Adams' Lameness in Horses

Ted S. Stashak

FOURTH EDITION

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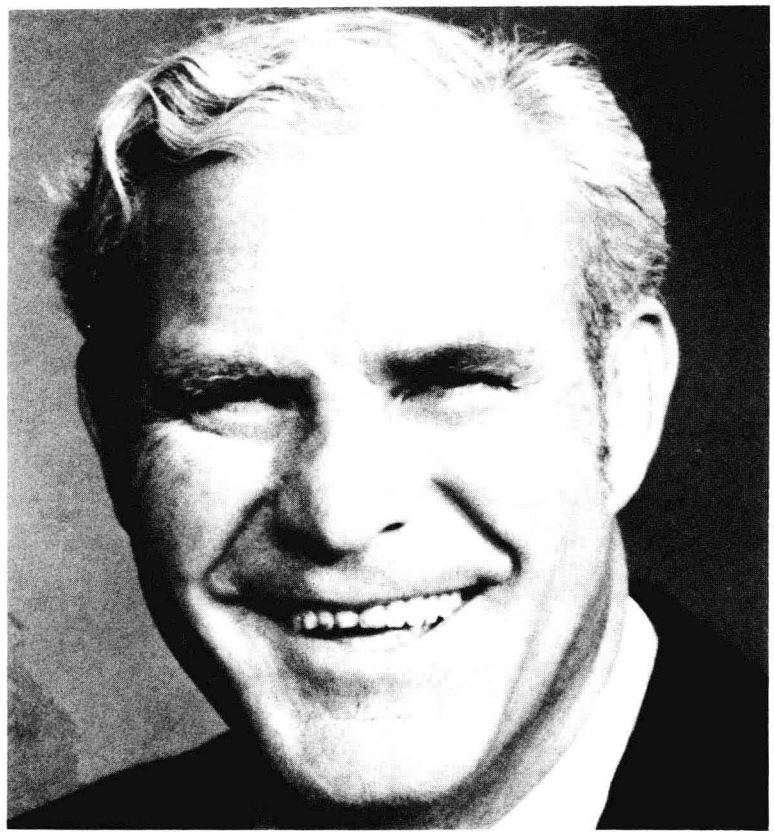
DEDICATION

To my wife Gloria, and my children Angela, Stephanie, and Ryan,
for their understanding and support.

To my parents for their inspiration
and
to the memory of Dr. O. R. Adams



O. R. ADAMS

In the absence of a modern textbook on the subject, Dr. O. R. Adams compiled his own *Veterinary Notes on Lameness and Shoeing of Horses* with the assistance of the class of 1957 of Colorado State University. This material provided a basis from which the equine lameness course was taught at Colorado State University. While Dr. Adams was on sabbatical leave in Kenya, copies of these notes were sent to colleagues in other universities for their comments. They were received favorably. Upon returning from Africa, Dr. Adams was encouraged by Lea & Febiger to develop the notes into a textbook.

The first edition of *Lameness in Horses* was published in 1962, even as new information and developments were appearing. Always seeking to improve the next edition, revisions were started as the previous one was sent to print.

Dr. Adams' love of horses and his pride in the veterinary profession continue to be apparent in this new revision capably edited by Dr. Ted Stashak.

—NANCY M. ADAMS

Preface

When I was contacted by Mr. George Mundorff, Executive Editor for Lea & Febiger, regarding the possibility of revising the third edition of "Lameness in Horses" by Dr. O. R. Adams, I was excited but naive to the task at hand. Dr. Adams had, in his previous three editions, established the state of the art of lameness diagnosis and treatment, presenting it in a unique manner that appealed to veterinarians, horse owners and trainers, and farriers. Without a doubt, he defined and directly influenced the course of this subject more than any other individual during this time. I was truly fortunate to train under him during my internship and surgical residency at Colorado State University. His never-ending thirst for knowledge, his humor, his friendship, and his love of the veterinary profession have inspired me throughout this endeavor. I only hope that I have served his memory well and that he would be proud of this fourth edition.

