The Invisible Light

The Journal

of

The Radiology History and Heritage Charitable Trust

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The RHHCT Web Site

The RHHCT web site is to be found at:

www.rhhct.org.uk

I am always interested in material for the web site, particularly related to radiotherapy and physics. There is also a hero's section. If you have a radiological hero then consider writing a short piece for inclusion with a photograph.

Editorial notes

I have never been to a real auction before and found it hard to resist an auction at Christies when *A rare collection of twenty-three early positive and negative glass X-ray plates* were on the list. The details had been sent to Tony Hudson at the BIR and passed on to me so I decided to go along. The earliest plate was of a child's foot labelled *Beatrice Harvey Age 7 28/11/96*. There was also a plate *Living Frog Dec 1896*. As you might imaging I was keen to acquire these plates. I am actively collecting radiographic images and old examinations. The estimate for the collection was £500-800. Other items in the sale were several collections of Geissler tubes, an induction coil and various static electrical machines. There was also a wonderful collection of model locomotives. The bidding was rather dominated by a dealer who seemed to be bidding for most of the interesting medical items on the list. The auctioneer announced the lot by saying that there has been a great deal of interest in this item and that bidding would start at £1200 that had been my initial maximum! The bidding ended for me at £2500 at which point I felt that I should not go higher. The dealer had the plates for £2600 and at least I had the satisfaction of making her pay more then she had anticipated. I came away feeling slightly sad that the plates had gone to a dealer with no personal passion for early radiology.

I am pleased to include the letter from Dulcie Staveley. Bob Dick from the Royal Free Hospital has kindly provided some further details. He writes: ' She was born in 1898 the daughter of a Belgravia GP and died in 1995 aged 97. So much for the dangers of radiation especially as she practised in an age not noted for its radiation protection measures. She qualified at the Royal Free School of Medicine in 1922 and worked in a radiological practice in Bournemouth before joining the Royal Free. In the 2nd WW Dulcie served as a Major in the RAMC in army hospitals in Belgium and Germany. She never married. Dulcie retired to Lincolnshire entering local life with great enthusiasm serving as council chairman and having a residential street in Alford named after her'.

I am delighted to include the long piece by Harry Crooks. It gives me a sense of privilege to be able to include this as the major item in the metamorphosed RHHCT Newsletter. Also thanks to radmagazine for permission to include the piece by Arpan Banerjee that first appeared in that excellent publication.

Adrian Thomas

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Chairman's Report

AJP Taylor once said "History is about what comes next", emphasising the all important fact that history is not a dull and dusty catalogue of past events but a lively, vibrant account of where we are, how we got there how our successors will perceive us in years to come. The Radiology History and Heritage Charitable Trust (RHHCT) was established some years ago, as a multi-disciplinary body, to record and preserve wherever possible , the artefacts which represent the progress of radiological science from its origins in 1895 to the present day.

Books, papers, obituaries, photographs, audio and visual recordings, three-dimensional objects are all relevant to future historians as a reflection of our collective heritage. Many important artefacts are often discarded as "out of date" or "too recent", particularly when central storage facilities cannot be provided. The RHHCT computer base, housed in the British Institute of Radiology, is meant, hopefully, to counter this problem and allow information on the existence and whereabouts of all relevant material in the British Isles to be collected and made available.

This new Journal of Radiology History – "The Invisible Light", is a tribute to the industry and enthusiasm of its Editor, Adrian Thomas. It is a natural development of an earlier and regular Newsletter recounting the activities of the RHHCT. The Journal is now the official organ of the Trust, available free to all "Friends of the RHHCT" and published two times a year. Why not become a "Friend" now and contribute to this worthy enterprise? The details are enclosed.

Professor Ian Isherwood CBE

Chairman RHHCT

Honorary Secretary's Report

I have taken over as Honorary Secretary of the RHHCT and my first duty is to thank Angela Newing for all of her hard work as the outgoing Honorary Secretary. Her work was invaluable and she will be difficult to follow.

The RHHCT remains active and involved in promoting the history of medial radiology in all of its aspects. A current concern is the recording of obituaries. Neither the British Journal of Radiology or Clinical Radiology/Clinical Oncology carry obituaries. This is not good. Obituaries are an invaluable resource and it is important that they are recorded in a cited journal. Desmond Hawkins and Ian Isherwood are tasking this forward and I will be making a presentation to the next Council Meeting of the British Institute of Radiology. Please write to me and let me know of your thoughts. The Royal College of Radiologists and the British Institute of Radiology has nor surveyed the membership over this important subject and our feeling is that there is considerable concern .

If you are interested in the history of radiology and want to get involved with the RHHCT then please do not hesitate to contact me.

Adrian Thomas

Honorary Secretary

RSM Finzi Lecture 2000:

This Eponymous Lecture of the Section of Radiology of the Royal Society of Medicine will be given by Dr Joel Howell from the University of Michigan at IOS 2000 on 22nd May at 11.15am. It is entitled: "A Century of Radiology in the US and UK". Joel Howell is interested in the history of medical technology and his book: 'Technology in the Hospital: Transforming patient care in the Early Twentieth Century' (Johns Hopkins 1995) is greatly recommended.

Abstract: Invented in 1895, the X-ray machine was applied to human health and disease on both sides of the Atlantic with astonishing speed, at least as reflected in the published medical

literature. Actual clinical application for day-to-day use was much slower to become a matter of routine. When the X-ray machine was finally incorporated in standard clinical care, this transition reflected structural as well as scientific influences. Moreover, the machine was located and applied to clinical activity in very different ways in the US and the UK. This presentation will focus on early use of the X-ray machine. In both the US and the UK negotiations took place over almost every aspect of the machine. Who was to take charge of its use, medically or non-medically trained people? Where was it to be placed within the hospital structure? What was the relationship between diagnostic and therapeutic use of radiology? I shall explore these various choices for the early years of the century. I shall then trace the use of the X-ray machine during the 20th century, in both the US and the UK, and will show how answers to these same sorts of questions have continued to be negotiated and renegotiated. I shall also explore how differences in the cultures of the US and the UK shaped and will continue to shape the status of how X-rays and other imaging technologies are applied to patient care.

The International Society for the History of Medicine.

Do consider joining the International Society for the History of Medicine. The cost of £25 is modest and there is an interesting journal called Vesalius. The International Congress this year is to be held at Galveston, Texas, USA from 10-15th September 2000.

If you are interested in joining the British membership of the ISHM than please contact me for details.

Friends of the Wellcome Institute

Also consider becoming a Friend of the Wellcome Institute. The subscription is £18.00 (£9.00 for pensioners and students). There is a magazine, events for friends and reduced subscription rates for Medical History and Current Works in the History of Medicine. Details from FWI, 183 Euston Road, London NW1 2BE UK.

There is an active History of Twentieth Century Medicine Group at the Wellcome Trust. There is an interesting newsletter. The Group's secretary is:

Mrs Wendy Kutner w.kutner@wellcome.ac.uk and details can also be obtained from the Wellcome Trust web-site at www.wellcome.ac.uk. The Wellcome Trust, 183 Euston Road, London NW1 2BE.

The Contemporary Medical Archives Centre (CMAC) and the Western Manuscripts Departments at The Wellcome Trust are merging to become **Archives and Manuscripts** with Julia Sheppard as Archivist and Richard Aspin as Deputy Archivist.

Book Notes

Light, Visible and Invisible and its medial applications.
By Angela Newing. Imperial College Press (1999) ISBN 1-86094-8 £19
This book which copies the title that Silvanus Thompson used for his book based on his Royal Institution lectures of 1896 is by our committee member Prof. Angela Newing who is Director

of Medical Physics in Gloucestershire. The book deals with medical aspects of the various types of radiation used in modern diagnosis and therapy. I wonder what Silvanus Thompson would think of the changes in the last 103 years!

To Light Such a Candle.
Chapters in the History of Science and Technology. By Keith J Laidler. Oxford University Press (1998) ISBN 0 19 850056 4 £20
This is a very interesting book looking at the most important scientific discoveries over the last couple of centuries. There are chapters on James Watt, Daguerre and Talbot, Michael Faraday, James Clerk Maxwell, J J Thomson, the Braggs and Max Planck and Albert Einstein. There are not so many books on the history of technology and its relation to science. As a book it bridges this gap between science and technology and is recommended.

The New World of Mr Tompkins.
By George Gamow and Russell Stannard. Cambridge University Press (1999) ISBN 0 521 63009 6
I was brought up on George Gamov and his *Mr Tomkins in Paperback* (Cambridge 1967). The facts of modern physics were presented in a very amusing via the dreams of Mr Tompkins a bank clerk. Russell Stannard has now updated the book in a very entertaining manner. Russell Stannard is Professor of Physics at the Open University and author of the excellent Uncle Albert series (for example *Uncle Albert and the Quantum Quest* Faber and Faber 1994). If you only buy one book on physics this years this should be it!

A History of the Radiological Sciences: A Project of Radiology Centennial, Inc.
Raymond A. Galliardi, Editor-in- Chief. Diagnosis, by Bruce McClennan, Radiation Physics, by Peter Almond. Radiation Oncology, by J Frank Wilson. Available from: RCI PO Box 18001, Merrifield, VA 22118-0001 (web site www.arrs.org) $99 for the 3 volumes.
A definitive history of medical radiology. A must-have for anyone with a serious interest in the field.

The History News: Medicine.
Author: Phil Gates. Consultant: Ghislane Lawrence. Walker Books, London ISBN 0-7445-6950-8 £5.99
Aimed at children and set in a newspaper format. There are two large pages devoted to X-rays. An interesting introduction to the history of medicine for young people. The consultant for the book is Ghislane Lawrence from the Science Museum in London, which says it all, so do find a young person, and to give them this book.

