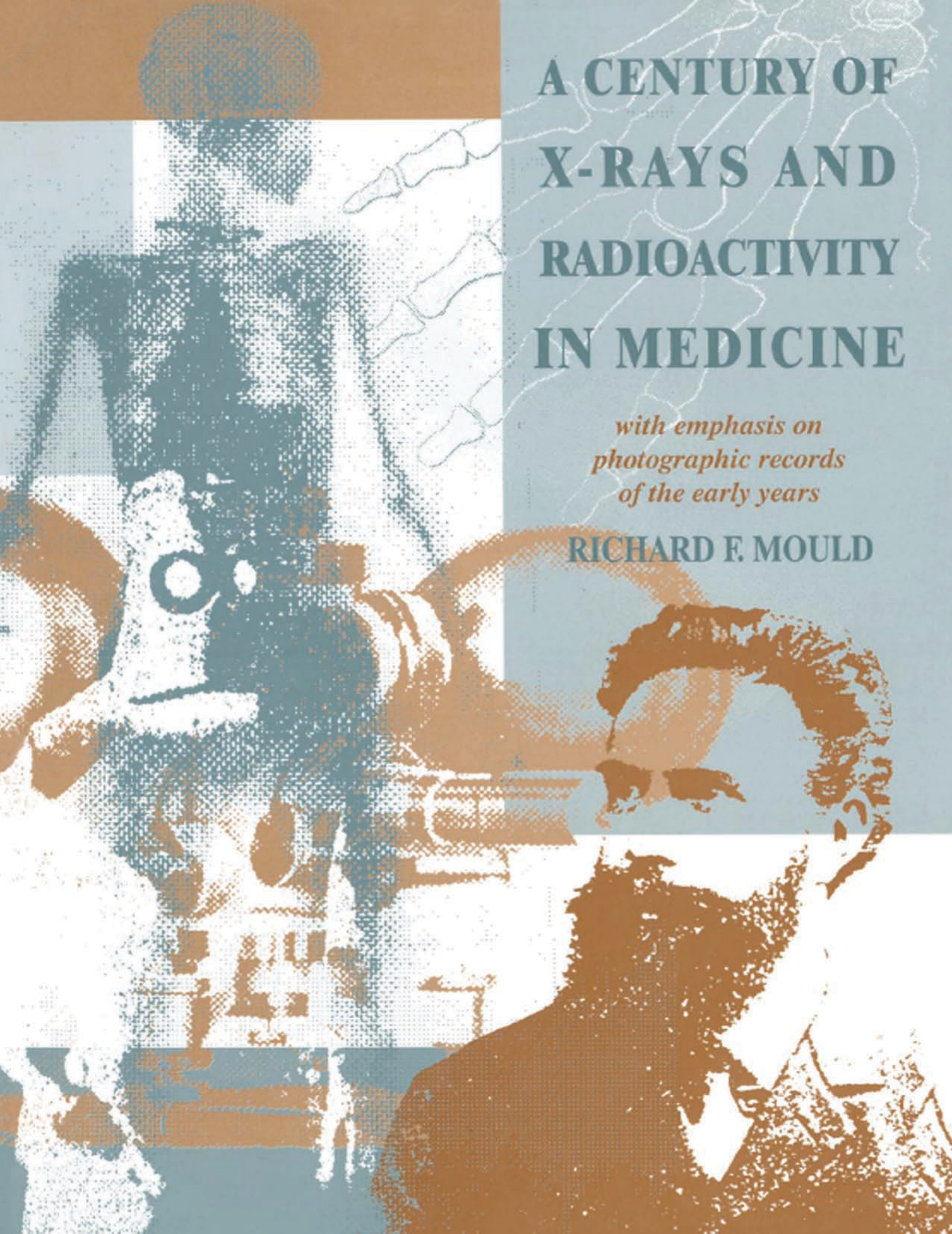
A CENTURY OF X-RAYS AND RADIOACTIVITY IN MEDICINE

with emphasis on photographic records of the early years

RICHARD F. MOULD



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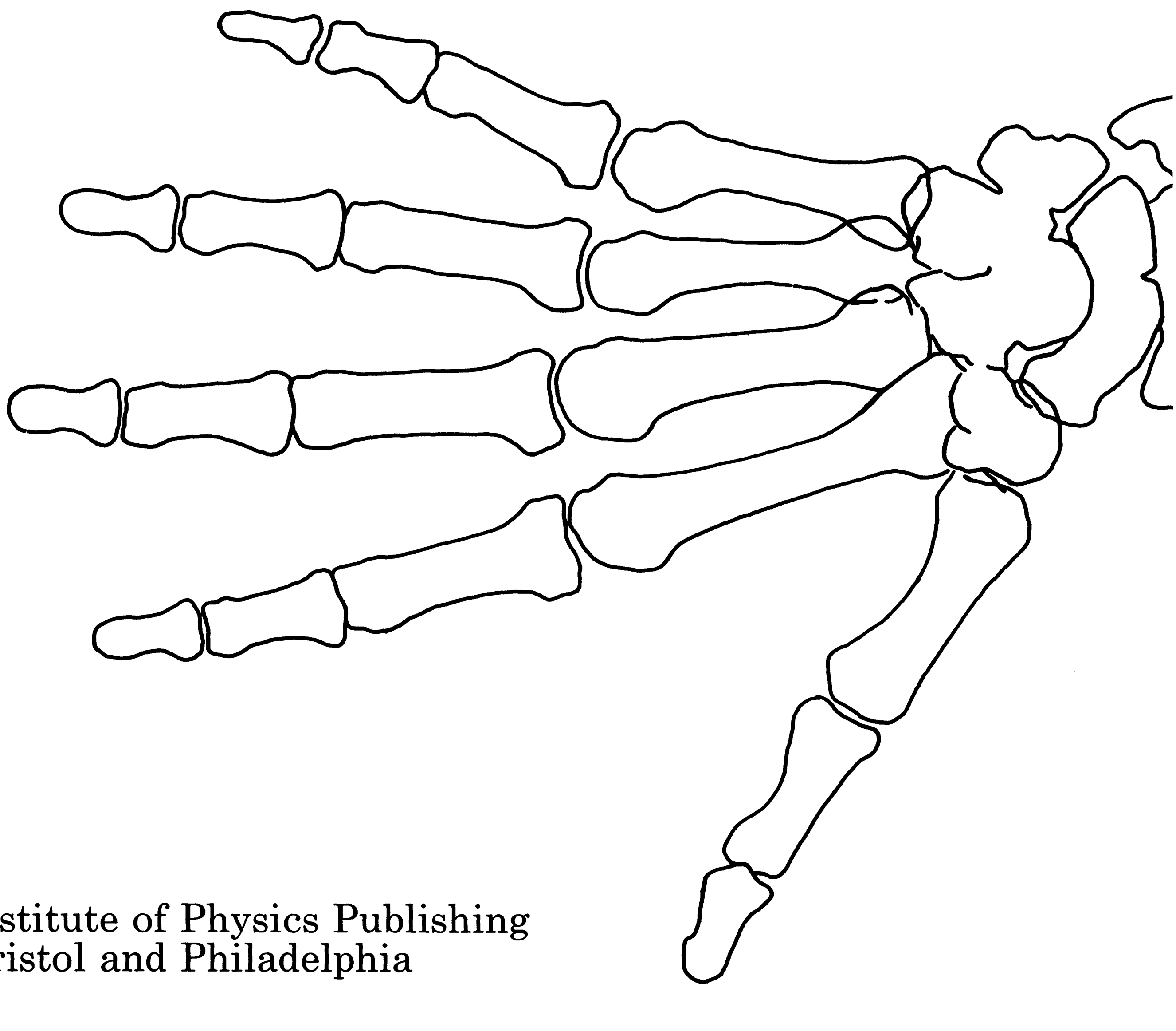

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To Imogen
with love from
Grandad

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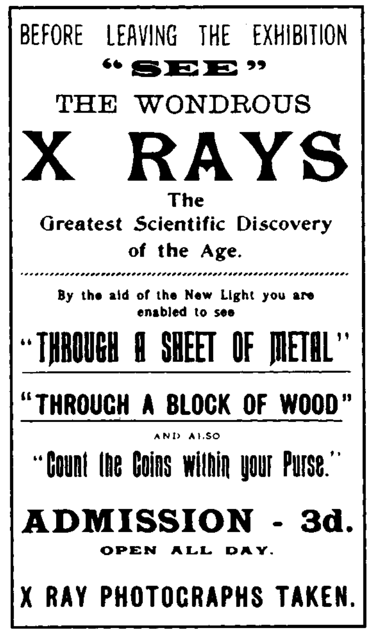