After considerable discussion with Lea & Febiger and the assurance of Mrs. Nancy Adams, Dr. Adams' widow, I embarked on the revision with some basic changes in format in mind. These included the addition of new authors, changes in chapter sequence and presentation, the addition of new chapters and deletion of some old ones, and the transition from a monograph to a reference text. Because I wanted the fourth edition to represent the school where Dr. Adams attended and taught, I selected mostly authors from our faculty on the basis of their expertise and their ability to provide a broad base of opinion for the reader.

With the idea of approaching the discussion of lameness as one would approach a lameness examination itself, I changed the sequence of presentation. Using the newest accepted nomenclature, Chapter 1 deals with the functional anatomy of the equine locomotor system and represents a complete revision of Chapter 2 in the previous edition. Dr. Kainer starts with the forelimb, advancing from the foot up the limb, describing the regional anatomy of each site. The hindlimb is covered in similar fashion. The nomenclature may be confusing initially to older graduates of American veterinary schools, but recent graduates as well as foreign veterinarians will be well versed in this terminology. We felt it was time to make this transition since the new nomenclature has been in use for at least 4 years. (Older terms are included parenthetically.)

Following a format similar to the previous edition, Chapter 2 deals with the relationship between conformation and lameness. I have eliminated "The Examination for Soundness," which was Chapter 3 in the previous edition, because it discussed many topics unrelated to lameness and, simply, because the subject of soundness is so comprehensive it could be covered in a separate text. The present Chapter 3 deals with the diagnosis of lameness. After defining lameness and establishing how to determine which limb is lame, the description of the physical examination begins at the foot of the forelimb and proceeds upward. Emphasis is placed on recognition of problems peculiar to the region examined. Following this is a description and illustration of perineural and intrasynovial anesthesia.

The next logical step in the diagnosis of lameness is radiology, which is discussed in Chapter 4. This chapter is comprehensive; nothing like it has been published elsewhere. The format of the text and illustrations should answer any question the reader may have regarding the techniques for taking radiographs and interpreting them. The artwork beautifully illustrates the different structures seen on various radiographic views, and the illustrations are labeled so that anatomic sites are easily identified.

Chapters 5 through 7 are new. Discussing the role of nutrition in musculoskeletal development and disease, Chapter 5 illustrates a unique approach not used elsewhere. Dr. Lewis provides a comprehensive review of specific nutritional disorders, their causes, and their treatment for all phases of growth and development in the foal, during pregnancy and lactation in the mare, and during maintenance of the working horse. This information will benefit both

the horseman and the veterinarian. Chapter 6, by Dr. Turner, starts with a brief review of endochondral ossification and then discusses the diseases associated with bones and muscles and their treatment. In Chapter 7, Dr. McIlwraith describes the developmental anatomy of joints and related structures, disease processes, clinical signs, and treatments. Both of these chapters present in-depth reviews, with major emphasis on the pathogenesis and pathobiology of the diseases. They are heavily referenced, and will be of major interest to the veterinary profession.

Representing a complete revision of Chapter 8, "Lameness" updates the reader on new diseases as well as new findings and treatment for previously recognized entities. Unlike past editions, this material is heavily referenced. Information regarding the prevalence of the disease within various breeds according to sex and age introduces each subject. The format of the chapter has been changed to start with diseases relating to the foot region and then proceeding upward anatomically, consistent with the way most equine practitioners approach a systematic examination. Specific diseases of each region are discussed separately. This chapter, though referenced heavily and written technically, should be of interest to the horseman as well as the veterinary profession. I am particularly grateful to Dr. Allen Nixon for his thorough and comprehensive review of the diagnosis and treatment of the "wobbler's syndrome" in horses. His presentation is clear and well illustrated, giving the reader the confidence to differentiate among the diseases that cause this syndrome.

Chapters 9 through 12 were written primarily for the horseman and farrier, though they will also be of interest to the veterinarian, particularly the equine practitioner. I have updated these chapters with new information, as well as listing what the horseman should look for when the horse is properly trimmed and shod. Chapter 13, "Natural and Artificial Gaits," is essentially unchanged. Chapter 14, "Methods of Therapy," has been updated, and includes an extensive revision of different methods of external coaptation. This chapter is primarily directed toward the veterinary profession, though the horse owner will obtain insight into why different treatments are selected.

