Scott Eaton's

Artistic Anatomy for Digital Artists

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Introduction

Why study artistic anatomy? In the digital arts, specifically character design, there is no subject that is more relevant. In fact, the necessity for anatomical knowledge in character design is far beyond that of the traditional arts. The digital artist must not only know human anatomy to model the figure, but he must also have a thorough understanding of the how the joints articulate and how the body deforms.

Sadly, there are few opportunities for students and professionals in the digital arts to receive structured training in traditional artistic anatomy. This course is designed to bring the anatomy lessons from the traditional academies to the professional digital artist.

Over seven lectures, the course provides an intensive introduction to artistic anatomy and a method for continuing study beyond the classroom. The course notes follow the lecture order and cover the body starting from the torso and moving toward the extremities. The notes for each lecture begin with plates covering the musculature. The plates are followed by a description of the bony landmarks and major surface forms of the region. The notes continue with lecture images that illustrate the area being investigated. Space is left beside each image to annotate and take notes during lecture. Finally, each lecture closes with a practical exercise designed to help the artist apply the anatomical principles being investigated.

"Hundreds of people talk for one who can think, but thousands think for one who can see."

– John Ruskin

Ecorche drawing over digital sculpture. Scott Eaton, 2005

Lecture 1: Proportion and Skeleton

"Every part of the whole must be proportionate to the whole... I will be well pleased if you avoid monstrous things, like long legs with short torsos, and narrow chests with long arms. "

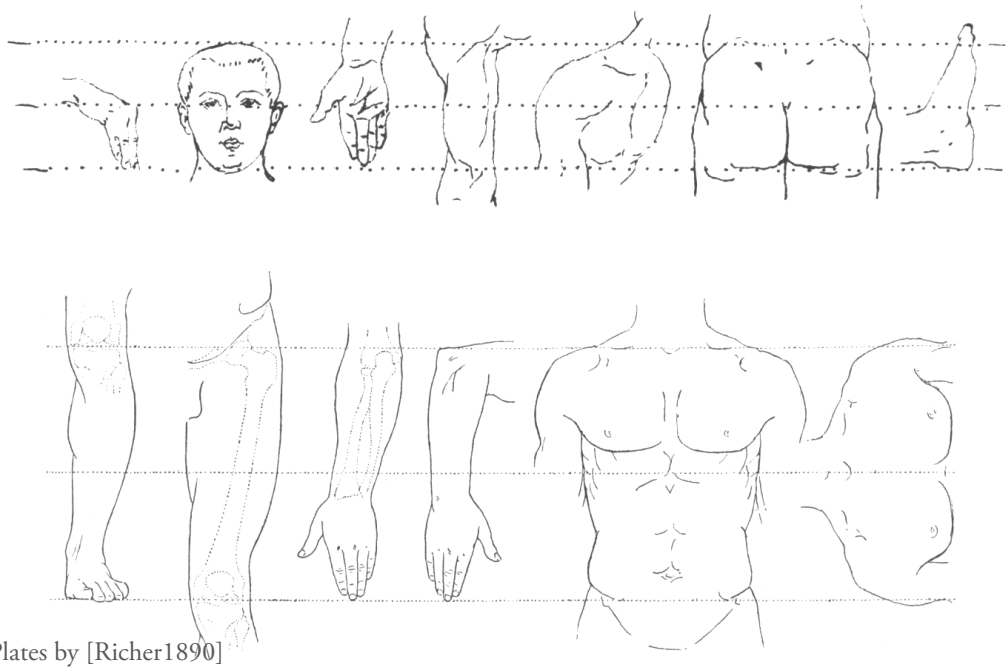
-Leonardo Da Vinci

"The pose, proportion and construction of the figure should receive our first attention, and placed to a hair's breadth… before the parts themselves are analysed"

