
Diagnostic Radiology

An Anglo-American Textbook of Imaging

VOLUME ONE

EDITED BY
Ronald G. Grainger

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An Anglo-American Textbook of Imaging

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Preface

This completely new, authoritative, Anglo-American, integrated text of organ imaging is designed to help the radiologist throughout the various stages of his professional career. It is particularly orientated towards the radiological trainee, resident or registrar and to facilitate this purpose many of the contributing authors have had experience as examiners for the American Boards, Royal College of Radiologists and other examining bodies. For the trainee, a rather didactic style has been adopted, the examination syllabi have been covered and special attention has been paid to favourite examination topics. An additional Multiple Choice Question volume based on this textbook is in an advanced stage of preparation.

This book is also designed for the working bench in the reading (reporting) room and is well illustrated and indexed to facilitate rapid reference to the appropriate subject. Each chapter carries an extensive updated bibliography and a further list of classic papers and monographs to encourage further reading, should more detail be required. It is therefore hoped that these volumes will continue to serve as an illustrated text and as an entry to the literature, long after the early formal years of radiological training.

We believe that this is the first attempt at producing a comprehensive and integrated text of the several modalities of organ imaging, written by a large and distinguished international group of teachers, authors, practitioners and research workers. About one half of the contributors are from either side of the Atlantic, equal prominence being given to American and British practice.

Probably no field of medicine is advancing so rapidly at the present time as organ imaging. The last 10–15 years have seen the introduction and development of completely new technologies such as computer assisted tomography, digital imaging, isotope studies, ultrasound and magnetic resonance imaging. All of these

and other techniques are discussed in this book, both in separate and specific technical chapters written by recognized authorities, and also by integration with conventional radiology in the general text where appropriate. Despite the great success of the alternative systems of organ imaging, conventional film radiology remains the major system in Departments of Radiology in the mid-1980s and this is reflected by the emphasis given in this text.

Radiology has become increasingly interventional and therapeutic as well as diagnostic, and good coverage of these procedures is presented by internationally acknowledged practising experts.

Imaging technology is developing so rapidly and so expensively that the major problems are those of providing the finances for the necessary technical and clinical developments, and in selecting the optimal imaging technique. As Dr Margulis points out in the opening chapter, the allocation of the necessary finance and resources is a matter for society in general, and for the medical profession in particular.

The editors wish to thank the Section and Advisory Editors and all of the many contributors to this work for their conscientious collaboration despite the many other demands on their valuable time and expertise.

We wish to thank Dr Anne Hemingway, Dr C. R. Merrill and Dr A. Adam for their major assistance in preparing the text for publication and in proof-reading, our secretaries Ms N. Moorcraft, Mrs V. Morris, Miss H. Pybus, Miss S. Smith and Mrs Y. Steel for typing and organisational assistance, and the photographic and illustration departments of our hospitals for their ever-willing and high-quality contributions.

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R.G.G.
D.J.A.

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Anyone who has participated in writing or publishing a book will know that the project is not viable without the co-operation and contributions of very many people.

To publish a completely new integrated textbook of a rapidly changing subject in which major technological advances are being made every year, with over 100 authors, writing in two different languages (American English and British English), with over 2000 pages and several thousand illustrations is absolutely impossible without the help, support, co-operation and advice of an army of several hundred people involved in the writing, illustrating, typing, editing, designing, typesetting, proofreading, printing, etc., etc.

It is obviously impossible to thank individually in print everyone who has endeavoured to secure the success of this book. The editors and publishers wish most sincerely to thank them collectively for the magnificent co-operation which we have received throughout this major project over its 5-year gestation.

The editors are particularly grateful to the Fleischner Society for permission to publish, at the end of Section Two, the 'Glossary of "Chest" Radiological Terms' suggested by their Terminology Committee.

Dr Nolan would like to thank his secretary, Miss Susan Dyson, for the preparation of his own chapters, 44 and 46, and for preparing the final manuscripts for all the other chapters in

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1

Introduction: developments in imaging

Alexander R. Margulis

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Digital radiography

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Ultrasound

Magnetic resonance imaging/nuclear magnetic resonance

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Historical considerations

There has at no time been a more exciting era in radiology than the early 1980s. This is not because radiology has been standing still since the momentous introduction of X-rays by Konrad Röntgen in 1895 (Fig. 1.1) and the discovery of radioactivity by Mme Curie. There have been steady advances in



Fig. 1.1 Fluoroscopy of the chest about 1900.

the acquisition of diagnostic information made possible by continuous technical innovations, as well as by new invasive diagnostic approaches. These owed their advent to new equipment and the perseverance of the pharmaceutical industry in developing better and safer contrast media and the ingenuity of the medical and imaging professions.

The Coolidge X-ray tube, phototiming, rapid film changers, image intensification, the introduction of cine radiography and television cameras into fluoroscopy and the development of relatively safe radio-opaque contrast media for intravenous and intra-arterial use, all formed a succession of achievements that made selective angiography possible. Selective angiography developed because of the skill of radiologists to manipulate intravascular catheters at challenging angles and through small orifices. These skills were applied to create a new discipline, interventional radiology, which is crossing the borders of diagnosis into therapy.

