes and suitable reducing cameras were offered by most equipment and accessory suppliers. Obviously, the process of producing a radiograph from exposure to final image would often become a lengthy and tedious process.

Despite their high cost and fragility, glass plates continued in general use until Kodak's introduction in 1914 of a single-coated X-ray film of improved X-ray sensitivity on a cellulose nitrate base. However, this film also had disadvantages in that the base was highly inflammable, potentially explosive and difficult to process in a shallow dish because it curled excessively. Traditionalists therefore continued using plates. Meanwhile, any intended changeover to film required new types of film holders and cassettes to be devised and deep, vertical processing tanks and film suspension frames adopted. Finally, in 1918, Kodak's Dupli-Tized, double-coated film was made available allowing an enormous reduction in exposure times as a result of a greater absorption of X-rays in the thicker combined emulsion and the possibility to use fluorescent intensifying screens on both sides.

The hazards of cellulose nitrate as a film base was recognised but the adoption of "safe" and potentially more suitable cellulose acetate was not possible until its original disadvantages of brittleness, low strength, poor clarity and included impurities had been overcome. In 1924 Kodak finally introduced an X-ray film on an acetate base but because it was more expensive and initially had certain disadvantages such as wrinkling and growing mould in storage, nitrate-based films continued to be used. In 1929 a disastrous film fire occurred in the X-ray Department of the Cleveland Clinic in the USA in which 124 people perished and the outcry which followed finally forced cellulose nitrate to be outlawed and cellulose acetate adopted as the standard base material for all professional films used for X-ray, photographic and cinematographic purposes.

The 35 "magic lantern" slides on display are contemporaneous copy reductions from the original negatives and mainly depict subjects typical of the period — foreign bodies, fractures, physical abnormalities and curiosities of nature. Because of the extremely low power of the early equipment and the lack of sensitivity in the photographic plates, most of the human radiographs are limited to the extremities of hand and foot.

Photographic journals - of which there were many - were one of the main media for the discussion of X-rays during the first two years following their discovery and in fact, radiography was for a short while considered as a new form of photography and, as such, adopted by many enthusiasts as a new and interesting hobby. There was also intense interest from the public so that lantern slides of radiographs might equally well be shown by the parson in the village hall as by the physician to his medical colleagues and students. Slides of pre-1900 radiographs made by pioneer X-ray workers such as Campbell Swinton and Colonel Gifford remained in the catalogues of specialist dealers like Newton & Co. and Flatters & Garnett until the mid-1920's. Despite the considerable numbers produced, pre-1900 lantern slides of radiographs are now almost as rare as the original negatives from which they were copied.

Slide Nos. 1 - 12 are copies of a series of radiographs taken during early 1896 by James MacKenzie Davidson (1857-1919). Davidson was in private practice as an Aberdeen ophthalmologist when X-rays were discovered. Using his own Crookes tube and an induction coil with 10" spark, he succeeded in the early part of February 1896 in making a radiograph of a broken needle in a patient's foot. The new discovery soon persuaded him to devote his future career to radiology and in 1897 he was elected to the staff of Charing Cross Hospital as "Consulting Surgeon to the X-ray Department". He remained at Charing Cross until his death twenty years later by which time he had become the leader of his profession and the first man to receive a knighthood for services to medical radiology. One of his especial personal interests was stereoscopic radiography.

MacKenzie Davidson's slides were published by the Aberdeen photographic company G.W. Wilson at one shilling each and first announced as being available in the April 1896 issue of THE PHOTOGRAM.

In some examples, slide No.1 "Hand of adult male" is labeled "Hand of gentleman" and in that form contrasts with the obviously gnarled "Hand of workman" depicted in slide No.2. The radiographs of three different hands depicted on slide Nos.5, 6 and 7 were obviously taken before the availability of Jackson's "focus" tube in March, 1896; this may equally apply to the radiograph of a foot on slide No.11.