-John Vanderpoel

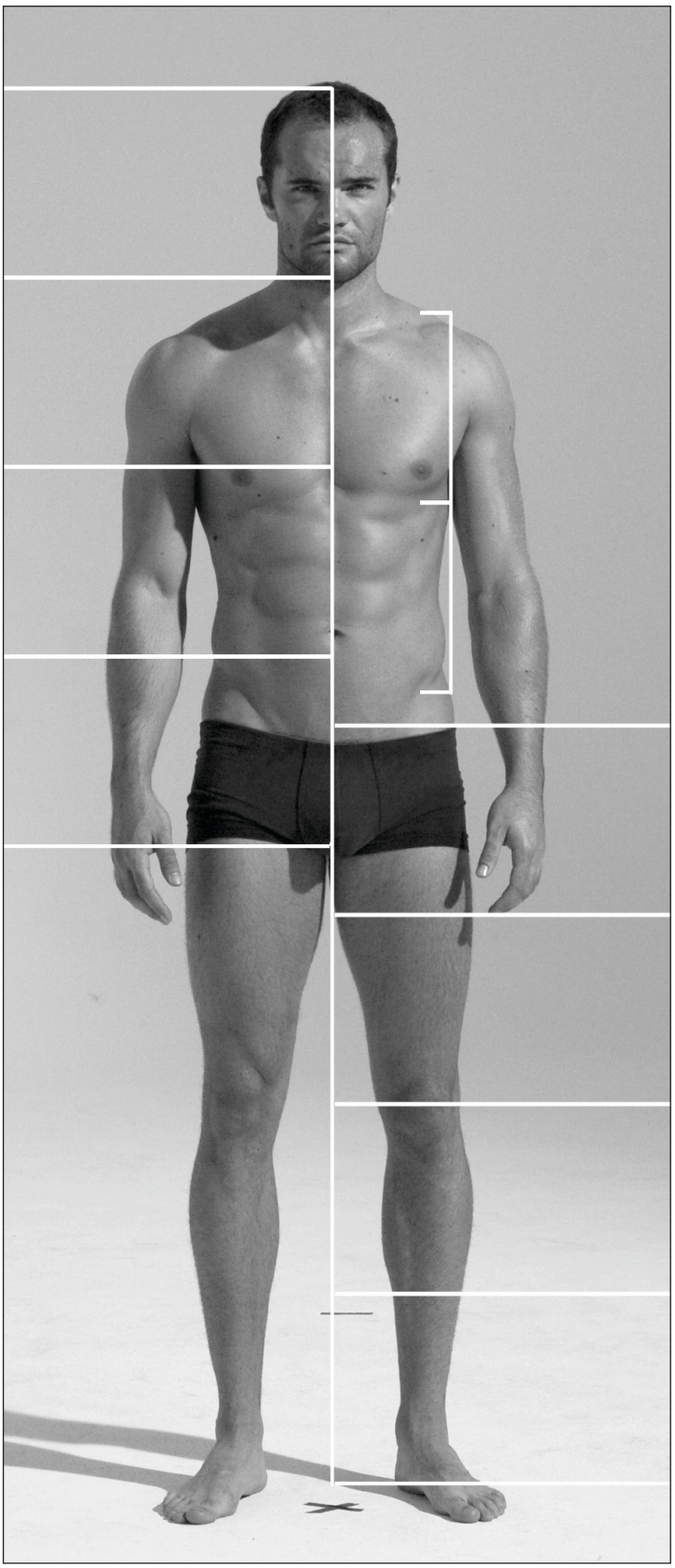
Proper proportion is the starting point for building any well constructed figure. When constructing a realistic human figure proportions are even more important. You can produce a figure with fine musculature but without accurate proportions it will appear grossly incorrect, even to the casual viewer. To simplify the assessment of proportion when constructing a figure reference systems are helpful.

