PHOTOGRAPHIC REGIONAL ATLAS OF BONE DISEASE

Second Edition

PHOTOGRAPHIC REGIONAL ATLAS OF BONE DISEASE

A Guide to Pathologic and Normal Variation in the Human Skeleton

By

ROBERT W. MANN, PH.D.

and

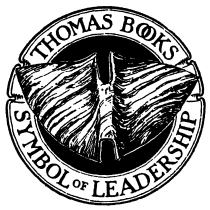
DAVID R. HUNT, PH.D.

Foreword by

O'Brien C. Smith

Introduction by

Donald J. Ortner



CHARLES C THOMAS • PUBLISHER, LTD.
Springfield • Illinois • U.S.A.

Published and Distributed Throughout the World by

CHARLES C THOMAS • PUBLISHER, LTD.
2600 South First Street
Springfield, Illinois 62704

ISBN 0-398-07539-5 (hard)
ISBN 0-398-07540-9 (paper)

Library of Congress Catalog Card Number: 2004055376

With THOMAS BOOKS *careful attention is given to all details of manufacturing and design. It is the Publisher's desire to present books that are satisfactory as to their physical qualities and artistic possibilities and appropriate for their particular use.* THOMAS BOOKS *will be true to those laws of quality that assure a good name and good will.*

Printed in the United States of America
MM-R-3

Library of Congress Cataloging-in-Publication Data

Mann, Robert W., 1949–
Photographic regional atlas of bone disease : a guide to pathologic and normal variation in the human skeleton / by Robert W. Mann and David R. Hunt ; foreword by O'Brian C. Smith ; introduction by Donald J. Ortner.–2nd ed.
p. cm.
Rev. ed. of: Regional atlas of bone disease. c1990.
Includes bibliographical references and index.
ISBN 0-398-07539-5 – ISBN 0-398-07540-9 (pbk.)
1. Bones–Diseases–Atlases. 2. Paleopathology–Atlases. I. Mann, Robert W., 1949– . Regional atlas of bone disease. II. Title.

RC930.4.M35 2004
616.7'12–dc22

2004055376

FOREWORD

Art is I, Science is We.
—Claude Bernard

Enthusiasm. The most motivating force in a student is enthusiasm. Many bring it with them, already on fire for their particular area of interest. Most though are infected with it by their instructors and fellow students as a sense of discovery, for advancement and competency develops. Enthusiasm dwarfs things petty to science; egos, attitudes, personal agendas, and the like. It creates an aura of academic purity, an environment without fear where "we" is paramount, and "I" becomes a measure of capacity, not importance. It is a time where we can be smart together and we can be dumb together without pride or fear.

Cultivating enthusiasm is one of the hardest tasks for an educator, especially in students just entering an area of study. Many disciplines have their own language, because it requires precisely defined concepts to advance the field. The introductory student needs to acquire some of this to be facile in developing his knowledge and thinking, but too much can intimidate and dampen enthusiasm. The educator, well versed in terminology, needs to introduce his topic in the language of the layman in order to assure communication. This latter is not an easy task because precision of concept suffers.

It is a bold step then for any introductory text to be written especially for the entering student. Colleagues who have already achieved their knowledge-base can always be critical of the authors license and charge oversimplification; and in part will always be right. My reply is that I've rarely found reference books to have a well-thumbed appearance. If I have to choose between precision and enthusiasm for the new student, it will always be enthusiasm! If the fire gets stoked, the opportunity for full potential is achieved.

Let the above be enough to explain this book to my colleagues. I hope too, that they will learn some things from the authors, because I did. For you, the most important reader, the newest generation, I wel-

come you as colleagues and invite you to these pages. Read! Enjoy! Discover! Think!

