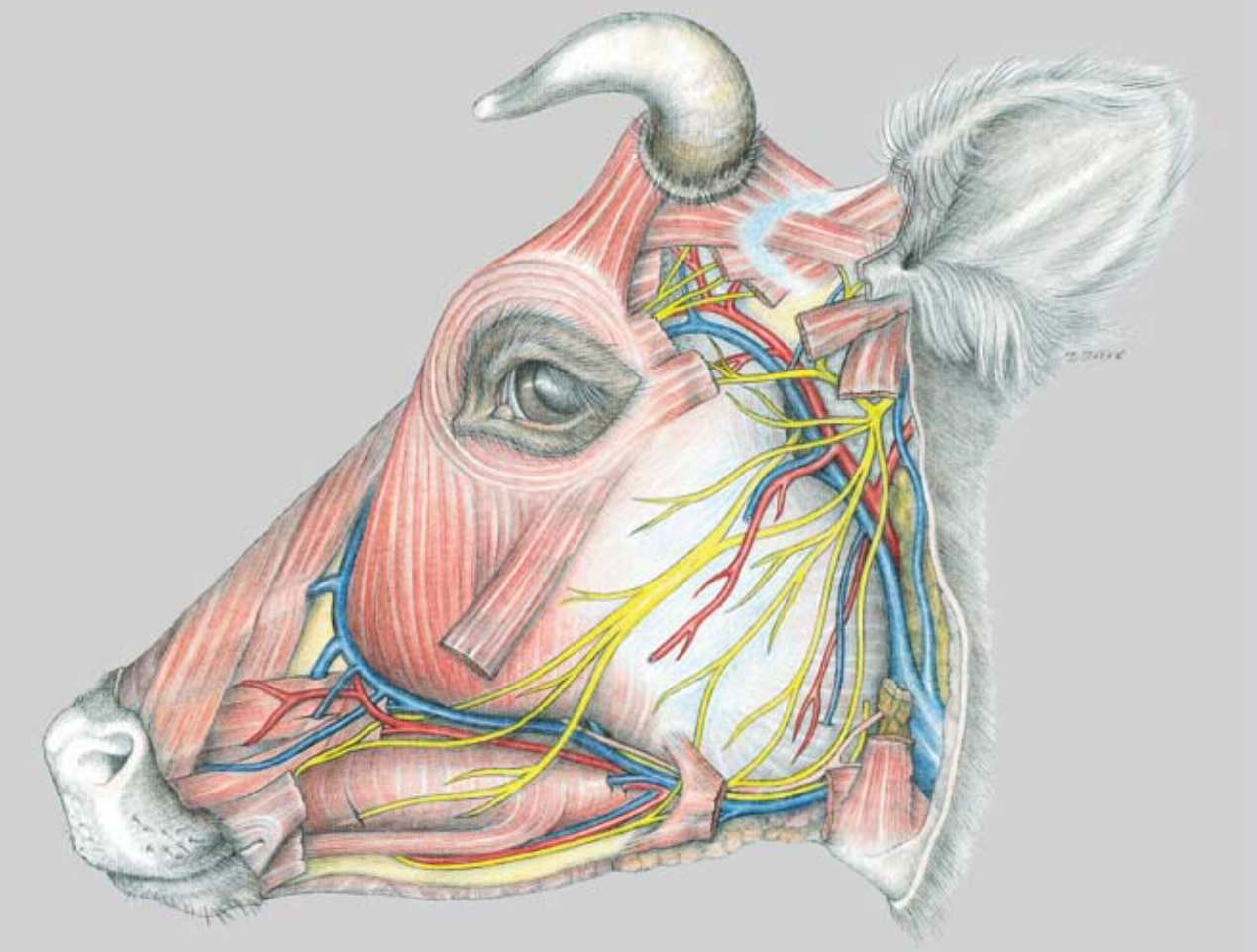
Klaus-Dieter Budras · Robert E. Habel

Bovine Anatomy

with Christoph K. W. Mülling and Paul R. Greenough



Scientific Illustration: Gisela Jahrmärker,
Renate Richter, Diemut Starke

Second, extended edition

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Klaus-Dieter Budras/Robert E. Habel

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SECOND, EXTENDED EDITION

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HOW TO USE THIS BOOK

In all three volumes the illustrations were drawn from dissections especially made for that purpose. The boxed information at the top of some text pages is intended to be a dissection guide for students and to give information on the methods used to make the preparations illustrated. Species characteristics of the ox, in contrast to the dog and horse, are printed in italics. Important terms are printed in boldface type, and when a number is attached to the name, it corresponds to a number in the adjacent illustration. Less important anatomical features are not mentioned in the text, but are listed in the legends of the illustrations. The descriptions are based on normal anatomy. Individual variations are mentioned only when they have clinical importance. The gaps in the numbering of items in the legends of the skeletal system (pp. 3, 15, 31, 33) are caused by omission of features that do not occur in the ox, therefore are not illustrated, but were listed in the German edition for comparison with the dog and horse.

The cranial nerves are indicated by Roman numerals I–XII. Vertebral and spinal nerves are indicated by Arabic numerals.

Abbreviations
The anatomical/medical terms and expressions occurring in the text are explained and interpreted in "Anatomical Terms". Abbreviations of anatomical terms follow the abbreviations as employed in the Nomina Anatomica Veterinaria (2005). Other abbreviations are explained in the appertaining text, and in the titles and legends for the illustrations. A few abbreviations that are not generally employed are listed here:

Spinal Nerves

n	—	Spinal nerve
nd	—	Dorsal branch (br.)
ndl	—	Lateral br. of dorsal br.
ndm	—	Medial br. of dorsal br.
nv	—	Ventral br.
nvl	—	Lateral br. of ventral br.
nvm	—	Medial br. of ventral br.
cut. br.	—	Cutaneous br.

Vertebrae and Spinal Nerves

C	—	Cervical (e.g. C1—first cervical vertebra or nerve)
Cd	—	Caudal (Coccygeal)
L	—	Lumbar
S	—	Sacral
T	—	Thoracic

Table of Contents
Chapters with a cross-reference to the *Contributions to Clinical-Functional Anatomy* are identified with a green square and a second page number.

Clinical-Functional Anatomy
The numbers within the green square at the beginning of a paragraph refer to the page number of the *Topographic Anatomy.*

Cross-references
The captions of the anatomical figures in the section **"Contributions to Clinical-Functional Anatomy"** have been deli - berately kept to a minimum because the identification of anatomical details with the aid of the figure tables in the front of the book is straightforward. This effectively fulfils the goal of providing an easily memorable exercise for students. The cross-reference numbers refer to both the plate number in the topographical part of the book and the respective structure (Example: Gluteobiceps [17.7] = Plate page 17, No. 7 in the legends).

The same principle is also used in the special anatomy tables.

* *Collegiate Dictionary*, 1993, 10th ed., Merriam-Webster, Springfield, Mass., U.S.A.

PREFACE TO THE FIRST ENGLISH EDITION (ABRIDGED)

This combination of topographic color atlas and concise textbook of *Bovine Anatomy* is the third volume of a series on the anatomy of domestic mammals. The first edition of the *Atlas and Textbook of the Anatomy of the Dog* appeared 20 years ago. It was followed 12 years ago by the second volume, the *Anatomy of the Horse.* In several German and foreign language editions they aroused world-wide interest. Therefore our next project was an *Atlas and Textbook of Bovine Anatomy* following the proven model and thereby closing a previously existing gap: no comparable work on bovine anatomy was available. The special features of the ox are presented to students in a well-grounded survey of topographic anatomy. **Special anatomy** is summarized as brief data in tables of muscles, lymph nodes, and nerves, with references to the corresponding pages in the text. **Comparative anatomy** is addressed through references to the horse and dog. In addition the text-atlas is intended to provide a valuable introduction to the **Anatomy of the Living Animal**. The authors were concerned with the preparation of a clear and graphic reference book of important anatomical facts for veterinarians in practice and research as well as anyone interested in morphology. This book can also serve as a dictionary of English anatomical nomenclature illustrated in color. An appendix on Applied Anatomy, included in the first and second volumes of the series, was omitted from this edition. Because of its extraordinary relevance for the practical instruction of students it will be provided in the next edition.

Our work on the ox has an unexpected urgency for three reasons: 1. Specialized textbooks for each individual species are required for curriculum revision with the trend to premature specialization and the accompanying formation of species-specific clinics. 2. In the present time of economic and social change, new diseases like bovine spongiform encephalopathy (BSE) attain enormous importance through their catastrophic effects. To determine the neuronal pathways of infection, including the autonomic nervous system, and the lymphatic system, and to judge the risk of noxious substances in the nervous system and in many organs of the body cavities, a graphic survey of bovine anatomy is necessary. 3. A licensed veterinarian is legally qualified to serve in a wide variety of positions: in private practice with small mammals, birds, horses, ruminants, and swine; in public health work to prevent transmission of diseases of animals to man; in governmental control of diseases of livestock; and in teaching and research with many species of experimental animals. To maintain public confidence in the profession, students should be required to master the basic as well as clinical sciences for food animals. This places high demands on teachers and students because a very broad and important body of information must be transmitted even though our teaching time has undergone an ill-advised reduction. Nevertheless, we are forced to accept the challenge, even with our compressed text-atlas, to reach the intended goal – to cover a huge amount of subject matter in the short time available.

This English edition is the responsibility of Professor Habel. His translation and scientific engagement in the production of this atlas and the writing and revision of many chapters are his personal service. His collaboration in the community of authors is a great enrichment. [...]

The provisional completion of our common effort offers the originator and editor, after 30 years of persistent work, the opportunity for a brief reflection. The enormous expense for the production of a book, together with the revision and improvement of many new editions, and the necessity of intensive anatomical preparation of subjects for illustration, were at first greatly underestimated. After overcoming many challenges, the dominant emotion is the joy of an unexpected success that came about through fruitful collaboration with the closest coworkers of our Berlin Institute, with the student body, with the readers, and with German and foreign colleagues across national and continental borders. The experience gained thereby is of inestimable value. The editor feels richly rewarded by the achievement of a professional life-work.

Berlin/Ithaca, May, 2003 — The authors

PREFACE TO THE SECOND ENGLISH EDITION

The second edition has been substantially expanded by contributions to clinical-functional anatomy which provide valuable information for students as well as veterinarians in practice. These contributions were prepared in close collegial collaboration between preclinical scientists and clinicians.

In consideration of his advanced age Professor Habel who was responsible for the first English edition turned the responsibility for the second English edition over to Professor Mülling and Professor Greenough.

The manner in which anatomy is taught in a veterinary curriculum has changed and continues to change. In newly designed modern as well as in reformed traditional curricula anatomy is taught integrated with other basic sciences, preclinical disciplines and clinical courses. Functional anatomy is presented within the context of practical and clinical application. For students the presentation and integration of anatomical knowledge with clinical procedures and problems provides the context of application that enhances their learning and facilitates understanding and retention of the acquired knowledge of anatomy. The functional and clinical anatomy as presented in this book provide a solid foundation for clinical examination such as transrectal palpation and other diagnostic techniques including modern diagnostic imaging and for surgical techniques.

In this book students as well as veterinarians in practice will find the anatomical essentials for their daily studies and work as well as valuable information for more challenging cases.

The authors hope that this book will foster further integration of anatomy with clinical teaching and learning in a university setting and at the same time support veterinarians in their professional work.