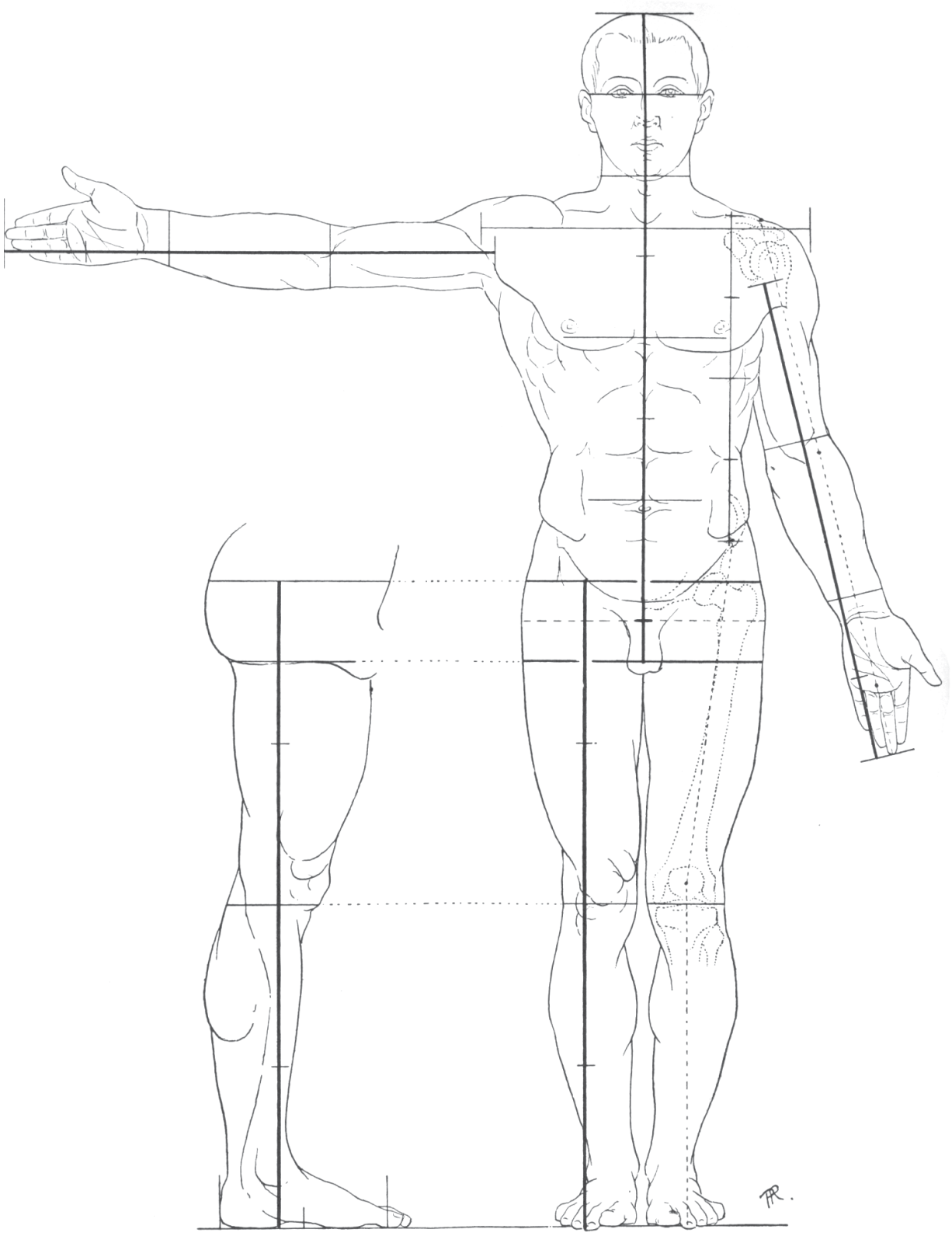
For centuries artists have recorded their own concept of proportion, usually reflecting the tastes of the time. One of the most accurate and detailed of these canons is that of Dr. Paul Richer. Orignally published in his book Anatomie Artistique, it has become a standard reference for artist.