With the explosion of literature pertaining to musculoskeletal disease in the horse and the demands put on authors and editors alike, it became obvious that a transition from a monograph to a reference text was timely. To this end the authors have attempted to provide the latest information. As with any large text, however, authors and editors alike feel somewhat frustrated because at the time of publication some of this information will be out of date. With few exceptions, we stopped referencing material published in 1985. Occasionally publications in 1985 changed the presentation of the materials so much that it could not be denied and therefore was included.

I am grateful to Dr. Robert Kainer, Professor of Anatomy and author of the first chapter, for taking the time to review and advise me on the nomenclature used in this book. A special thanks is extended to Dr. A. S. Turner for his review and comments on Chapter 8. The fine contributions of all the authors is sincerely appreciated. I want to thank Dr. Robert Perce (California) and Mr. Richard Klemish (farrier, Colorado) for their advice on the chapters dealing with trimming and shoeing horses.

The addition of many new illustrations and photographs represents a tremendous time commitment and effort on behalf of the Office of Biomedical Media at Colorado State University. For the illustrations, I am indebted to Mr. Tom McCracken and Mr. John Dougherty for their expertise and the cooperation they have given me. For the photographs I am grateful to Mr. Al Kilminster and Mr. David Clack, for their expertise, cooperation, and commitment to excellence. For the design of the book cover I thank Mr. Dave Carlson.

Most of the manuscript was typed by Mrs. Helen Acevedo. Her cooperation and patience with the many revisions necessary to complete this text are gratefully appreciated.

I am also grateful to my many colleagues who took the time to personally reveal their thoughts regarding certain topics. A special thanks is extended to the following: Dr. Joerg Auer (Texas), Dr. Peter Haynes (Louisiana), Dr. Larry Bramalage (Ohio), Dr. Joe Foerner (Illinois), Dr. Dallas Goble (Tennessee), Dr. Robert Baker (Southern California), Dr. Robert Copelan (Kentucky) and Dr. Scott Leith (deceased, Southern California).

Mr. Christian C. Febiger Spahr Jr., Veterinary Editor, Mr. George Mundorff, Executive Editor, Mr. Tom Colaiezzi, Production Manager, Ms. Constance Marino, and Mrs. Dorothy Di Rienzi, Manager of Copy Editors, and the entire staff at Lea & Febiger have been most helpful in the preparation of this book. I am grateful for their support and guidance.

I hope this book will be useful to all who read it. I hope to receive your cooperation in making corrections and suggested additions for further revisions.

Fort Collins, Colorado TED S. STASHAK

Contents

Functional Anatomy of Equine Locomotor Organs

ROBERT A. KAINER

Anatomic Nomenclature and Usage

Through the efforts of nomenclature committees, informative and logical names for parts of the horse's body, as well as positional and directional terms, have evolved (Nomina Anatomica Veterinaria).[15] Some older terminology is still acceptable. For example, while thoracic limb and pelvic limb are preferred anatomic designations, forelimb and hindlimb are commonly used. Navicular bone for distal sesamoid bone, coffin joint for distal interphalangeal joint, and fetlock joint for metacarpophalangeal joint, are acceptable synonyms. It behooves one to be familiar with many of the older terms. But some have become archaic and even add to the confusion in communicating structural concepts. These terms should be avoided. In this book acceptable synonyms will be indicated parenthetically, and the two terms may be used interchangeably.

In Figure 1–1 note that positional adjectives end in -al. When the terms are used as positional adverbs, the suffix -ally is added. When used as directional adverbs, those indicating direction from a given point, the suffix -ad is added. For example, a structure is located distally; another structure extends or courses distad. With the exception of the eye, the terms anterior and posterior are not applicable to quadrupeds. Cranial and caudal apply to the limbs proximal to the antebrachiocarpal (radiocarpal) joint and the tarsocrural (tibiotarsal) joint. Distal to these joints, dorsal and palmar (on the forelimb) or plantar (on the hindlimb) are the correct terms. The adjective, solar, is used to designate structures on the palmar (plantar) surface of the distal phalanx and the ground surface of the hoof.

