

Medicine for Managers

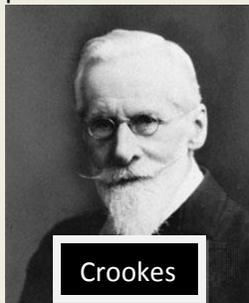
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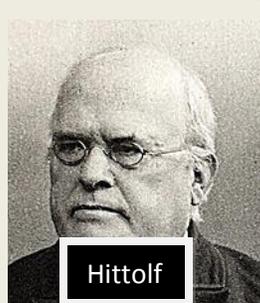
Amazing X-rays

The X-ray is about 120 years old and is a core investigation in the diagnosis of a vast number of conditions and the treatment of many. Indeed it seems hard to conceive of a circumstance where one couldn't 'pop down to casualty for an X-ray'. I can still remember, as a small boy, the pleasure of going into Clark's shoeshop to put my feet in the *Fluoroscope* to see an X-ray of my feet and toes.

There was much research into X-rays in the latter part of the nineteenth century and various scientists began to recognise that X-radiation had the ability to fog photographic plates. Sir William Crookes in Oxford and the



Crookes



Hittorf

German Johann Hittorf invented the 'Crookes tube' which produced radiation with showed as fogging on photographic film. However the principal accolades for discovering X-rays go to Willhelm Röntgen in 1895. He placed a piece of



Willhelm Röntgen

cardboard covered in fluorescent material near a source of cathode rays and noticed it glowed in the dark. Working in Munich University, he formalised the experiment and found that the fluorescent barium platinum cyanide would display a discharge on the screen every time his 'cathode ray machine' was switched on. He realised that the emission caused fluorescence through a vacuum tube and through dark cardboard where visible or ultraviolet radiation could not go. He called the agent *X-rays*. The Ukranium, Ivan Pulyui, published X-ray images a few weeks after Röntgen's work was published in Paris and London. Röntgen received the Nobel prize for Physics in 1901. Other work was also occurring and notable scientists such as Sanford at Stanford University, USA, Helmholtz in Berlin, and Hertz and Lenard in Bonn were developing the knowledge. Hertz described his '*electric photography*' in 1893, the year before he died at the age of 36.

Röntgen's discoveries were largely accidental and he coined the 'X' term because he didn't

know what it was. Using the tube designed by Crookes he noticed a glow from a fluorescent screen a metre from the tube and, to his astonishment, he discovered that the rays could pass through books. His first medical X-ray was a picture of his wife's hand, the first human body part using X-rays. His wife said "I have seen my death".



The harmful nature of X-rays soon became apparent. Shortly after Röntgen's discovery, Tarkhanov irradiated frogs and insects and found that some died. In 1903, following some research by Thomas Edison, Clarence Dally, one of his glassblowers, who tested his X-ray tubes by taking X-rays of his hands, developed an aggressive cancer and he died despite having both arms amputated. Research developed apace round the world and early experiments were associated with increased numbers of radiation overdoses. Researchers suffered burns, swelling, blistering and pain as a result of X-ray demonstrations. Others however claimed that there were no adverse effects from exposure to X-rays.

During the next fifteen years, research in Europe and America proliferated, much of it

directed towards trying to produce more efficient and effective X-ray tubes that could direct, focus and strengthen the quality of the radiation. In 1913, William Coolidge developed the *Coolidge X-ray tube* and similar X-ray tubes are still in use today.

Since that time a host of developments have resulted in increasingly accurate and detailed radiographs and they are now central to virtually every internal diagnosis.

Ionising radiation, of which X-ray radiation is one type, can affect body cells leading to the mutation of DNA which can lead to cancer. We are all exposed to radiation naturally. Radon gas, released from the earth's crust, contributes the largest single source of radiation to most people living in the United Kingdom. We are also irradiated by cosmic rays from the sun and stars as well as from a variety of other natural sources.

Perhaps the most important question about X-rays is "what harm can they do?" and "is it justified to use them?". Well, the short answer is that there are health risks from radiation but they are generally very low. Any risk is outweighed by the benefits of making a diagnosis and receiving appropriate treatment. The decision to take X-rays should not, of course, be made by the clinician without consultation with the patient because truly valid consent can only be given if there is a significant risk associated with the procedure and it has been explained.