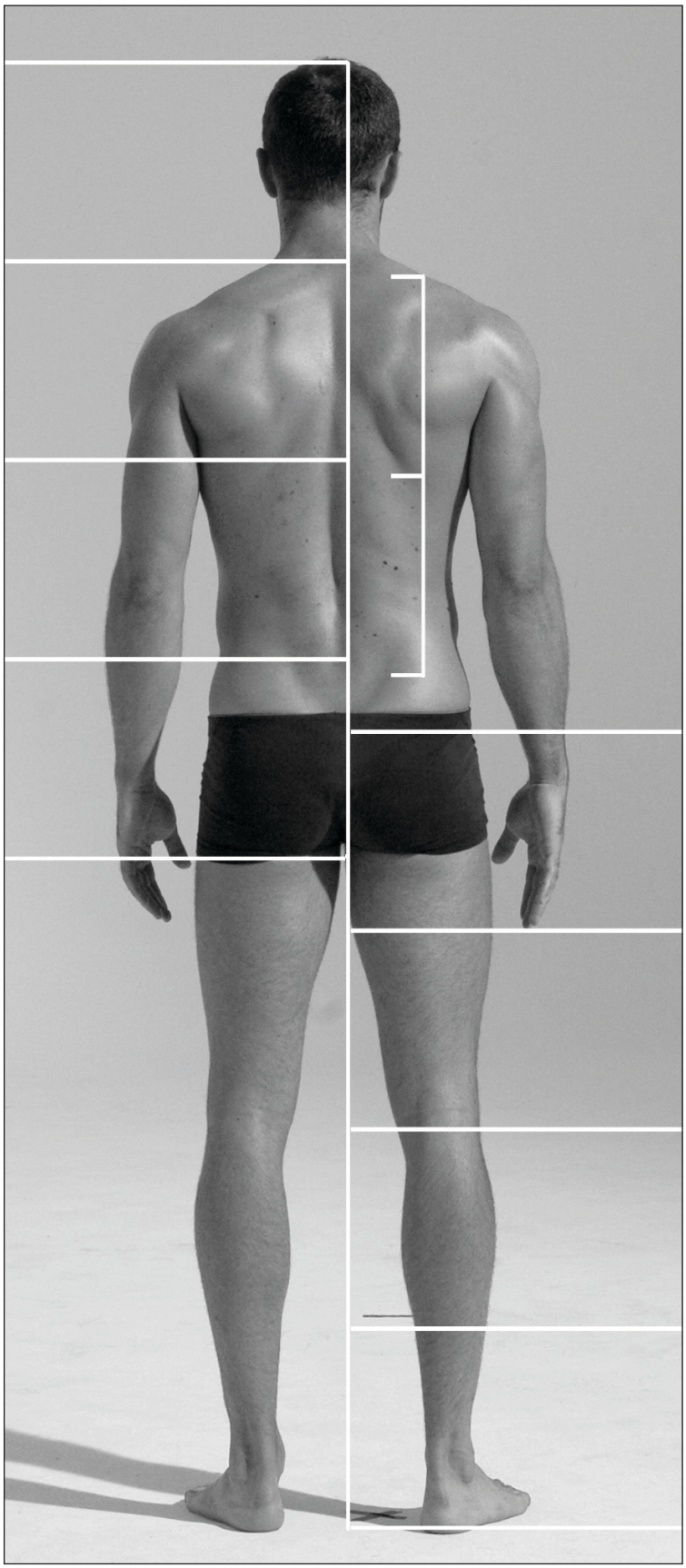
Plates by [Richer1890]