Berlin, Leipzig, Saskatoon, June 2011 — K.-D. Budras, C.K.W. Mülling, P.R. Greenough

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Finally, without the prodigious effort of our excellent artists, Renate Richter, Gisela Jahrmärker, and Diemut Starke, the atlas in its present form would be inconceivable. Susanne Poersch deserves thankful recognition for her careful computer composition, and the coworkers Dr. Claudia Schlüter (nee Nöller) and DVM Thilo Voges for the preparation of subjects to be illustrated, together with computer processing, and for making the Index. Our thanks are also due to the publisher, Schlütersche Verlagsgesellschaft in Hannover, and especially to Dr. Oslage for always providing support and understanding cooperation in the development of this book.

For their highly valuable contributions to the clinical-functional anatomy and for being part of the process of completing this work, we thank the following colleagues: Dr. Silke Buda, Prof. Dr. Rolf Berg, Assoc. Prof. Dr. Dörte Döpfer, Prof. Dr. Reinhard Fries, Prof. em. Dr. Peter Glatzel, Prof. Dr. Kerstin Müller, Prof. em. Dr. Christian Stanek.

TOPOGRAPHIC ANATOMY

CHAPTER 1: THORACIC LIMB

1. SKELETON OF THE THORACIC LIMB

The **thoracic and pelvic limb** of the ox, a heavy herbivore, are quite similar in basic structure to those of the horse.

a) On the **SCAPULA** is a large, half-moon-shaped **scapular cartilage** (**14**). The **supraspinous fossa** (**6**) is remarkably narrow. It is cranial to the **scapular spine** (**5**). On the distal end of the spine is a prominent sharp-edged **acromion** (**8**), as in the dog.

b) On the proximal end of the compact **HUMERUS** the lateral **major tubercle** (**25**) and the medial **minor tubercle** (**29**) are divided into cranial and caudal parts, as in the horse. Distal to the cran. part of the major tubercle is the **crest of the major tubercle** (**26**), and distal to the caudal part lies the round **surface for the infraspinatus** (**26'**) where the superficial part of the tendon terminates. The **intertubercular groove** (**28**) *is covered craniolaterally by the major tubercle, so that it is not visible in lateral view. The intermediate tubercle is insignificant, unlike that of the horse.* On the medial surface of the **body of the humerus** (**31**) is the raised **tuberosity of the teres major** (**32'**). Laterally the hooked **teres minor tuberosity** (**27'**) and the crest-like **deltoid tuberosity** (**32**) stand out. On the distal end of the humerus, the articular surface is the **humeral condyle** (**35**). The **lateral epicondyle** (**38**) and the **medial epicondyle** (**39**) include areas for attachment of the collateral ligg. and caudal projections for the origins of flexor mm. The caudally located **olecranon fossa** (**40**) and the cranial **radial fossa** (**41**) are like those of the horse.

c) The two **BONES OF THE FOREARM (ANTEBRACHIUM)** remain complete, and, except for a **proximal** (**62'**) and a **distal** (**62"**) **interosseous space**, are joined by syndesmosis in youth and by a **synostosis** in later life. The **radius** is flattened and relatively short. The articular circumference of carnivores is reduced to two small caudal **articular facets** (**44**) in ungulates. The slightly elevated **radial tuberosity** (**46**) lies farther distally than in the dog and horse. On the distal end the radius bears the **radial trochlea** (**48**), with tendon grooves on the cranial surface, and the **medial styloid process** (**50**) medially. The proximal end of the **ulna**, the **olecranon tuber** (**52**), is a crest with two tubercles, projecting above the radius. The distal end, the pointed **lateral styloid process** (**61**), extends distally beyond the radius, with which it is fused, and articulates with the ulnar carpal bone.

d) The proximal row of **CARPAL BONES** consists of the **radial** (**63**), **intermediate** (**63'**), **ulnar** (**64**), and the thick, bulbous **accessory** (**65**), **carpal bones.** Of the bones of the distal row, **C I** is always missing, **C II** and **C III** (**66**) are fused, and **C IV** (**66**) is a relatively larger, separate bone.

e) Of the **METACARPAL BONES, Mc I** and **Mc II** are absent, and **Mc V** is a much reduced, rod-like bone articulating with Mc IV. The weight-bearing main metacarpal bones (**Mc III and Mc IV**) are not completely fused, as shown by the **dorsal** and **palmar longitudinal grooves** with the perforating **proximal** and **distal metacarpal canals**, and by the **intercapital notch** (**69'**) between the two separate distal **heads** (**capita, 69**). Internally there is an incomplete bony septum between the marrow cavities. On the proximal **base** (**67**) the flat articular surface is partially divided by a palmar notch into a larger medial part and a smaller lateral part.

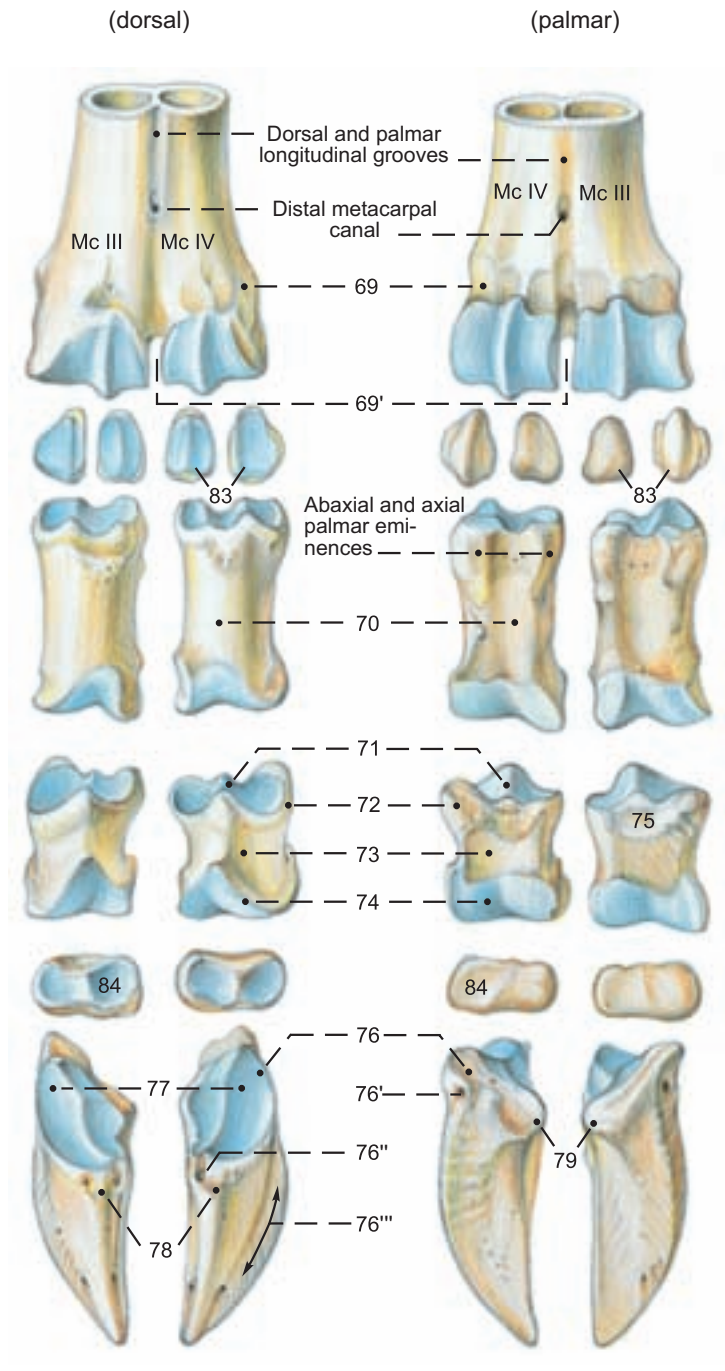
f) The **PHALANGES** form two main **digits** (**III and IV**) and two **dewclaws** (**paradigiti II and V**). The sides of the digits are designated axial and abaxial with reference to the long axis of the limb, and the joints are called, for the sake of brevity, the **fetlock**, **pastern**, and **coffin joints,** as in the horse. Only on digits III and IV are three phalanges present: the **proximal** (**70**), **middle** (**71**), and **distal** (**76**) **phalanges.** They are somewhat prismatic, being flattened on the interdigital surface. The prominent **abaxial palmar eminence** (see text figure) of the prox. phalanx is a landmark for the fetlock joint. *The* **dorsal border** *of the distal phalanx extends from the* **extensor proc.** (**78**) *to the apex*. The dewclaws, which do not reach the ground, except on soft footing, lack the proximal phalanx, and sometimes also the middle phalanx, and are attached to the main digits by fascial ligaments only.

In small ruminants, the dewclaws often lack phalanges; they are then purely cutaneous structures.

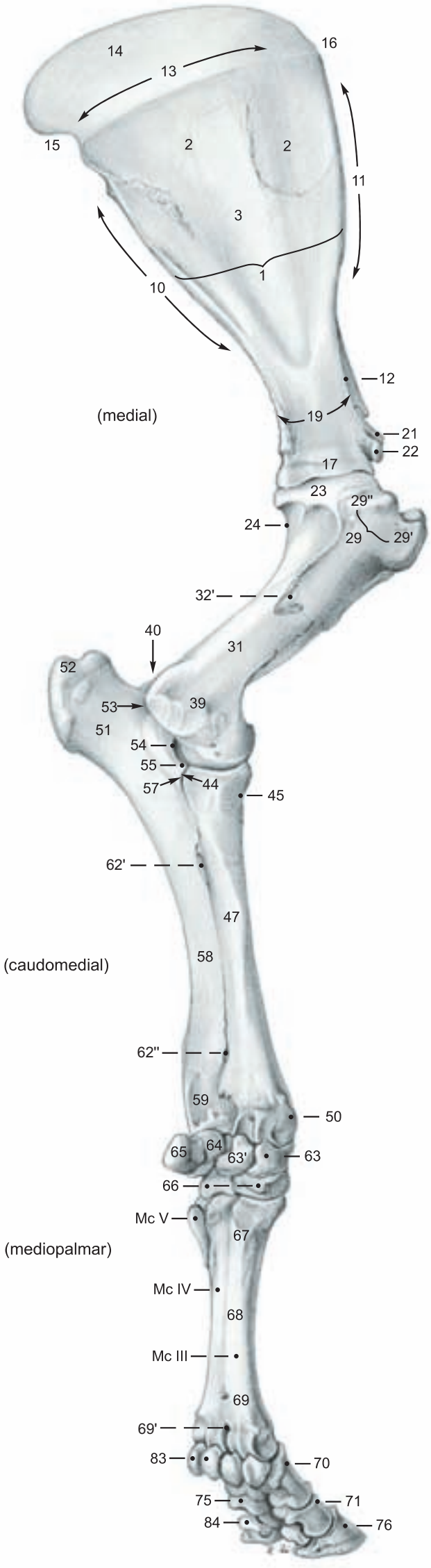
Superficial details of the phalanges of the main digits are similar to those of the horse.