Slide Nos.15-17 are of three radiographs of the human hand taken by Lieutenant-Colonel James William Gifford, F.R.P.S. (1856-1930) or, possibly, by his wife, Emma.. All were taken during early 1896. The severe undercutting and lack of definition apparent in slides 16 and 17 (taken in January) almost certainly results from the fact that they were taken with the tube suspended approximately 2" above the plate rather than because of an unfocussed cathode beam. Gifford soon realised the benefits to be obtained by increasing the distance to 6".

Colonel Gifford, of Chard, Somerset, was a wealthy lace manufacturer, astronomer, skilled photographer, amateur scientist, one-time voluntary assistant to William Crookes and, when it was founded in 1897, one of the first members of the Röntgen Society. The photograph at the foot of page 6 below was taken in February, 1896 and published in the April issue of the WINDSOR MAGAZINE. It shows Gifford in his home laboratory surrounded by a plethora of the apparatus needed to generate X-rays — 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 chemicals pictured in the background.

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

His first attempt to produce X-rays was a failure leading him to suppose that the newspaper account was either a hoax or a misconception and on this basis addressed a letter to the Royal Photographic Society for its 14 January meeting detailing his experiments and their failure. More definite 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 through cardboard. The exposure time was 10-15 minutes

Mrs Gifford recalled the event in a letter to the TIMES nearly forty years later (27 February, 1932):

"...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!' " This was amongst the very first radiographs taken in this country.

In an article in the April 1896 issue of 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. 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..." and so on, in a similar vein.

Gifford gave one of the earliest public demonstrations of X-rays in London (at the Royal Photographic Society, 12 Hanover Square) on 21 January 1896 and also published many articles on the subject in NATURE, KNOWLEDGE and various photographic journals but soon withdrew from the scene to concentrate on other matters.

Slide Nos.22-23 — foot in woollen sock and foot in nailed shoe

Slide No.24 — foot with seven - or possibly eight - toes

Slide No.25 — halfpenny in child's gullet

Slide Nos.26-27 — slide No.26 is of the hand of a young child with a supernumerary thumb taken by Snowden Ward at Southport during the afternoon of 24 March, 1896. The 15-min. exposure was interrupted because the child moved. It was taken at the request of the surgical staff of the Infirmary to determine the feasibility of an operation to correct the abnormality. Slide No.27 is probably of the same subject in adult life.

Slide No.30 — composite whole-body radiograph

Slide No.31 — mummy's hand with amputated thumb taken by A.W.Isenthal, equipment supplier and joint author with Snowden Ward of the second and third editions of Practical Radiography (1898 and 1901)

Slide No.32 — chicken's foot. The original radiograph was taken on 3 February, 1896 by Alfred W.Porter (1865-1939), at that time Fellow and Assistant Professor of Physics at University College, London. He was later to become Sir Alfred Porter, F.R.S. For the purpose of the exposure, the chicken's foot was placed on a photographic plate at the bottom of a cardboard box and packed with corrugated paper up to the lid which explains the horizontal shadow markings in the background. The apparatus used was a battery-powered induction coil in conjunction with what Porter claimed to be a type of 'focus' Crookes tube which he had first shown in a lecture at University College on 29 January and which employing a saucer-shaped cathode to focus the cathode rays on a platinum target. Porter praised the result as being of "unsurpassed sharpness"

The development of the eponymous 'focus' tube is generally credited to Herbert Jackson (later Sir Herbert Jackson, F.R.S.) whilst he was lecturer in chemistry at King's College London based on a modified Crookes tube he had devised in July 1894 for research on the fluorescence of glass in vacua. However, A.W.Porter, Professor Hicks of Sheffield and no doubt many others also realised the need to produce a point source of X-rays almost immediately following their first fumbling attempts to take radiographs. A commercial version of the "Jackson focus tube" was announced as being available from Newton & Co. of No.3 Fleet Street in the 7 March, 1896 issue of the British Medical Journal. Röntgen describes a similar type of tube in his "second communication" submitted 10 March 1896 and Sir William Crookes had used a concave cathode and platinum anode as early as 1879 during his research into the heating effect of cathode rays. An 1880 Crookes tube with saucer shaped cathode was also used by J.W.Gifford (slides Nos.15-17) during his experiments with X-rays in the early part of January 1896.