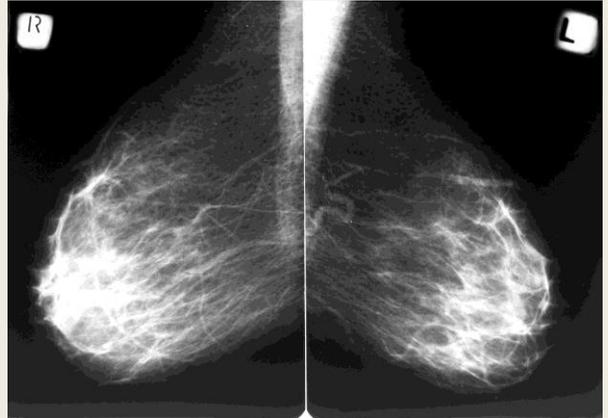
In modern medicine, radiation for medical investigation is now available in many forms to investigate different problems. Of course plain X-rays still form a mainstay of investigations and most people have had a chest X-ray or an X-ray following an accident to identify if a bone has been fractured. However, other methods of viewing internal structures using X-rays have been developed and have extended their use hugely.

- Fluoroscopy is a long established technique for reviewing such areas as the gut. The technique involves the introduction of a radio-opaque material in or around the structure to be examined to outline it and allow it to be assessed. For intestinal investigation, barium is administered as a liquid (either by mouth or, as below, rectally) and the bowel lining is outlined and can reveal a defect such as an ulcer.



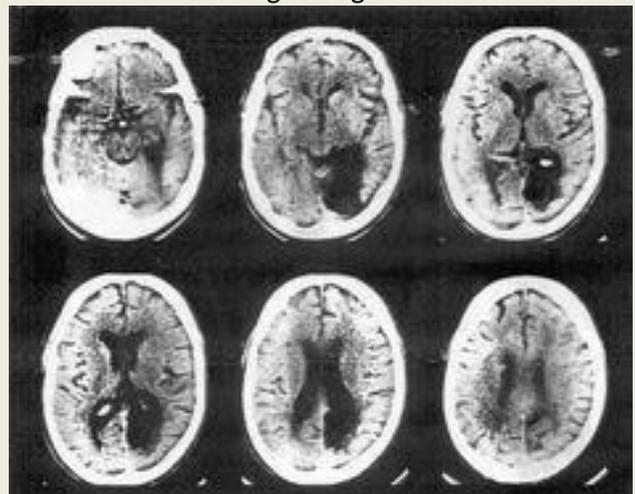
The technique is used less now than it was as more modern techniques have superceded it.

- Mammography is now a central part of the programme to screen for cancer of the breast early.



The softer X-rays penetrate the breast tissue to identify any suspicious area.

- Computerised Tomography (CT) scans have now been available for well over thirty years. They use a technique which involves taking tomograms



A tomogram is a 'slice' through the tissue and serial slices provide different views. The view above shows slices

through a brain with an abnormality on the lower right outlined in serial sections. The computerised element of the system allows the information to be viewed in any direction, i.e. the slices can be rearranged so that a 3-D picture of a particular lesion can be built up.

Radiation doses are strictly controlled and the minimum necessary for any given investigation. Risks are generally low. It is increased in the young and in pregnant women. The UK Health Protection Agency monitors radiation usage to ensure they are as safe as possible. Average dosage is now half what it was in the 1980s.

For many investigations, there are alternative techniques and, for example, ultrasound or magnetic resonance imaging (MRI) are non-radiation methods which may be equally valuable or indeed, more appropriate in some circumstances.

At the beginning of the item, I mentioned the **Fluoroscope**. If one grew up in the 30s, 40s or 50s, a trip to the shoe shop was associated, once a shoe had been chosen, with a test to see if it was a good fit. This involved the use of the Fluoroscope. It was necessary to stand on the step at the front of the device and insert one's feet into the slot. For a child the wonder of seeing the feet and toes with all the bones laid out and being able to visualise the movement as the toes were wiggled was very exciting. Not only was each child being irradiated by the machine but the assistant would insert his or



her hand into the machine to squeeze the shoes to ensure that the fit was right. So those of us who used the machine received a 20-second blast of unshielded X-rays every time we looked at our feet!

I shall leave the final word to Willhelm Röntgen in his Bibliographical study "A new kind of rays" *If the hand is held between the discharge tube and the screen, the darker shadow of the bones is seen within the slightly dark shadow-image of the hand itself . . . for brevity's sake I shall use the expression 'rays' and to distinguish them from others of this name I shall call them X-rays.*

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