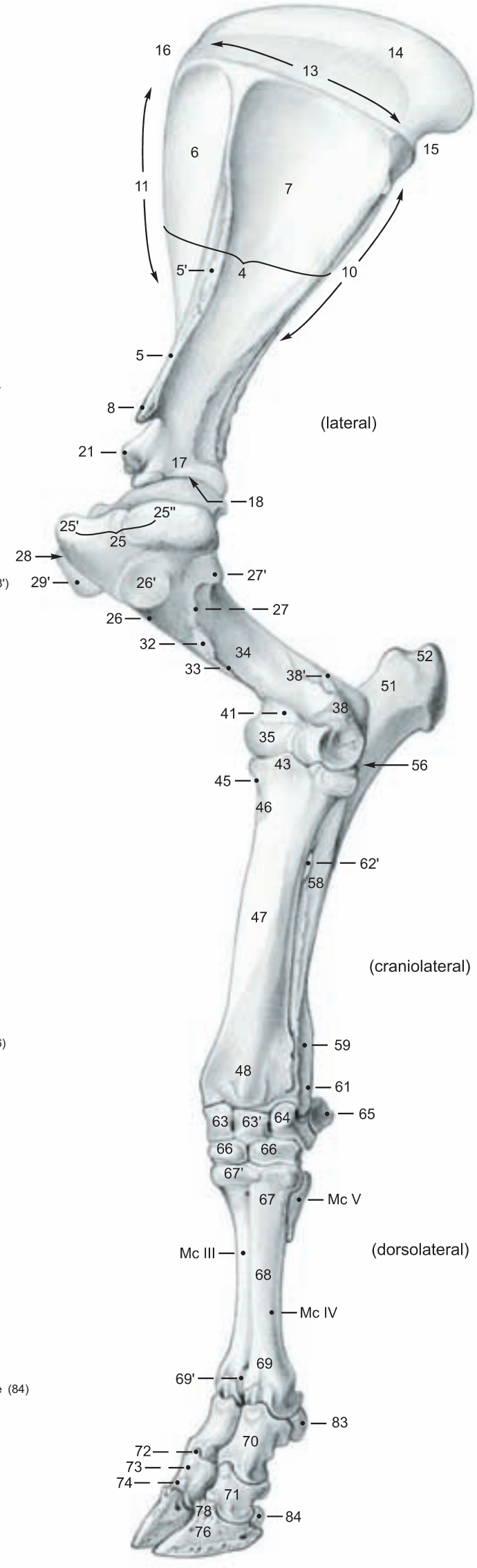
g) The **SESAMOID BONES.** The four **proximal sesamoid bones** (**83**) are in the palmar part of the fetlock joints, and the **distal sesamoid** (**navicular**) **bone** (**84**) is in the palmar part of each coffin joint. They are not present in the dewclaws.

Digital Bones of the Manus



Bones of the Thoracic Limb





Scapula

Costal surface (1)
  Serrated surface (2)
  Subscapular fossa (3)
Lateral surface (4)
  Scapular spine (5)
  Tuber of scap. spine (5') + -
  Supraspinous fossa (6)
  Infraspinous fossa (7)
Acromion (8)
Caudal border (10)
Cranial border (11)
  Scapular notch (12)
Dorsal border (13)
Scapular cartilage (14)
Caudal angle (15)
Cranial angle (16)
Ventral angle (17)
  Glenoid cavity (18)
Neck of scapula (19)
Supraglenoid tubercle (21) + -
Coracoid process (22)

Humerus

Head of humerus (23)
Neck of humerus (24)
Major tubercle (25)
  Cranial part (25')
  Caudal part (25")
  Crest of major tubercle (26) + -
Infraspinatus surface (26')
Triceps line (27)
Teres minor tuberosity (27')
Intertubercular groove (28)
Minor tubercle (29)
  Cranial part (29')
  Caudal part (29")
Body of humerus (31)
  Deltoid tuberosity (32)
  Teres major tuberosity (32')
  Crest of humerus (33)
  Brachialis groove (34)
Condyle of humerus (35)
  Lateral epicondyle (38)
  Lateral supracondylar crest (38')
  Medial epicondyle (39)
  Olecranon fossa (40)
  Radial fossa (41)

Radius

Head of radius (43)
  Articular facets (44)
Neck of radius (45)
  Radial tuberosity (46)
Body of radius (47)
Trochlea of radius (48)
  Medial styloid process (50)

Ulna

Olecranon (51)
  Olecranon tuber (52)
  Anconeal process (53)
Trochlear notch (54)
Medial coronoid process (55)
Lateral coronoid process (56)
Radial notch (57)
Body of ulna (58)
Head of ulna (59)
  Lateral styloid process (61)
  Prox. interosseous space (62')
  Dist. interosseous space (62")

Carpal bones

Radial carpal bone (63)
Intermediate carpal bone (63')
Ulnar carpal bone (64)
Accessory carpal bone (65)
Carpal bones II and III fused (66)
Carpal bone IV (66)

Metacarpal bones III and IV, V

Base (67)
  Tuberosity of Mc III (67')
Body (68)
Heads (capita, 69)
  Intercapital notch (69')

Digital bones

Proximal phalanx (70)
Middle phalanx (71)
  Base (72)
  Body (73)
  Head (74)
  Flexor tuberosity (75)
Distal phalanx (coffin bone 76)
  Abaxial foramen (76')
  Axial foramen (76")
  Parietal groove (76"')
  Articular surface (77)
  Extensor process (78)
  Flexor tubercle (79)
Proximal sesamoid bones (83)
Distal sesamoid (navicular) bone (84)

(See also p. 2 text figure)

2. MUSCLES AND NERVES OF THE SHOULDER, ARM, AND FOREARM

The thoracic limb is skinned down to the hoofs as carefully as possible to preserve the cutaneous nn. and superficial vessels. At the carpus the precarpal subcutaneous bursa should be examined. The skin is carefully cut around the dewclaws to leave them on the limb. In the following nerve and muscle dissection, the pectoral mm. are removed with attention to the cranial and caudal pectoral nn. The blood vessels are spared for their subsequent demonstration. The scapular part of the deltoideus is removed, except for a small stump on the scapula, sparing the cutaneous branch of the axillary n. The tensor fasciae antebrachii is transected at its attachment to the fascia, and the lateral head of the triceps is transected over the superficial branch of the radial n. and reflected distally.

a) The NERVES AND MUSCLES OF THE SHOULDER AND ARM. The nerves are supplied by the brachial plexus. The **roots of the plexus** (**5**) come from the ventral branches of C6–T2. *The number of nerves that arise from the plexus is the same in all species of domestic mammals*.

The **suprascapular n.** (**8**), from C6–C7; motor, passes laterally between the cranial border of the subscapularis and the **supraspinatus** (**1**) and innervates the latter as well as the strongly tendinous **infraspinatus** (**11**). The 1–4 **subscapular nn.** (**4**), from C7–C8; motor, are the main nerves of the *tripartite* **subscapularis** (**4**). Small caudal parts of it are innervated by the **axillary n.** (**13**), from C7–C8; mixed. This nerve passes laterally across the cranial border of the tendon of the **teres major** (**2**), which it innervates, to the three parts of the deltoideus: **scapular** (**6**)**, acromial** (**7**), and **clavicular** (**23**) [**cleidobrachialis**]. The axillary n. also innervates the **teres minor** (**12**), emerges through the scapular part of the deltoideus, runs distally on the extensor carpi radialis as the **cranial cutaneous antebrachial n.** (**30**), and ends in the proximal half of the forearm. The **thoracodorsal n.** (**3**), from C7–C8; motor, ends in the **latissimus dorsi** (**3**), the distal stump of which has been retained. The **median n.** (**14**) C8–T2, forms the axillary loop under the axillary a. with the musculocutaneous n., as in the horse. *The median n. is also bound by connective tissue to the ulnar n. in the upper arm*, and runs at first undivided craniomedially to the level of the elbow joint. The **musculocutaneous n.** (**9**), from C6–C8; mixed, gives off the **proximal muscular br.**(**b**), which passes between the parts of the **coracobrachialis** (**16**), innervating them and the **biceps brachii** (**26**). The nerve separates from the median n. in the middle of the arm, and gives off the **distal muscular br.** (**d**), which passes deep to the biceps and innervates the **brachialis** (**21**). The musculocutaneous n. is continued as the **medial cutaneous antebrachial n.** (**31**), which becomes subcutaneous over the lacertus fibrosus (*thin*, unlike that of the horse), and runs distally medial to the cephalic v. The **radial n.** (**15**), from C7–T1; mixed, passes laterally between the **medial** (**19**) and **long** (**18**) **heads of the triceps brachii** and gives off branches to them, as well as to the **lateral head** (**17**), **tensor fasciae antebrachii** (**22**), and **anconeus** (**25**). The anconeus is difficult to separate from the lateral head of the triceps, and *an accessory head is incompletely separable from the medial head*. The radial n. follows the spiral course of the brachialis around the humerus from caudal to lateral, and *occasionally it supplies the distal part of the brachialis*, as in the horse. While still under the lateral head of the triceps, the nerve divides into deep (20) and superficial (32) branches.

At the carpal joint the tendon sheaths of the digital extensors, ext. carpi obliquus, and flexor carpi radialis should be examined. The med. and lat. cutaneous antebrachial nerves must be preserved. To demonstrate the nerves and vessels, the pronator teres is transected. The flexor carpi ulnaris and -radialis are transected in the middle of the forearm.

b) NERVES AND MUSCLES ON THE CRANIOLATERAL SURFACE OF THE FOREARM. The muscles are innervated by the **deep branch** (**20**) of the radial n. Its **superficial branch** (**32**) becomes the occasionally double **lateral cutaneous antebrachial n.** (**33**), which runs distally on the extensor carpi radialis, lateral to the cephalic v., with the medial cutaneous antebrachial n. on the medial side of the vein, and gives off several branches to the lateral side of the forearm and carpus. On the metacarpus it divides into dorsal common digital nn. II and III.

The origins of the digital and carpal extensors are predominantly on the lateral epicondyle of the humerus.

The **common digital extensor** (**40**) has two bellies and two tendons, which cross the carpus in the same synovial sheath. The larger, more cranial one is the **medial digital extensor** (**proper extensor of digit III**). Its flat tendon ends mainly on the *extensor process and dorsal surface of the middle phalanx*, but a thin abaxial branch descends vertically to a termination *below the articular margin of the distal phalanx*. At the fetlock joint an axial band of the tendon goes to the proximal end of the *proximal phalanx of the other main digit*. Deep to this band and the tendon, *a fibrous dorsal sesamoid body is embedded in the joint capsule*.* Above the pastern joint the tendon is joined by **axial and abaxial** (**l**) **extensor branches** of interosseus III. The small caudal belly of the common digital extensor is the **common extensor of digits III and IV**. Its tendon bifurcates above the fetlock joint, and each branch, provided with a synovial sheath, ends on the extensor process of the respective distal phalanx.

The tendon of the **lateral digital extensor** (**41, proper extensor of digit IV**) receives the extensor branches of interosseus IV (l) and ends in the same way as the medial digital extensor. Each proper extensor has a synovial bursa at the fetlock joint.

The tendon of the large **extensor carpi radialis** (**35**) is almost surrounded by a synovial bursa on the carpus, and terminates on the tuberosity of Mc III.