Looking at the Unborn: Historical Aspects of obstetric ultrasound.
Volume 5 of the Wellcome Witnesses to Twentieth Century Medicine Series. Editors: E M Tansey, D A Christie & L A Reynolds.

This volume is available at £5 from:
Mrs Tracey Tillotson, The Wellcome Trust, 183 Euston road, London NW1 2BE
tel: +44(0)20 7611 8486 e-mail: t.tillotson@wellcome.ac.uk)
It can be ordered on line at : www.wellcome.ac.uk/witness .
It must be worth £5. Contributions from such luminaries as Prof. Peter Wells and Prof. Stuart Campbell.

A History of Radiotherapy at the London Hospital 1896-1996.

(ISBN 0951 7976 1-3): by H.F.Hope-Stone. This has recently been published (October 1999) and is available from The Royal London Hospital Archives and Museum, Whitechapel, London E1 BB (Price £12.00 + £1.55 P&P UK adding £2.00 for overseas mail).
Dr Hope-Stone was Consultant Radiotherapist and Oncologist, The London Hospital 1963-1991.
A full review will appear in the next issue of this journal.

Chernobyl Record. The Definitive History of the Chernobyl Catastrophe.
By Richard F Mould (ISBN 0 7503 0670 X) £35.00/$57.00 Institute of Physics Publishing. This is published in May 2000. The author's previous *Chernobyl - The Real Story* (Pergamon 1988) was quite fascinating in the coverage of this recent disaster. I am sure that this new book will be as interesting and is recommended.

Frankenstein's Children.
(ISBN 0 691 05952 7) Iwan Rhys Morus. Princeton University Press. Iwan Morus is Lecturer in the History and Philosophy of Science at Queen's University, Belfast. He is interested in 19th century electrical science which had many medical applications. The book is a fascinating account of popular electricity and medical applications. The book deals with the early 19th century and the author is working on a project looking at late nineteenth century electrotherapy and
electrical views of the body more generally. Electrotherapists performed much of the early work in radiology and in the United Kingdom at any rate most early X-ray work for example would have been done in hospital electrotherapy
departments. The book is greatly recommended and he is now working on a book on late 19th century electrotherapy.

Recent Historical Articles

Centennial Dissertation: "A Sound Perspective". George R Leopold AJR 2000 :174, 9-15.
This is an interesting journey through the history of ultrasound from a personal perspective by an American ultrasound pioneer. The text can be downloaded from the ARRS web site, which is linked to the AJR (www.arrs.org).
Historical Perspective: "Europe contributes much to early evolution of MRI". Peter Rink Diagnostic Imaging Europe (December 1999) 29-35
Peter Rinck is senior lecturer at the University of Mons-Hainaut in Mons, Belgium and in this article gives and interesting chronology of the contribution made by workers in Europe to the development of MRI. It includes a nice picture of Paul Lauterbur.

Miss 'Katie' Clark (1898-1968) the pioneer Radiographer and editor of **Positioning in Radiography** (1938) the standard textbook for Radiographers. She passed the first examination ever set by the Society of Radiographers in 1921. She founded a school of radiography at the Royal Northern Hospital in London (1927) and led the way for the establishment of similar schools elsewhere.

She was Principal of the Department of Radiography at Ilford Ltd. (a photographic company) and under her leadership the department acquired a world-wide reputation.

Letter from Dr Dulcie Staveley

7th August 1987

Alford, Lincs.

I was qualified in 1922 and joined the staff in 1926. In the 14-18 war the R.F.H. 2nd and 3rd year medical students used to do short spells of war work in the summer vac. One year, I think 1918, I went with various friends to the Endell St (Covent Garden) military hospital, which was run by the redoubtable two women Flora Murray and Margaret Garret Anderson (daughter of Elizabeth). We were shot into various jobs and by chance I went to the X-ray dept which was pretty primitive. I took over from another R.F.H. student, who was able to spare the afternoon of that day to show me how to use the machines and so forth (no radiographers of course). The radiologist, whose name I have forgotten, came in the subsequent afternoons on 2/3 days – I was expected to take the X-rays of anything that turned up except skulls (? why). When screening you used to "switch on the intensive" whatever that meant, and take care to stand on a rubber mat, or else you would take a shock off the table. This did indeed happen one day when we took in a Canadian soldier who had jumped out of a 3rd floor window (he was tight) into the Strand in order to avoid arrest. As far as I remember he was uninjured except for a dislocated hip. Miss Murray wanted him screened and came down with various assistants. Of course one of these did step off and everyone in the room took a shock. I don't think the patient took much notice. No films of course in those days. The glass sheets were developed in dishes and were very fragile and also sharp around the edges. No gloves of any kind and I seem to think that you made up the necessary developer and fixer liquids yourself.

I don't think I was inspired to take up radiology until much later but I certainly enjoyed the fortnight I had in Endell St. I got a D.M.R.E. as it was in those days, and was trained this at U.C.H. where I was when an appointment to the R.F.H. came up. At that time there was only one radiologist – Ulysses Williams, no registrar or clinical assistant for that matter, and no clerk.

Cecil Joll (surgeon) was not in favour of me because he said that no one knew anything about X-rays who had not been trained at the London Hospital. I knew various people there and without difficulty got taken on as a clinical assistant and was able to produce a testimonial. Of course there was no pay in this pre N.H.S. period in fact the consulting staff were generally known as "the honoraries". We all had private practices and I took a room in Portland place and installed the necessary machine etc. My colleagues sent me work so I did not starve. I gained an unmerited popularity because my senior radiologist had a totally illegible handwriting.

We did therapy as well as diagnostic. Things were progressing. Joe Cunning was the senior surgeon and he was interested to ask me about the method and use of barium meals as they were only just coming in. Emily Kate Lewis was interested in renal surgery. IVPs were only just coming in and she started asking for them.

Frances Gardner similarly was a cardiac expert. One day she was introducing an intravenous catheter and I was screening it with her. She was beginning to withdraw the catheter whet it appeared to have tied itself into a knot in the auricle. Neither she nor I said anything but I heard her catch her breath as she pushed it on a little further after all went well.

Time went on and the 1939 war started. The R.F.H. was evacuated into the three counties at Shenlegh and the Oster House at St Albans. I was sent to the latter which was an ex workhouse alive with ants. We got an X-ray plant from a children's hospital, which had been closed for the duration, and this was erected and came into use at once. I went into the R.A.M.C. and the Oster House people got busy of course as time went on.

I had two rules when I was teaching; -

1. When looking at an X-ray force your eye to go round it as thought you were doing a tracing, or looking at a landscape.
2. Don't get a radiographer up at night unless the result is for immediate emergency and the result of the X-ray affects treatment.

(My great niece, Catherine S, who has recently qualified from the R.F.H. tells me that I was remembered as being "a Tartar". Quite unwarranted!)

The apparatus in early days was primitive. Gas tubes which were highly unreliable and needed constant attention. "Coolidge tubes" were an immense improvement.

When Ulysses Williams retired and I was the senior I never had a waiting list – everyone did overtime when required. Portable machines appeared. Protection from radiation progressed. With the advent of the N.H.S. we were actually paid.

I hope that some of this rigmarole is of interest to you. I have enjoyed doing it.

Best wishes

Yours sincerely

Dulcie Staveley

Presentation of a collection of early X-ray tubes
Belonging to the British Institute of Radiology
To the Science Museum
At the President's Day
5th April 2000.

The British Institute has a collection of very early X-ray tubes and other material that has been on a long-term loan to the Science Museum. The collection is priceless and records the major contribution made by British scientists to the discovery and development of X-ray equipment. The British Institute of Radiology originated as the Röntgen Society and members of that Society had the foresight to bring together a collection of X-ray tubes so that they "may be studied freely by those who are anxious to trace the development of X-ray bulbs". The President of the Röntgen Society signed a loan agreement with the Science Museum on the 15th December 1908 and the collection was displayed in the South Kensington Museum on the 20th February 1909.
Professor Wilhelm Röntgen had discovered the X-rays on November 8th 1895 using a vacuum tube designed by Sir William Crookes. The BIR collection contains several tubes used by Crookes personally including one made in 1879, which he used in his experiments on radiant matter. In 1896 Crookes investigated the penetration of X-rays through different substances and the lattice of metal strips that he used and an original radiograph are preserved.
The collection contains many early examples of therapy and diagnostic X-ray tubes including Herbert Jackson's first Kings College focus tube, experimental tubes used by A. A. Campbell Swinton and C. H. F. Müller's 'Gold Medal' tube of 1901.
In the spirit of the Röntgen Society that the tubes should be studied freely, it is now very appropriate that they are presented to the Science Museum as guardian of our national heritage as a gift.