O'BRIAN C. SMITH, M.D.
Professor of Pathology;
University of Tennessee School of Medicine, Knoxville
Chief Medical Examiner;
State of Tennessee

INTRODUCTION

Careful description and classification are basic methodological tools in all categories of science. This is particularly the case in biomedical research where substantial resources are invested in a continuous process of refining diagnostic criteria (classification) for various diseases. The field of paleopathology has been slow in confronting some long-standing problems in description and classification and this has limited its development. The result is a substantial proportion of the existing literature that is of minimal value in clarifying many of the broader questions that must be addressed if paleopathology is to reach its full potential as a legitimate biomedical discipline.

For example, it would be very helpful to have a database that provides information on the antiquity, geographical distribution and evolutionary trends of disease. We also need data that will help to clarify the evolution of complex relationships that exist between the many factors that affect the human response to disease, including: (1) the pathogenic agent, (2) environmental factors (e.g., air pollution) that affect health, (3) nutrition and (4) the immune response of a patient to disease. However, without a clearly defined and generally accepted descriptive terminology and classificatory system it is difficult, if not impossible, to compare the research of one scientist with that of another in building a relevant base of data.

An important contribution to the study of skeletal paleopathology would be the development of a rigorous method to describe the abnormal conditions encountered in archeological human skeletons. It is both surprising and frustrating that after 150 years of research in paleopathology there is still much to do in creating a careful and comprehensive descriptive terminology as well as a general classification of the abnormal conditions encountered in skeletal specimens. Much of how we describe pathological conditions in archeological skeletons is derivative of medical and particularly orthopedic nomenclature and classificatory systems. These systems continue to develop and staying conversant with current usage is a challenging exercise. The major problem, however, is not one of semantics. Rather it is that many of

the lesions and their distribution patterns in archeological dry bone specimens bear minimal relationship to descriptive and classificatory features that are central in clinical orthopedic practice. What is crucial for paleopathology is a nomenclature and classificatory system that integrates all of the pathological information that is apparent in skeletal paleopathological specimens. Such a system would necessarily include orthopedic terms and classification where the features were closely related to those used in a clinical setting. There are, however, occasional conditions in paleopathological cases that are not well known in clinical orthopedic practice and a precise classificatory system might demonstrate relationships that previously had not been understood.

In working with both professional colleagues and graduate students I have, for many years, emphasized the importance of first describing carefully what one sees in cases of skeletal paleopathology. Careful description is timeless and, if done well, forever gives future readers of reports the option of reinterpreting your conclusions (i.e., diagnoses). Demographic data, including age and sex, are important factors in interpreting descriptive information. However, the most important element in paleopathological research is the basic description of abnormal bone including the type and distribution pattern within the skeleton. There are four basic abnormalities of bone: (1) abnormal size, (2) abnormal shape, (3) abnormal bone formation and, (4) abnormal bone destruction. There are additional features associated with these general abnormalities that provide helpful supplemental information. For example, is the abnormal bone formation poorly organized (this typically means rapid growth) or well organized (usually slow growth)? Do destructive lesions have well-defined margins with evidence of well-organized bony repair (circumscribed and generally less aggressive) or poorly-defined margins (permeative and generally more aggressive)? These and other features are all critical elements in any interpretation of a paleopathological case of skeletal disease.

The location of lesions within the skeleton provides an important link with clinical experience but one needs to be cautious in making such associations. In dry-bone paleopathological cases one often sees lesions that would not be apparent in clinical radiographs and are thus not well documented in the medical descriptive and classificatory systems. Indeed the added information on skeletal lesions is one of the significant potential contributions that careful study of paleopathological cases can make to a more complete understanding of the skeletal manifestations in orthopedic pathology. A pathology based on dry-bone conditions also means that some distribution patterns of abnormal tissue within a pathological skeleton will vary from patterns estab-

lished on the basis of radiology in living patients.