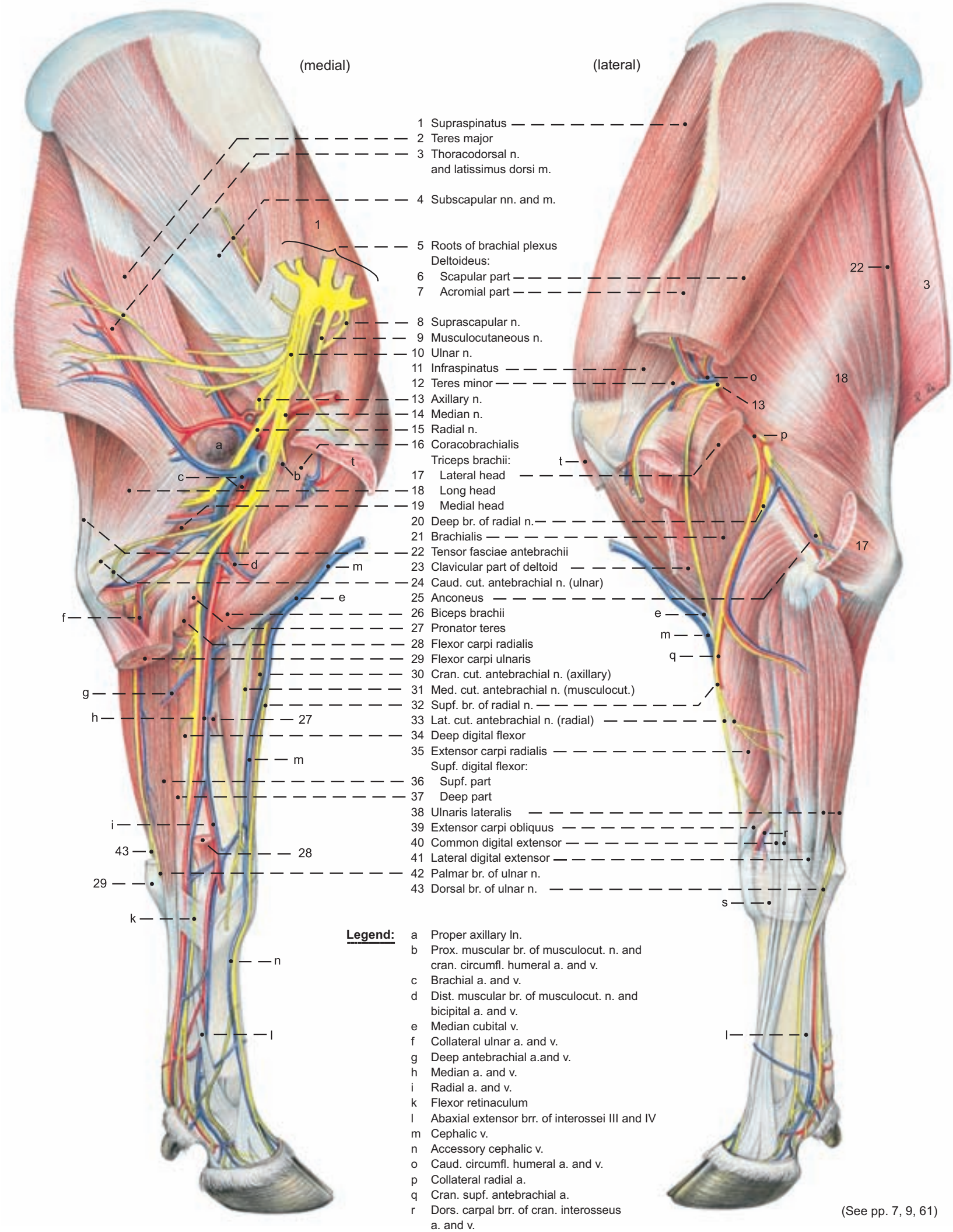
The **ulnaris lateralis** (**38**) [extensor carpi ulnaris] is on the laterocaudal surface of the forearm. It terminates with a *phylogenetically older accessory tendon on the rudimentary Mc V, and with a newer main tendon on the accessory carpal bone, making the muscle a flexor of the carpus*.

The tendon of the **extensor carpi obliquus** (**39**) [abductor pollicis longus], enclosed in a synovial sheath, runs across the tendon of the extensor carpi radialis and ends on Mc III. *The supinator is absent*.

c) NERVES AND MUSCLES OF THE CAUDOMEDIAL SURFACE OF THE FOREARM. The muscles are innervated by the ulnar n. and **median n.** (**14**) from C8–T2; mixed. The latter courses, accompanied by the brachial a. and v., deep to the **pronator teres** (**27**) and **flexor carpi radialis** (**28**), giving off muscular branches to them and to the **humeral** and **radial heads** of the **deep digital flexor** (**34**). *The pronator quadratus is absent*. The nerve continues in the forearm, accompanied by the median a. and v. It supplies the skin on the medial surface of the carpus and the proximal third of the metacarpus, and, *without division*, *unlike that of the horse*, passes through the carpal canal on the medial border of the deep tendon of the supf. dig. flexor. In the metacarpus it divides into palmar common digital nn. II and III and the communicating br. to the supf. palmar br. of the ulnar n. Palmar common dig. n. III divides into axial palmar dig. nn. III and IV. The **ulnar n.** (**10**), from C8–T2; mixed, while still in the upper arm, gives off the double **caudal cutaneous antebrachial n.** (**24**) to the caudomedial and caudolateral surfaces of the forearm and carpus. The ulnar n., accompanied by the collateral ulnar a. and v., passes to the caudal surface of the elbow joint. It gives branches to the **flexor carpi ulnaris** (**29**) and **supf. digital flexor** (**36, 37**), as well as to the **ulnar** and **humeral heads** of the **deep dig. flexor** (**34**). Between the flexor carpi ulnaris and ulnaris lateralis it divides into the **dorsal branch** (**43**), which in the metacarpus becomes dorsal common dig. n. IV, and the **palmar branch** (**42**), which passes through the carpal canal and runs lateral to the tendons of the supf. dig. flexor. It divides into a **deep branch** for the interossei, and a **superficial branch**, which runs distally in the lateral groove between the deep flexor tendon and interosseus IV to form, with the communicating br. of the median n., palmar common digital n. IV.

The supf. dig. flexor is composed of two parts. The tendon of the supf. part passes between the two layers of the **flexor retinaculum** (**k**). *The tendon of the deep part passes through the carpal canal with the tendon of the deep flexor. The two tendons of the supf. flexor join in the distal part of the metacarpus*.

* Habermehl, 1961



1 Supraspinatus
2 Teres major
3 Thoracodorsal n. and latissimus dorsi m.
4 Subscapular nn. and m.
5 Roots of brachial plexus
Deltoideus:
6 Scapular part
7 Acromial part
8 Suprascapular n.
9 Musculocutaneous n.
10 Ulnar n.
11 Infraspinatus
12 Teres minor
13 Axillary n.
14 Median n.
15 Radial n.
16 Coracobrachialis
Triceps brachii:
17 Lateral head
18 Long head
19 Medial head
20 Deep br. of radial n.
21 Brachialis
22 Tensor fasciae antebrachii
23 Clavicular part of deltoid
24 Caud. cut. antebrachial n. (ulnar)
25 Anconeus
26 Biceps brachii
27 Pronator teres
28 Flexor carpi radialis
29 Flexor carpi ulnaris
30 Cran. cut. antebrachial n. (axillary)
31 Med. cut. antebrachial n. (musculocut.)
32 Supf. br. of radial n.
33 Lat. cut. antebrachial n. (radial)
34 Deep digital flexor
35 Extensor carpi radialis
Supf. digital flexor:
36 Supf. part
37 Deep part
38 Ulnaris lateralis
39 Extensor carpi obliquus
40 Common digital extensor
41 Lateral digital extensor
42 Palmar br. of ulnar n.
43 Dorsal br. of ulnar n.

Legend:

a Proper axillary ln.
b Prox. muscular br. of musculocut. n. and cran. circumfl. humeral a. and v.
c Brachial a. and v.
d Dist. muscular br. of musculocut. n. and bicipital a. and v.
e Median cubital v.
f Collateral ulnar a. and v.
g Deep antebrachial a.and v.
h Median a. and v.
i Radial a. and v.
k Flexor retinaculum
l Abaxial extensor brr. of interossei III and IV
m Cephalic v.
n Accessory cephalic v.
o Caud. circumfl. humeral a. and v.
p Collateral radial a.
q Cran. supf. antebrachial a.
r Dors. carpal brr. of cran. interosseus a. and v.
s Extensor retinaculum
t Med. and lat. terminal tendons of deep pectoral (cut)

(See pp. 7, 9, 61)

3. CUTANEOUS NERVES, BLOOD VESSELS, AND LYMPH NODES OF THE THORACIC LIMB

a) The **CUTANEOUS INNERVATION** of the dorsal part of the scapular region is supplied by the dorsal branches of C8 and T1 to T5, which come over the dorsal border of the scapular cartilage. The **supraclavicular nn.** innervate the craniolateral surface of the shoulder and arm, and the **intercostobrachial n.** supplies the caudolateral surface to the level of the olecranon (see text figure).

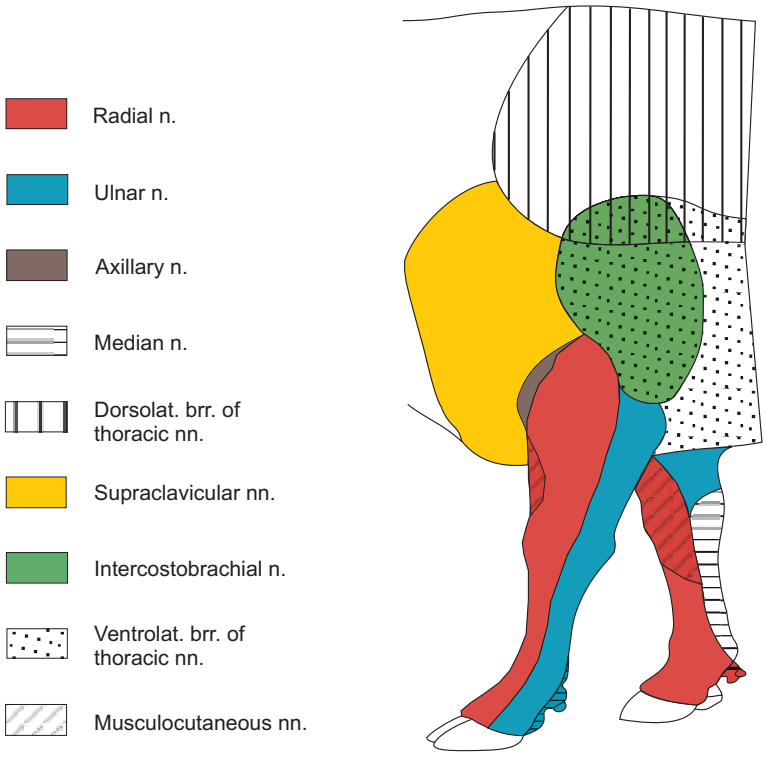
The small **cranial cut. antebrachial n.** (**25**, axillary) supplies the arm and extends down to the middle of the forearm. The skin of the forearm is also innervated by the large **lateral cut. antebrachial n.** (**27**, supf. br. of radial), running on the cranial surface of the extensor carpi radialis lateral to the cephalic v. and accompanied medial to the vein by the **medial cut. antebrachial n.** (**30**, musculocutaneous). The **caudal cut. antebrachial n.** (**7**, ulnar) ends at the accessory carpal bone.