The 1970s produced advances in ultrasonography with the high quality grey scale image in B-mode and with high resolution real-time ultrasonograms. Computed tomography arrived on the scene in the mid 1970s and within a short time revolutionized the diagnostic approach to medicine. Exploratory surgery has almost been eliminated in major medical centres. Most patients are admitted into hospitals with a correct, specific diagnosis made on the basis of precise noninvasive diagnostic studies.

Organ and tissue imaging, with the simultaneous advances in digital radiography, introduction of magnetic resonance imaging and the promise of its linkage with *in vivo* magnetic resonance spectroscopy is becoming very exciting. The advent of the millisecond X-ray computed tomographic scanner with no moving parts except for electrons is promising to revolutionize the field of X-ray computed tomography.

While all these advances in technology have greatly improved the diagnostic potential, they have brought many problems. The greatest are the expense of purchasing these costly machines, deciding on their location and distributions and maintaining and replacing them as the technology advances. The tremendous recent progress in organ imaging has threatened to divide the medical world into three geographic areas: (1) countries that can afford any and all medical equipment; (2) countries that can almost afford it in specifically chosen sites; and (3) countries that cannot afford any of the expensive radiological installations^{1,2}.

Conventional radiography

Conventional radiological procedures today in the western world and Japan are being performed on expensive equipment that is often much more sophisticated than necessary and frequently so complex that it is difficult to use and to maintain. Equipment is becoming more and more specialized, a direction that should not be followed. Equipment, except for automated chest rooms, should be multipurpose and should be used continuously. For example a bi-plane fluoroscopic unit with a table capable of 90° upright or head down tilt can be used for gastrointestinal barium examinations, myelo-

graphy, interventional diagnostic and therapeutic procedures, angiography and arthrography (Fig. 1.2).

With the continuously increasing costs of equipment, space and personnel, it is essential that an expensive radiographic room be used round the clock. This means that the complexion of some X-ray departments will change. Huge departments with multiple rooms, which have special functions, and are used only occasionally, must become more cost efficient. They will have to be efficiently run, small in size, with continuous room occupancy and great versatility.

Certain additional advances which do not increase the complexity but are aimed only at cost savings will also occur. One of these directions will be the multiframing of all diagnostic images once larger image intensifiers, (at least 14 inch × 14 inch) are available and are reasonable in price. The multiframing camera will be capable of producing the format of one in one, two in one, four or as many as eight in one images on one 14 inch × 14 inch film sheet. The advantage of this will be a decrease in the amount of silver used and a much faster throughput of patients. As

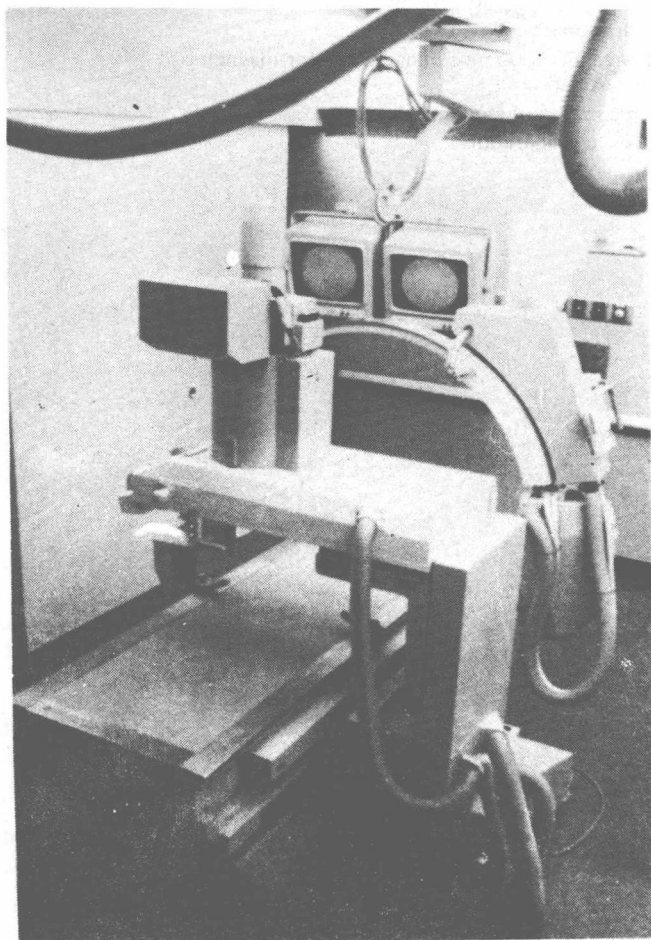


Fig. 1.2 Bi-plane fluoroscopic room with overhead tube capability and a 90°-90° fluoroscopic table. This multipurpose room can be used for interventional radiology, angiography, myelography, gastrointestinal studies, etc. It is often the busiest room in the department.