Careful description is not easy and I do not wish to underestimate the difficulty of the process. Nevertheless, most people can, with discipline, learn to recognize the essential features of bone reaction to disease. The first step is, of course, a thorough knowledge of normal gross anatomy of bone at all ages from fetal through old age. Archeological skeletal samples are a wonderful source of anatomical knowledge since the entire age spectrum is usually represented. Classification or diagnosis is a much more complicated matter and for many cases encountered by the researcher investigating paleopathology, years of experience and a comprehensive knowledge of orthopedic pathology may be necessary and, even so, may not be possible.

For those conducting research on skeletal paleopathology great attention needs to be paid to using a well defined and widely recognized terminology in describing pathological skeletal lesions. Excellent reference materials in radiology exist such as Resnick's five-volume work (2002). The second edition of my book on human skeletal paleopathology (Ortner 2003) may also be helpful in highlighting both the terminology and the diagnostic options for some cases of skeletal disease.

I am optimistic that further advances will be made in developing descriptive and classificatory methodology for paleopathology in the near future. In the meantime it is important to use descriptive terms and modifiers that are part of the general lexicon we all share. Bone addition, bone destruction, porous bone, and destructive lesions are examples of terms that are descriptive and have wide recognition in many disciplines and I encourage their use. Jargon, is one of the biggest barriers to effective communication that exists and should be eliminated or, at the very least, kept to a minimum. At some point, however, you will need to acquire a working knowledge of medical terminology if only to understand and interpret the existing literature on paleopathology and communicate with medically trained colleagues.

The second edition of the *Regional Atlas of Bone Disease* is a new attempt to assist the beginning skeletal paleopathologist to recognize some of the more common pathological conditions that may be encountered in dry-bone specimens. The authors have provided new cases to illustrate their points but continue to insist that their endeavor be viewed as an initial step in any classificatory process. This is wise counsel, given the complexity of classification. One of the fundamental problems for any classificatory system is that the bone reaction to disease is limited. In view of this it is not surprising that a given pathological condition (i.e., osseous response) may be the result of any one

of several pathological processes.

The reader should also be aware of the strengths and weaknesses of a regional approach to skeletal paleopathology. Archeological skeletal samples often do not have complete skeletons. This is particularly true of older museum collections where only the skull and mandible may have been recovered. However, even where an attempt was made to excavate the entire skeleton the result is usually only partially successful. In this context a regional review of pathological conditions may be the only one possible and is certainly helpful. It is also true that many pathological conditions occur in a single location in the skeleton (solitary or unifocal conditions). A regional focus is generally adequate for such lesions.

However, a regional approach is less helpful in multifocal pathological conditions. In this type of skeletal paleopathology, the distribution pattern of abnormal bone is a critical element in classification and the user of a regional approach will need to reconstruct the overall pattern by carefully reviewing the information for each region of the skeleton. A review of the distribution pattern of abnormal bone is important for classification but also contributes to the general understanding of pathogenesis in orthopedic disorders.

Despite this cautionary note, the beginning skeletal paleopathologist should find the new edition of the Regional Atlas a helpful starting point when he or she encounters a skeletal abnormality in archeological burials. Remember, however, first provide a careful and detailed description of the abnormalities you see including the nature of the abnormalities and their location in the skeleton. An attempt at diagnosis can then be made with the assurance that others will at least have the option of reaching a different diagnostic conclusion on the basis of the descriptive information you have provided should that be appropriate. The authors' counsel to seek advice on diagnosis from specialists in skeletal disease is wise. Keep in mind, however, that very few medical specialists have experience with dry-bone specimens and are often as baffled by a pathological case as is the osteologist. The orthopedist does, however, have the advantage of knowing what most of the diagnostic options are and this is a very useful point of departure.