Adrian Thomas
Tuesday, 04 April 2000

A Life History with X-Rays

by Henry Crooks FSR, FCR

Part 1

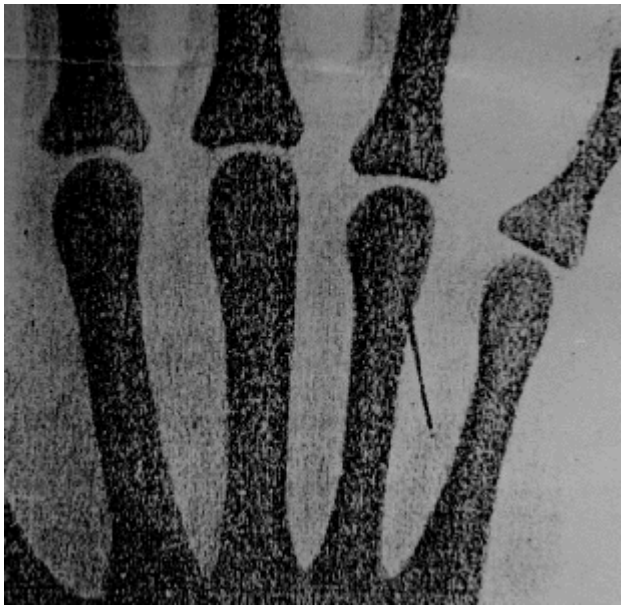
Preamble

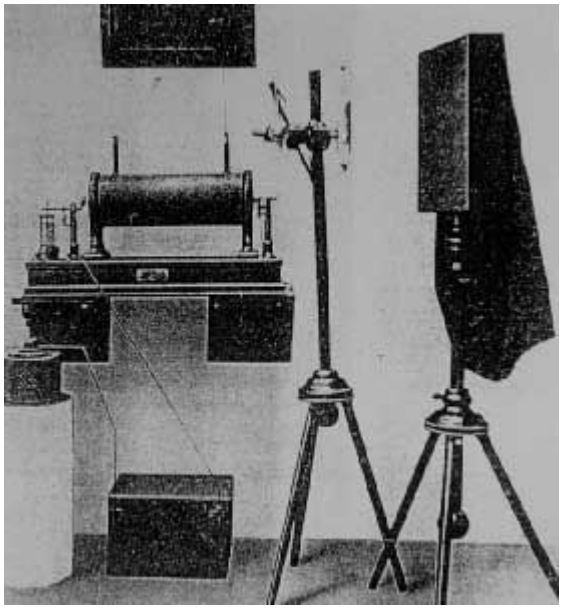
A family relationship commenced in 1898 when the newly acquired X-ray equipment at the General Hospital, Nottingham was used to diagnose a fracture of my father's right elbow. While not related to Sir William Crookes *(the creator of the means to produce x-rays),* there are peripheral connections. Our names are homophonetically the same, we both did work at the Oxford Radcliffe Observatory, were one time professional photographers and worked with x-rays – although at the time, Sir William was not aware of this. Thus it is natural that a keen interest should be taken of Sir William and his many scientific achievements. Experiments

with Crookes Radiometer and Crookes Tube *(circa 1876)* enabled him to recognise cathode rays, which he assumed to be a fourth state of matter. This discovery led some 20 years later on November 8th 1895 to the discovery of X or Röntgen Rays by Wilhelm Röntgen. Crookes also demonstrated that cathode rays could be diverted by a magnet, the principle of which is used in the present day Television Tube. Also in the early days of photography *(1855)* Crookes obtained a beautifully sharp 11/4" diameter photograph of the moon. Research into the electric light bulb allowed Crookes to be the first in Britain to use electric bulb house lighting.

Soon after the introduction of the Crookes Tube, scientists all over the world began to investigate the properties of cathode rays *(later called electrons)*. On hindsight, A.W. Goodspeed in America suspected that on November 22nd 1890, using a Crookes Tube, he had unknowingly produced an x-ray image; a repeat experiment under the same conditions proved to be correct – others may have had a similar experience. In December 1895 Röntgen obtained a radiograph of his wife's hand, he was therefore the first to take a radiograph – and was the first radiographer.

He announced his discovery in Germany in December 1895 and it became world wide at the beginning of 1896 and there was a rush to use the new rays in medicine. During this time, Sir William Crookes was on a working holiday in South Africa and on his return in April 1896 there is no record that he followed up Röntgen's discovery.





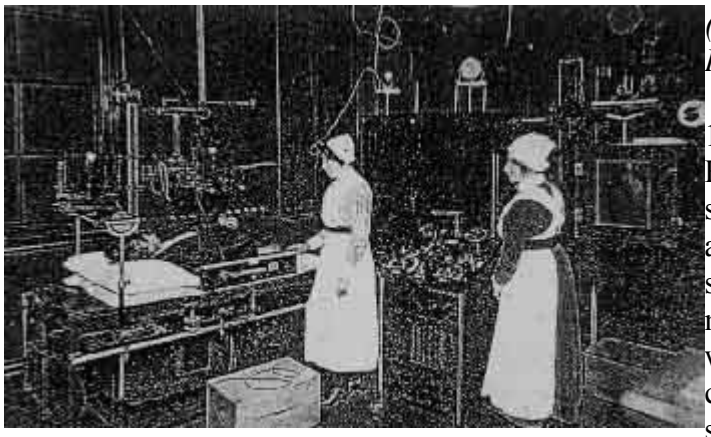
One of the first doctors to use x-rays in diagnosis was Dr. Hogarth of the General Hospital, Nottingham *(my hometown)* when a broken needle was located in a lady's hand. *(Fig. 1, above.)*
The Lancet March 28th 1896 reported this and we must presume that the work was carried out as early as the end of February 1896.

The report is interesting and read as follows: -

"In order to locate a broken needle, Mr. Simpson, FRMS Senior Demonstrator, University

College, Nottingham, kindly offered *(Dr. Hogarth)* to take a photograph of a hand, which was done… and a needle was discovered lying parallel to and along the inner side of the metacarpal bone of the ring finger. The conditions under which the photograph was taken were as follows: A five inch spark gap induction coil was driven to give a two inch spark and one of Newton's Focus tubes was used with Ilford extra rapid plate, under a thin plate of vulcanised film. The exposure was given at two-and-a half minutes at six inches distance.
The Nottingham General Hospital obtained more advanced x-ray equipment in November 1898 *(Fig. 2, right)* and my father was one of the first to be examined using this when a fracture of the right elbow was revealed.

First Encounter with X-rays



(Fig, 3, Nottingham Children's Hospital)

1921 at the Nottingham Children's Hospital, I at the age of three, while seated on a table was bemused watching a man manipulating a strange object some 20" above my left foot. My mother held me still while a radiograph was taken. Later, in a large white ceramic panelled room orthopaedic specialist Mr. Crooks *(again no relation)* surrounded by many white-coated persons, carried out a manipulation of my left foot.

This was my first encounter with x-rays, followed in 1935 in the now well equipped Nottingham General Hospital *(Fig. 3: bottom of previous page)* when with my head held in clamps, three sinus exposures were made, presumable the O.M.O.F. and lateral projections.

The radiographs revealed extensive frontal sinus osteomyelitis due to a 6-month previous cricket ball injury. Mr Tweedie ENT Specialist had earlier established that something was out of order when, after dark adaptation, he pressed a small tubular torch into the orbital sinus area, presumably to detect opacity, then with the torch in my mouth was able to check for any opacity in the antra. He then ordered the x-ray examination and after seeing the radiographs, arranged an emergency operation in the afternoon of the same day when a considerable portion of the frontal sinus area was removed. The following day Mr. Tweedie told my mother that she was a very lucky woman.

When recovering from this operation, I again visited the x-ray department when an impacted wisdom tooth was diagnosed; this was later extracted painfully after the anaesthetic had become ineffective.

While in hospital, I acquired knowledge of hospital practice and once, exploring the building, I came across a large iron safe at the head of some stairs. I was inspecting this with some curiosity when a staff member rushed up to warn me not to get close to the safe because it contained radium and was dangerous – my first introduction to radioactivity. After recovery I returned to apprenticeship in commercial photography. During this time I obtained a good knowledge of the photographic process – proving very useful in later radiography. I had a photograph printed in the September 1937 issue of the Nottingham Evening Post and in 1938

winning first prize in a photographic competition. *(Interestingly, Sir William Crookes and Röntgen took an interest in Landscape photography).*

Goodwood House November 1939 – August 1940
With six years of commercial photography behind me, I had hoped to enter the RAF in November 1939 but was rejected on medical grounds (sinus operation healing not complete*)* and thus was enlisted into the RAMC where hospital and photographic experience would qualify me to become a radiographer. Thus, I was detailed to obtain basic military and medical orderly training at the temporary 27th Company Military Hospital housed in Goodwood House, Chichester.

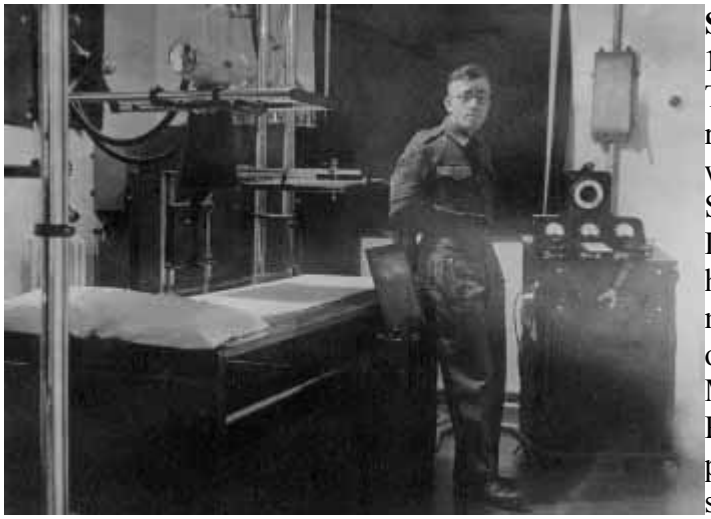
During eight months at Goodwood, I was able to obtain some knowledge of radiography when Radiographer Corporal John Twose explained the function of various items of his x-ray equipment. He also allowed me to develop photographic films taken with my Zeiss Nettar camera – several photographs were taken of colleagues and staff to be printed by my previous employers *(Marshall & Co. Commercial Photographers, Nottingham).* Company Officer Captain Potter *(Fig. 4, right)* countersigned my request to take photographs at Goodwood. He also steered me into 39 years of radiography.

North London August 1940 – November 1940
In August 1940 I was transferred via Boyce Barracks (where a one-week stay was spent digging trenches!) to a medical post in Broomfield House, Broomfield Park, Palmers Green, North London preparatory to joining the next course of radiographer training at the Royal Army Medical College, Millbank.
The Blitz had just commenced and during the three months a Broomfield House saw much ambulance duty, including a hazardous visit to blazing Poplar during very heavy bombing to assist the evacuation of a hospital.
During the stay a Broomfield House the then head of London Medical Services (later director GENERAL RAMC) inspected us (on parade). Brigadier General Alexander Hood; this Imposing man asked where I came from "Nottingham Sir" and "What was your work" "Commercial Photography, Sir".