Thoracic Limb

Digit and Fetlock

The foot and pastern comprise the equine digit, a region including the distal (third), middle (second), and proximal (first) phalanges and associated structures (Fig. 1–2). The fetlock consists of the metacarpophalangeal (fetlock) joint and the structures surrounding it.

Foot

The foot consists of the epidermal hoof and all it encloses: the connective tissue corium (dermis), digital cushion, distal phalanx (coffin bone, since it is enclosed as in a coffin), most of the lateral (collateral) cartilages of the distal phalanx, distal interphalangeal (coffin) joint, distal extremity of the middle phalanx (short pastern bone), distal sesamoid (navicular) bone, bursa podotrochlearis (navicular bursa), several ligaments, tendons of insertion of the common digital extensor and deep digital flexor muscles, blood vessels, and nerves.

The hoof is continuous with the epidermis at the coronet. Here the dermis of the skin is continuous with the dermis (corium or pododerm) subjacent to the hoof. Regions of the corium correspond to the parts of the hoof under which they are located: perioplic corium, coronary corium, laminar (lamellar) corium, corium of the frog, and corium of the sole.

Grossly definitive parts of the hoof protect underlying structures of the foot and initiate dissipation of concussive forces when the hoof strikes the ground. Examination of the ground surface of the hoof reveals the sole, frog, heels, bars, and ground surface of the wall (Fig. 1–3). The ground surface of the forefoot is wider than that of the hindfoot, reflecting the shape of the distal surface of the enclosed distal phalanx (coffin bone).

The hoof wall extends from the ground proximad to the coronary border where the soft white horn of the periople joins the epidermis of the skin at the coronet. Regions of the wall are the dorsal toe, the medial and lateral quarters, and the rounded heels continuing palmarad from the quarters (see Fig. 1–3;