DONALD J. ORTNER, PH.D.
Department of Anthropology
National Museum of Natural History
Smithsonian Institution

ACKNOWLEDGMENTS

The authors would like to extend a special debt of gratitude to Dr. Donald J. Ortner, Dr. Douglas W. Owsley, Mr. Paul S. Sledzik, and Mr. Sean P. Murphy to this enterprise. Each of these scientists played a significant role not only in the development of this book, but its contents. Dr. O'Brian C. Smith contributed substantially to writing the Foreword and Chapter IV. The authors would also like to express their gratitude to Drs. J. Lawrence Angel, Ethne Barnes, William M. Bass, Hugh E. Berryman, Bruce Bradtmiller, Mr. Henry W. Case, Drs. Leslie E. Eisenberg, Eugene Giles, Thomas D. Holland, Lee Jantz, Richard L. Jantz, Marc A. Kelley, Linda Klepinger, Ms. Marilyn R. London, Keith A. Manchester, Marc S. Micozzi, Bruce Ragsdale, Charlotte A. Roberts, T. Dale Stewart, Douglas H. Ubelaker, and P. Willey. It was through their friendship, teaching, and professional guidance that this book came to fruition.

All illustrations were drawn by Robert W. Mann, except Figure 124 (Elizabeth C. Lockett) and Figure 93b (Neil Fallon). Drawings and most of the photographs were based on anatomical specimens at the Smithsonian Institution. Unless stated otherwise, all photographs were taken by the authors. Chip Clark of the National Museum of Natural History, Smithsonian Institution, graciously allowed us to reproduce several of his photographs. The opinions expressed in the Photographic Regional Atlas are the sole responsibility of the authors. Last but certainly not least we thank our wives, Vara Mann and Kim Wells, and our parents Adele D. Mann and Arlys Roehm Hunt and James C. Hunt for their love and support.

CONTENTS

PHOTOGRAPHIC REGIONAL ATLAS OF BONE DISEASE

Chapter I

USING THE PHOTOGRAPHIC REGIONAL ATLAS

The information contained in the Photographic Regional Atlas–herein referred to as the Regional Atlas–is based on paleopathological examination of more than 8,000 complete or nearly complete skeletons from archaeological sites for forensic investigations throughout the world. The majority of their studies are from prehistoric collections from North America, particularly from the Great Plains, Pacific Coastal regions and the NorthEastern United States; historic cemeteries and burials from Louisiana, Maryland, Nevada, Virginia, Washington, D.C. (including War of 1812, Civil War soldiers and iron coffin burials; as well as approximately two hundred forensic cases including Americans missing in action (MIA). Skeletal collections from Africa, Australia, Central Asia, and South America have also been investigated by the authors. Contemporary skeletal samples have been studied by the authors from the Hamann-Todd (Cleveland, Ohio) and Robert J. Terry Anatomical and George S. Huntington Anatomical (Smithsonian Institution) collections.

The Regional Atlas approaches the recognition of disease according to the bone affected. The format of this handbook begins with a description of how to use the Photographic Regional Atlas (Chapter I), followed by a brief history of paleopathology (Chapter II). Chapter III gives step-by-step instructions on how the authors conduct a paleopathological analysis. Chapter IV briefly covers the mechanics of bone remodeling. The bulk of the Regional Atlas is Chapter V. This chapter deals with specific diseases affecting each bone in the body, beginning with the skull and progressing down the skeleton. Accompanying some lesion descriptions is a statement of the relative frequency (e.g., uncommon to rare finding) or percentage that one might expect to find in most archaeological skeletal samples, in most cases for Native American groups since the majority of the author's studies encompassed these populations.

References cited within a sentence indicate that the information was derived from these sources. References at the end of a paragraph (following the period) were included as additional sources for the reader to access for further information. Many of these references are the seminal reports of research for these pathological conditions or anomalies or extensively cover the condition. It is not necessary to reiterate the information published and available in these volumes.

The reader will find that many of the references used in this book were culled from the medical, clinical, and radiological literature rather than the anthropological literature. The reason is multiple. First, clinical studies and case reports provide information based on findings of known age, race, and sex individuals in living groups. Anthropological studies, in comparison, tend to focus on samples of unknown age, race and sex individuals in recent or ancient groups. Second, most diseases can be specifically identified in modern clinical studies, but not necessarily in ancient remains.