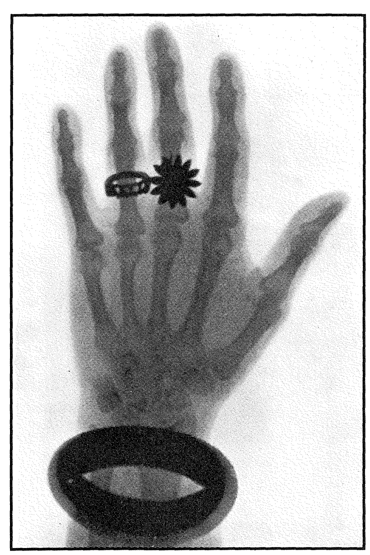

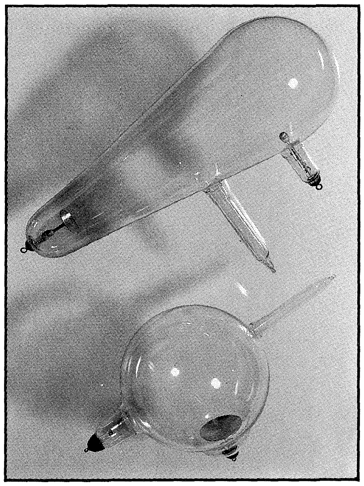

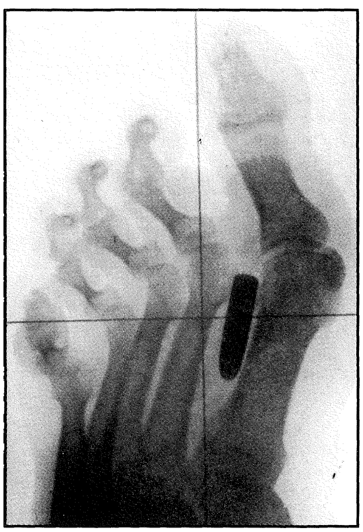

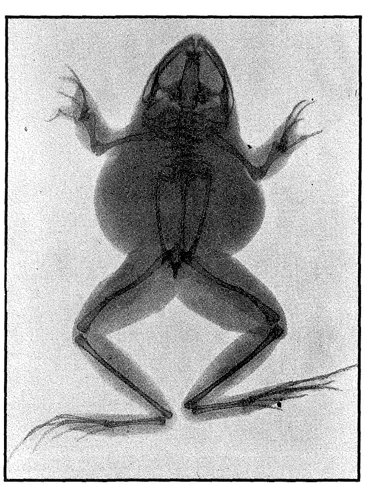

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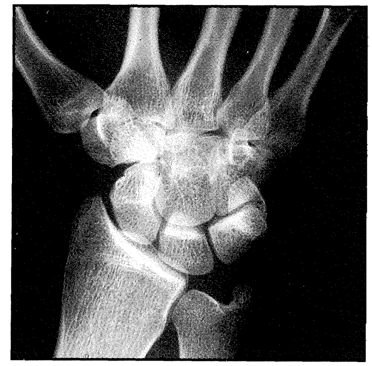

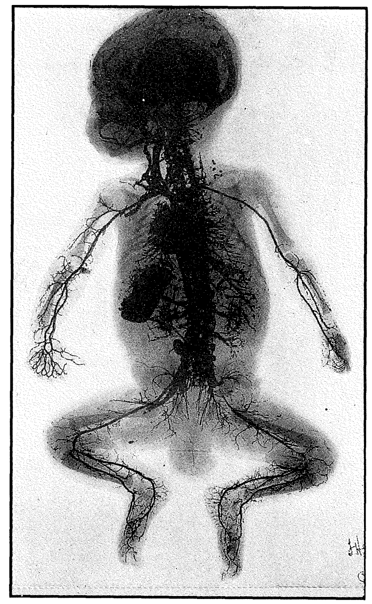

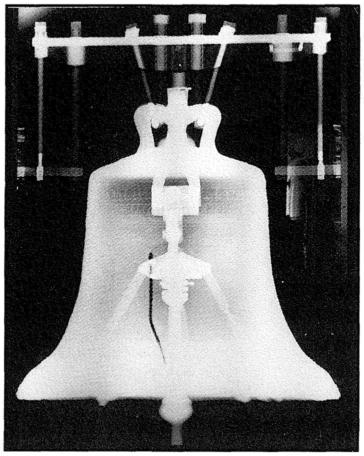

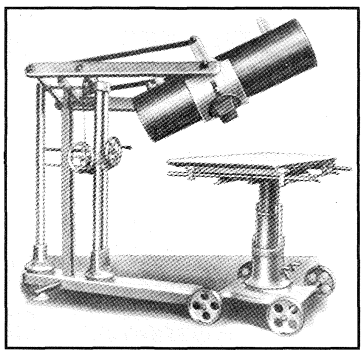

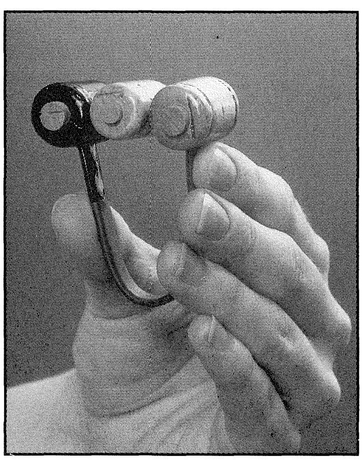

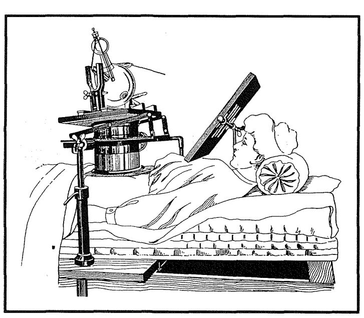

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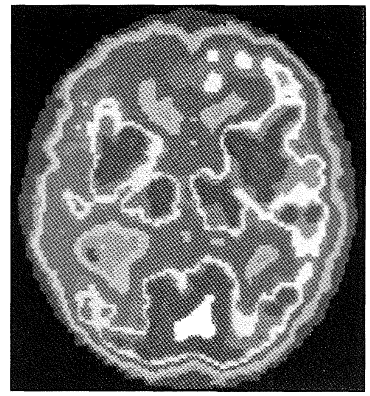

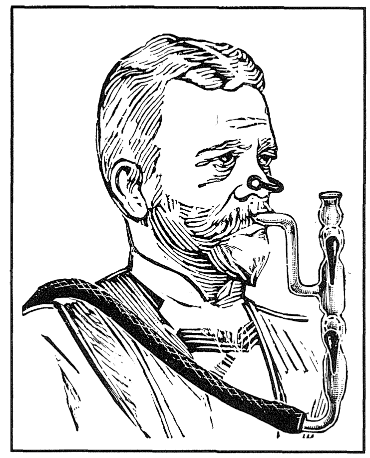

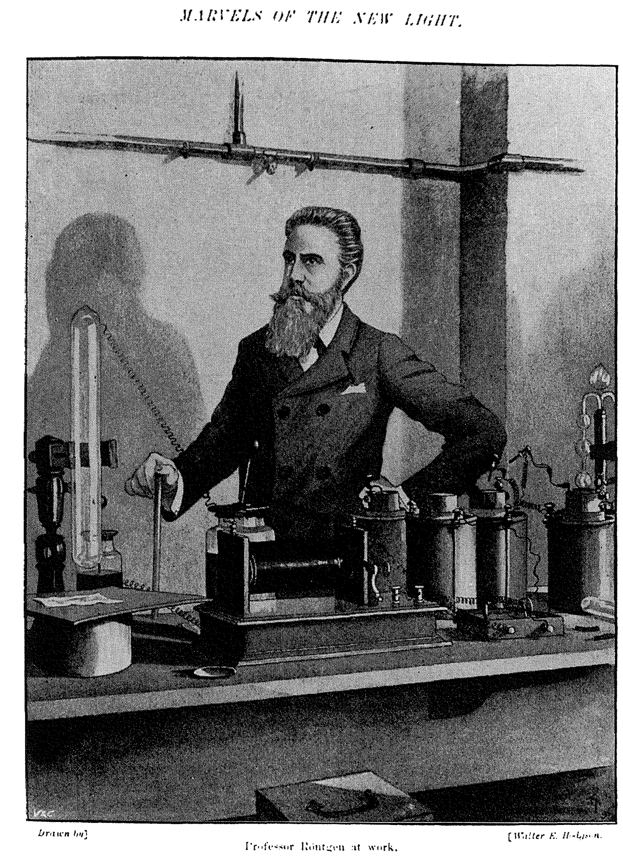

Figure 1. The world's first journalistic drawing of Röntgen in his laboratory. This was commissioned by the photographer and author on X-rays, Snowden Ward, and published in the April 1896 *Windsor Magazine.* It is a good likeness, but there is an obvious error on the left in the shape of the discharge tube which is of cylindrical design and not the famous pear shape.