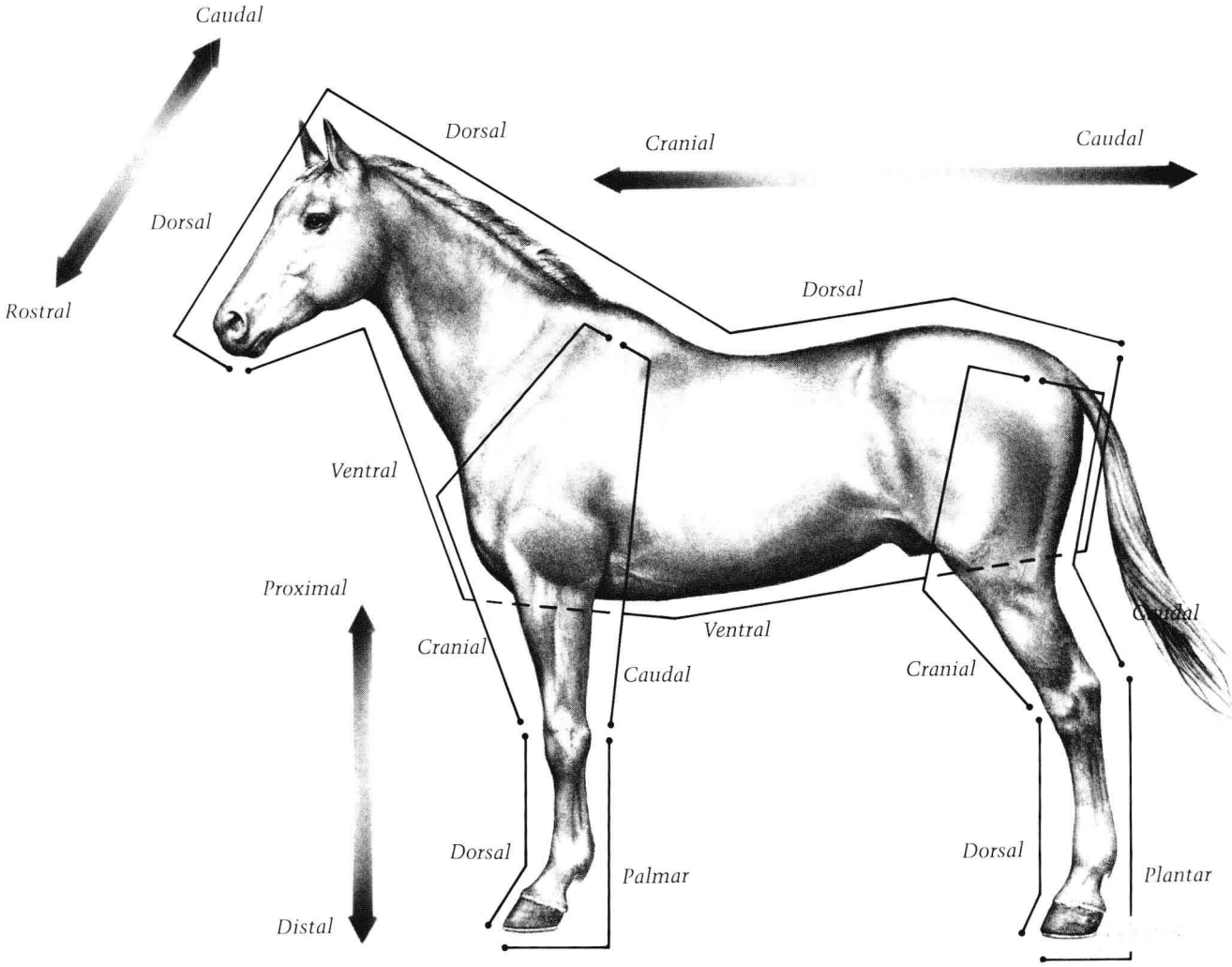


Fig. 1–1. Topographical and directional terms.

1–4). From the thick toe the wall becomes progressively thinner and more elastic toward the heels where it thickens again at the junction of the bars (the "buttress" of the hoof). The wall usually curves more widely on the lateral side, and the lateral angle is less steep than the medial angle. The angle of the toe between the dorsal surface and the ground surface is 48 to 60° in the forefoot.[26]

Fine, proximodistal, parallel lines visible on the smooth surface of the wall are due to the orientation of the horn's tubules (Fig. 1–5). Differential growth rates of the wall from the coronary border toward the ground account for the smooth ridges parallel to the coronary border.

The fibrous connective tissue corium contains blood vessels and nerves. It provides nourishment as well as attachment for the overlying germinal layer (stratum germinativum) of the stratified squamous epithelium comprising the ungual epidermis (L. ungula, hoof). The basal layer (stratum basale) of the stratum germinativum is a single layer of proliferating cylindrical cells. One to a few layers of polyhedral cells in the process of keratinization (formation of horn) make up the stratum spinosum.[11] The rest of the ungual epidermis is a stratum corneum of anucleate squamous cells containing hard keratin with a higher sulfur content than the soft keratin of the cutaneous epidermis. Cells of the ungual epidermis form horn tubules, intertubular horn or lamellae (sheets), corresponding to the configuration of the underlying corium. Most of the ungual epidermis, the horny stratum corneum, is devoid of nerve endings; it is the "insensitive" part of the foot. A few sensory nerve endings from the corium penetrate between cells of the germinal layer of the epidermis. In addition to many sensory nerve endings, the corium contains motor sympathetic endings to blood vessels.

