Taming the Rays

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Acknowledgements

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Preface

Radiation protection has emerged from early years when gruesome injuries crippled or killed many of the pioneers of x-rays to a point where it is built around one of the most complex and transparent protection regimes on the planet. The story is one of science and engineering but also of organisation, politics and ethics. At one end it touches the benevolent possibilities of medicine and nuclear power; at the other the awesome and destructive ones of nuclear weapons and, some would add, nuclear power too.

The main aim in this book has been to trace, in some sort of synchronism, the evolution of sources of radiation and our attempts to understand and control the risks to people from them. One way to do this would have been to follow a straightforward chronological approach, tracing the developments right across the field year-by-year. However, this seemed (it was tried) to lose so much of the intellectual structure of the subject. So, with the exception of the early years, the evolution of different aspects (theory, measurement, standards and others) has been followed separately. While this risks fragmenting the subject it does, at least, give more flexibility to set some of the areas – such as genetics and the changing ideas of cancer – in a broader context.

Some readers will be disappointed that the work is not more anecdotal. Even if I had wanted to do this, it would have been difficult. There seems to have been little attempt, particularly in the UK, to record the experiences of individuals that might have been the fuel for such an approach (although those interested in the history of medicine have characteristically done better than most). The largest impact of this is probably on the coverage of practical health physics, where there would surely be fascinating stories to tell of the evolution of organisations, of working methods and of relationships between health physicists and operators. However, a plentiful supply of such material would have made it even harder than it was to omit areas such as training, monitoring strategies, implementation of ALARA and emergency response in the attempt to stay focussed on the evolution of the central ideas.

A preoccupation of part of the health physics community for several decades – the 1950s to the 1980s – was civil defence, with the aim of limiting the number of early radiation casualties. It was an important episode, with a strong emphasis on the acute effects of radiation, and it required an understanding of these to be won by the study of the bomb survivors, accidents and through experiments on animals. As a result the acute effects are classified, their symptoms recognised and some effective treatment regimes are available. However, the early effects are seldom encountered, occurring only after infrequent accidents, and the risks they pose are usually minimised by good engineering design and proper training. They have been deemed to lie outside the scope of this book.

Medical uses dominated for the first 50 years of the atomic age and remained the single largest man-made source of radiation exposure through the period. However the focus of this book is elsewhere. Partly this is an acknowledgement of the existence of a substantial body of work on the history of medicine – a profession which seems to take its past seriously. Here, after an account of the early years, the therapeutic side of radiation medicine, where the biggest developments have taken place, is ignored: the doses employed are far larger than usually experienced elsewhere and the cost-benefit equation is unique. In no other area are the potential benefits so great for the person exposed and the consequences of under or over exposure so potentially devastating. Diagnostic uses have (or should have) a similarly direct association of costs and benefits for an individual but the doses and perceived risks are lower. So much lower in fact that, after the first decades when diagnostic doses came under proper control, the risks associated with them were for a long time disregarded. This became a concern in perhaps the 1970s and even at the end of the century there were concerns that a large number of diagnostic examinations had a flimsy clinical basis. So it would have been wrong to ignore the area. Diagnostic radiography has therefore been addressed - but without much technical or medical detail.

Even given this, medical applications have had a major impact on the developments described in this book, originally through the demands they made for clear definition of measurable quantities and on the measurement techniques themselves, and throughout as the motivation for much of the fundamental radiobiological research described here.

The evolution of standards is an important part of radological protection and it has probably received more attention than any other aspect. It has been approached here from an international perspective because meaningful extension to national situations would need some account of their individual legal systems. These differ enough to make it a fascinating subject of study but a potentially tedious one for many readers. So the account of standards here takes little account of national standards except where they contributed - as they did after the Second World War for example – to the formulation of international ones. Since all major nations follow, or aspire to follow however tardily, at least the general ideas of the ICRP, this is not considered too serious a omission.

Some might see as much more serious the absence of much reference to alternative views of the risks posed by radiation to those of the professional mainstream, the official view. The defence is that they have, right or wrong, had rather little impact on the direction of radiological protection although they succeeded, at least temporarily, in undermining the credibility of nuclear power in the public mind. They will be found to crop up from time to time in the narrative.

Over the century a wide range of radiation units have been used and they have been applied to several related concepts: exposure, absorbed dose, dose equivalent are just some. While modern units and concepts have sometimes been used to put things in context over time, the original units and concepts have been used in many places. Translating these into modern terms is not always straightforward anyway. So the reader will find rads and rems scattered around the text without conversions into Grays and Sieverts. Where an activity has been quoted in Curies in an original document, this has generally been reproduced here – with a translation into Becquerels where this seems to help significantly in understanding. The simple conversion factors 100 rad=1 Gy, 100 rem=1 Sv and 1 Ci= 37 GBq will be enough to disentangle any confusion for most purposes.