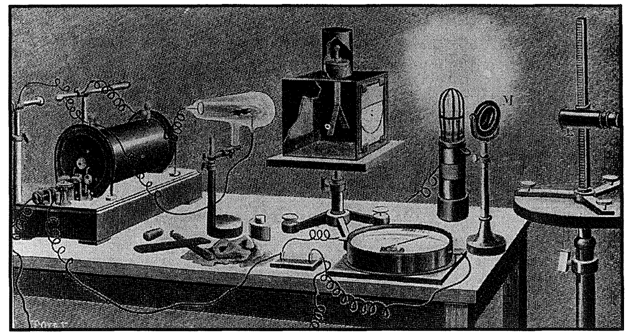

Figure 2. The first illustration of an experimental arrangement in 1896 for the study of ionisation in air produced by X-rays, using a gold leaf electroscope as the measuring device. This was published by two Frenchmen, Benoist and Hurmuzescu.

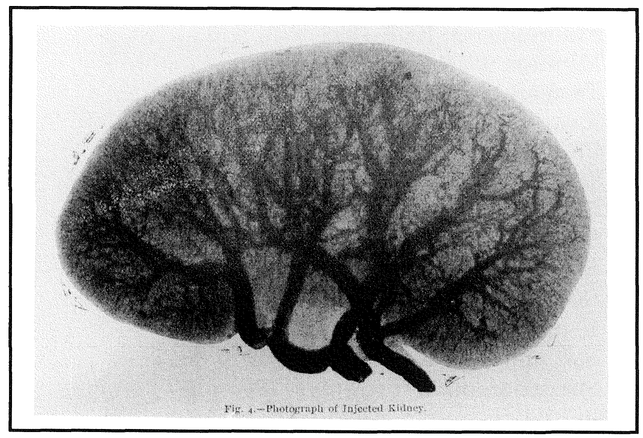

Figure 3. The first published arteriogram. Sydney Rowland was a medical student at St. Bartholomew's Hospital, London, at the time of the discovery of X-rays, and, unusually for one so young, was appointed 'Special Commissioner to the *British Medical Journal* for investigation of the applications of the new photography to medicine and surgery'. He published 26 reports between 8 February and 5 December 1896 and the BMJ included this 'photograph of an injected kidney' which was taken in Sheffield on 6 February 1896. Rowland went on to become editor of the world's first radiological journal in May 1896, The *Archives of Clinical Skiagraphy*, and the first issue was based largely on the BMJ reports; but for some unknown reason this arteriogram was never published in *The Archives* and is to be found only in the BMJ.

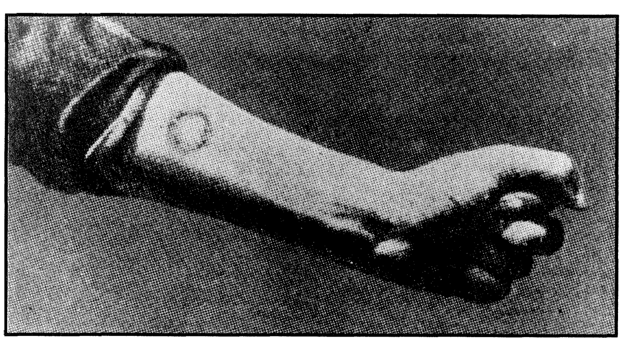

Figure 4. A photograph from a French newspaper of Pierre Curie's self-inflicted radium burn, 1901, which can be said to be the start of radiation biology and of radium therapy. (Courtesy: Muzeum Marii Sklodowskiej-Curie of the Polish Chemical Society, Warsaw.)

Figure 5. German 1995 postage stamp commemorating the centenary of X-rays.

Preface to the First Reprint

It is always a pleasure for an author when his book requires a reprint and I am most grateful to all those who have thought it worthy of purchase and to the many journal reviewers who have recommended it to healthcare personnel and to the general public.

The centenary of the discovery of X-rays is this year, 1995, and I have been fortunate to have been invited to speak at several congresses and university venues, but I would particularly like to take this opportunity to thank Professor Karsten Rotte and the *Physikalisch-medizinischen Gesellschaft of Würzburg* for their invitation in 1994 to deliver a lecture on *Marie Curie & Radium* to the very same society before which Röntgen gave his only public lecture on X-rays in January 1896; to Professor Andrzej Kulakowski for his invitation to speak in 1994 in Warsaw on *Marie Curie & Radium Therapy* at the commemoration at the *Maria-Sklodowska-Curie Memorial Cancer Center & Institute of Oncology* of the 60th anniversary of Marie Curie's death; and to Professor Axel Haase of the *Physical Institute of the University of Würzburg* who has invited me in 1995 to deliver an illustrated after-dinner speech at the Residenz Palace in Würzburg, for the magnetic resonance microscopy conference, and to speak on *Röntgen and X-rays in Medicine*. I would also like to thank Madame Eve Curie-Labouisse, the daughter of Marie Curie and also her biographer, for the invitation to visit her at her home in New York in 1994 for an afternoon of historical discussions. Such invitations in historical surroundings make an author's life very enjoyable!

I am also most grateful to those who have sent me additional historical material to that already contained in the following pages, and to the Libraries which continue to help me with my ongoing radiological history research. A single book is never large enough to contain all the illustrations one would wish, and since 1993 when it was first published I have found the following four 'firsts' from 1896 and I now take the opportunity to include them with this Preface together with the commemorative stamp from Germany for the X-ray centenary, Figure 5. I also list four invited review papers[1,2,3,4] published 1995–1996 and which complement the chapters in this book.

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1 Mould R F, *The early years of radiotherapy with emphasis on X-ray and radium apparatus*, Brit. J. Radiology, **68**, 567–582, June 1995.

2 Mould R F, *Röntgen and the discovery of X-rays*, Brit. J. Radiology, **68**, In press, November 1995.

3 Mould R F, *The early history of X-ray diagnosis with emphasis on the contributions of physics 1895–1915*, Physics in Medicine and Biology, In press, November 1995.

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Dick Mould
London, 1995

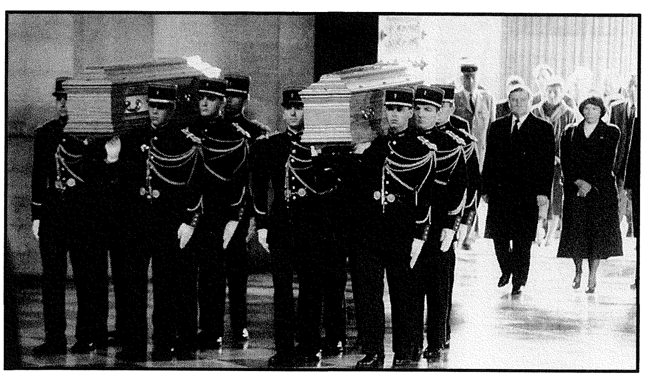

Figure 6. On 20 April 1995 the coffins of Marie and Pierre Curie were reinterred in the Panthéon, Paris, from their initial resting place in Sceaux, see Figure 2.11. Marie Curie is the first woman ever to be honoured by burial in the Panthéon and the ceremony was attended by the Presidents of France and Poland, François Mitterand and Lech Walesa, together with the Mayor of Paris, Jacques Chirac, and other dignitaries. The Joliot-Curie family accompanied the coffins which were carried by soldiers of the Republic Guard. It was also appropriate that the ceremony closed with the playing of a nocturne by Poland's most famous composer, Chopin, and that the Panthéon is very close indeed to the Rue L'Homond where radium was discovered and to the Institut du Radium in the Rue d'Ulm. The row of young people standing behind the two coffins are holding symbols relating to the work of the Curies. 'Po' for the discovery of polonium is clearly seen, as is β, symbolising beta rays.

Preface

This book has been written to fill a gap in radiological history, namely the publication of a comprehensively representative and entertaining photographic album which may be dipped into at random or browsed from cover to cover, yet also be regarded as an authoritative source of historical information. It might perhaps be described as a 'coffee table book' but not if that means remaining pristine on the inside and dusty on the cover—the more well-thumbed the edges, the better pleased this author will be!

