

Contents

SECTION EDITOR AND CONTRIBUTOR, VI

PREFACE, VII

ACKNOWLEDGMENTS, X

1. Introduction to the Imaging Sciences, 1

SECTION I: PRINCIPLES OF RADIATION PHYSICS, 16

2. Structure of the Atom, 16

3. Electromagnetic and Particulate Radiation, 26

4. The X-Ray Circuit, 34

5. The X-Ray Tube, 53

6. X-Ray Production, 62

7. X-Ray Interactions with Matter, 74

SECTION II: IMAGE PRODUCTION AND EVALUATION, 83

8. Image Production, 83

9. Image Quality and Characteristics, 94

10. Digital Image Receptors, 111

11. Radiographic Exposure Technique, 127

12. Scatter Control, 150

13. Exposure Technique Selection, 168

14. Image Evaluation, 187

SECTION III: SPECIALIZED RADIOGRAPHIC EQUIPMENT, 192

15. Fluoroscopic Imaging, 192

16. Additional Equipment, 213

17. Computed Tomography, 224

APPENDIX A: ANSWERS TO REVIEW QUESTIONS, 248

GLOSSARY, 250

INDEX, 259

DISCOVERY AND USE OF X-RAYS

DR. ROENTGEN'S DISCOVERY

Dr. Wilhelm Conrad Roentgen (Fig. 1.1) was born on March 27, 1845, in Lennep, Germany. His public education and academic career were marked by struggle, not for lack of intelligence but for want of opportunity. After an unfortunate prank perpetrated by a classmate, he was expelled from school because he would not name the perpetrator. This began his struggle to find a place in a university to study. He eventually triumphed, receiving his PhD degree from the University of Zurich in 1869. He did, however, continue to struggle initially to establish himself as a professor and academician. Again, as a credit to his scientific skill and knowledge, he achieved considerable success, most notably being named director of the then

Physics Institute at the University of Wurzburg in 1894. It was in this "state-of-the-art" (for its time) laboratory that Dr. Roentgen forever changed the world of medicine.

The story of Dr. Roentgen's discovery of x-rays has been recounted with some variability. The general and important aspects are presented here, but attempts to establish a full and detailed picture have been complicated by Dr. Roentgen himself; in his last will and testament, he requested that, on his death, all of his laboratory notes and books be destroyed unread. Many specifics of his research, however, may be found in his own publications of the discovery and in some of the biographies and stories from his friends and colleagues. What is most important to remember, beyond his discovery, is the superb investigative and scientific skill with which he researched "x-light," as he called it (x being the term representing the unknown).

Late on a Friday afternoon, November 8, 1895, Dr. Roentgen was working in his laboratory. He had prepared a series of experiments involving a cathode ray tube of the Crookes type (it may have been a Hittorf tube, but the general design and features of both types are the same: a partial vacuum tube that produces an electron stream). The nature of cathode