The skin of the carpus and metacarpus is innervated on the dorsal surface by the lat. cut. antebrachial n. and its branches: **dorsal common digital nn. II** (**34**) **and III** (**35**), from the supf. br. of the radial n. The lat. cut. antebrachial n. communicates above the carpus with the medial cut. antebrachial n., which supplies the dorsomedial surface. The dorsolateral surface is innervated by the dorsal br. of the ulnar n. and its continuation, **dorsal common digital n. IV** (**33**).

On the palmar surface the skin is innervated by the median n. and its branches, **palmar common digital nn. II** (**18**) **and III** (**17**), and by the supf. palmar br. of the ulnar n. (p. 9, 8) which receives the **communicating br.** (**f**) from the median n. and continues as the short **palmar common digital n. IV**.

The digits are supplied by the dorsal and palmar proper digital nn. from the corresponding common digital nn. (See p. 8).

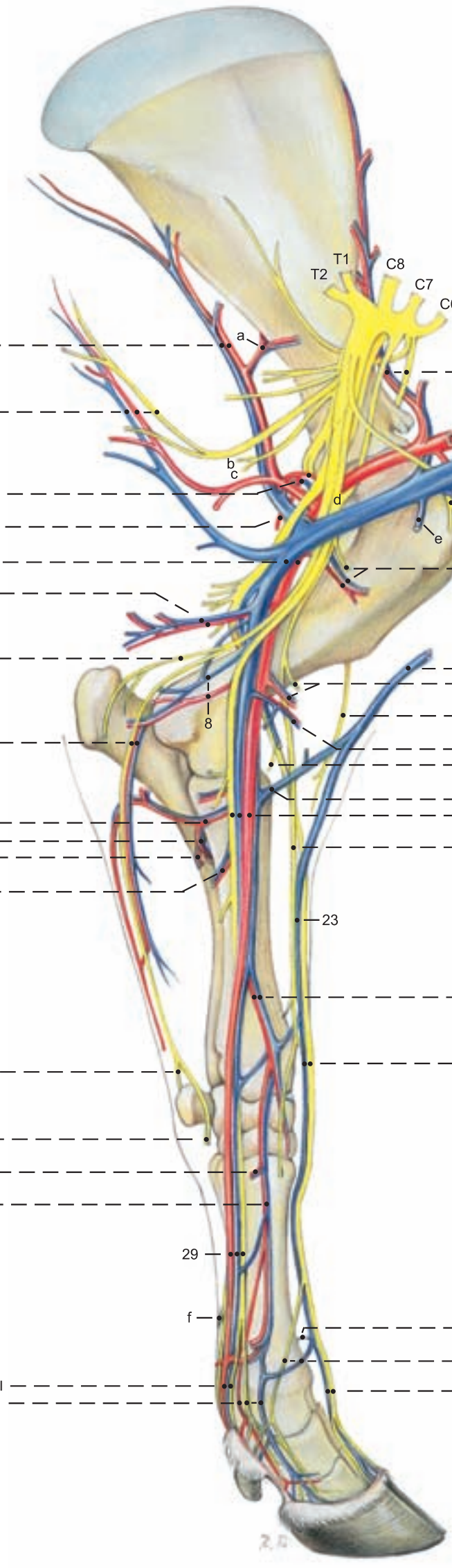
Nerves of the thoracic limb



b) The **BLOOD VESSELS** of the thoracic limb come from the **subclavian a. and v.** and the external jugular v., from which the **cephalic v.** (**23**) originates. The latter, as in the horse, but unlike the dog, has no anastomosis with the axillary v. Distal to the cranial border of the first rib, where the subclavian vessels become the **axillary a. and v.** (**20**), the latter vessels give off the **external thoracic a. and v.** (**21**), as well as the **suprascapular a. and v.** (**19**) for the lateral muscles of the shoulder and for the shoulder joint, and the large **subscapular a. and v.** (**1**), which run along the caudal border of the scapula and supply most of the muscles of the shoulder joint, and the long head of the triceps. One branch of the axillary a. is the **caudal circumflex humeral a.** (**3**), which gives off the **collateral radial a.** (**4**), from which arises the **cranial supf. antebrachial a.** (**p. 9, 1**). This ends in the small **dorsal common digital aa. II and III** (**p. 9; 9, 12**). The caudal circumflex humeral v. ends in the region of the shoulder joint. Distal to the origin of the **cranial circumflex humeral a.** (**22**) – *the vein comes from the subscapular v.* – the axillary vessels become the **brachial a. and v.** (**5**). These first give off the **deep brachial a. and v.** (**6**) to the caudal muscles of the elbow joint. The next branches are the **collateral ulnar a. and v.** (**8**), of which the artery continues indirectly to the *small* **dorsal common digital a. IV**, while the vein ends at the elbow joint, mostly in the caudomedial muscles of the forearm. Distal to the collateral ulnar vessels, the **bicipital a. and v.** (**24**) arise and supply the biceps. They may originate from the next distal vessels, the **transverse cubital a. and v.** (**26**). The last branches of the brachial vessels are the **common interosseus a. and v.** (**9**), arising distal to the elbow joint. These divide into the large **cranial interosseous a. and v.** (**10**) and the *insignificant* **caudal interosseous a. and v.** (**11**), *which usually do not reach the carpus*. The cranial interosseous a. and v. pass laterally through the proximal interosseous space and run on the lateral surface of the radius and ulna to the distal interosseous space, *where they are continued by the interosseous brr., passing medially through the space to become the palmar brr. These divide into* **deep and superficial brr.** (**p. 9. 8**) The ulnar a. and v. are absent, as in the horse. The **cephalic v.** (**23**), on the surface of the cleidobrachialis, gives off the **median cubital v.** (**28**), a long oblique anastomosis to the brachial v. at its point of transition to the median v. The cephalic v. continues distally on the extensor carpi radialis to the distal third of the forearm, where it gives off the **accessory cephalic v.** (**32**). This continues the direction of the cephalic v. to the dorsal surface of the metacarpus and becomes **dorsal common digital v. III** (**35**). Inconstant **dorsal common digital vv. II** (**34**) **and IV** (**33**) are given off the main trunk and *end in the distal deep palmar arch*. The cephalic v. turns medially and joins the radial v. above the carpus. The brachial a. and v. are continued medially in the forearm by the **median a. and v.** (**29**), which give off in their course several branches: the **deep antebrachial aa. and vv.** (**12**) to the caudal muscles of the forearm, and the **radial a. and v.** (**31**) in the middle of the forearm. The sometimes double radial vein receives the cephalic v. proximal to the carpus. At the carpus the radial a. and v. join their respective **dorsal carpal networks**, which also receive the cranial interosseous a. and v. and the dorsal carpal br. of the collateral ulnar a. (without the corresponding v.). **Dorsal metacarpal a. III** comes from the arterial dorsal carpal network. It is accompanied in the dorsal groove of the metacarpal bone by **dorsal metacarpal v. III** from the venous dorsal carpal network. On the palmar surface of the metacarpal bone the radial a. and v. and the deep palmar branches of the cranial interosseus a. and v. form the **deep palmar arches** (**15**), which give off the deep **palmar metacarpal aa. and vv. II–IV**. Palmar metacarpal v. II is the direct continuation of the radial v. The continuing median a. and v. pass through the carpal canal on the palmaromedial surface of the deep flexor tendon and the tendon of the deep part of the supf. flexor, to the metacarpus. Here the median a., the supf. palmar br. of the cranial interosseous a., and the supf. palmar br. of the radial a. are connected across the surface of the flexor tendons by the zigzag **superficial palmar arch**, which gives off **palmar common digital aa. II** (**18**) **and IV. Palmar common digital a. III** (**17**) is the direct continuation of the median a. distal to the arch, and it is the main blood supply to the large digits. It courses to the interdigital space, crossing the medial branch of the supf. flexor tendon, where the pulse is palpable. It is accompanied by **palmar common digital v. III** (**17**). The **interdigital a. and v.** (**p. 11, 5'**) connect the palmar with the dorsal digital vessels. *The palmar common digital veins II and IV originate from the distal deep palmar venous arch*. (See also pp. 8–11.)

c) **LYMPHATIC STRUCTURES**. The large **proper axillary ln.** (**p. 5, a**) lies caudal to the shoulder joint at the level of the second intercostal space between the thoracic wall and the medial surface of the teres major. Small **axillary lnn. of the first rib** are associated with the axillary vessels on the lateral surface of the rib. *Both groups of lnn. are examined in meat inspection in special cases. In the hanging split carcass the proper axillary node is drawn cranially by the weight of the limb, and may be conveniently found by an incision from the inside of the thoracic wall in the middle of the first intercostal space*. The afferent lymphatics come from the bones, joints, and muscles of the shoulder, and from the arm and forearm. The efferent lymphatics go to the lnn. of the first rib, proper axillary ln., and caudal deep cervical lnn., which are drained on the left side by the thoracic duct and on the right by the right tracheal duct. The lymphatic drainage of the manus goes to the supf. cervical ln.

Arteries, Veins, and Nerves of thoracic limb



1 Subscapular a. and v.
2 Thoracodorsal a., v., and n.
3 Caud. circumfl. humeral a. and v.
4 Collateral radial a.
5 Brachial a. and v.
6 Deep brachial a. and v.
7 Caud. cut. antebrachial n. (ulnar)
8 Collat. ulnar a. and v. and ulnar n.
9 Common interosseous a. and v.
10 Cran. interosseous a. and v.
11 Caud. interosseous a. and v.
12 Deep antebrachial a. and v.
13 Dorsal br. of ulnar n.
14 Palmar br. of ulnar n.
15 Deep palmar arch
16 Supf. palmar br. of radial a. and v.
17 Palmar common digital a., v., and n. III
18 Palmar common digital a., v., and n. II

19 Suprascapular a., v., and n.
20 Axillary a. and v.
21 Ext. thoracic a. and v. and Cran. pectoral nn.
22 Cran. circumfl. humeral a. and v. and Prox. musc. br. of musculocut. n.
23 Cephalic v.
24 Bicipital a. and v. and Dist. musc. br. of musculocut. n.
25 Cran. cut. antebrachial n. (axillary)
26 Transverse cubital a. and v.
27 Lat. cut. antebrachial n. (radial)
28 Median cubital v.
29 Median a., v., and n.
30 Medial cut. antebrachial n. (musculocut.)
31 Radial a. and v.
32 Accessory cephalic v. and Supf. br. of radial n.
33 Dorsal common digital v. IV
34 Dorsal common digital v. and n. II
35 Dorsal common digital v. and n. III

(See pp. 5, 9)

Legend:

a Circumfl. scapular a. and v.
b Lat. thoracic n.
c Caud. pectoral nn.
d Axillary loop (median and musculocut. nn.)
e Supf. thoracic v.
f Communicating br. (median n. and supf. palmar br. of ulnar n.)

4. VESSELS AND NERVES OF THE MANUS

The dissection is done on the embalmed limbs provided and on fresh specimens of the metacarpus and digits. The skin is carefully removed down to the hoofs, preserving the nerves and vessels.

a) The **PALMAR NERVES** come predominantly from the median n., but also from the palmar br. of the ulnar n. (For vessels, see p. 6.)