The predominantly photographic presentation, with full and informative captions supported by short introductory essays, has been further encouraged by the favourable response to my smaller 1980 book *A History of X-rays and Radium*, now long out of print but still regularly requested. With over 640 illustrations, grouped into 200 topics, it is not surprising that the present collection has taken some 30 years to complete. It intentionally concentrates on the early years of discovery and invention, diagnosis and therapy, with archival accounts complementing the photographic record of the pioneering scientists and physicians, and their achievements and misfortunes. In most chapters, the history is more quickly brought up to date so that the old methods may be compared, or contrasted, with newer technologies. It is interspersed with a variety of radiological anecdotes and historical snippets which have been used over the years to keep students awake and enliven lectures on professional topics.

The material has been obtained from libraries, museums, hospitals, universities and individuals in more than 20 countries. There is something within its pages for everybody: radiotherapist, nuclear medicine physician, diagnostic radiologist, physicist, engineer, radiographer, technologist, nurse, equipment manufacturer, and art gallery and museum visitor. The more general reader will be intrigued by such esoteric topics as an X-ray aeroplane, radium baths, the court martial of a *British Medical Journal* author, customs and smuggling, an X-ray 'zoo', and radiographs of Egyptian mummies, old Masters, a Mercedes car and the Liberty Bell. An unusual insight into the difficulties of early radiation dosimetry is provided by the diversity of quantities and units of measurement proposed for X-rays and radium in the 40 years following their discovery. Recorded interviews with Röntgen have been included together with photographs of Marie Curie not previously widely published. Early patient photographs before and after X-ray or radium treatment have been located, including one taken 70 years after X-ray treatment. Research has been based on original source material and it will be difficult to find an early X-ray or radium application which has not been included, whereas the text and illustrations are very comprehensively indexed to make it easy to locate or retrieve the wide variety of people, methods, apparatus and examples featured in this book.

By the 1990s much documentation from the pioneer era has been irretrievably lost and many of the early textbooks and journals can now be viewed in only very few libraries throughout the world, not all of which are now routinely accessible. This illustrated history seeks to redress this imbalance by blowing the dust off our fascinating radiological past and presenting to a wider audience much material that has been buried for at least 50 years. As we approach the centenaries of the discoveries of X-rays (in 1995), radioactivity (in 1996) and radium (in 1998), I therefore wish you enjoyable reading on X-ray cannons, radium bombs, chiroscopes and osteoscopes, skiagrams, patents, X-ray spectacles and cosmetic radium creams.

Dick Mould
London, 1993

Acknowledgements

A book of this nature, researched over a period of 30 years, could not have been completed without a great deal of help from many people, not to mention organisations with radiological archives. The latter have included the British Institute of Radiology (including the extensive Thurstan Holland Collection and the Isenthal Bequest), British Museum, Science Museum in South Kensington, Deutsches Röntgen-Museum in Remscheid-Lennep, Institut Curie in Paris, Muzeum Marii Sklodowskiej-Curie of the Polish Chemical Society in Warsaw, Germanisches Nationalmuseum in Nürnberg, American College of Radiology in Reston, Virginia, Physical Institute of the University of Würzburg, Fachhochschule Würzburg-Schweinfurt, Siemens Archives in Erlangen, Deutsches Museum in Munich, the Otis Archives of the Armed Forces Institute of Pathology, Walter Reed Medical Center in Washington, the Welcome Library for the History of Medicine in London, the National Radiological Protection Board in Harwell, and the libraries of Westminster Medical School and the Royal Marsden Hospital/ Institute of Cancer Research in London, and of the World Health Organisation in Geneva and the International Atomic Energy Agency in Vienna. In addition, many companies in the radiological field have been very kind in providing me with photographs and information on equipment and I am most grateful to Amersham International, CGR Medical, Cuthbert Andrews, EMI, General Electric, Nucletron, Philips, Siemens, TEM Instruments and Varian.

It would, though, be impossible to list all those who have assisted me in one way or another with illustrations, tracing references and searching hospital libraries and I apologise if I have been at fault with omissions among those acknowledged below and in the captions of various figures.

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Dr Colin Orton
The late Dr W. Petzold
The late Prof. Edith Quimby
Mr L. J. Ramsey
Mr Michael Rhode
Prof. Jurgen Richter
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Dr Alex Rudic
Dr Robert Shields
Dr Heinrich Seegenschmiedt
Dr Margaret Snelling
M. Malgorzata Sobieszczak
Dr Burton Speiser
Ms Marilyn Stovall
The late Herr Ernst Streller
Herr H. Studtrucker
Dr Lauriston S. Taylor
Dr Nigel Trott
The late Prof. Dale Trout
Prof. Helmut Vahrson
Frau Helga Wagner
Prof. Rune Walstam
Mr John Wareing
Mr Roland Weigand
Prof. Hisao Yamashita
Prof. Yin Wei Bo
Dr Christian Zwicker

I would also like to express my appreciation to those at Institute of Physics Publishing in Bristol and Philadelphia, without whom this book could never have been published: Adrienne Fenton, Sean Pidgeon, Jenny Pickles and Tamara Isaccs-Smith, and especially to my production editor, Martin Beavis, who has cheerfully provided superb expertise in all the phases of production.

Finally, I would like to acknowledge my debt of gratitude to the early pioneers of the applications of X-rays and radium, both professionals and public alike, for their achievements under what cannot have been easy circumstances, and their foresight in recording their observations, results and theories. Their prodigious output has enabled me to rescue from late 20th century obscurity and from the passage of time, which has caused much to be irretrievably lost, a wide spectrum of unique illustrative material for inclusion in this record of virtually 100 years of X-rays and radioactivity applied to medicine.

Chapter 1

Discovery of X-rays

Wilhelm Conrad Röntgen

X-rays were discovered by Wilhelm Conrad Röntgen on November 8th 1895 in his laboratory at the Physical Institute of the Julius-Maximilians University of Würzburg in Bavaria. At the time Röntgen was investigating the phenomena caused by the passage of an electrical discharge from an induction coil through a partially evacuated glass tube. The tube was covered with black paper and the whole room was in complete darkness, yet he observed that, elsewhere in the room, a paper screen covered with the fluorescent material barium platinocyanide became illuminated. It did not take him long to discover that not only black paper, but other objects such as a wooden plank, a thick book and metal sheets, were also penetrated by these X-rays. More important though, he found that[1] 'Strangest of all, while flesh was very transparent, bones were fairly opaque, and interposing his hand between the source of the rays and his bit of luminescent cardboard, he saw the bones of his living hand projected in silhouette upon the screen. The great discovery was made.'

Although Röntgen published 55 scientific papers only three were on the topic of X-rays, none of which included any of his own radiographs. The first, 'Ueber eine neue Art von Strahlen', communicated on December 28th 1895 and set out in 17 numbered paragraphs, was published in the *Sitzungsberichte der Physikalisch-medizinischen Gesellschaft zu Würzburg* [1.13] and translations, some including radiographs made by other scientists, were soon available in English and in French:

January 23rd 1896 in *Nature* (London)
February 1896 in a special issue of *The Photogram* (London) entitled *The New Light and the New Photography* 'With many examples of Photography through "opaque" substances, wood, leather, ebonite, &c., and photography of the skeleton within the living flesh.'
January 24th 1896 in *The Electrician* (London)
February 8th 1896 in *L'Eclair Electricité* (Paris)
February 14th 1896 in *Science* (New York).

On January 1st 1896 Röntgen wrote to scientific colleagues in several countries enclosing some example radiographs, each marked with the stamp 'Physik Institut der Universität Würzburg' [1.14–1.16]. Two of these packages were sent to the United Kingdom, to Lord Kelvin (University of Glasgow) and to Sir Arthur Schuster (University of Manchester) of which only the Schuster set survives, donated by his daughter Dr. Norah Schuster to the Wellcome Institute for the History of Medicine, London.

Röntgen's second communication to the Physikalisch-medizinischen Gesellschaft was on March 9th 1896 and was a continuation of the first with additional numbered paragraphs 18–21. His third and final communication on the subject of X-rays, entitled 'Further observations on the properties of X-rays' was submitted to the Royal Prussian Academy of Science, Berlin on March 10th 1897 and published in the *Annalen der Physik und Chemie*. An English translation appeared in the *Archives of the Roentgen Ray* in February 1899.

His first and only public lecture was delivered on January 23rd 1896 at the Physikalisch-medizinischen Gesellschaft in Würzburg and the demonstration that day was of a radiograph of the hand of the famous anatomist Albert von Kölliker [1.18], who then proposed the term 'Röntgen rays' and called for three cheers for Röntgen. The audience cheered again and again.