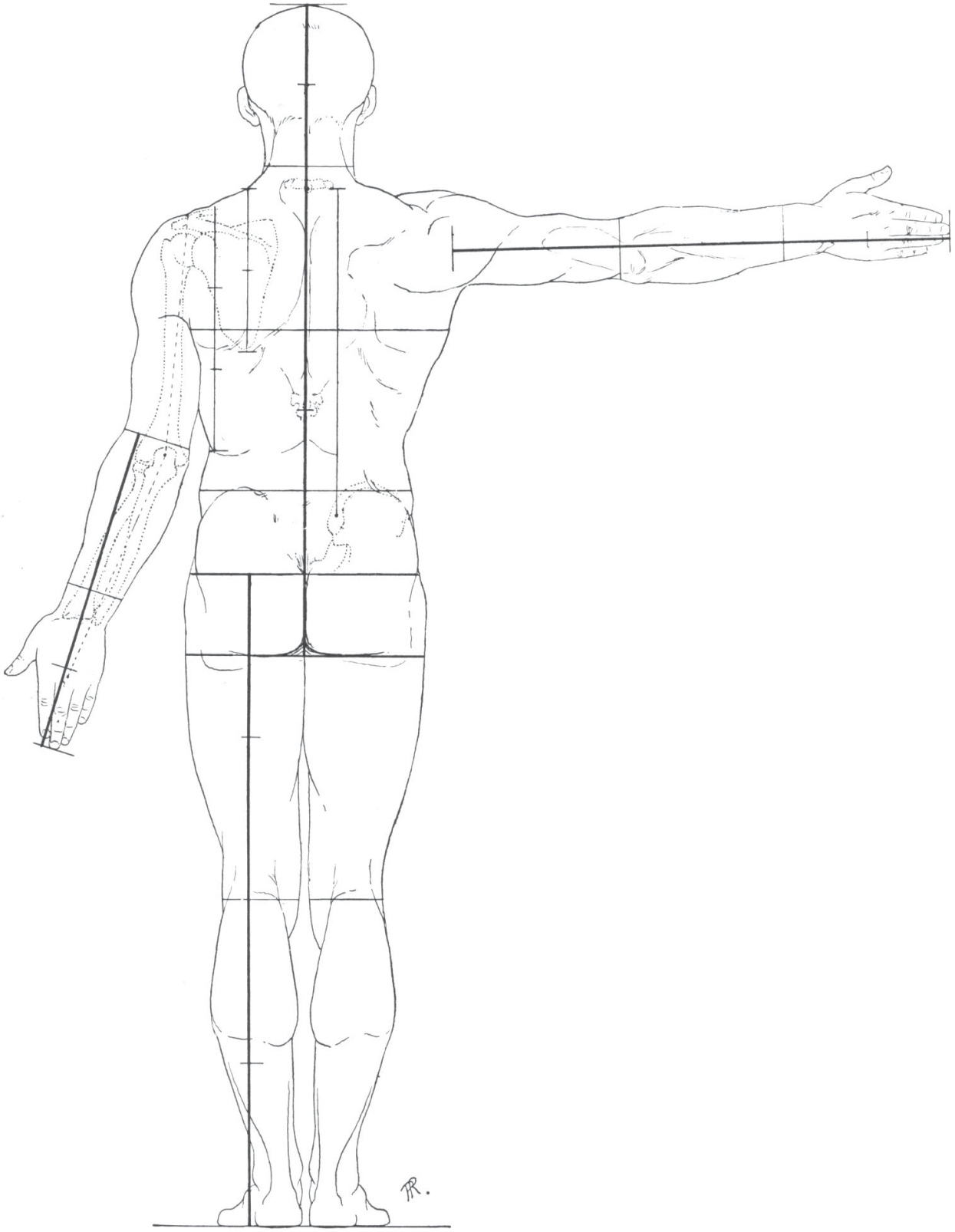
The following plates show Richer's canon of proportions for the human figure. The canon is based on the 7 1/2 head figure. In addition to dividing the figure vertically into head lengths, the plates present information showing the useful distances between bony landmarks and also body parts of equal length. It is helpful for the artist to internalise these proportions.