The **median n.** (**4**), accompanied by the **median a. and v.**, passes through the carpal canal, medial to the flexor tendons, to the mediopalmar surface of the metacarpus, where it is covered by deep fascia. (See p. 10.) Here the nerve lies between the *small* **superficial brr. of the radial a. and v.** (**6**) medially, and the *large* median a. and the *usually double* median v. on the other side. In the middle of the metacarpus the nerve divides under the proximal ligament of the medial dewclaw into palmar common digital nn. II and III. **Palmar common digital n. II** (**13**) runs in the medial groove between interosseus III and the flexor tendons, accompanied from the distal third of the metacarpus by **palmar common digital a. and v. II** (**13**). They divide proximal to the fetlock joint into the **axial palmar a., v., and n. of digit II** (**18,** dewclaw) and the continuing **abaxial palmar digital a., v., and n. III** (**19**) for deep digital structures and the dermis of the bulb and wall as far as the apex of the hoof. (Axial and abaxial digital nerves and vessels are understood to be "proper", and this adjective may be omitted.) **Palmar common digital n. III** (**15**) is usually double. The branches are accompanied on each side by the branches of the also double **palmar common digital v. III,** and between them by **palmar common digital a. III**, proceeding in the direction of the interdigital space (see p. 10).

The **ulnar n.** divides near the middle of the forearm into dorsal and palmar branches. The **palmar br.** (**p. 7. 14**) crosses deep to the tendon of the flexor carpi ulnaris and runs between the deep part of the superficial digital flexor and the accessory carpal bone. Just distal to the carpus it gives off the **deep br.** to the interossei and continues as the **supf. br.** (**8**), which runs in the lateral groove between interosseus IV and the digital flexor tendons, accompanied by the **supf. palmar br. of the cranial interosseous a.** (**8**). Distal to the **communicating br.** (**10**) from the median n., the supf. br. of the palmar br. of the ulnar becomes the short **palmar common digital n. IV,** accompanied by the corresponding a. and v. Proximal to the fetlock joint of the fourth digit they divide into the **axial palmar digital a., v., and n. of digit V** (**22,** dewclaw) and the **abaxial palmar digital a., v., and n. IV** (**24**), with distribution like that of the corresponding structures of digits II and III. *Deep palmar metacarpal nn. like those of the dog and horse do not exist*. Deep **palmar metacarpal aa. and vv. II - IV** from the deep palmar arches run distally on the metacarpal bone and anastomose proximal to the fetlock joint with the supf. palmar vessels (see p. 6).

b) The **DORSAL NERVES** come mainly from the supf. br. of the radial n. (lat. cut. antebrachial n.) and also from the dorsal br. of the ulnar. (Vessels, see p. 6.)

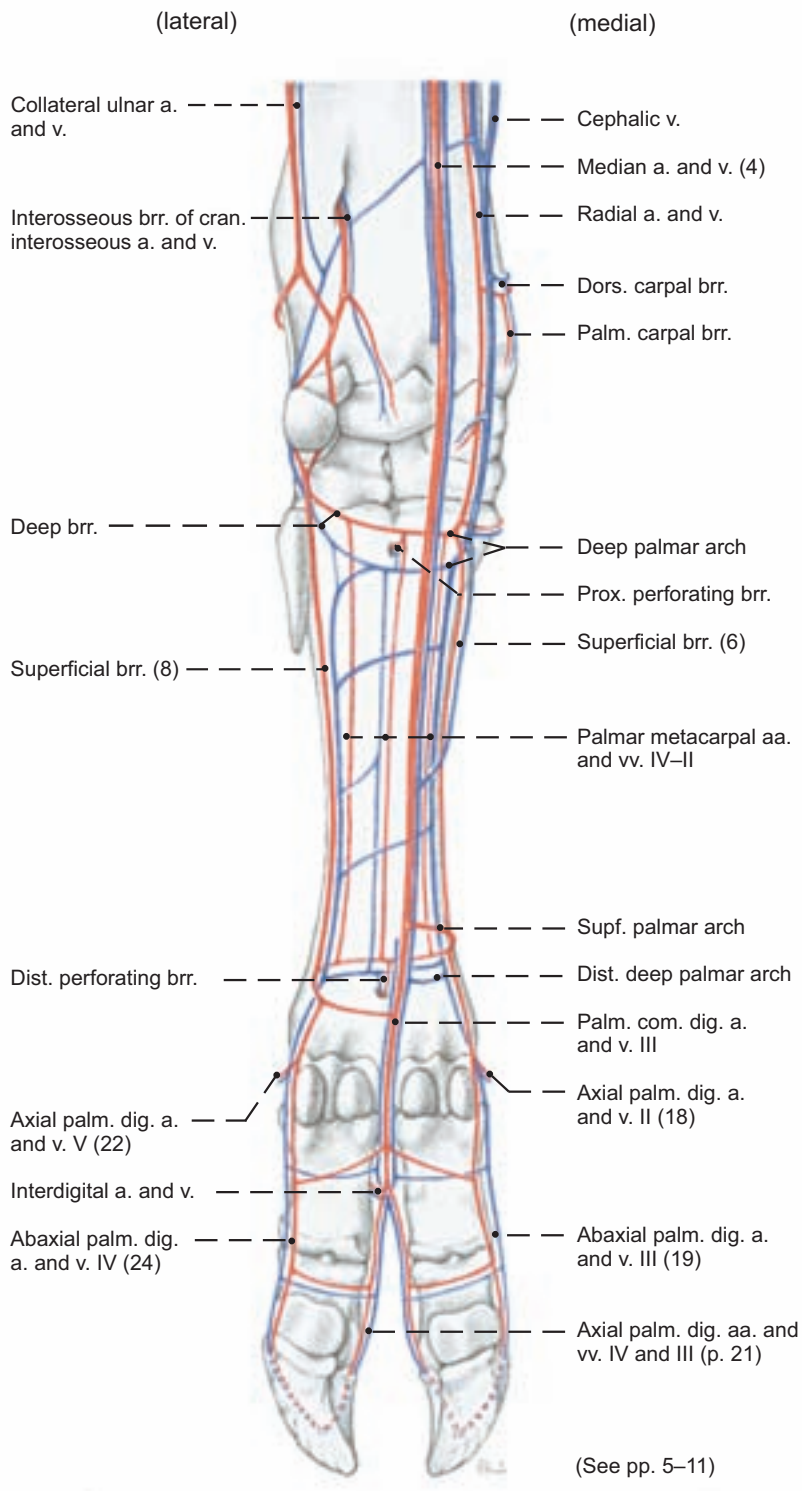
The **dorsal br. of the ulnar n.** (**5**) emerges between the ulnaris lateralis and the flexor carpi ulnaris, about 2 cm proximal to the accessory carpal bone and runs distally across the bone. It continues on the lateral surface of the carpus to the groove between the metacarpal bone and interosseus IV, where it becomes **dorsal common digital n. IV** (**7**). On the dorsolateral surface of the fetlock joint it gives off the small **axial dorsal digital n. V** (**23**). (The dewclaws have migrated to the palmar surface from their original lateral and medial positions.) Common digital n. IV is continued by **abaxial dorsal digital n. IV** (**25**) to the dorsolateral coronary region of the fourth digit.

The **supf. br. of the radial n.** (**3,** lat. cut. antebrachial n.), accompanied medially by the **accessory cephalic v.** (**2**) and the often double **cranial supf. antebrachial a.** (**1**) passes across the dorsomedial surface of the carpus. Just distal to the middle of the metacarpus the nerve can be palpated on the bone medial to the three digital extensor tendons. Here it divides into **dorsal common digital nn. III** (**12**) **and II** (**9**)**.** The latter is small. It crosses under **dorsal common digital v. II** (**11**) if that is present, reaches the medial surface of the fetlock joint with the small **dorsal common digital a. II** (**9**), and divides into **axial dorsal digital n. II** to the dewclaw (16), and **abaxial dorsal digital n. III** (**17**) to the dorsomedial coronary region of the third digit. *As they cross the fetlock joints the abaxial dorsal and palmar digital nn. course on opposite borders of the abaxial palmar digital v. They may be connected by a communicating br. at the level of the proximal phalanx*.

The continuing **dorsal common digital a., v., and n. III** (**12**) cross the tendon of the medial digital extensor (p. 5, 40) and the medial branch of the tendon of the common extensor of digits III and IV (p. 5, 41) to reach the interdigital space where they divide into the **axial dorsal aa., vv., and nn. of digits III and IV.**

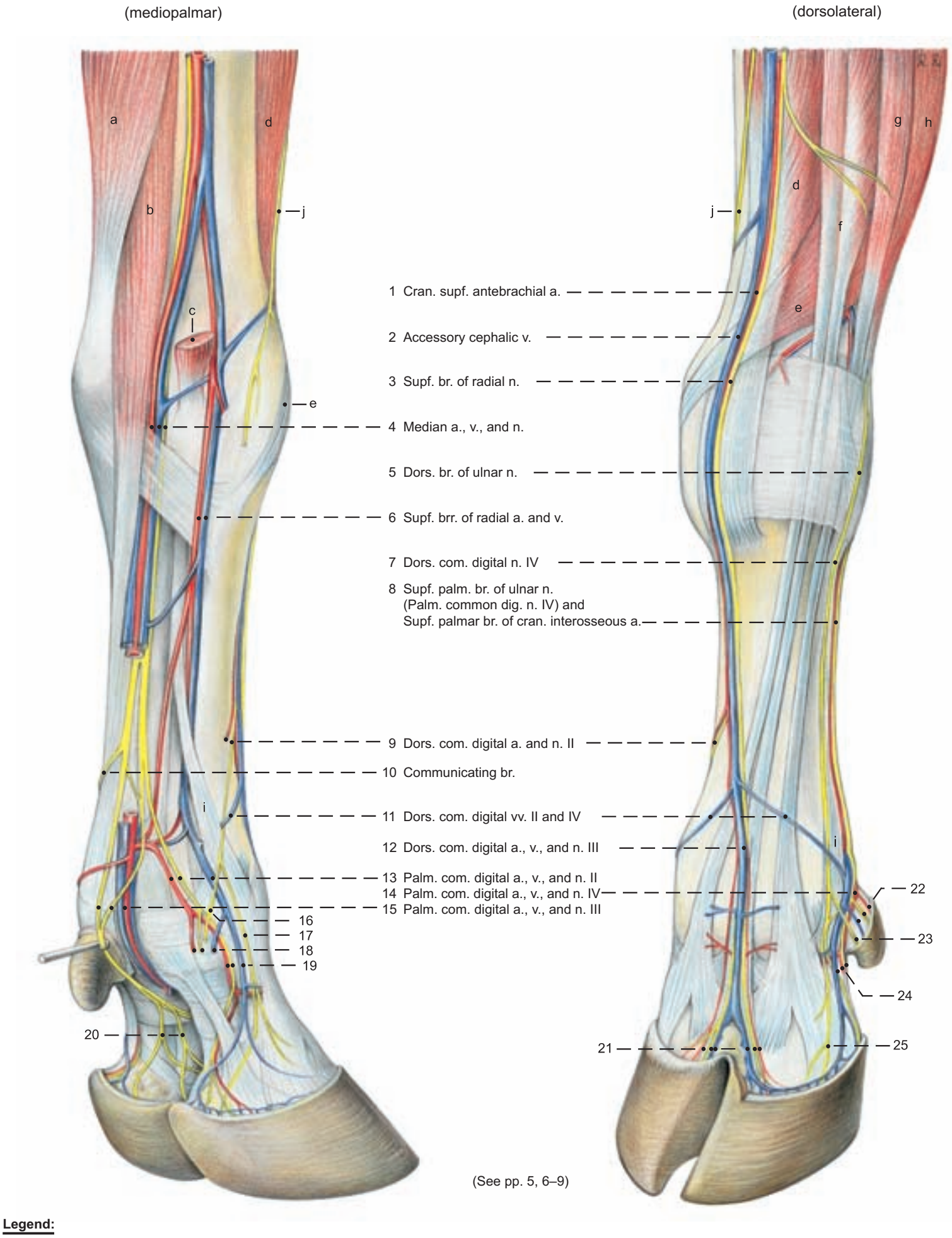
There are no deep dorsal metacarpal nn., unlike the system in the metatarsus. Deep dorsal vessels are reduced to the **dorsal metacarpal a. III and** (inconstant) **v. III** (**p. 11, 4**), running in the dorsal longitudinal groove of the bone to the interdigital space, where they anastomose with the superficial dorsal common digital vessels.