The most detailed biography of Röntgen was written in 1931 by Otto Glasser[1], who describes the reaction of the world literature: daily press, popular magazines and scientific journals including:

'Electrical photography through solid bodies' *Electrical Engineer* (New York), January 8th 1896
'Sensational worded story' *The Electrician* (London), January 10th 1896
'Illuminated tissue' *New York Medical Record*, January 11th 1896
'Searchlight of photography' *The Lancet*, January 11th 1896
'Photography of unseen substances' *Literary Digest*, January 25th 1896
'Remarkable discovery: photographing through opaque matter' *Daily Telegraph* (Sydney), January 31st 1896.

Not all the responses were favourable, however, and in 1896 the London *Pall Mall Gazette* stated 'We are sick of the röntgen rays . . . you can see other people's bones with the naked eye, and also see through eight inches of solid wood. On the revolting indecency of this there is no need to dwell.' *Punch* magazine referred in a pessimistic poem to 'grim and graveyard humour' and X-rays were also linked with vivisection[2]. Such comment could not, however, halt the progress of such a useful medical tool.

Röntgen had previously worked in several universities before moving to Würzburg in 1888, including

Strassburg and Giessen, and early in 1895 he had refused the offer of a professorial chair by the University of Freiburg because the government of Baden was unable to fulfil his laboratory equipment requirements. He wanted 11,000 Deutschmarks for several pieces of physical apparatus and improvements for planned experiments. The negotiations with the Government of Baden were short but intensive. When he left Freiburg, he was reported[3] to have said at the railway station 'This small country is doing a lot for the three universities [which were within its borders], but I understand that they cannot spend such a lot of money to offer an appointment to a foreigner [Röntgen was not born in Baden]. The idea to come to Freiburg was a nice dream for both [himself and the university], but could not be realised like many other dreams.' Instead of Röntgen, the University of Freiburg appointed Franz Himstedt (1852–1933) whose equipment requirements totalled only 1,250 Deutschmarks[3]. The X-ray fame of Würzburg therefore has an economic aspect and Freiburg had to wait until the summer of 1896 for its first X-ray images, made by the physicist Ludwig Zehnder (see also [3.5]), one of Röntgen's former students.

Röntgen remained at Würzburg until 1900 when he left to work at the University of Munich. In 1901 he was awarded the first Nobel Prize in Physics [1.5] and donated the prize money to the University of Würzburg. On the tenth anniversary of his discovery in 1905 a group of prominent German physicists, including Kohlrausch, Planck and Wien, had a marble plaque placed at the Physical Institute, Würzburg, with the inscription 'In diesem Häuse entdeckte W. C. Röntgen im Jahre 1895 die nach ihm benannten Strahlen' (In this house in 1895 W. C. Röntgen discovered the rays which were named after him)[4]. For many years, though, this large plaque was lost until it was found being used in the Institute as a laboratory table top!

Despite the recognition accorded to Röntgen, there was, even into the 1970s, some debate concerning the contribution towards the discovery of X-rays by other researchers of electricity in high vacua, although Röntgen's pre-eminence was not challenged. Comroe[5] in his 1977 book *Retrospectroscope* which gives insights into medical discoveries (and near-miss discoverers), also rejects the view that the discovery of X-rays happened fortuitously, and is in agreement with Röntgen's biographer Glasser[1], who posed the question 'Was Röntgen's discovery accidental?' and then gave the answer that it was the final step in a brilliant and logical correlation of a multitude of facts which had been disclosed by many scientists, including Hertz, Lenard, Hittorf and Crookes.

Some insight into the well ordered mind of Röntgen can be found in two quotations he used in his speech in January 1894 when Rector of the University of Würzburg[6].

> 'Nature often reveals astounding marvels in even the most unremarkable things, but they can be recognised only by those who, with sagacity and a mind created for research, ask counsel from experience, the teacher in all things' (Athanasius Kircher, born 1602).

> 'When a law of nature, hitherto hidden, suddenly emerges from the surrounding fog, when the key, long sought after, to a mechanical combination is found, when the missing link takes its place in a chain of thought, there is the elation of spiritual victory for the discoverer, which by itself alone richly rewards him and lifts him for a brief moment onto a higher plane' (Werner von Siemens, 1816–1892).

Although Röntgen did not suffer from exposure to X-rays, probably because his experiments were over relatively few years and his X-ray tubes were shielded within metal boxes, he was well aware of the harmful biological effects experienced by other early workers. His warning to British scientists was conveyed by the London instrument manufacturer A. W. Isenthal [13.7] following a meeting with Röntgen in 1898[13].

'In April 1898 I was asked by my colleagues on the Council of the Röntgen Society, to arrange, if possible, for an interview with Röntgen at Würzburg University. Obtaining Röntgen's consent I called on him at his laboratory in the Physical Department, where he explained to me the set-up of his apparatus when he was led to the discovery of a new form of radiation. Röntgen was a very tall man, with a scholarly stoop, his face somewhat pock-marked, stern but kindly, and very modest in his remarks upon his achievement. I felt, of course, greatly elated at being in the presence of this world-renowned scientist. I became even more so when he asked me to accompany him to his private residence, offering me tea and chatting to me about "this English Röntgen Society" which I represented. He could, however, not accept my semi-official invitation to come to England, owing to so many previous engagements. In the course of our conversation he enquired of me whether we, in England, knew of the biological effects of the X-rays, and from a large portfolio produced some telling photographs of skin affectations, and asked me to make the facts known over here.'

Isenthal concluded his report with: 'On my return to England, I reported to the Röntgen Society, however, without evoking much interest regarding Röntgen's warning . . . as for myself, however, I immediately took what precautions were then possible.'

It is noted, however, in Chapter 3, that at a meeting on March 1st 1898 the Röntgen Society selected a Committee of Inquiry 'on the alleged injurious effects of Roentgen rays', and therefore at least some members were considering the possibility of harmful effects of radiation. Unfortunately though, the 'telling photographs of skin affectations' have been lost to posterity.

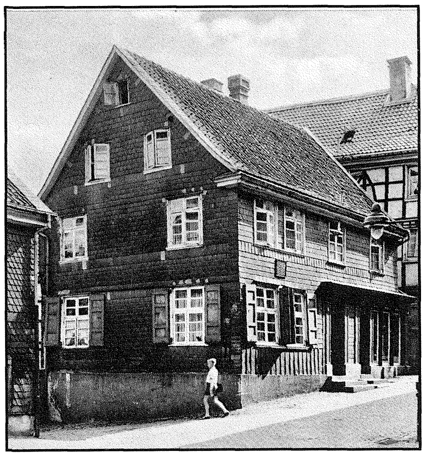
The Physics Department of the University of Würzburg has now moved to the outskirts from its original site in the centre of the city, but has a few permanent display cases commemorating Röntgen. Exhibits include his Nobel Prize of 1901, the original radiograph of the hand of Frau Röntgen [1.14], the box of weights used as one of his first X-ray test objects and his double-barrelled gun with accompanying radiograph [17.1]. The old buildings of the Physical Institute [1.9] are now the Fachhochschule Würzburg-Schweinfurt, but Röntgen's laboratory [1.11] is retained as part of a special Röntgen Museum. Some of his apparatus is displayed together with medals awarded to him, reprints of his scientific papers, a plaster death cast of his hands [1.7] and a very rare copy from Vienna of a book containing reproduction radiographs, of exceptionally high quality, of small animals taken in 1896 by Eder and Valenta[7] [9.7, 9.11].

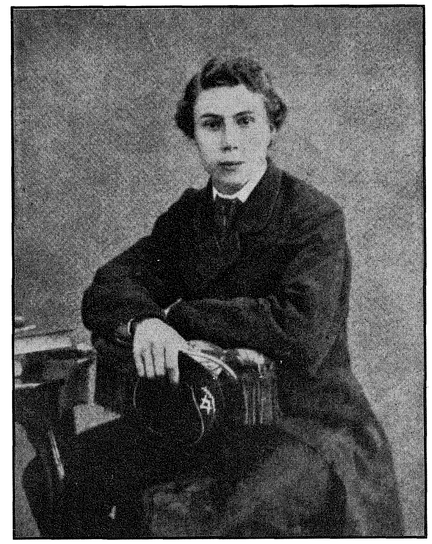
The most extensive Röntgen museum is, however, the

Deutsches Röntgen-Museum in Remscheid-Lennep, in the city of Röntgen's birth, which includes the only existing radiograph of Röntgen's own hand, as distinct from that of his wife which he had circulated widely. It not only contains material relating directly to Röntgen but also a wide range of interesting X-ray apparatus and many unusual radiographs. The Museum is both an educational centre for schools and an unrivalled resource for historical research.