R.A.M.C. College Millbank November 1940 – March 1941
The Blitz was now at its height in November 1940 when the next course commenced at Millbank. Training continued with occasional clearing up bomb damage. Once there was all out effort to control fire in the Museum wing until the auxiliary fire service arrived to save the College.
The first lecture was given by Brigadier McGrigor, Commanding Officer of the College when we were told to standardise techniques in order to produce radiographs of unvarying first class quality.
Towards the end of basic training, the unit was kited out for the Middle East. When I was

called before the Company Officer "Crooks, you have a choice of going to London for radiography training or go with the unit – there is someone willing to take your place and your kit, what do you want to do?" The adventure of going abroad was hard to resist and said, "I don't know Sir, what would you do?" Without hesitation he said, "train to be a Radiographer. Sergeant Major Fairless gave lectures on x-ray equipment – he obligingly took me aside to give me an explanation of the mysterious line focus. Lt. Booker was responsible for x-ray physics and his description of 4-valve rectification was impressive. Sergeant Denley lectured on opaque media and I particularly remember having to write down the tongue twister Tetraiodophenalphalin – Sergeant Denley later became for many years Secretary of the society of Radiographers. An elderly civilian gave lectures on Anatomy and Physiology. The X-ray equipment included a Cuthbert Andrews portable unit and a Schall 4 valve generator and Potter-Bucky table.
Having struggled with the first preliminary examination, I obtained (with two others) top marks in the final examination – amusingly during the examination, I was asked to give the constituents of developer Metol Hydroquinine 'Carbonate', 'Sulphite' and 'Bromide'. The examiner (Capt. X) was not satisfied and asked "and what else?" "That is all, Sir", "What about Water!".

Royal United Hospital, Bath March 1941 – June 1941
It was necessary to have practical radiographic experience in a civilian hospital and thus, after being posted to Shaftesbury Military Hospital in Dorset, I was immediately sent to the Royal United Hospital, Bath, where Corporal Gay was in charge of a contingent of three trainee radiographers (Cpl. Gay later became President of the Society of Radiographers).
Mr. Spedding was the principal radiographer and it was interesting that he not only conducted Barium Meal examinations but also gave the diagnosis.
Regretfully we were not allowed to do much radiography and once, in the absence of Cpl. Gay, an officer turned up for a pelvis x-ray, there was minor argument among the three trainees to take the radiograph. I was given the privilege and produced a quite satisfactory radiograph. Other duties included loading up electro-cardiograph cylinders and processing the resulting films. During the stay in Bath, the town was bombed and we helped to treat the casualties. As we had little practical work to do, I requested the Company Officer that I may be returned to Shaftesbury, where I knew there would be plenty of activity, this request was immediately granted.



Shaftesbury Military Hospital June 1941 – March 1946
Training now complete and five raw radiographers (privates) had to cope with running a fully equipped Shaftesbury Military Hospital X-ray Department, the sergeant in charge having been posted elsewhere. Two of my colleagues were soon posted to other establishments and Radiologist Major Baird gave me responsibility of Room 1, which was virtually the senior position. Room 1 was equipped with screening facilities and Potter-Bucky table.

We soon became inundated with requests for x-ray examinations, these included Barium Meals and Enemas (using Horlicks Barium Meal from a large circular tin), Chest Radiography including Bronchography, also Myelography, Arthrography, Intravenous and Retrograde Pyelography, Complete Skeletal Radiography and foreign body localisation.

Fig 5. *(immediately above*) shows Room 1. Room 2 was mainly used for extremities being equipped with a Watson portable. Table 1 *(next page)* gives the range of techniques used in the two rooms – interestingly, 90kV for P.A. chest radiography was an innovation 75-80 usually used elsewhere.

I was also able to construct a printer and enlarger. This small photographic unit (with my own cameras) was able to supply many hospital needs; including passport photography, copying radiographs for lecture purposes and medical photography – Major John Charnley often asked me to photograph his cases to aid his research. Some 20 years later he perfected hip replacement technique.

Table 1: range of techniques (Click on the image for a bigger picture)

Portable radiography was conducted using a Watson 90kV – 30mA apparatus frequently for ward and operating theatre work. Thankfully the corridors were level but even so; a great deal of strength was required to move the heavy apparatus.

On one occasion I had to take a portable x-ray of the chest of an RAF serviceman. His face was unrecognisable and a sister was carefully treating his injuries assisted by a tearful VAD. The sister told the girl to pull herself together which she did and helped me to position the film behind the patient. Another patient was the sole survivor (pilot) if a nearby plane crash. His mother was present at the bedside and assisted me during radiography of his chest.

On another occasion, on entertainment duty, I was operating a 16-mm projector giving an evening hospital ward film show to patients (and staff) when I was called urgently to x-ray a badly injured hand. Risking a possible projector breakdown, I dashed to the x-ray department, produced the radiograph and was back in my position in twenty minutes with the projector running 'perfectly'.

After a 'Friendly Fire' tragedy on Salisbury Plain in April 1942, all departments were heavily involved dealing with some 87 casualties, night and day, when a great deal of radiography was conducted both in the theatres and casualty ward. I later researched this episode which appeared in Sir Martin Gilbert's 1995 book 'The Day the War Ended' published by Harper-Collins and also in 'The Countryman' July/Aug 1998.

There was a steady flow through of radiographers. These included Sgt. Denis Wilkinson who in 1942 brought with him a photographic detail printer which was quickly adopted, he also later like Cpl. Gay became President of the Society of Radiographers. Sgt. (Bill) Stripp later earned a reputation for his work as principle radiographer of the National Orthopaedic Hospital. My earlier meeting at Goodwood with John Twose was renewed when he gave a very useful service at Shaftesbury. He later became Principle Radiographer at the Chichester General Hospital. Sgt. Pike, a qualified radiographer, gave me useful guidance in my quest to become a civilian radiographer.

Radiologists were Major Baird, Major Gaskell, Major Brocklebank, Major Wearing, Major Blaikie and Major Webster, the latter three gave me references for my future occupation, but Captain Reid had obtained my address for further reference, and they proved not to be necessary.

Fig 6 *(overleaf)* is Maj. Webster's reference.

Commanding Officers Release Remarks:

> Release Leave Certificate March 26 1946
>
> Colonel Williamson, Commanding Officer 21st company RAMC writes:
>
> "Conduct Exemplary. He has been 5 years here as NCO i/c X-ray Department. He is a first class radiographer, a hard worker and a good organiser. I shall be sorry to lose his services2

X-ray Department,
Military Hospital,
Shaftesbury,
Dorset.

6/9/44

Sgt. Crooks has been working with this unit for several years and has proved satisfactory in every way.

He is an excellent radiographer, skilled and knowledgeable in his work. He always turns out radiographs of the first quality and is keenly interested in the subject, which he wants to make his life's work.

He is quite a good administrator and the department runs most smoothly under him, despite the volume of the work which is done here and which keeps us all busy.

He also plays a big part in the social side of the unit. He runs the hockey team, of which he is not only the moving spirit but also one of the best players. He also runs the Musical Society, arranging and playing in many concerts, not only in the Hospital but in the surrounding villages and in neighbouring units.

I cannot say more than that I shall be very sorry to lose him on demobilisation and that his departure will be a great loss to the Unit.

I wish him every success in the future and shall be always glad to do anything for him that lies in my power.

I can confidently recommend him highly.

J.S. [redacted] (sgd.)
Major, R.A.M.C.

Radiologist,
Military Hospital,
Shaftesbury.

(Click on the image for a bigger picture)

Fig 6:

Maj. Webster's reference.

On one occasion I was "on the mat" before the then rather stern radiologist, for positioning a lumbar spine patient PA without pressure band instead of AP with pressure band. This alternative technique was described in our 1938 K C Clark's Positioning in Radiography – the radiographers bible. My reasoning was that a better radiographic imaging would be obtained of the vertebral spaces and pressure band would not be used, also exposure would be less and centring would be more accurate. This common sense view was not shared by the radiologist – although the radiograph was accepted for diagnosis. Some 15 years later this technique was described in the British Journal of Radiology, stressing the many advantages but even today (1999) with general use of the fine focus this technique is not routine.

When an American counterpart of our commanding Officer visited the department, I mentioned that our x-ray darkroom was rather small, to which he replied in broad American "The proof of the pudding is in the eating".

We did very many Pyelograms using Pyelectan and I was permitted on two occasions (under supervision) to perform the injection. Myelography and Bronchography examinations using Lipiodol were often performed.

Several Italian P.O.W's were x-rayed and on one occasion a rather important German Officer who, while I conducted the x-ray of his pelvis, was watched by two heavily armed Red Caps

(Military Police Officers). Our initiation into basic foreign phraseology always came in useful in these cases.

Female patients always wore gowns with the exception when our radiologist objected to parts of the gown showing during chest radiography; this practice was quickly discontinued.

On one occasion I x-rayed the knee of a stocky sergeant whose name was Alan Feeney. I told him that in 1936 I saw a Notts. County Footballer of his name pick the ball up on the half-way line, beat four men and score a brilliant goal "Yes, that was me, we beat Port Vale 2-1"!

There were many colourful colleagues and patients at Shaftesbury including John Veale who wrote the music to the film 'Purple Plain' – with Gregory Peck, also the son of one of the Elgar Enigma Variations characters and Sydney Fawcett, a brilliant pianist who, when he was a scholar at Christchurch College, Oxford had the distinction of being clipped around the ears by William Walton the Composer.

Among the VAD staff was a niece of the then Queen (now Queen Mother) and Colonel-in Chief of the R.A.M.C.

