PEDIATRIC X-RAY DIAGNOSIS

A Textbook for Students and Practitioners of Pediatrics, Surgery & Radiology

by

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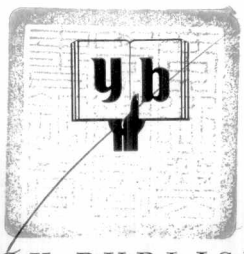
THIRD EDITION



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Affectionately inscribed to

my dear wife

Sidneth Earle Caffey

Preface to Third Edition

During the last 10 years, roentgen methods for diagnosis of infants and children have become much more widely used than previously. At the same time a phenomenal expansion has occurred in the field of pediatric radiology, and the accuracy of the method has improved greatly. This increase in the usefulness of radiology in pediatrics and the belated recognition of its values are most gratifying to me, in part because the first two editions of this book have played some role in the genesis and growth of the expanded interest in radiologic investigation of young patients. This recent rapid continuing increase in knowledge has made necessary many major revisions and additions in the third edition which have inevitably increased the size of the book. We have striven to include the most important new information which is actually useful in the diagnosis of disease and in the treatment of patients. Some of the more elaborate new technics have been intentionally omitted because they require so much space; these include opaque angiocardiography, cardiac catheterization, planigraphy, opaque cerebral angiography and opaque myelography. There are now several different monographs which treat all of these subjects in encyclopedic detail, not possible in a text such as this on general diagnosis.

The new material in the section on the urinary tract is largely from the files of Dr. Frederic N. Silverman, pediatrician and radiologist to the Children's Hospital of Cincinnati. It is a pleasure to acknowledge this fine contribution from a former colleague and old friend.

It goes without saying that accurate identification of the abnormal is impossible before one becomes thoroughly familiar with the normal and all of the important normal variants. For this reason, normal radiologic findings have been discussed and illustrated as fully as available space has permitted in the third edition. It is a pity that, 60 years after Roentgen's discovery of x-rays, knowledge of the normal is still so defective—a deficiency which can be overcome only by comprehensive radiologic study of large groups of healthy infants and children at all ages. It is to be hoped that substantial funds will some day become available for the correction of this crucial weakness in current knowledge.

A second neglected important aspect in radiologic practice and teaching, it seems to me, is the failure to emphasize sufficiently the limitations of the roentgen method. Actually, there are only a few circumstances in which a conclusive diagnosis of the cause of disease can be made from the radiologic findings alone; opaque foreign bodies in the tissues are the only examples of such circumstances which come to mind. Ordinarily the great value of the roentgen method is that it suggests the line of investigation by which a conclusive diagnosis can be made by non-roentgen methods. Radiologic findings are often seriously misleading when the radiologist is unfamiliar with normal variations and the inherent limitations of the method itself.

In comparison with the second edition, there are 250 new illustrations which contain 383 different images. Among the more notable new figures are those which show the circulation of the blood inside congenitally deformed hearts, and the normal anatomy of the cecum and the ileocecal valve. The new tables for estimation of maturation of the skeleton are by Elgenmark.

Perhaps the most important addition to the third edition is the new section on congenital dysplasia and dislocation of the hip. This includes some of the data from our own recent studies on this subject which fail to support the widely held hypothesis that actual dislocation is preceded during the neonatal period by a predislocation phase which is characterized radiographically by enlargement of the acetabular angle at the site of future dislocation. The entire section on congenital heart disease has been rewritten, as well as the sections on megacolon, Perthes' coxa plana and slipping of the upper femoral epiphysis. Other important new subjects and new considerations include the interparietal bone, accessory ossicles of the occipital, trigonocephaly, leptomeningeal cysts, familial fibrosis of the jaws, absence of the main branch of the pulmonary artery, progressive shapes and positions of collapsing lobes in the lungs, pneumonia of dysautonomia (Riley-Day syndrome), pneumonia of agammaglobulinemia, bronchial lesions of the primary tuberculous complex, neoplastic disease after radiation of the thymus, esophageal ulcer, partial thoracic stomach with sliding hiatus hernia and short esophagus, transdiaphragmatic duplications of the intestinal tube, urethrography, adrenal hypertrophy and neoplasm, multiple epiphyseal dysplasia, multiple metaphyseal dysostosis and hypophosphatasemia, traumatic cortical hyperostosis, coalition of tarsal bones, osteochondrosis dissecans, prenatal and chronic infantile cortical hyperostosis, Milkman's syndrome, oxalosis of the skeleton, Cushing's disease in the growing spine, Scheuermann's disease and the intervertebral disk, and idiopathic calcification of the intervertebral disks. There are also 36 new items of less importance.