Arteries and Veins of the Manus (palmar)



(See pp. 5–11)

Arteries, Veins, and Nerves of the Manus



(See pp. 5, 6–9)

Legend:

16 Axial dors. digital n. II
17 Abaxial dors. digital n. III
18 Axial palm. digital a., v., and n. II
19 Abaxial palm. digital a., v., and n. III
20 Axial palm. digital nn. III and IV
21 Axial dors. digital aa., vv., and nn. III and IV
22 Axial palm. digital a., v., and n. V
23 Axial dors. digital n. V
24 Abaxial palm. digital a., v., and n. IV
25 Abaxial dors. digital n. IV

a Flexor carpi ulnaris
b Supf. digital flexor
c Flexor carpi radialis (resected)
d Extensor carpi radialis
e Extensor carpi obliquus
f Common digital extensor
Medial digital extensor
Common extensor of digits III and IV
g Lat. digital extensor
h Ulnaris lateralis
i Abaxial extensor branches Interosseus III and IV
j Med. cut. antebrachial n. (musculocuteous)

5. INTERDIGITAL NERVES AND VESSELS, INTEROSSEI, AND FASCIAE OF THE MANUS

a) The **INTERDIGITAL NERVES AND VESSELS** of the manus come primarily from the **palmar common digital a., v., and n. III** (**5**), whose branches communicate with the corresponding dorsal nerves and vessels (see p. 8).

On the pes the main blood supply of the digits is the *dorsal* **metatarsal a. III** (**11 and p. 21, 12**). This difference is important surgically. The digital vessels and nn. of the pes have the same connections as on the manus. Usually the branches of the double palmar common digital n. III unite for a short distance at the beginning of the interdigital space, and divide again into **axial palmar digital nn. III** (**6**) **and IV** (**7**)**.** If there is no common trunk, the branches are continued by the axial palmar digital nn., which give off communicating branches to the **axial dorsal digital nn. III and IV**. **Palmar common digital a. III** (**5**) gives off branches to the proximal phalanges. These branches pass between the deep flexor tendon and the bone and anastomose with the abaxial palmar digital aa. A dorsal branch, the **interdigital a.** (**5'**), anastomoses with the **dorsal metacarpal a. III** (**4**) and the small **dorsal common digital a. III** (**1**) and supplies the **axial dorsal digital aa. III** (**3**) **and IV** (**2**). Distal to the interdigital a., palmar common digital a. III divides into **axial palmar digital aa. III** (**6**) and **IV** (**7**). **Palmar common digital v. III** (**5**), often double, unites at the middle of the proximal phalanx, where it receives the anastomotic branches of the abaxial palmar digital vv. and gives off the **interdigital v.** (**5'**) and the **axial palmar digital vv** (**6, 7**). The interdigital v. has connections with dorsal digital vv. corresponding to the arteries. The axial dorsal digital aa., vv., and nn. supply the dorsal coronary and interdigital regions of the third and fourth digits. The axial palmar (plantar) aa., vv., and nn. supply the interdigital deep structures and dermis of the bulb and hoof of the third and fourth digits. (For the supply of the abaxial surface of the digits, see p. 8.) The axial palmar (plantar) a. and v. enter the axial foramen in the distal phalanx and anastomose in the bone with the abaxial palmar a. and v., which enter through the abaxial foramen, to form the terminal arches.

b) The **INTEROSSEI III AND IV** (see p. 18) provide support for the fetlock joints of the ox comparable to that of interosseus III (medius) in the horse. These muscles originate from the proximal end of the metacarpal (metatarsal) bone and the deep palmar (plantar) carpal ligg. In young animals they are relatively fleshy, and in older animals, predominantly tendinous. Interossei III and IV are fused along their axial borders in the metacarpus (metatarsus), but they separate and terminate on the corresponding digits. *In the middle of the metacarpus* (*metatarsus*) *the interossei give off the* **accessory lig.,** *which bifurcates and joins the branches of the supf. digital flexor tendon at the level of the fetlock joints in the formation of the* **sleeves** (**manicae flexoriae**) *through which the branches of the deep flexor tendon pass*. Proximal to the fetlock joints each interosseus divides into two tendons (h), each with two **extensor branches** (**p. 5, l; p. 9, i**). The two tendons are attached to the sesamoid bones (i) of the corresponding digit. A flat **abaxial extensor branch** (**g**) passes across the surface of the sesamoid bone, to which it is attached, and joins the tendon of the proper digital extensor. The **axial extensor branches** (**f**) remain fused together until they pass through the intercapital notch in the end of the metacarpal (metatarsal) bone. Then they separate and join the tendons of their respective proper digital extensors. The interosseus, sesamoid bones, and sesamoid ligg. of each digit form a suspensory apparatus which aids the digital flexor tendons in the support of the fetlock joint. In addition, the extensor branches oppose the tension of the deep flexor tendon on the distal phalanx when the weight is on the foot.

c) On the carpus the **FASCIA OF THE MANUS** is thickened dorsally to form the **extensor retinaculum** (**p. 5, s**) and especially on the palmar surface to form the **flexor retinaculum** (**p. 5, k**).

On the dorsal surface of the metacarpus (metatarsus) the fascia is thin, but on the palmar surface, in continuation of the flexor retinaculum, it is thick, forming the **proximal ligg. of the dewclaws**. These come from the borders of the metacarpal (metatarsal) bone and have been cut to expose the palmar (plantar) nerves and vessels. At the level of the fetlock joints, the **transverse lig.** connects the dewclaws, and a palpable **distal lig.** runs from each dewclaw to the fascia on the abaxial surface of the coffin joint, resembling in its course the lig. of the ergot in the horse. It also blends with the abaxial end of the distal interdigital lig. (see below). The whole system of ligaments of both dewclaws forms a letter H.

On the fetlock joints the fascia around the digital flexor tendons of each digit is thickened to form the **palmar annular lig.** (**12**), which joins the **collateral sesamoid ligg.** and the **proximal scutum** – the fibrocartilaginous bearing surface for the flexor tendons, formed on the sesamoid bones and the **palmar** (**plantar**) **lig.** between them, and extending proximal to the sesamoid bones.

Distal to the fetlock joint the fascia is reinforced in the **proximal** (**13**) **and distal** (**15**) **digital annular ligg.**, attached to the proximal phalanx. The main digits are connected by the proximal and distal interdigital ligg. The **proximal interdigital lig.** (**14**) is short and thick; it is attached on the axial surfaces of the proximal halves of the proximal phalanges, and is supplemented by the crossed **interdigital phalangosesamoid ligg.** These extend from the sesamoid bones of one digit to the axial tubercle of the proximal phalanx of the other digit. The **distal interdigital lig.** (**16**) has greater mechanical advantage in resisting the spread of the digits. It consists of superficial and deep parts. The **superficial part** is palpable. Its crossed fibers extend from the abaxial eminence of the flexor tuberosity of the middle phalanx (see p. 3, 71), around the palmar surface of the deep flexor tendon to the navicular bone of the other digit. It serves to hold the deep flexor tendon in place. The crossed fibers of the **deep part** pass from the axial surface of the distal end of the middle phalanx of one digit to the distal phalanx and navicular bone of the other digit. The attachment to the navicular bone is by means of the **distal scutum** – a plate of fibrocartilage that covers the flexor surface of the bone and extends proximal to it. The terminal branches of the deep and supf. flexor tendons have **common digital synovial sheaths,** which begin between the middle and distal thirds of the metacarpus and end just above the coffin joint.

They form **six pouches for each main digit**: two abaxial pouches and one palmar (plantar) pouch proximal to the palmar (plantar) annular lig., two between the two digital annular ligg., and one distal to the superficial part of the distal interdigital lig.

Of the three pouches proximal to the palmar (plantar) annular lig., (I) is between the interossei and the accessory lig.; (II) lies along the accessory lig., partially surrounding the deep flexor tendon; and III is on the palmar (plantar) surface of the supf. flexor tendon. Abaxial (IV) and axial (V) pouches bulge between the two digital annular ligg. The sixth pouch (VI) is distal to the supf. part of the distal digital annular lig. The sheaths of both digits may communicate with each other where they are in contact.

Digital Arteries, Veins, and Nerves

Digit III, left manus, axial surface

Digit III, right pes, axial surface*

Legend:

1 Dors. com. digital a., v., and n. III

2 Axial dors. digital a., v., and n. IV

3 Axial dors. digital a., v., and n. III

4 Dors. metacarpal a. and v. III

5 Palm. (plant.) com. dig. a., v., and n. III

5' Interdigital a. and v.

6 Axial palm. (plant.) digital a., v., and n. III

6' Communicating br. (nerve)