It was inevitable that there would be equipment breakdowns and on one occasion the heavily used x-ray to be of Room 1 expired. During the wait for a replacement the portable unit was positioned over the Potter-Bucky table and examinations continued with some difficulty. On one occasion during an Intravenous Pyelogram the patient and I noticed that the sound emitted by the portable unit exposure (3.0 seconds) was like a passage in the Finlandia Overture of Sibelius -we were both musicians!

On one occasion I had to do follow up portable radiography during the night to check the passage of a tube, via oesophagus, inserted by Colonel Edwards a then eminent gastro-intestinal surgeon.

On one occasion I did relief duty at Tidworth and Bovington Barracks Hospital. I did not know that Lawrence of Arabia had died in this hospital after his fatal accident on his Brough Superior motor cycle. (I was fortunate to meet George Brough in 1935 when I delivered proof photographs of his lately produced motor car).

Towards the end of my days at Shaftesbury, I contemplated my peace time future and decided not to return to commercial photography where my position was kept open for me but to train to be a peace time radiographer. At the end of hostilities, opportunity was given to service personnel by the London County Council to train to obtain peacetime employment in their chosen medical profession. After an interview in the LCC Town Hall (opposite the Houses of Parliament) I was accepted to work, for a salary, for 3 days at St. Mary's, Harrow Road Hospital (now demolished) and train at Lambeth Brook Green Hospital and Hammersmith Hospital for Part II of the MSR

diploma requirements – which included Radiotherapy, operating the Cobalt Bomb and other radiotherapy apparatus. Fig. 7 *(right)* shows Hammersmith colleagues Miss Hymen and Mr Gorill.

Work at St. Mary's was interesting including theatre portable work. Gastro Intestinal work radiography, much extremity work and a technique devised by Dr. Jacob, Obstetrician, where by placing a metal wedge with 1cm indentations between the legs of the expectant mother during lateral radiography, this gave an indication of the relationship of the pelvic brim and the foetal skull. On one occasion during portable radiography of an old lady's hip, the patient must have been impressed and said she was going to leave me all her money!

Lectures at Hammersmith were supplemented by detailed therapy sessions given by Dr. Walters in the Operating Theatre. Dr. Clark the eminent x-ray physicist gave fascinating lectures and demonstrations.

During the MSR examination in December 1946, I remember doing a diagram of the three main Sinus projections and described 4 valve rectification and the viva voce, when Mr. Spedding (Principle Radiographer, Royal Berks. Hospital, Reading) asking me to describe the technique of ringworm radiotherapy and also the proportion and constituents of barium meal, regretfully this was made up by the St. Mary's dispensary and mentioned this to cover my inadequate knowledge. The other examiner was Mr. Ferrier (Radiographer to King George VI). One of his questions was the constituents of x-ray developer which I answered not forgetting water!

I duly passed the examination and intended staying in London having acquired several interesting social and musical interests. But towards the end of the MSR course, a letter arrived from a previous Shaftesbury radiologist Dr. (Captain) frank Reid to apply for position of radiographer in the Medical division of the newly formed Atomic Energy Research Establishment, Harwell. I duly applied and on being accepted told the administration of St. Mary's, Harrow Road Hospital who strongly suggested that I should stay there where new opportunities would soon present themselves.

However, Harwell was an adventure I could not miss and on January 17th 1947 commenced 32 years of radiography, x-ray research and a unique social life and marriage.

Acknowledgements

I have to thank Mr. Brian Spencer of Nottingham Health Care NHS Trust for information and for the Figs. 2 & 3 and to History & Heritage Charitable Trust for the information concerning a radiograph produced by A.W. Goodspeed prior to Röntgen.

Part II

The Atomic Energy Research Establishment, Harwell

Preliminary

Harwell (the description used throughout) was founded in April 1946 with the eminent scientist Professor John Cockcroft as first Director (later Sir). The foundations of GLEEP were

laid, when, during its construction I made visits to see a friend engaged in the construction and often saw Professor Cockcroft checking the progress of his brain child. Harwell quickly became a thriving industry.

The Medical division was soon in operation with Dr. Katherine Williams as Principal Medical Officer. The basic medical services were gradually implemented with others, including Haematology and X-ray departments.

Extramural help was essential in order that advance into the various disciplines would be thorough. Thus a healthy liaison was established with Industrial, Government and University laboratories.

In the case our X-ray department, in addition to Radiologist Dr. Frank Reid and Consultant Dr. Frank Kemp, contact was made with other leading figures in Radiology and associated practices. Dr. Reid worked 3 days per week and Dr. Kemp visited us as and when required.

Building 166

First class equipment was ear-marked when the Medical Division became firmly established, until then, Radiographer Crooks on February 27th 1947 had to build up a department in Building 166 with one room (darkroom), several vulcanite tanks and other essentials. The X-ray unit was a pedestal Solus 70-30 portable unit only suitable for extremities. Nevertheless adequate radiographs of a hand and ankle were produced on the second day.

Building 152

X-ray and Haematological sections of the Medical Division moved to a larger building (152) and a more sophisticated Solus Portable together with Potter-Bucky table enabled a wide range of x-ray examinations to be carried out.

At this time the Industrial X-ray Department had not been formed and I was asked to x-ray a suspect graphite block. The radiograph showed a large iron bolt embedded in the centre! This was the first of many occasions when the x-ray department was used for non-medical purposes.

A wide range of routine and diagnostic radiography was required from the better-equipped department and, after meetings with the Director, Principle Medical Officers, radiologist and Consultant, measures were put into operation to reduce the x-ray exposure to Harwell employees to an absolute minimum. In order to accomplish this the fastest available x-ray films (Ilford Red Seal) and Intensifying Screen (Patterson Par Speed) were obtained and, at the instigation of Dr. Kemp, the x-ray tube was fitted with a 2mm Aluminium filter, which effectively removed a considerable amount of soft unuseful radiation. Crooks with extensive knowledge of the photographic process increased the temperature of the developer a few degrees to obtain further reduction; this made the films more contrasty and balanced the loss of contrast using the filter.

These combined measures reduced the radiographic exposure required to produce a good quality radiograph to 25% that given in most General Hospital X-ray Departments.

The volume of work required a second radiographer and Miss Jean Lyon was recruited to give

20 years valuable service.

As part of the radiation protection programme, routine radiography was carried out on staff exposed to radioactive material, these included pelvis and shoulders, this carried on for a limited period when it was thought that the high degree of safety measures made X-ray exposure to these individuals unnecessary.

During the occupation of Building 152, the then Foreign Secretary Mr. Ernest Bevin, MP visited Harwell and when inspecting the X-ray department he, referring to the x-ray table said, "We've all been on one of them".

Building 166 A

In early 1948 the X-ray department was moved back into an adjacent of building 166, for a 3-year stint and to be equipped with the latest General Radiological apparatus with screening facilities. Fig.8 *(overleaf)* shows some of this equipment with Crooks positioning a patient for a routine examination.

Fig.8

In 1949 a method was devised to monitor the bone density of some radiation workers. This involved taking a radiograph of the hands alongside varying thicknesses of ivory when using an EEL densitometer a comparative measure of bone density of metacarpal shafts could be obtained and stored for future reference. This programme involved a tightening up of x-ray processing and a multiple automatic timer was devised (AP2 see list of articles published) also a method of developer replenishment AP7 this enabled unvarying density quality to be obtained – likewise the x-ray exposure factors were standardised. (kV, mA, Exposure, Filtration, focal distance and x-ray beam alignment) This experience was to prove valuable for a future penetrameter exercise.

During this time Dr. Kemp (with Radiographer and X-ray engineer Alan Nicholls) had used a lead putty X-ray tube insert to reduce unwanted and detail destroying radiation which was produced from the anode surface beyond the x-ray focus. Experiments using a 1/8" lead ring with hole in the centre proved to be equally satisfactory and was adopted when radiographic quality was improved, also leakage radiation eliminated.

It was always necessary to improve existing equipment and devise other items. Just prior to his arrest Klaus Fuchs attended for his annual chest-x-ray. During this session he asked me about the research we were doing. I of course divulged everything to this famous scientist – After his arrest my Theoretical Physics friend Philip Preston, out of respect for his chief, said that he (Philip) was not fit to clean his superiors shoes.

Bruno Pont also attended for X-ray examination –this very friendly character was once invited to join our chess team, he played board 5 (of 6) in the second team and lost his game.

It was policy to encourage local GP's to send their diagnostic x-ray requests for Harwell employees to be examined in our department when the patients would receive a very low radiation exposure and be monitored, including Sir John Cockcroft, Sir Basil Schonland, Dr Vick, Dr Spence, Sir William Penney and all other senior ranks.

Barium Meals were frequent and it was considered wise to measure the screening time and determine by dosimetry and a special timer, the radiation received during Fluoroscopic Screening.

During occupation of Building 166a a visit was made by local radiographers *(Fig.9: below)* . Dr Reid can be seen in the centre with, to his left is Miss Robbins (senior radiographer of the then Wingfield Memis X-ray Department – now Nuffield Orthopaedic Centre). Alan Nicholls is on the extreme left.

Building 364

In 1951 the department moved to the service built Building 364, and, after being involved in designing the new X-ray department, Dr Reid left Harwell to have a practice in Harrogate and his place was taken by Dr Gordon Ardran as both Radiologist and consultant. He was then in charge of X-ray section of the Nuffield Institute for Medical Research housed in 'The Tower of the Winds' building adjacent to the Oxford Radcliffe Infirmary. Dr Ardran visited three days per week and also had a liaison with the Radcliffe X-ray department, and other disciples. He was also university lecturer helping several DMR students to 'obtain their degree. He also had earned a reputation for special radiological studies (including cine-radiography of the throat which he described in a television programme) and other radiological studies.

Fig. 10 : Dr Ardran reporting at Harwell.

For several reasons Dr Ardran refused Professorship of Oxford. He was always willing to give help both private and professional and once advised that "It is an unfair world".