The success of this book has depended on the continuing co-operation of many persons—the attending and resident physicians, nurses and social service workers, and especially the technicians, secretaries and aids in our own department. I cannot thank them sufficiently for their sustained interest during many years. We have been indebted to many parents for late follow-up examinations long after the immediate problems of diagnosis and treatment had been solved. I have always had special pride in our gentle handling of sick and sometimes frightened patients, and the friendly consideration given to their sometimes distraught parents. These benign and friendly practices have developed in large part from the cheerful example set by Mrs. Moira Shannon in her capacity as supervisor. Finally, I want to express my gratitude to Mr. Paul Perles and Mrs. Anabel Ireland Janssen for their past and future expert contributions in publication; it is a pleasure to submit, for a third time, a manuscript for their skilful services.

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August 6, 1955

Preface to First Edition

Shadows are but dark holes in radiant streams, twisted rifts beyond the substance, meaningless in themselves.

He who would comprehend Röntgen's pallid shades, needs always to know well the solid matrix whence they spring. The physician needs to know intimately each living patient through whom the racing black light darts, and flashing the hidden depths reveals them in a glowing mirage of thin images, each cast delicately in its own halo, but all veiled and blended endlessly.

Man—warm, lively, fleshy man—and his story are both root and key to his shadows; shadows cold, silent and empty.

Within a few weeks after Röntgen announced his now renowned discovery to the world in December, 1895, the x-ray method of examination was applied to infants and children. The Vienna letter of February 29 (M. Rec. 49:312, 1896) contained a roentgen print of the arm of an infant made by Kreidl in Vienna; this is the second reproduction of a roentgen image in the American literature. Credit for the first recorded roentgen examination of an infant in the United States undoubtedly belongs to Dr. E. P. Davis of New York City, who described the roentgen shadows cast by the trunk of a living infant and the skull of a dead fetus in March, 1896. In his remarkable article (The study of the infant body and the pregnant womb by the roentgen ray, Am. J. M. Sc. 111:263, 1896) Dr. Davis also included three drawings of shadows visualized by means of a skiascope—shadows of the feet, elbows and orbit of a living infant. Feilchenfeld's discussion of spina ventosa in May, 1896, is probably the first roentgen description of morbid anatomy in children (Berlin. klin. Wchnschr. 33:403, 1896). There were only two roentgen pediatric publications in 1896; the number increased to 14 in 1897.

In 1898, Escherich of Graz had had sufficient experience with pediatric roentgen examinations to write a general exposition on the merits and weaknesses of the method (La valeur diagnostique de la radiographie chez les enfants, Rev. d. mal. de l'enf. 16:233, May, 1898). This is a highly interesting and illuminating discussion in which Escherich points out that roentgen examination was already not being used as commonly in young patients as in adults. He states that a roentgen laboratory was established especially for children at Graz in 1897, and it seems probable that this was the first of its kind. A single film is reproduced—a print of an infantile hand and forearm which shows rachitic changes. The uncertainties of the mediastinal shadows, which still bedevil us, were fully appreciated by Escherich, and he was quite unhappy about this baffling structure "in which so many important infantile lesions lie concealed." He was enthusiastic in regard to the possible estimation of the state of hydration of soft tissues in infantile diarrhea from their roentgen densities.

Reyher's German monograph in 1908 is the earliest review of the world literature on pediatric roentgenology which I have found (Reyher, P.: Die roentgenologische Diag-

nostik in der Kinderheilkunde, Ergebn. d. inn. Med. u. Kinderh. 2:613, 1908). In it there are 276 references to articles published during the first 12 years following Röntgen's discovery, and these furnish a good key for the study of the early writings in this field. The appendix contains 40 small but clear roentgen prints.