To give Röntgen himself the final word, it was recorded[8] that when interviewed in 1896 by Sir James Mackenzie Davidson who asked 'What did you think?, referring to the original experiment with the tube covered by light-tight black paper and the fluorescence of the distant barium platinocyanide screen, Röntgen replied 'I did not think, I investigated.'

Röntgen: 1845–1923

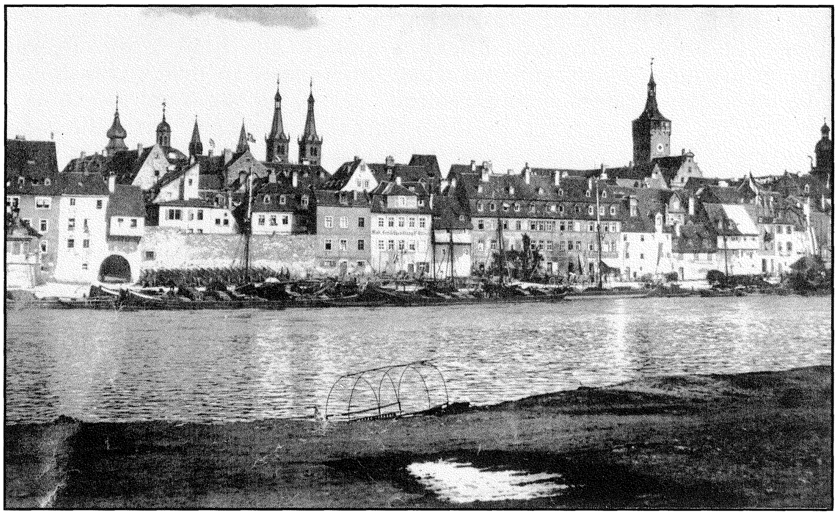




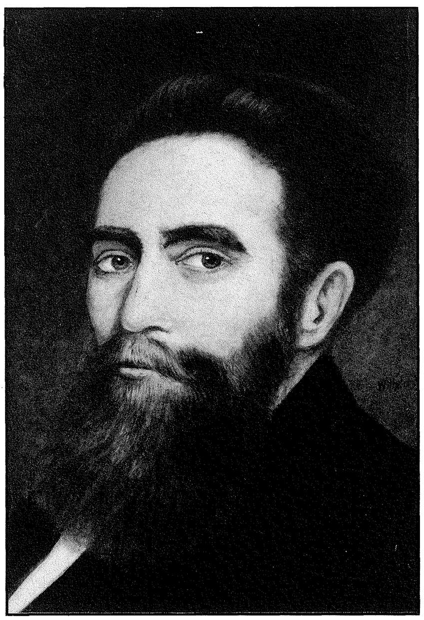
[1.1] Röntgen's early life in Germany and Holland. Left: the house in the Westphalian town of Lennep (present-day Remscheid) in which Röntgen was born in 1845. Centre: the only child of a German textile merchant and a Dutch mother. (Courtesy: Deutsches Röntgen-Museum, Remscheid-Lennep.) Right: Röntgen as a student in Holland.

The house in Lennep is now part of the Deutsches Röntgen-Museum and houses Röntgen's library of books and scientific papers. He did, however, only live in Lennep for the first three years of his life, at which point in time his father sold this home and moved to Apeldoorn in Holland where Röntgen received his initial education. This was followed in 1862 by his entrance to the Utrecht Technical School, and then a period of 10 months at the University of Utrecht (1865), although not as a regular student, until he passed in November 1865 the entrance examination to the Polytechnic School at Zurich, when he moved to Switzerland to become a student of mechanical engineering, receiving his diploma in 1868. One year later, studying under the Professor of Physics, August Kundt, he obtained his PhD degree after submitting a thesis on *Studies on gases.* In 1871 he followed Kundt to Würzburg and then (1872) to Strassburg. In 1875 he became a Professor of Physics in Hohenheim, in 1876 moving back to Strassburg and then in 1879 to Giessen and in 1888 to Würzburg to succeed Friedrich Kohlrausch. His final move was in 1900 when he took over the Physical Institute of the University of Munich at the special request of the Bavarian Government. It was in Munich that Röntgen died of cancer of the intestines in 1923.

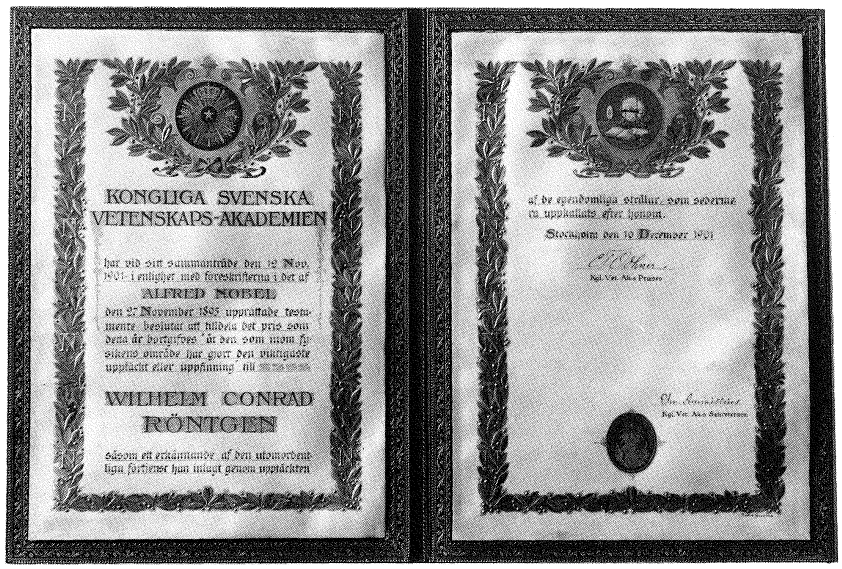
[1.2] Photographs of Professor and Frau Röntgen. This likeness of Röntgen (left), taken in 1896, appears in a selection of his scientific papers published by the Deutsches Röntgen-Museum[9] but a similar photograph appeared as the frontispiece of one of the earliest books[10] on X-rays. The photographs above are both halves of stereographic pairs. (Courtesy: The Science Museum, London.)



[1.3] The old harbour of Würzburg photographed by Röntgen between 1890 and 1900. His interests outside science included the outdoor life and photography, and his biographer Glasser[1] records how Röntgen and his wife often spent their vacations at Pontresian in the beautiful Engadin mountains, taking with them Josephine Bertha Ludwig, the daughter of his wife's only brother, whom they had taken into their home in 1887 when she was six and adopted during her twenty-first year. On one such visit she found Röntgen especially intriguing because 'he often walked around with a great box and black piece of cloth and took photographs.'



[1.4] The only portrait in oils of Röntgen; it is by Wilhelm Reitz and dated 1895. It is unlikely, however, that the portrait was actually painted in 1895 since X-rays were only discovered in November of that year and it would have been out of character for him to have had his portrait painted. In addition, there is no record of any such event in any of his biographical material.



KONGLIGA SVENSKA VETENSKAPS-AKADEMIEN

har vid sitt sammanträde den 12 Nov. 1901 i enlighet med föreskrifterna i det af

ALFRED NOBEL

den 27 November 1895 upprättade testamente beslutat att tilldela det pris som dena år bortgifves åt den som inom fysikens område har gjort den viktigaste upptäckt eller uppfinning till

WILHELM CONRAD RÖNTGEN

såsom ett erkännande af den utomordentliga förtjenst han inlagt genom upptäckten

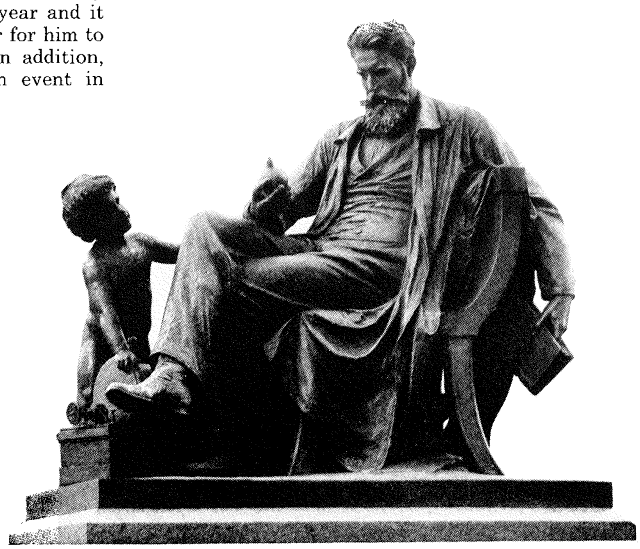
af de egendomliga strålar, som sedermera eu uppkallats efter honom.