On his first visit, Dr. Ardran listed 12 items of research that he thought worth while pursuing

and asked that if at any time I thought any ideas were suspect, I was to tell him without fear or favour. Thus we commenced an association which produced 53 joint papers in national and international journals which earned international notice and for radiographer Crooks the Fellowship in 1974 of the Society of Radiographers (FRS), later altered to College of Radiographers (FCR). A few months before Ardran died in 1996 I asked his advice on which of these to use in my correspondence, he replied both, so hence I use FSR-FCR. Fig. 10 *(overleaf)* shows Dr Ardran reporting at Harwell.

Before moving into Building 364 plans for the new X-ray department were drawn up by Dr Reid and myself and there was much toing and froing transferring the various items of equipment into the new building before final occupation.

The work load increased to require further members of staff, the first was David MacDonald-Brown who finished his MSR diploma training while working in the department, he later joined the Harwell industrial x-ray testing department and finally emigrated to Australia where he was engaged as radiographer until retirement. The third Radiographer was Miss Muriel Hitchin, who was later appointed radiographer to the Atomic Weapons Research Establishment, Aldermaston, a department which helped to design.

The staff finally consisted of Radiologist, three Radiographers, one general worker and one clerk.

Fig. 11 *(above)* shows four of these members, also the film filing racks, which included a system of colour coding.

Fig. 12 *(above)* shows Miss Hitchen positioning a patient before the Hills automatic exposure timer.

Fig. 13 shows Crooks engaged with Mr Peter Holt during a dosimeter test.

It was policy for research papers first published as an AERE Report, for major work and an AERE Memorandum for minor work. Afterwards, providing there were no restrictions, the authors were allowed to publish their material in appropriate journals.

The first report in November 1952 concerned the chest technique used at Harwell followed at regular intervals, others, sometimes jointly often with other workers and occasionally solely. Dr Ardran being the senior member naturally was named first, but occasionally he preferred that he should not head the list. The total of joint papers at Harwell was 53 and sole author Dr Ardran 18 and H Crooks 15. Details of these are given in the list of publications.

At this time I was suffering from re-occurrence of my 1935 cricket ball injury and Dr Ardran mentioned this to Radcliffe Hospital ENT specialist Mr Macbeth and he decided to do an osteo plastic operation – removing all the offending sinus regions and replacing according to Mr Macbeth's recently introduced osteoplastic technique. Before the operation, an ex Shaftesbury colleague, Mr Tugwell (who was now senior photographer of the hospital) took photographs. Later in the X-ray department, markers were fitted to my forehead to indicate radiographically the sinus edges prior to drilling of the sinus wall before being removed. A perfect operation completely eradicated years of discomfort and brought lasting normality.

On one occasion Dr Ardran suggested I make a phantom to simulate a body from which measurements could be made to indicate the x-ray radiation delivered to various parts of the body. Later I travelled to London (Cork Street) to collect an outfitters dummy which proved more satisfactory.

An important finding was in regard to radiation received by the gonads during pelvic radiography – new information indicated that pelvic exposure during normal diagnostic procedure could have a damaging effect to the gonads.

A Swedish answer to this problem was to enclose the testes in lead foil and a pilot test at Harwell showed that by merely placing a piece of lead sheet over the gonad areas was a better and more convenient protection than the lead foil. The lead sheet had to be cut to shape in order not to be included in any bony structure. This information was communicated to the

Radcliffe Hospital when Alan Nicholls made up several gonad protectors to be used in the Oxford Hospitals. The device thus became known as 'The Oxford Fig Leaf' and was soon to be used world-wide. The first description of this was in AP30 and later in AP88.

Tests using an air gap to improve x-ray quality were carried out and showed that by using a 6" air gap, increasing the focal distance to 12 feet, and increasing the kilovoltage to 96 and mA to 400, filtration (a combination of copper and aluminium) and collimating the beam to restrict the beam within the film boundaries, a very good radiograph was produced with low radiation received by the patient especially in the gonad area. This technique is described in AP90.

It had long been known that kilovoltage value varied considerably in X-ray departments world-wide. It was also well known that patient exposure could be unnecessarily high. The eminent Ilford Ltd. Radiographer and Researcher Miss Kathleen C Clark (author of the radiographs bible - Positioning in Radiography), emphasised this in a lecture which Crooks was fortunate to attend when she hoped that researchers should concentrate to correct this irregularity.

Calibration by manufacturers (if regularly carried out) usually ensures a degree of stability but x-ray quality change due to changes in target angle and x-ray tube condition and other reasons, would not be considered during this procedure, which was time consuming and expensive.

Thus a programme of inferential testing was staged employing a Victoreen dose meter using different values of filtration. A method used by Newel & Henney (see AP66 and 69) showed promise of being very accurate and involved using a low sensitive ionisation chamber exposed simultaneously with a more sensitive ionisation chamber covered by a metal filter, the differential reading between the two chambers when kilovoltage was changed were dramatic and gave (after suitable calibration), a good indication of the kilovoltage value. This method was time consuming, expensive and involved a high possibility of overloading of the x-ray tube and generator; operator protection was another important consideration.

During my day (and night) musings my knowledge of photography, sensitrometry, densitometry and radiography came together on February 20th 1965 to form an idea using a fast intensifying screen superimposed by a penetrameter and a slow screen intensifying (the standard) lying alongside not covered. Then, films taken at various kV levels should show a different step density match the standard, which simply means that when the penetration of the penetrameter at any point reaches the same ratio as the screens (in this case 1-4) then the density is the same, is held, and will not be varied by the vagaries of processing and x-ray exposure time. A quick test using surplus materials proved that a simple cheap and accurate x-ray measuring device had been created for which x-ray physicists had been searching since 1895 which allowed, with 1.5mm Cu beam filtration, accurate measure of kilovoltage peak to be obtained, but also, without the 1.5mm Cu filter, the X-ray tube inherent filtration.

I realised that this new penetrameter was 'hot' so continued for some weeks to refine the system before divulging the details.

Eventually after refining, I explained the new pentrameter to Dr Ardran who thought it was too similar to previous pentrameter with all their drawbacks and would not be used or made with the only possible exception being tested in a University department.

A similar view was entertained from colleagues employed in x-ray spectroscopy and my idea

of using varying amounts of filtration to give an indication of spectral measurements was met with derision.

After using the penetrameter for a few months, I decided to publish a paper on my own account and thus showed the draft to Dr Ardran for comment – who by then had second thoughts and rightly suggested the calibration in kV was not accurate enough and duly advised a visit to the National Physics Laboratory (NPL) for calibration, which I duly carried out.

In the meantime I described the penetrameter to a Harwell scientist friend who suggested that the standard should be known as the reference, thus (now being made of pure copper) the name Copper Reference Number Penetrameter was given after the thickness number in 1/1000 of copper to obtain a density match.

After being demoted from a report to a memorandum the paper was published June 1967 (AP66), request for patenting was rejected even though I forecast that a considerable sum could be made by its manufacture (in due course, with a modification, Wisconsin of America marketed their version and was sold world wide). Later the paper was rejected by the British Journal of Photography but eventually published in March 1968 (AP69).

Work continued to reveal unknown aspects of x-ray production and the penetrameter was calibrated up to 400kV. (AP96)

Some years later a Swedish physicist made up a penetrameter to our specifications and wrote to Dr Ardran to say how delighted he was that the penetrameter principle was sound. Dr Laws of Edinburgh then also tested the penetrameter and visited Harwell for consultation. The penetrameter was now accepted on a scientific basis and soon used internationally

I gave lecture demonstrations of the penetrameter to the local Oxford, Berks. and Bucks section of the Society of Radiographers also the Ilford Radiography course and in 1974 the European and African Society of Radiographers in Madrid. A paper (AP87) is composite of this lecture.

Experiments continued throughout this time in a wide variety of interests as shown in AP and a 0.6 focus z-ray tube was in general use, that allowed extensive use (without the overloading problems experienced at St Mary's Hospital where a water cooled tube had to be regularly re-charged to prevent heating). We also had a 0.3mm focus, which enabled enlargement techniques to be evaluated and used.

A light beam diaphragm was an added facility when in order to do low tube filtration experiments the existing glass mirror was removed to be replaced by one of aluminium foil and an aperture was made to allow added filters to be used as required.

Particular reference should be made of a dental cone we devised which reduced patient and operator dramatically in dentistry AP 68, this cone was recognised by the Code of Practice and its use was advised and widely used in America. Also an air gap technique for mammography was devised which produced good radiographs for ¼ the usual radiation received by the patient. A pilot test at Harwell of 100 cases discovered several cases of abnormality and 6 patients were operated within two days. The apparatus was transferred to Oxford but used only little abandoned within a few months and was not published.

Experiments (AP 82) to establish if plastics swallowed by children revealed surprising facts when at certain kV's it was shown that the plastic would be invisible. Other research revealed an unsuspected irregularity in the waveform of electrical input especially 3 phase.

During experiments to show that X-rays were produced below the surface of the tungsten anode, it was established when measuring 45 scatter from succeeding thicknesses of 1/1000 tungsten that scatter increased as the tungsten was increased, thus proving the phenomena.

Being curious to see close up the anode focus being bombarded by cathode stream, I obtained a fibre glass flexible tube which enabled me, without being exposed to radiation to observe an intensive blue/white scintillation.

A 2" air gap was applied to extremity radiography when, with the part to be radiographed in contact with film cassette, radiography was easier and radiographs better for a lower exposure dose. kV was increased and focal distance increased from 100cms to 120cms. This technique was not published and not used beyond Harwell, although the film quality was noticed when films were sent to other establishments.

While at Harwell, I made up 6 penetrameters for Agfa Ltd earning £1,000 for the UK Authority and with surplus pieces was able to make up a seventh which I now use occasionally to check earlier data and to note its response to background radiation which is off scale to indicate 400 kV plus). I have to thank the Wantage Health Practice for use of their x-ray facilities for this information.