Porter took an active part in demonstrating, lecturing and writing about X rays during the first two years following Röntgen's discovery and was President of the Röntgen Society, 1913-14.

Slide No.33 — German frog; Slide No.34 —adder; Slide No.35 — sheep's leg.

X-RAY TUBE MAKER - A.C.COSSOR, 1861-1922: Notes by the late Derek Guttery

Alfred Charles Cossor left the family business of thermometer making in 1890 to start his own company of A.C.Cossor at 56 Faringdon-road in the London Parish of St.John's Clerkenwell and rapidly became established as a respected, innovative and highly-skilled scientific glassblower and one of the first British X-ray tube maker.

Cossor had made gas discharge tubes for Sir William Crookes from early on in his career and was therefore an obvious source of supply for the many scientific and photographic experimentalists who rushed to confirm and reproduce the "new rays" following successive announcement of Röntgen's discovery in the London press on 6, 7, 8 and 9 January, 1896 and the appearance of a translation of the full text of his "First Communication" on "a new kind of rays" in the 23 January issue of the scientific journal NATURE.

The photograph, taken in early February 1896, shows the standing figure of Cossor in his sparse Faringdon-road workshop with his chief assistant, William Underhill Hilliar, seated at the bench. The identity of the two young workers in the background - who appear to be assembling an induction coil - is unknown.

The picture includes a number of small X-ray tubes in the course of construction and illustrates the paraphernalia of scientific glassblowing at the time: glassblowers' bench, gas torches, foot-operated bellows and a stock of glass tubing and metalwork. The benches are littered with the simple tools of the craft: pincers, triangular tool and carbon cones. The boarded wall behind Cossor is decorated with an extensive collection of fin de siècle postcards of Gaiety Girls — the avidly collected "pin-ups" of the period.

When X-rays were discovered, the traditional material of British glassblower was lead-glass whereas continental workers used cheaper soda, potash or lime-glass. Whilst lead glass was completely satisfactory for making gas-discharge tubes it was rapidly found to have disadvantages for the early X ray tubes because of its higher absorption of the low-powered emission. The disadvantage was immediately recognised by Cossor who always used "German" glass for his X-ray tubes and also claimed that the glass walls of his tube envelopes were thinner than in continental models. Glass for tube making was mainly imported from Germany and Belgium and it was not until the cessation of supplies from continental sources during the 1914-18 that the Government prompted English chemists and glassmakers to experiment and manufacture new glasses suitable for tube making.

Cossor's assistant, William Hilliar, was well known and respected as a highly skilled craftsman. He was also joint author with Cossor of four patents (subsequently abandoned) on matters relating to X-ray tubes and vacuum pumps. He was thought to have died in about 1903 as one of the first victims of radiation injury and on this basis is commemorated on the Radiation Martyrs' Memorial in Hamburg. The facts are different as he "disappeared" from scientific glassblowing in about 1908 to return to the family business of flageolet (recorder) and tubophone making at 94 Gore-road, Hackney where he died in January 1941 at the age of 74. (A tubophone is a percussion instrument similar to a glockenspiel)

Cossor's company went on to produce electro-medical and infra-red equipment, Crookes' radium "spinthariscopes, experimental wireless apparatus for the young Guglielmo Marconi, radio valves and radio sets, miniature lamps for surgical probes, incandescent lamps for miners and motor cars and a series of world-famous oscilloscopes. It discontinued the manufacture and "re-making" of X-ray tubes in about 1924, by which time the use of the "gas" tube was nearing its long decline following the introduction of the modern "hot cathode" Coolidge tube in 1913.

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