PREFACE

There have been strong links between the pure sciences and medicine since the Scientific Revolution. This began in the late 16th century when the medieval notions of the earth being the centre of the universe and the human body somehow working by divine magic were gradually overcome.

In 1603, Heironymous Fabricius, a scientist in Padua, Italy, published a description of the valves in veins. Shortly afterwards, William Harvey, physician to James I, discovered the circulation of the blood and that the heart was merely a sophisticated pump. Luigi Galvani and Alessandro Volta, Italian physicists, famous for their construction of the first batteries in 1800, recognised the existence of electric currents and found that minute electric currents controlled nervous impulses and the movement of muscles. A century later, Sir Humphry Davy investigated the therapeutic effect of various gases, and demonstrated the anaesthetic effect of nitrous oxide (laughing gas). His assistant Michael Faraday, who subsequently replaced him as director of the Royal Institution and whose greatest achievements were in electromagnetism, worked on a number of applications of physics to medical science such as the development of optical glass. By removing impurities, he produced lenses which transmitted a high proportion of the visible spectrum. This introduced major developments in microscopy and allowed opticians to manufacture sophisticated aids to vision. The 19th century also saw the invention of such diagnostic instruments as the stethoscope (1818), the laryngoscope and the thermometer by physicists.

In the 1880s, various muscle and nerve disorders were treated by connecting patients via tin electrodes into electrical circuits. This was said to give good results in some cases. A few years later patients were exposed to magnetic fields by being made to lie on an insulated couch within a solenoid of stout copper wire. The apparatus was called a cage of conduction and it was considered to be an effective treatment for neuralgia, angina, gout, lumbago, sciatica, and rheumatism, as well as for various non-specific problems such as insomnia. S. Kuznitzky in Germany and P. Ishewsky in Russia noted skin changes and increases in blood pressure while using variable magnetic fields on patients in these cages, but no measurements of field values or treatment durations seem to have survived. One suspects that none were made.

The events which introduced physicists in numbers, and eventually led to the establishment of departments of Medical Physics in most large hospitals in the developed world, began just over a century ago. In 1895, Wilhelm Röntgen, professor of physics at Würzburg in Germany, produced X-rays, and a few months later Henri Becquerel, professor of physics in Paris, discovered radioactivity. The significance for medical science of both of these important happenings was quickly realised. Physicists were needed to construct and install X-ray apparatus, to try to measure the radiations involved, and, after the damaging effects of ionising radiation had been recognised, to design protective barriers.

Nobel Prizes were established in 1901 in accordance with the will of Alfred Nobel. He was a Swede who had made an immense fortune from making explosives and exploiting the oil fields between the Black and Caspian Seas. When he died in 1896, he left a very large sum to establish a Trust to distribute annual prizes in the fields of physics, chemistry and physiology or medicine. He also established prizes for 'idealism' and 'fraternity between nations'. Because his relatives contested the will, Nobel Prizes were not awarded until 1901. The first Nobel Prize for physics was awarded to Röntgen in 1901, and the 1903 prize went jointly to Becquerel and Marie and Pierre Curie for their discoveries in the field of radioactivity. Marie Curie was also awarded the 1911 Nobel Prize for chemistry.

More recently, Godfrey, (later Sir Godfrey) Hounsfield, a physicist working in industry, developed Computed Axial Tomography. This is now called CT Scanning. He cautiously suggested, when introducing this development to the medical science community at the 1972 British Institute of Radiology Congress, that "It is possible that this technique may open up a new chapter in X-ray diagnosis". This was probably the greatest step forward in medical physics since Röntgen's original discovery, and won for Hounsfield and

Allen Cormack, a South African physicist with similar ideas, the 1979 Nobel Prize.

The chapters which follow take the reader through the various discoveries and developments of radiation physics applied to medicine and bring each of them up to date, explaining the theory on the way. Many of the developers and discoverers were honoured for their work, and there was a liberal distribution of Nobel Prizes among them.

Modern medical physics encompasses non-ionising radiations too. Lasers, ultraviolet radiation, ultrasound, magnetic fields and so on are dealt with also using the same historical approach. The bioengineering areas are not covered, neither is medical computing, which is often the province of Medical Physics, but the reader is referred to several introductory books in these areas in the bibliography. A knowledge of physics up to GCE 'A' level is assumed, some anatomical or biological knowledge would also be helpful to the reader, but it is hoped that the explanations are fairly straightforward.

Historical details, which are not strictly required in order to understand the subject matter but which led up to the development of the subject, appear in a different typeface. By skipping these passages, the reader will still gain the appropriate knowledge of the subject of medical radiation physics, but will miss a lot of the interest.

"Light, Visible and Invisible" was the title chosen by Professor Silvanus P. Thompson, F.R.S. for his series of Christmas Lectures delivered at the Royal Institution, London, in 1896. Enormous progress has been made during the intervening century, but this still seems an excellent title for this book.

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