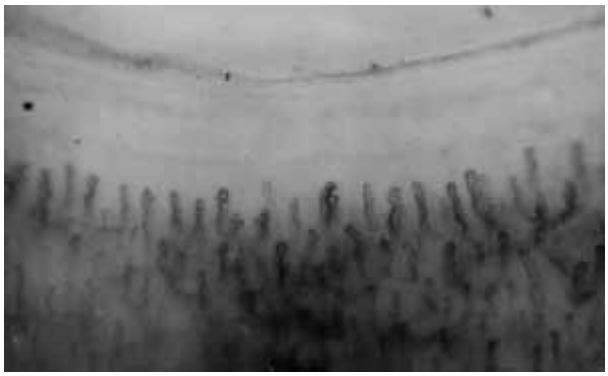
Much other work done and published as shown in the list of publications.

After retirement, chest, hips, shoulder, knees, feet and teeth and urinary system were x-rayed and CTR revealed a plaque in my upper chest wall. I was glad however that the Oxford Fig Leaf gonad protector was used as and when necessary.

Whilst being exposed to direct and scattered x-radiation throughout a career lasting 38 years 1941 – 1979 with additional post retirement visits to X-ray departments, blood counts have not shown any deleterious affects and am grateful to have been engaged in such a fine practice which brought me into contact with some first class people, both on and off the X-ray table.

Photography has always had a leading part in both professional and private life.

While at Harwell, I devised a polyphase photographic system to allow photographs to be taken of several anatomical surfaces simultaneously AP18. This unit was used to produce a record of the fingers of certain radiation workers; a companion technique was devised to check the finger ridge capillaries. Fig. 14 *(below)* is a typical example. A Voigtlander 35mm camera with close up lens facility was used for medical photography as required including a staff photograph on the occasion of the retirement of Principal Medical Officer in 1963 and also Fig. of X-ray staff.



Cameras were constant companions during my private life, the first 3½ x 2½ Zeiss Nettar be substituted by a Zeiss Super Ikonta *(Fig. 15, right)* and this earned two first prizes - Didcot Open competition in 1953 and UKAEA competition in 1963 – two Scottish studies. First prize was also obtained in the Wantage Photographic Competition in 1953 and the first AERE competition in 1948, both using the Nettar cameras. Several photographs were used in the AERA staff magazine 'Harlequin'.

Retirement saw no abating in photography and with excellence of the colour slide and then colour print, two exhibitions of photographs were shown at the Wantage Vale and Downland Museum in 1982 and 1985.

Photographs have also been used to illustrate the Wantage Guide and other minor publications associated with Wantage, also two in the Oxford Mail to illustrate a fine tree on the Wooley estate before and after it had been felled during the 1991 hurricane.

The camera in present use is a Canon F1000 which offers a wide range of facilities. A photograph taken with this of nearby Lockinge Church earned commendation at the 1997 UKAEA photographic competition.

Fig. 16 *(right)* shows Joan and Gordon Ardran (left) and Marian and Harry Crooks taken by delayed action photography at a 1953 Buckland house Garden Party hosted by Sir John and Lady Cockcroft.

Fig. 17 *(above)* shows Sir John Cockcroft speaking at a A.E.R.E. Sports Day with Lord Burghley waiting in the wings.

Fig. 18 *(below)* is a section of my first publication in radiography.

This was taken at the Second Annual conference of the society of Radiographers at Leamington Spa showing the principal figures of Mr Denley (then Assistant Secretary) is seen with hands clasped. Editor T.A. Longmore is top right and X-ray manufacturer Cuthbert Andrews can be seen in the foreground (bald headed).

Fig. 19 *(above)* was taken in April 1957 when the Queen opened the Harwell Training Centre, Sir John Cockcroft strides in the rear – demonstrations were regularly given to the students in the X-ray Department of exposure dose measures used.

Postscript

This Life with X-rays would not be complete without sincere thanks to my mother (who took me and helped with my first x-ray) and father (who introduced me to photography with his box camera and daylight printing). Major Hayden, Major Baird (Radiologist) and Capt. Potter at Goodwood who all had a hand in my RAMC Millbank radiographic training.

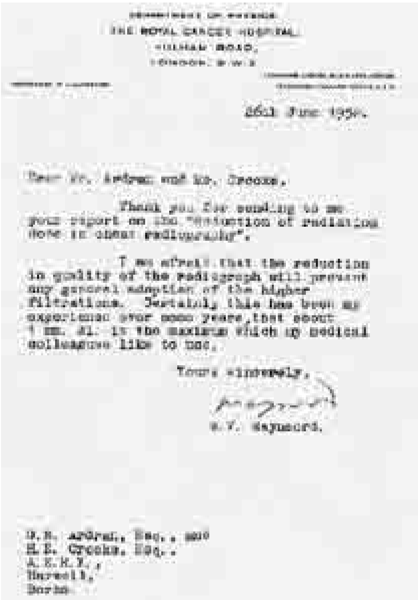
Dr Boulton-Myles at Millbank and Dr Duncan White who later ensured my installation in the LCC training scheme (during County Hall interview) and overlooked my training at the Hammersmith Hospital therapy Department, also Dr Gross, radiologist at St Mary's Hospital, Paddington with whom I had gained a firm friendship and who wished me to stay at St Mary's.

I would also like to mention x-ray associates Mr K.C. Denley, Miss Rogers, Miss Ohanlon and Grace X (Radiographers of St Mary's Hospital), John Twose, Bill Stripp, Dennis Wilkinson, Les Pike, Dr Webster, Dr Wearing, Dr Reid and Dr Winteler of Shaftesbury Hospital also Dr Katherine Williams and colleagues at AERE, Barbara Willoughby (clerk), Mrs Wood (general worker) and radiographers Jean Prouse-Lyon, David Macdonald-Brown, Miss Muriel Hitchen all who in one way or another played a part in 'A Radiographers Life With X-Rays'. And finally to my wife Marian who has been involved for some 46 years, in the proceedings.

But principally Dr Frank Reid who had the perspicacity (after our work together in Shaftesbury) to invite me to apply for the AERE Harwell position, and Dr Ardran whose enthusiasm and encouragement led to so many opportunities to explore adventurous studies into the science of X-rays.

June 1999

Addenda



THE ROYAL CANCER HOSPITAL,
FULHAM ROAD,
LONDON, S.W.3

26th June 1950.

Dear Mr. Ardran and Mr. Crooks,

Thank you for sending to me your report on the "Reduction of radiation dose in chest radiography".

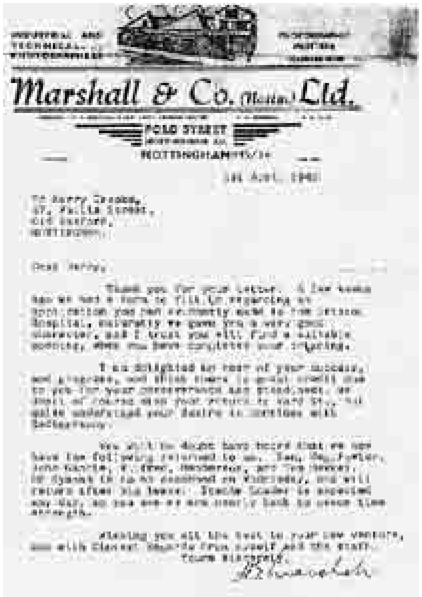
I am afraid that the reduction in quality of the radiograph will prevent any general adoption of the higher filtrations. Certainly this has been my experience over some years, that about 1 mm. Al. is the maximum which my medical colleagues like to use.

Yours sincerely,

W.V. Mayneord.

G.M. Ardran, Esq., and
H.E. Crooks, Esq.,
A.E.R.E.,
Harwell,
Berks.

1. Use of additional x-ray tube filtration to reduce patient x-ray exposure effectively 'hardens' the x-ray beam and lessens the radiographic contrast (sometimes referred to as quality) proportionately with the amount and type of filter employed. This had been recognised for sometime as Professor Mayneord's letter Fig 20 *(right)* will illustrate.



Marshall & Co. (Notts) Ltd.

NOTTINGHAM

Dear Harry,

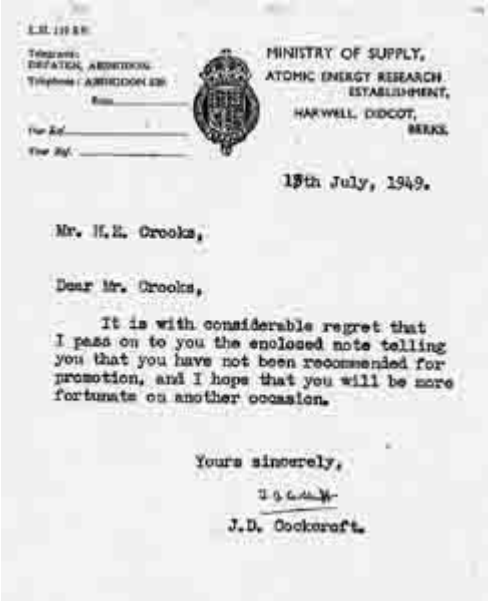
Thank you for your letter. [illegible]

[illegible]

2.Photography is an art allied to Radiography and 6 years in this profession was a boost to may career as a Radiographer, and I am grateful to Director, H E Marshall and Manager, F W Symons for much help and encouragement at 'Marshall's', the letter *(Fig 21, above. Click on the image for a larger picture)* after my army release, is confirmative of this.

Both during and after hostilities, Marshall printed from my photography of people and places. Sometimes runs of 100 (thanks to X-ray association with Kodak Ltd) Kodak Ivory Fine Lustre photographic paper which gave excellent gradation with a pleasant 'off-white' to landscape and architectural work.