Rotch's *The Roentgen Rays in Pediatrics* appeared in 1910—the first book in any language devoted exclusively to pediatric x-ray diagnosis and still, I believe, the only one in English. Dr. Thomas Morgan Rotch was Professor of Pediatrics, Harvard University, and an outstanding pediatrist of his time.* In this pioneer treatise he stresses the importance of mastering the shadows of normal structure before attempting the recognition and interpretation of the abnormal, and he carefully correlates the clinical findings with the roentgen findings in the cases illustrated; 42 of 264 figures depict the "normal living anatomy of infants and children." This material was taken largely from the files of the Boston Children's Hospital, and the author's statement that more than 2,300 cases were available for study demonstrates that roentgen examination had long been a commonplace in his clinic. Dr. Rotch's early fostering of roentgen examination of infants and children, his appreciation of the special problems in applying this method to the young, his careful anatomicoroentgen studies and his text, monumental for its time, all mark him as the father of pediatric roentgenology in America.

Two years later—1912—the first German book, Reyher's *Das Roentgenverfahren in der Kinderheilkunde* was published. Later and more familiar texts are Gralka's *Roentgendiagnostik im Kindesalter* (1927), Becker's *Roentgendiagnostik und Strahlentherapie in der Kinderheilkunde* (1931) and the *Handbuch der Roentgendiagnostik und Therapie im Kindesalter* by Engel and Schall (1933). As far as I have been able to determine, no book on pediatric roentgen diagnosis has been published in English during the 35 years which have passed since Rotch's unique publication in 1910. The absence of pediatric roentgenology in the flood of medical texts which has streamed from the American and English presses during the last three decades constitutes a dereliction unmatched in other equally important fields of medical diagnosis—a literary developmental hypoplasia which it is hoped *Pediatric X-Ray Diagnosis* will remedy.

This book stems from the roentgen conferences held semimonthly at the Babies Hospital during the last 20 years. The films reproduced herein were all selected from our own roentgen files save those for which credit to others is indicated in the legends. The purpose of the author is twofold: description of shadows cast by normal and morbid tissues, and clinical appraisal of roentgen findings in pediatric diagnosis. Roentgen physics, technic and therapy have been omitted intentionally. As references and acknowledgments testify, the writer has borrowed freely from the literature and is indebted to many contributors for subject matter and illustrations. To all of them I am sincerely grateful. In the broad and deep field of pediatric diagnosis, selection of the most appropriate material has posed many dilemmas. In the main, data have been chosen which have proved the most useful and instructive in solving the common and important diagnostic problems which have arisen during two decades in a large and busy pediatric hospital and outpatient clinic.

The limitations of space do not permit adequate recognition here of all those to whom credit is due for the making of this book. The roentgen examinations which are its foundation could not have been made without the co-operation of thousands of patients —many weak and pain-weary; to all of these I am profoundly thankful. Intimate clinical contacts have been maintained and essential collateral examinations have been made possible through the sustained collaboration of

*Jacobi, A.: In memoriam Thomas Morgan Rotch, Am. J. Dis. Child. 8:245, 1914.

my colleagues—attending physicians and surgeons, resident physicians and nurses. I am under deep and solid obligation to Dr. Rustin McIntosh who read the entire manuscript; his discerning criticism and valuable suggestions are responsible for numerous corrections and improvements in the text. The sympathetic reception given to our early endeavors by Dr. Ross Golden will always be remembered gratefully, as well as his continuing wise and friendly council. We have benefited much and often from the discipline of the necropsy table—from the instructive dissections of Dr. Martha Wollstein, Dr. Beryl Paige and Dr. Dorothy Andersen.

To none, however, do I owe more than to my loyal co-workers in the roentgen department of the Babies Hospital—Edgar Watts, Cecelia Peck, Moira Shannon, Mary Fennell and Mary Jean Cadman—for their gentle handling of patients, unfailing industry and superlative technical skill. Mrs. Cadman typed the manuscript; I am grateful to her for the speedy completion of a thorny chore. The drawings are the work of Alfred Feinberg, and they reflect his rich experience in medical illustration.

The final phase in the preparation of the manuscript was saddened by the death of Mr. H. A. Simons, President of the Year Book Publishers. His stimulating enthusiasm and generosity were indispensable to the completion of the book during these unsettled war years. His passing was a grievous loss. The task of publication has fallen to the capable and patient hands of Mr. Paul Perles and Mrs. Anabel Ireland Janssen.

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Figures 3, 126 and 191: R. E. Scammon, in *Abt's Pediatrics* (Philadelphia: W. B. Saunders Company, 1923).

Figures 8 and 23: Dr. Howard C. Moloy.

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Figures 87 and 89: Dr. Juan H. Taveras.

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