Three layers comprise the hoof wall: the stratum externum (stratum tectorium), stratum medium, and stratum internum (stratum lamellatum)[11] (see Fig. 1–5). The superficial stratum externum is a thin

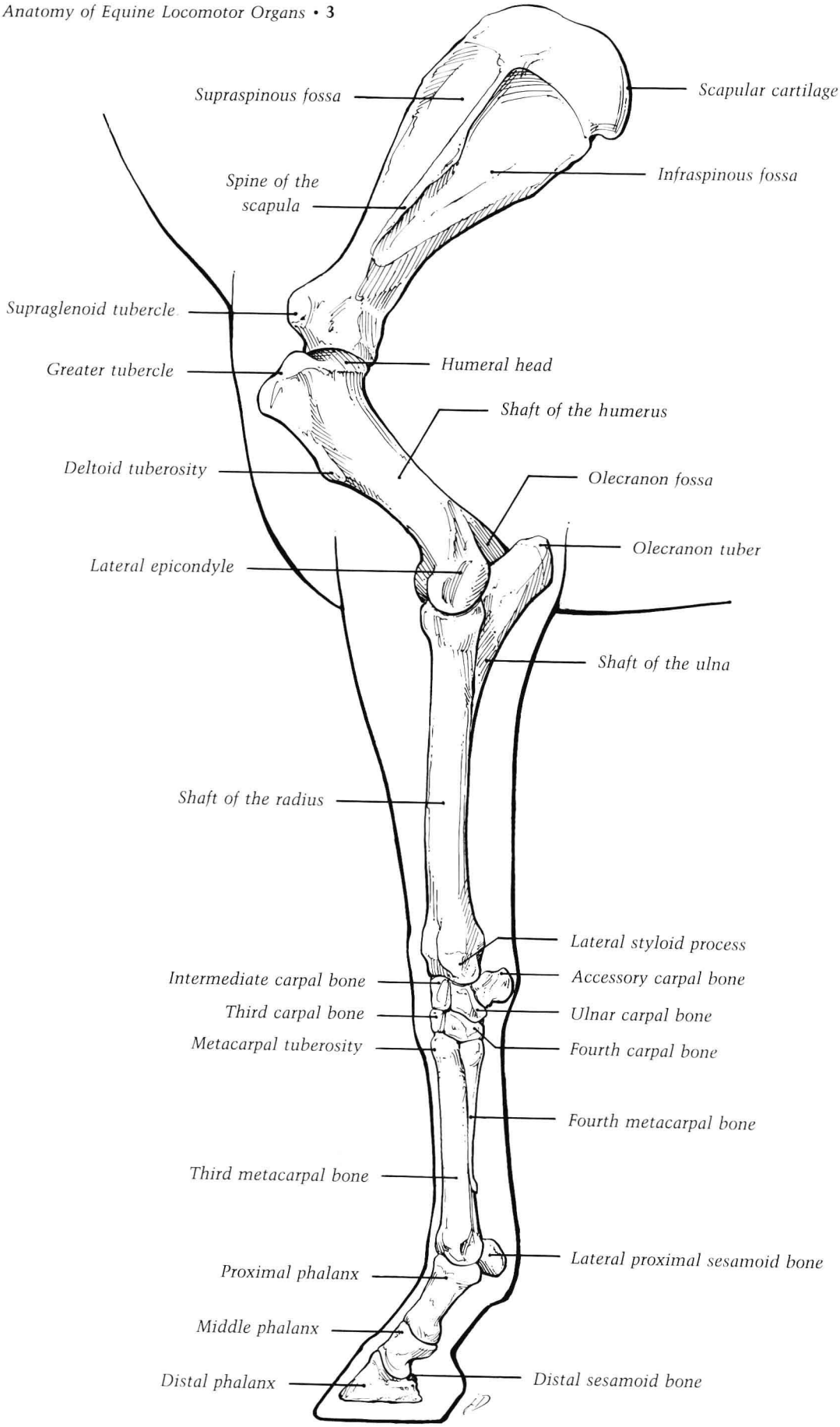


FIG. 1–2. Bones of the equine thoracic limb; lateral view.