Stockholm den 10 December 1901

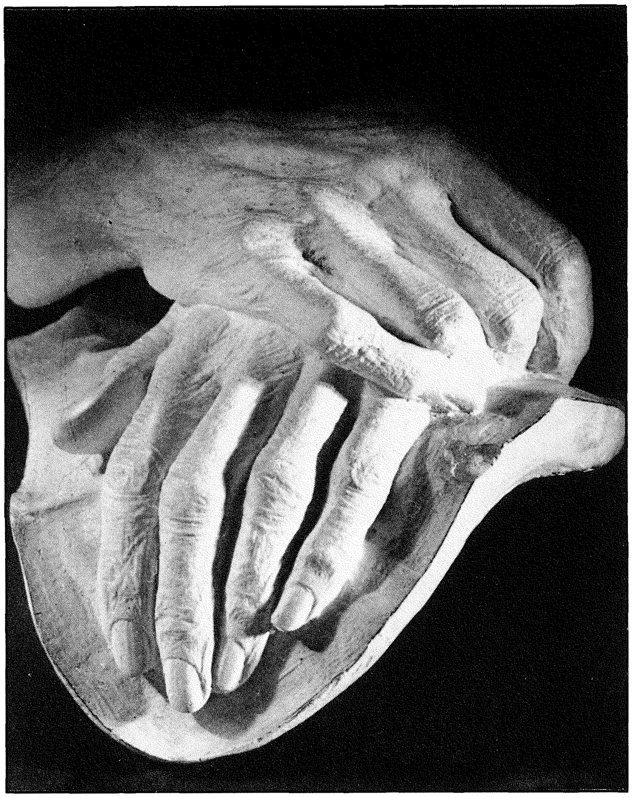
Kgl. Vet. Aka Praeses

Kgl. Vet. Aka Secreterare

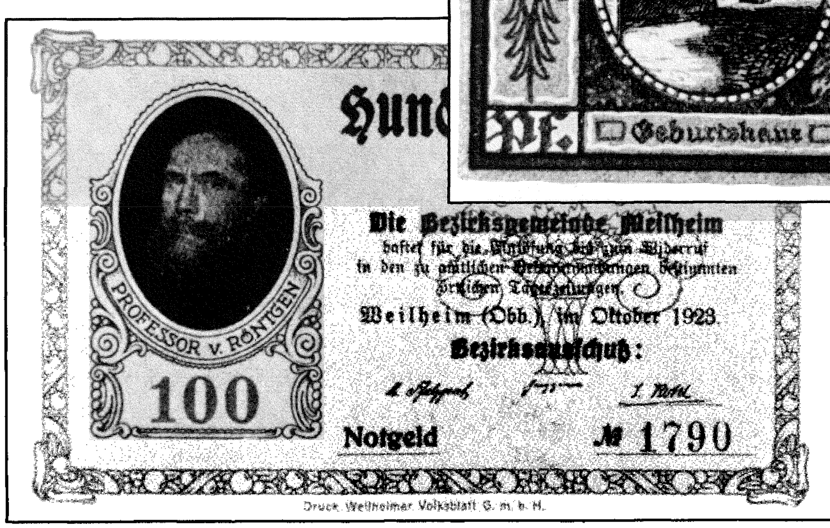
[1.5] The Nobel Prize document awarded to Röntgen in 1901. (Courtesy: Physical Institute, University of Würzburg.)



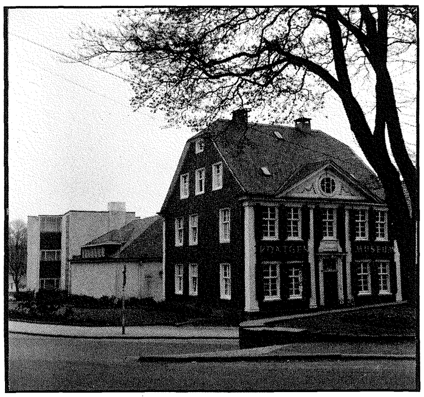
[1.6] Bust of Röntgen (far right) sculpted by Reinhold Felderhoff in 1896. (Courtesy: Deutsches Röntgen-Museum, Remscheid-Lennep). The statue of Röntgen, holding an X-ray tube in his right hand, was also sculpted by Felderhoff, in 1898, at the command of the German Emperor, and was sited on the Potsdam Bridge in Berlin. During World War II, in 1942, it was removed and smelted down for the metallurgical industry. This photograph formed part of the frontispiece of the 1907 textbook by Kassabian[14].



[1.7] Left: plaster cast of Röntgen's hands made immediately after his death in 1923. Unlike the hands of other X-ray pioneers [3.35], it is seen that Röntgen's are undamaged. (Courtesy: Deutsches Röntgen-Museum, Remscheid-Lennep.) Right: Röntgen's family grave in the Old Giessen Cemetery which is now a public park. Röntgen was Professor of Physics at the University of Giessen from 1879 to 1888 when he left for Würzburg. In later years, he often said[1] that except for his years in Würzburg the most pleasant period of his life was his time in Giessen. Both his parents died whilst he lived there, his mother in 1880 and his father in 1884 and both their names can be seen on the gravestone, together with that of his wife Bertha who died in 1919. (Courtesy: Prof. H. Vahrson.)



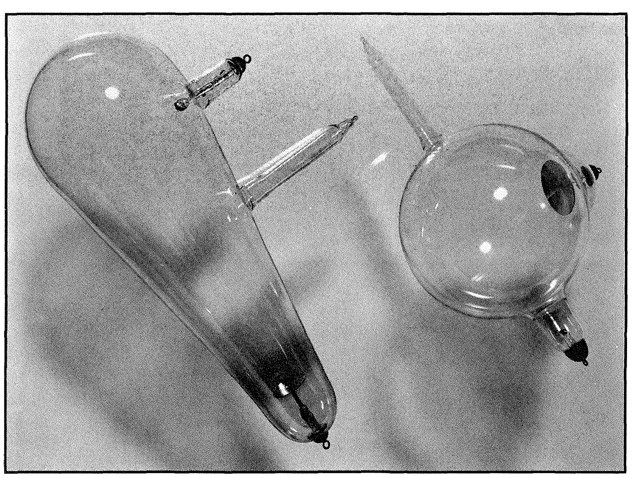
[1.8] Röntgen is commemorated on many postage stamps; the example shown was issued by Danzig Free State (now Gdansk in Poland) in 1939 bearing the slogan 'Fight Cancer, Cancer is Curable'. The two banknotes depicting Röntgen were emergency money issued in Lennep and Wellheim after World War I. Röntgen's birthplace is seen on the left of one of the notes.



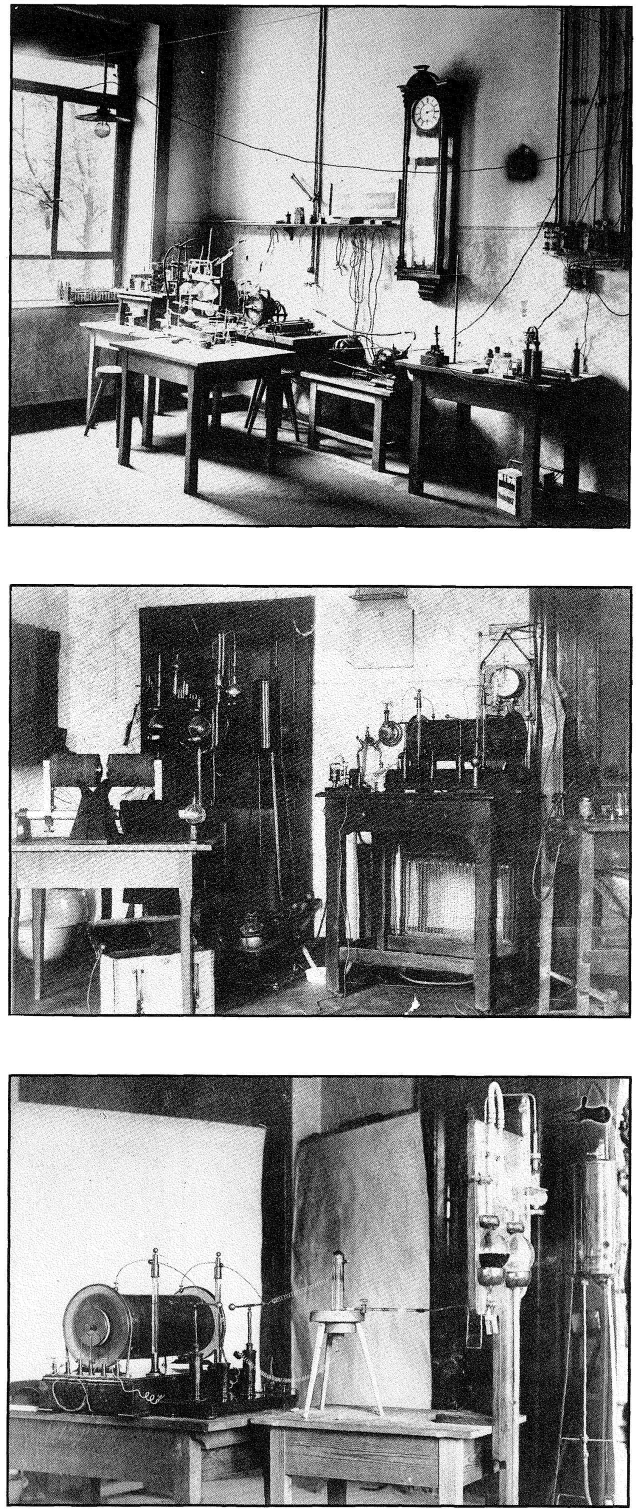
[1.9] The main building of the Deutsches Röntgen-Museum was formerly the Lennep Rathaus and now contains an extensive radiological collection. The museum's collection of Röntgen's books and papers is held elsewhere in the town, in Röntgen's birthplace [1.1].