Chapter VI provides information on fungal infections. The treponematoses (i.e., syphilis and allied conditions) are summarized in Chapter VII. Chapter VIII briefly discusses tumors, perhaps the most difficult skeletal to be diagnosed. Chapter IX discusses perimortem and postmortem fractures. Chapters VI through IX are designed to only briefly present the effects of these pathological skeletal conditions on the human skeleton. The references cited in those chapters much more extensively cover these particular diseases and should be referred to by the reader for more in-depth research.

As an anatomical overview, dorsal and ventral views of the human skeleton are provided in Chapter X and the major muscle attachments which attach and would be most influential to skeletal morphology are illustrated in Chapter XI.

This book was rewritten after being "field tested" by physicians, students, and paleopathologists for more than a decade. Updated references and findings in the field of archaeology, paleopathology, and medicine have been incorporated into the Photographic Regional Atlas. Most importantly and, as many readers have suggested, the book is spiral bound for easy handling, and most of the drawings have been replaced with photographs to give the reader more detail and a better understanding of exactly what is being presented. This book also reflects the authors' own experiences examining more than 8,000 human skeletons from around the world since the Regional Atlas was first published in 1990. Diseases, lesions, and skeletal anomalies too rare to be expected to be encountered in a routine skeletal analysis have been removed and replaced with those that might be expected to be encountered in most skeletal collections around the world.

It should be remembered that no text could fully or even adequately cover every disease, anomaly, or normal anatomical variant present in the human skeleton; the present text is no exception. While some topics in the Photographic Regional Atlas are discussed in great detail, others are conspicuously brief owing to their extreme difficulty in differential diagnosis or rarity on most skeletal collections (e.g., tumors). One goal of the Regional Atlas was to include the findings and hypotheses of contemporary clinical practitioners (e.g., paleopathologists, radiologists, etc.) to supply the reader with a number of interpretations from which to choose. Such an approach also serves to educate the reader as to the complexity and controversy surrounding the identification, classification, and etiology of many bone diseases.

It is hoped that the experiences of the authors will make it possible for anyone with a sound knowledge of human osteology and skeletal morphology to conduct a basic **descriptive** paleopathological analysis of one or many skeletons. It should be noted, however, that the field of paleopathology is filled with ambiguities and subtleties. Committing this atlas to memory doesn't make one a paleopathologist; only knowledge, training, and above all, experience will qualify you for such a title. The Photographic Regional Atlas will, however, enable you to conduct your own analysis and, in questionable cases, alert you to seek the advice of an experienced paleopathologist, radiologist, or orthopaedist. The importance of a thorough descriptive analysis, however, cannot be overemphasized.

To use the Regional Atlas, first become familiar with what and where lesions, conditions, and anomalies might be expected in the skeleton, locate and identify them in the text, and then refer to the excellent paleopathology, developmental and clinical texts by Allison and Gerszten, 1982; Barnes (1994), Beighton (1978), Brothwell and Sandison (1967), Cockburn and Cockburn (1980), Dieppe et al. (1986), Greenfield (1975), Hauser and DeStefano (1989), Jarcho (1966), Manchester (1983), McCarty (1989), Morse (1969), Moskowitz et al. (1984), Ortner (2003), Ortner and Aufderheide (1991), Ortner and Putschar (1985), Resnick (2002), Resnick and Niwayama (1988), Robbins 1968, Rogers and Waldron 1995, Steinbock (1976), Thijn and Steensma (1990), Tyson and Dyer (1980), Webb (1995), Wells (1964) Zimmerman and Kelley (1982), or other references in the text, especially the *Journal of Bone and Joint Surgery* that deals primarily with the skeleton. Refer also to paleopathology bibiliographies compiled by Crain (1971) and by Elerich and Tyson (1997). While some of these texts may appear to be outdated, they continue to serve the scientific and medical community as some of the most relevant and useable texts in circulation to date. It is hoped that the Photographic Regional