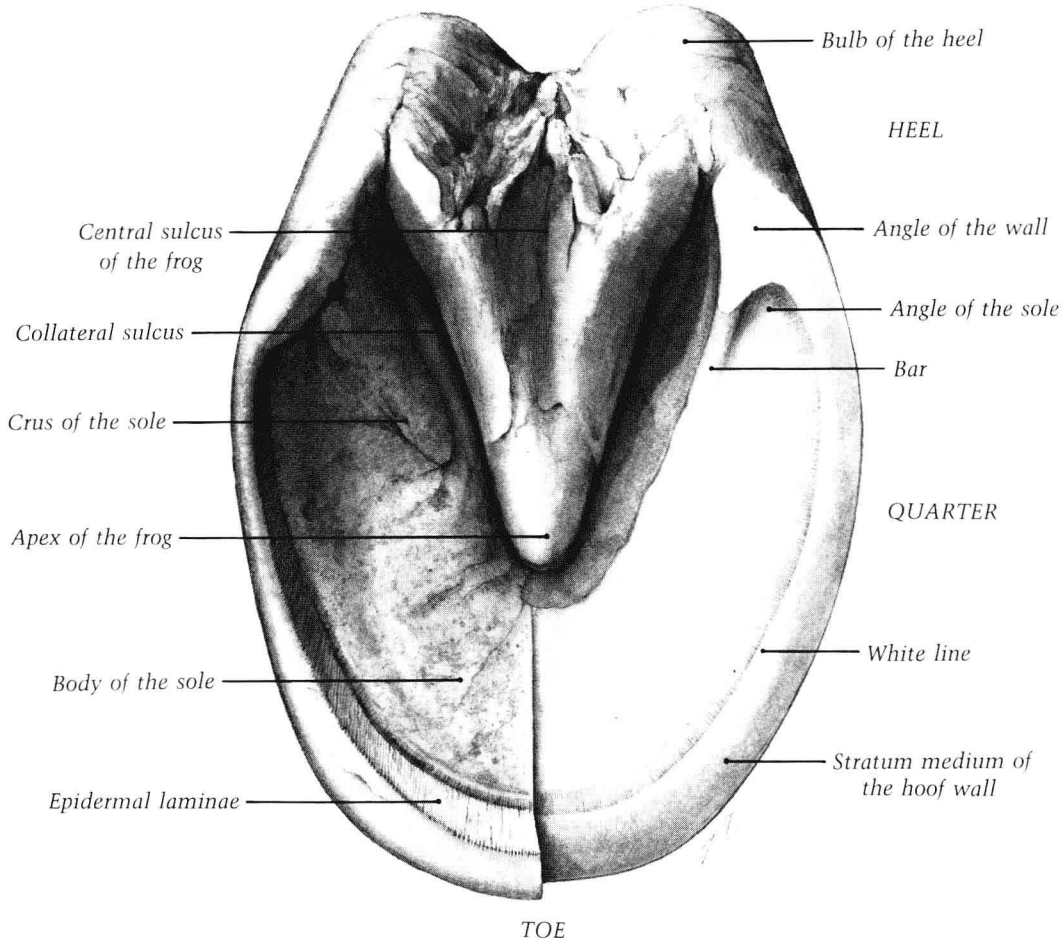


FIG. 1–3. Ground (solar) surface of the hoof. The right half has been trimmed to emphasize the formation of the white line (zona lamellata) by the epidermal laminae.

layer of horn extending distad from the periople a variable distance that decreases with age. The bulk of the wall is a stratum medium consisting of horn tubules and intertubular horn. The horn tubules are generated by the germinal layer of the coronary epidermis covering the long papillae of the coronary corium.[1] Intertubular horn is formed in between the projections. The relationship of the coronary papillae to the epidermis can be clarified by examining the coronary groove of the hoof into which the coronary corium fits. Fine pits that accommodate the papillae can be seen in the coronary groove. Distal to the coronary groove around 600 primary epidermal laminae (lamellae) of the stratum internum interleave with the primary dermal laminae of the laminar (lamellar) corium (see Figs. 1–4 and 1–5). Approximately 100 microscopic secondary laminae branch at an angle from each primary lamina, further binding the hoof and corium together (Fig. 1–6).

Some confusion exists concerning the terms "insensitive" and "sensitive" laminae. In the strictest sense the keratinized parts of the primary epidermal laminae are insensitive; the stratum germinativum, which includes all of the secondary epidermal laminae, and the laminar corium are "sensitive." The terms epidermal and dermal (or corial) are far more accurate adjectives.[24]

A relationship similar to that between the coro-