Röntgen's apparatus: 1895–1896

[1.10] The frontage of the Physical Institute, Würzburg, in 1896[10]. The building is now the Fachhochschule Würzburg-Schweinfurt.



[1.11] Two X-ray tubes of 1895. The pear-shaped tube was known as a Hittorf tube and one of a similar design was being used by Röntgen when he made his discovery. See also [5.9] for a selection of tubes used by Röntgen. (Courtesy: Deutsches Museum, Munich.)



[1.12] Röntgen's laboratory in the University of Würzburg. (Courtesy: Deutsches Röntgen-Museum, Remscheid-Lennep.)

Röntgen's first communication and X-ray pictures


Professor Röntgen's wichtige Entdeckung!

EINE NEUE ART

VON

STRAHLEN.

VON

DR. W. RÖNTGEN,

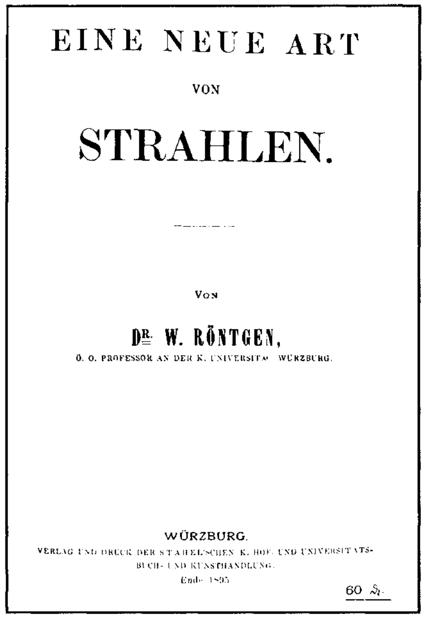
O. Ö. PROFESSOR AN DER K. UNIVERSITÄT WÜRZBURG.

WÜRZBURG.

VERLAG UND DRUCK DER STAHEL'SCHEN K. HOF- UND UNIVERSITÄTS-BUCH- UND KUNSTHANDLUNG.

Ende 1895.

50 ₰.


EINE NEUE ART

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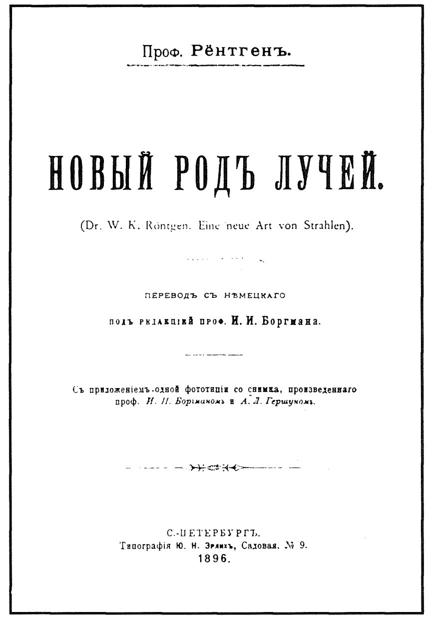
WÜRZBURG.

VERLAG UND DRUCK DER STAHEL'SCHEN K. HOF- UND UNIVERSITÄTS-BUCH- UND KUNSTHANDLUNG.

Ende 1895.

60 ₰.


Проф. Рëнтгенъ.

НОВЫЙ РОДЪ ЛУЧЕЙ.

(Dr. W. K. Röntgen. Eine neue Art von Strahlen).

ПЕРЕВОДЪ СЪ НѢМЕЦКАГО

подъ редакціей проф. И. И. Боргмана.

Съ приложеніемъ одной фототипіи со снимка, произведеннаго проф. И. И. Боргманомъ и А. Л. Гершуномъ.

С.-ПЕТЕРБУРГЪ.

Типографія Ю. Н. Эрлихъ, Садовая, № 9.

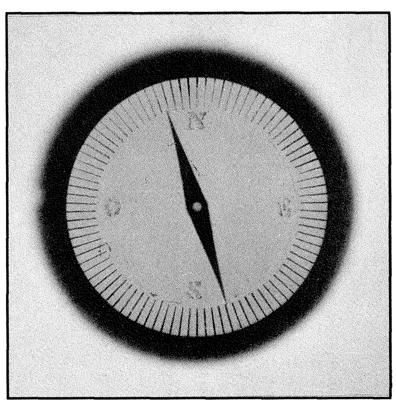
1896.

[1.13] Front covers of Röntgen's first communication, submitted for publication on December 28th 1895, under the title 'On a new kind of ray'. The paper cover of the first print run of his communication included the headline caption 'Professor Röntgen's wichtige Entdeckung!' (Important Discovery by Professor Röntgen!), a caption with which he disagreed and thus caused the cover to be reprinted without the offending headline. The original copy (left) is probably the only one remaining, and is now kept under lock and key in a safe in Würzburg. It cost 50 pfennigs whereas the reprint (centre) was priced at 60 pfennigs.

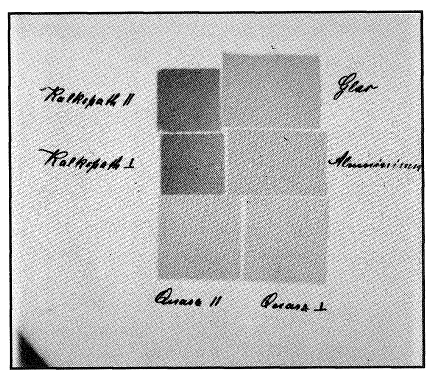
The Russian translation was printed in St. Petersburg in 1896 and includes the words 'Appended one phototypic plate made from a photograph recorded by Professor I. I. Borgmann and A. L. Gershun.' Many different language versions are exhibited in the Deutsches Röntgen-Museum, including a Japanese translation dated 1888.

[1.14–1.16] Three examples of Röntgen's radiographs mentioned in 'Ueber eine neue Art von Strahlen' (1895). Figures [1.15] and [1.16] were sent to Sir Arthur Schuster in Manchester on January 1st 1896. (Courtesy: Wellcome Trustees.) Figure [1.14] is inscribed by Röntgen to Professor Zehnder of Freiburg im Breisgau. (Courtesy: Deutsches Röntgen-Museum, Remscheid-Lennep.)

[1.14] Hand of Frau Röntgen. (Courtesy: Deutsches Röntgen-Museum, Remscheid-Lennep.)



[1.15] 'The justification for calling by the name "rays" the agent which proceeds from the wall of the discharge apparatus I derive in part from the entirely regular formation of shadows, which are seen when more or less transparent bodies are brought between the apparatus and the fluorescent screen (or the photographic plate). I have observed, and in part photographed, many shadow-pictures of this kind, the production of which has a particular charm.' The compass was one such example. (Courtesy: Wellcome Trustees.)



[1.16] This experiment was described as follows. 'These results lead to the conclusion that the transparency of different substances, assumed to be of equal thickness, is essentially conditioned upon their density; no other property makes itself felt like this, certainly to so high a degree. They show, however, that the density is not the only cause acting. I have examined, with reference to their transparency, plates of glass, aluminium calcite and quartz, of nearly the same thickness, and while these substances are almost equal in density, yet it was quite evident that the calcite was sensibly less transparent than the other substances which appeared almost exactly alike. No particularly strong fluorescence of calcite, especially by comparison with glass, has been noticed.' (Courtesy: Wellcome Trustees.)