3. I have cause to have a very high regard for Sir John and Lady Cockcroft, who I met socially and at work. John Cockcroft and T S Walton earned lasting fame when in April 1932 they were the first to obtain disintegration of the atom (splitting the atom).



MINISTRY OF SUPPLY,
ATOMIC ENERGY RESEARCH ESTABLISHMENT,
HARWELL, DIDCOT, BERKS.

13th July, 1949.

Mr. H.E. Crooks,

Dear Mr. Crooks,

It is with considerable regret that I pass on to you the enclosed note telling you that you have not been recommended for promotion, and I hope that you will be more fortunate on another occasion.

Yours sincerely,

J.D. Cockcroft.

Thus I felt very honoured to receive from this famous man *(Fig 2, above2. Click on the image for a larger picture)* written to a somewhat lowly member of his staff.

The relative examination was to obtain the civil service grade of Experimental Officer and conducted strictly on scientific lines with little reference to my medical radiographic research. However, no doubt on Cockcroft's instigation, Dr Howlett (who later built the Atlas computer) visited my department and examined what I had done and what I was in the progress of doing – the rank Experimental Officer followed shortly afterwards.

4. More details of Shaftesbury Military Hospital and the Copper-Reference Penetrameter are held in the archives of the Wellcome Institute.

5. Of topical interest (written July 29, 1999) is the following: Sir William Crookes took a photograph of the partial solar eclipse in 1860, but in December 1870, he travelled to North Africa to take photographs of the complete in order to study the corona. Extraordinary preparations were made to achieve this object but they were thwarted when a cloud obscured the eclipse at the vital moments.

Crookes did however observe that during a storm in the Bay of Biscay that the ship heeled over to 40°!

Wilhelm Conrad Roentgen

from

Roentgen, A Brief Biography, by Percy Ghent, Toronto 1924

Presented to members at the 15th Annual Meeting of the RSNA 1929

Diagnostic Imaging

of the

Gastrointestinal System

A historical review

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The history of radiology began on November 8, 1895, in Wurzburg with Roentgen's discovery of the new phenomenon of x-rays, named by Roentgen after the algebraic term for the unknown. Six weeks later the first paper on the subject was produced entitled "Uber eine neue Art von Strahlen" (On a new kind of ray)[1] and within one year a further thousand articles

related to this finding were published.

Early attempts to image the abdomen were unsuccessful because the weak x-rays produced were unable to penetrate the soft tissue. However, Wegele suggested that a stomach tube should be placed in the patient with a wire placed through it and by this means, the dimensions of the stomach would be obtained.[2] The first published pictures of this technique, however, were produced by Lindemann a year later in 1897.[3]

The real major breakthrough in gastrointestinal radiology came with the discovery of bismuth as a suitable contrast agent. A Philadelphian, G. E. Pfahler (1874-1957) noted in 1897 that a photographic plate of a patient's abdomen showed bismuth in the stomach.[4] Bismuth used to be a remedy for gastric ulcers at the turn of the century. The observations were followed up by another pioneering radiologist from Philadelphia, Charles L. Leonard (1861-1913)[5] and also by two Frenchmen, Roux and Balthazard who mixed bismuth with liquid and solid food to study the movements of the stomach.

Around this time a first year medical student at Harvard Medical School (later to become a professor) named Walter B. Cannon began a research project with a fellow student, Moser. The project had been suggested by Bowditch who was a Professor of Physiology at that time. The students performed experiments studying deglutition with x-rays using bismuth capsules. They studied deglutition in dogs, frogs and cats and presented their work before the American Physiological Society. They studied gastric movements and Cannon observed

"The stomach movements are inhibited whenever the cat shows signs of anxiety, rage or distress".[7]

Cannon eventually studied gastric movements in humans and collaborated with Francis H. Williams in the study of oesophageal and stomach movement in children. Williams was a respected Boston physician who in 1901 produced an important 658 page textbook 'The Roentgen Rays in Medicine and Surgery'.

Pioneering work in gastrointestinal imaging was also being conducted in Europe. In Germany, Hermann Rieder (1885-1932) published a paper describing the bismuth meal and advocated rapid serial filming, a forerunner of the modern barium meal.[8] In Vienna in 1905, G. Hotzknecht (1872-1931) a future radiation martyr advocated fluoroscopic examination of the gastrointestinal tract.

Back in New York, Lewis G. Idle (1874-1954), the innovative American radiologist, built up a vast experience using the Rieder method, whereas at the Mayo Clinic, Russell D. Carman (1875-1926), a follower of the Viennese School built up a vast experience of fluoroscopic investigations resulting in probably the first book on gastrointestinal radiology.[10]

British pioneers included A. E. Barclay (whose name has been given to a medal awarded by the British Institute of Radiology) preferred a combination of screen and plate methods in the investigation of the upper gastrointestinal tract.[11]

A review of the radiology literature would be incomplete without mentioning the pioneering, Swedish School of Radiology. Radiology began in 1905 in Sweden thanks mainly to the pioneering anatomist Gosta Forsell who undertook scientific studies on the stomach and duodenum. In addition, he was founder editor of Acta Radiolgica , was involved in the

planning of the Karolinska Institute and trained Lysholm and Lindgren both subsequently becoming pioneering neuroradiologists in their own right.

The early part of the twentieth century resulted in workers concentrating primarily on the upper gastrointestinal tract. However, it was not long before the colon became an organ of interest.

Schule probably first described a contrast investigation of the large bowel using bismuth and oil enema to image the colon in 1904.[12] Initial studies were all single contrast studies. The value of double contrast studies for studying mucosal detail, however, had been recognised as early as 1906 by Holzknecht who used an effervescent agent for studying the stomach.

The first double contrast enema was described by Laurell of Upsala in 1921. By this time bismuth which was found to be toxic had been replaced by barium.

Fischer in Frankfurt refined the technique of air insufflation and following a visit by Kirklin in 1928, the technique was brought into use at the Mayo Clinic.[13] The technique became firmly established following the publications by Welin in Malmo, Sweden [14,15] who showed that polyps could be demonstrated in 12.5% of all patients. Back in England, Young introduced a modification of the Malmo enema at St Mark's Hospital [16] whereas Miller of Indiana University popularised the method in the U.S.A.[17] The Japanese too were great enthusiasts of the double contrast technique following the pioneering studies of Shirakabe who used the double contrast enema study of the colon to study the pathology of intestinal tuberculosis.[18] With the improvement in barium suspensions and effervescent agents, double contrast studies of both the lower and upper gastrointestinal tracts have become routine.

Diagnostic imaging of the small bowel was not really possible until the development of flocculation resistant barium suspensions in the 1950's. Pioneers included Golden who favoured a small volume of oral barium (250mls) and Marshak who favoured larger volumes 500-600mls.[19, 20]

The first person to describe a technique of duodenal intubation was Pesquera in 1929.[21] It was Schatzki, however, who coined the term small intestinal enema in 1943 reporting on 75 cases.[22] This method of investigating the mucosal detail of the small bowel has been modified by several workers including the British radiologist Scott-Harden who is notable for the introduction of the co-axial tube for easier duodenal intubation.[23] Sellink in America has popularised his simple contrast enteroclysis technique using a modified Bilbao-Dotter tube and Gianturco wire.[24] The technique has been simplified by Nolan, the Oxford radiologist using a trans-nasal 12 French catheter for duodenal intubation.

A historical review of diagnostic imaging of the gastrointestinal tract would be incomplete without at least some mention of endoscopic imaging. Rigid tubes were introduced into the stomach as long ago as 1865 by Kussmaul who used a gastric tube for aspirating the stomach contents of a patient attending his clinic.[26]

The semiflexible gastroscope was introduced in 1932 by Schindler (1888-1968) who produced the first book on the subject entitled 'Lehrbuch und Atlas der Gastroskopie'.[26] Further advanced in instrumentation were made possible with the development of fibre-optic systems by Hopkins[27] and following this, fibre-optic flexible instruments were introduced in Japan, the U.S.A. and U.K.

By the end of the 1960's a colonoscope with a controllable tip became available enabling the complete colon to be imaged using this technique.[28]

Other new imaging techniques to evaluate the gastrointestinal tract include ultrasonography. Following Edler's initial studies in the 1950's using this technique to study the heart and Donald's studies in the pregnant mother it was realised that the abdomen could be imaged by this method. However, the upper and lower gastrointestinal tracts are poorly imaged by this technique due to intraluminal bowel gas. However, recent studies have shown that ingestion of water may create a sonic window for the diagnosis of mucosal lesions in the stomach.[29]

Computed tomography became available following the pioneering studies of Hounsfield and Cormack and it was soon realised that the gastrointestinal tract could be imaged using this technique. It is particularly useful at defining intramural and extramural extent of masses within the bowel and, of course, can also provide information on lymph node involvement and metastatic spread of tumours and also enables guided biopsies to be obtained for histological diagnosis.

The most recent imaging modality magnetic resonance imaging may prove to be of equal if not greater value than computed tomography but further studies are necessary before firm conclusions can be drawn. What is certain, however, if that if the rapid advances in imaging that have taken place in the past continue; many of the techniques mentioned in this review may prove to be obsolete by the end of the decade.

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LINES ON AN X-RAY PORTRAIT OF A LADY

She is so tall, so slender, and her bones

Those frail phosphates, those carbonates of lime

Are well produced by cathode rays sublime,

By oscillations, amperes and by ohms

Her dorsal vertebrae are not concealed

By epidermis, but are well revealed

Around her ribs, those beauteous twenty-four,

Her flesh a halo makes, misty in line,

Her noseless, eyeless face looks into mine,

And I but whisper, "Sweetheart, Je t'adore,"

Her white and gleaming teeth at me do laugh.

Ah! Lovely, cruel, sweet cathodagraph!

Lawrence K. Russel – LIFE, 27 March 1896.