7 Axial palm. (plant.) digital a., v., and n. IV

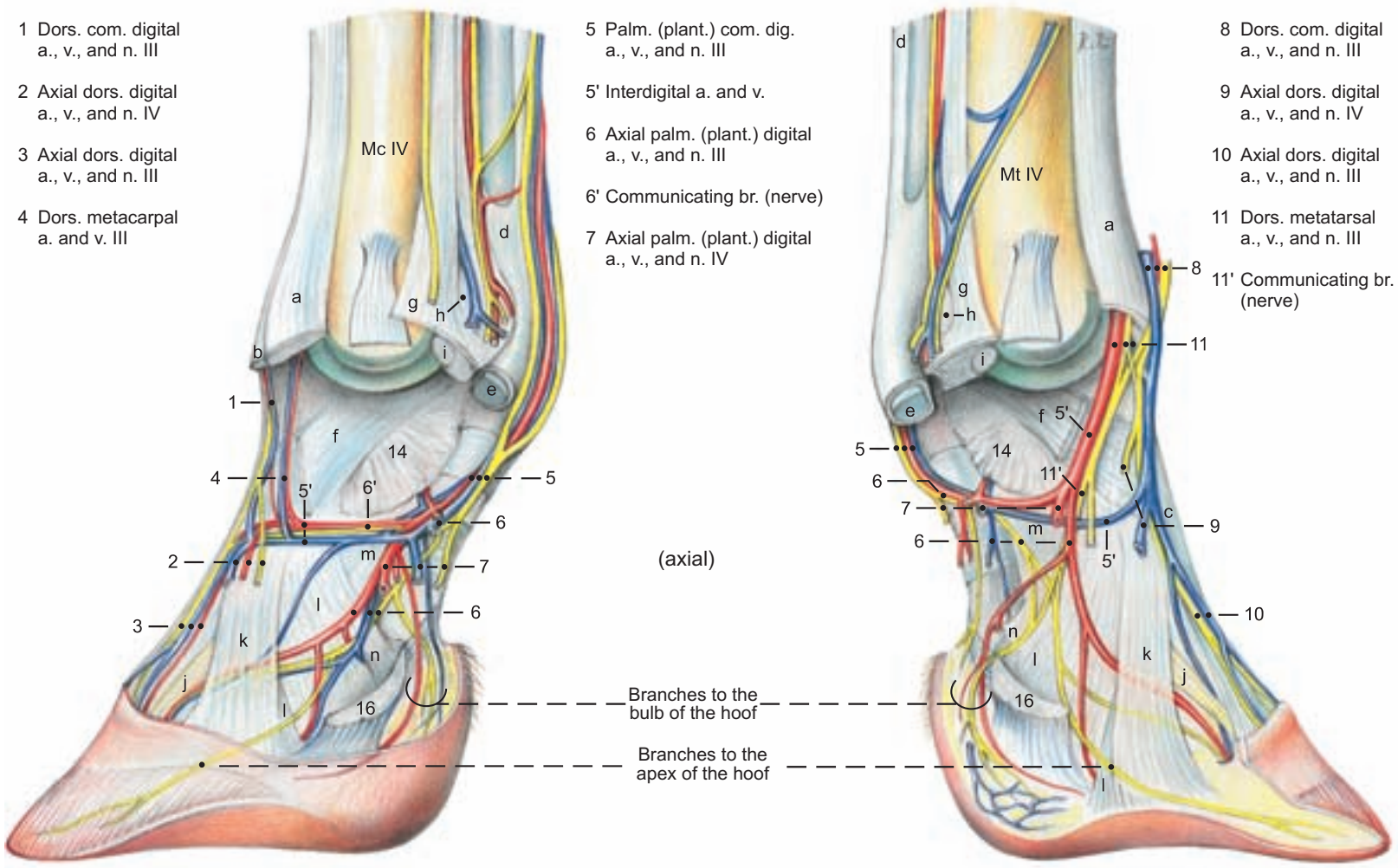
8 Dors. com. digital a., v., and n. III

9 Axial dors. digital a., v., and n. IV

10 Axial dors. digital a., v., and n. III

11 Dors. metatarsal a., v., and n. III

11' Communicating br. (nerve)



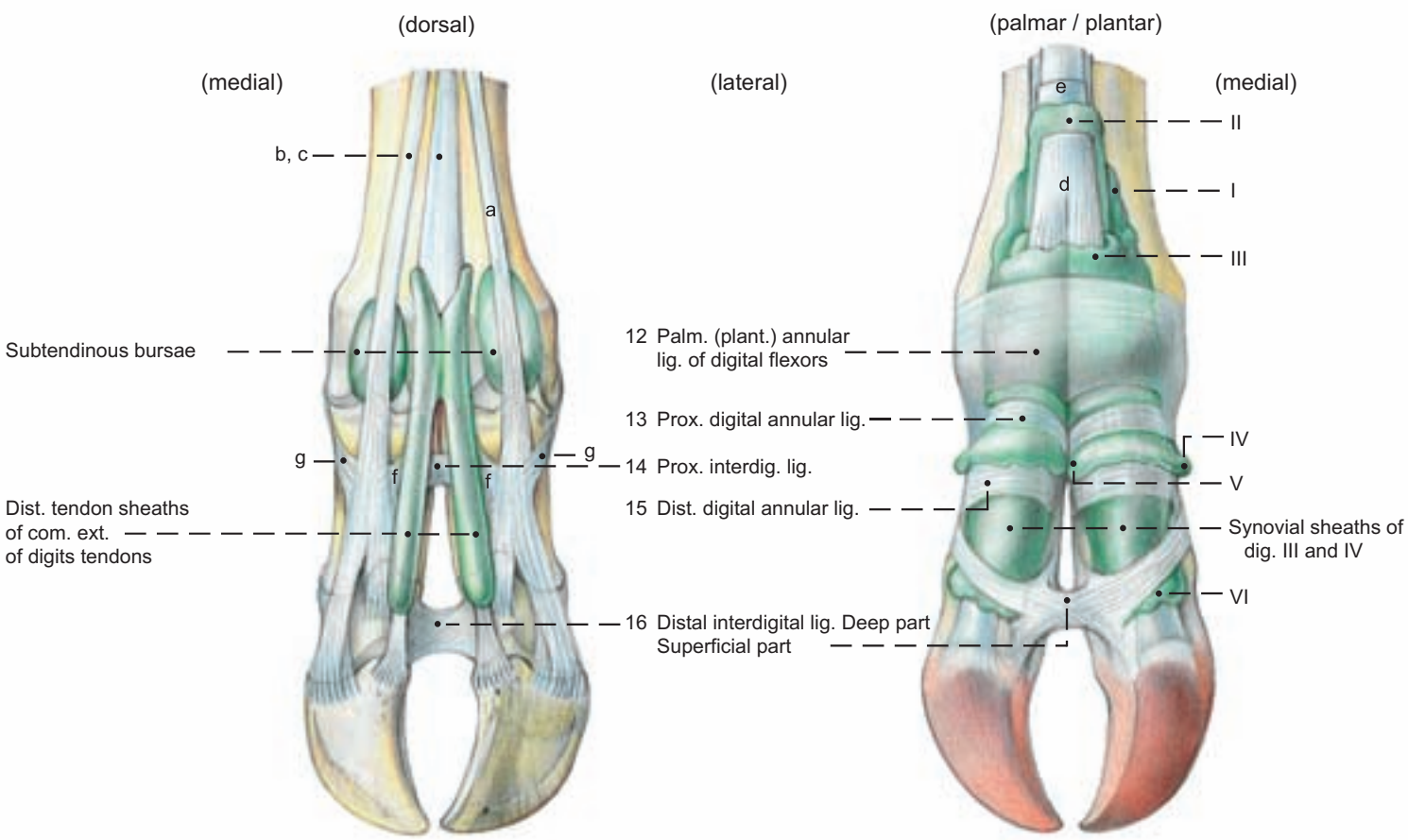
(See pp. 5, 7, 9)

(See pp. 17, 21, 23)

Legend:

Tendons:
a Lateral digital extensor
b, c Common digital extensor or Long digital extensor (Med. dig. ext., and common (long) ext. of digits III and IV)
d Supf. digital flexor
e Deep digital flexors
Interossei III and IV:
f Axial extensor branches
g Abax. extensor branches
h Tendon to sesamoid bone
i Prox. sesamoid bone of dig. IV
j Dorsal lig.
k Axial common collat. lig.
l Axial collat. ligg.
m Axial palm. (plant.) lig. of pastern joint
n Axial collat. sesamoid lig.

Digital fascia, Fibrous and synovial digital sheaths of manus and pes



* Nerves and vessels of the upper right figure are described on p. 22.

6. SYNOVIAL STRUCTURES OF THE THORACIC LIMB

a) JOINTS OF THE THORACIC LIMB

NAME		BONES involved	TYPE OF JOINT	FUNCTION	REMARKS
I.	**Shoulder joint**	Glenoid cavity of scapula and head of humerus	Simple spheroidal	Restricted to flexion and extension	Infraspinatus and subscapularis act as contractile ligaments
II.	**Elbow joint**		Composite joint		
a)	Humeroulnar joint	Humeral condyle and ulna	Simple hinge joint	a–b) Flexion and extension, snap joint	Because the collateral ligg. are attached to the humerus prox. to axis of rotation of the condyle they are stretched in the neutral position of joint and tend to snap it into extension or flexion Pronator teres is feebly muscular.
b)	Humeroradial joint	Humeral condyle and head of radius	Simple hinge		
c)	Proximal radioulnar joint	Articular circumference of radius and radial notch of ulna	Simple rotating	c) No movement	
III.	**Distal radioulnar joint:**	Absent			Synostosis
JOINTS OF THE MANUS					
IV.	**Carpal joint**		Composite joint		
a)	Antebrachiocarpal joint	Radial trochlea and ulnar styloid process with carpal bones	Composite cochlear	Flexion and extension to 95°	Collateral ligg. have long supf. parts and prox., middle, and distal short deep parts. Med. collat. lig. is stronger. Synovial sac of a) rarely communicates with b); b) and c) always communicate*
b)	Midcarpal joint	Prox. and dist. rows of carpal bones	Composite condylar	Flexion and extension to 45°	
c)	Carpometacarpal joint	Carpal II–IV and metacarpal bones III and IV	Composite plane joint	Little movement	
d)	Intercarpal joints	Carpal bones of same row	Composite plane joints	Little movement	
V.	**Fetlock (metacarpo-phalangeal) joints**	Metacarpal III and IV, prox. phalanges, and prox. sesamoid bones	Composite hinge joint	Flexion and extension	The ox has two fetlock joints, whose capsules communicate. In their dorsal walls are fibrocartilaginous sesamoid bodies.
VI.	**Pastern (prox. interphalangeal) joints**	Prox. and middle phalanges	Simple saddle joint	Flexion, extension, and small lateral and rotational movements	There is no communication between pastern joints. Their dorsal pouches extend to the coffin joint pouches.
VII.	**Coffin (dist. Interphalangeal) joints**	Middle and dist. phalanges and navicular (dist. sesamoid) bones	Composite saddle joint	Flexion, extension, and small lateral and rotational movements	

b) SYNOVIAL BURSAE

The large (up to 8 cm in diameter, Schmidtchen**) **infraspinatus bursa** lies deep to the flat superficial part of the tendon, which terminates on the distinct infraspinatus surface (p. 3, 26') distal to the major tubercle. (The deep part of the tendon ends on the proximal border of the tubercle). The voluminous **intertubercular bursa** on the medial surface of the major tubercle lies deep to the tendon of origin of the biceps and on both sides of it. At the level of the **transverse humeral retinaculum** the bursa surrounds the tendon. As in the horse, the bursa is separate from the joint capsule. The **bursa of the triceps brachii** lies under the terminal tendon on the olecranon tuber. The inconstant **subcutaneous olecranon bursa** lies on the caudal surface of the olecranon in old cattle.

The **subcutaneous precarpal bursa** develops in adults and enlarges with age. It may reach the size of an apple. It extends on the dorsal surface from the midcarpal joint to a point just below the metacarpal tuberosity, covering the termination of the extensor carpi radialis. It usually does not communicate with underlying synovial structures and can be surgically removed when enlarged (hygroma). The **subtendinous bursae of the ext. carpi obliquus, ext. carpi radialis, ulnaris lateralis, and the supf. and deep digital flexors** lie under the respective tendons on the medial, dorsal, lateral, and palmar surfaces of the carpal joint.

The **subtendinous bursae of the medial and lateral proper digital extensors** lie dorsally on the fetlock joints. The **navicular bursae** are between the terminal branches of the deep flexor tendon and the navicular bones. Inflammations of the bursae have the same clinical signs as in the horse.

c) TENDON SHEATHS (VAGINAE SYNOVIALES)

On the **dorsal and lateral surfaces of the carpus** the extensor carpi obliquus and the digital extensors have synovial sheaths; the tendons of the ext. carpi radialis and ulnaris lat. do not. On the **medial surface,** only the flexor carpi radialis has a synovial sheath.

On the **dorsal surface of the phalanges** the terminal branches of the tendon of the common extensor of digits III and IV have synovial sheaths. On the **palmar surface** is the **common synovial sheath** of the supf. and deep digital flexor tendons. They are held in position at the fetlock joint and on the proximal phalanx by annular ligg., and in the region of the pastern joint by the supf. part of the distal interdigital lig.

* Desrochers et al., 1997
** Schmidtchen, 1906