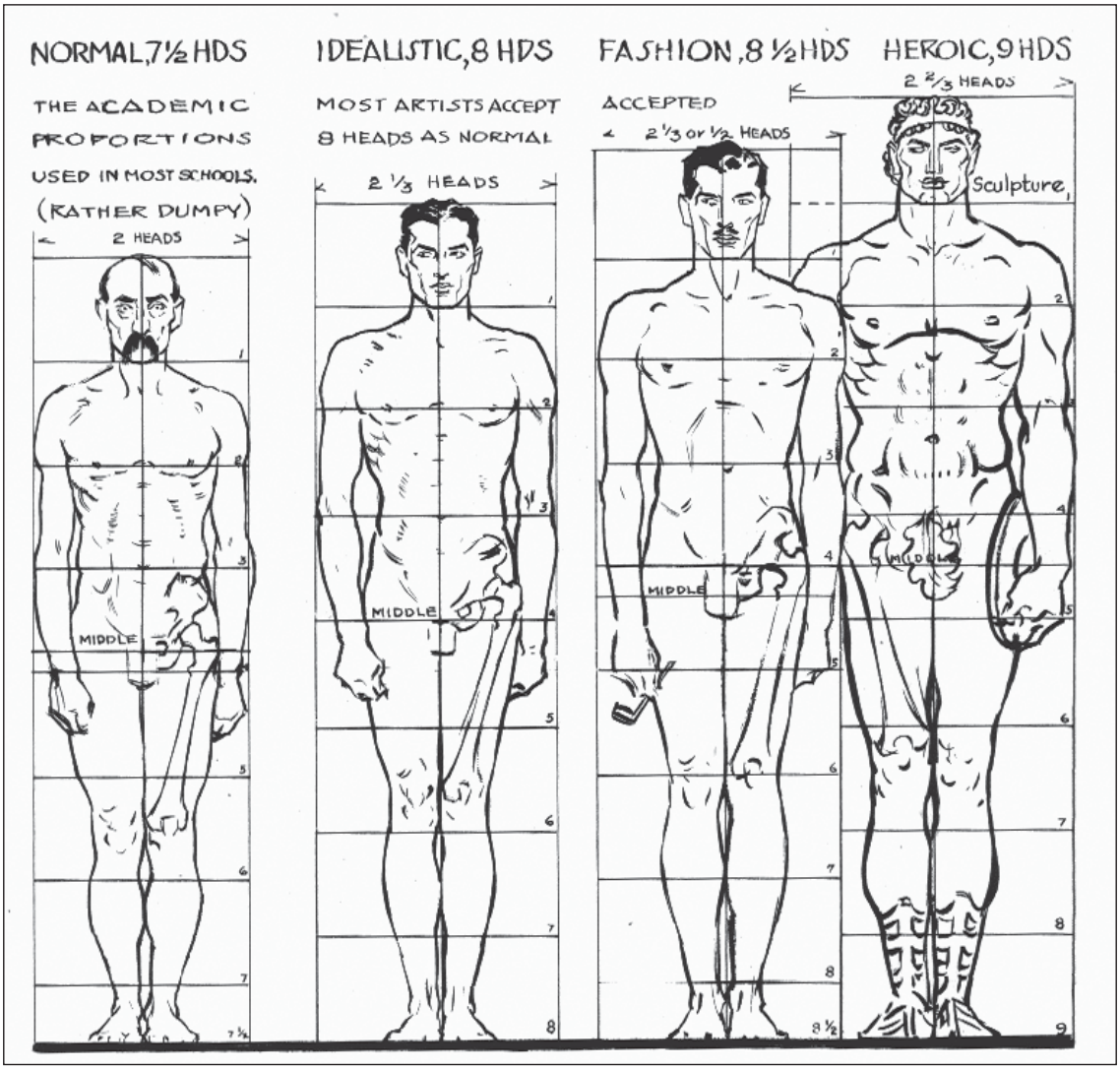


Plates by [Richer1890]





Plates by [Richer1890]

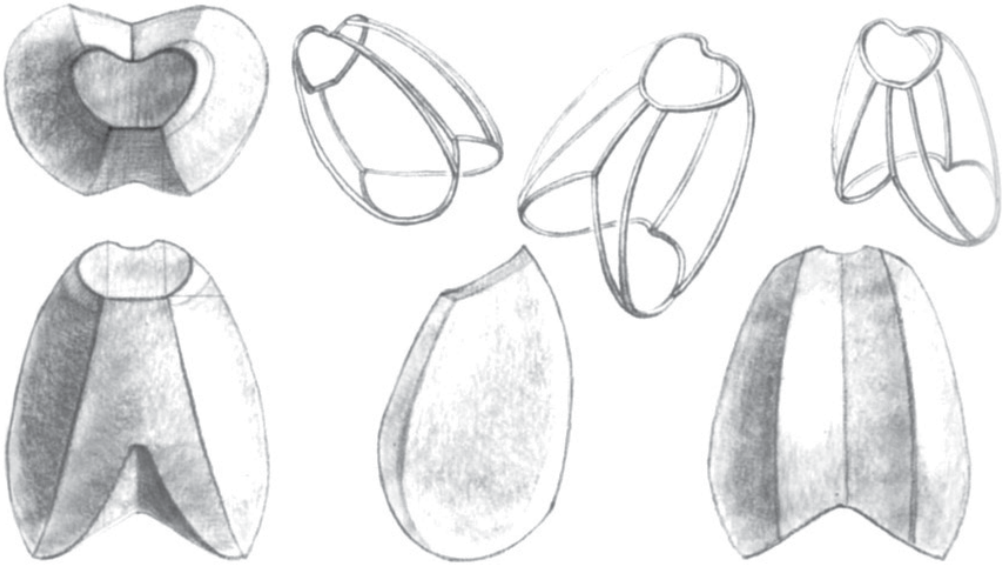


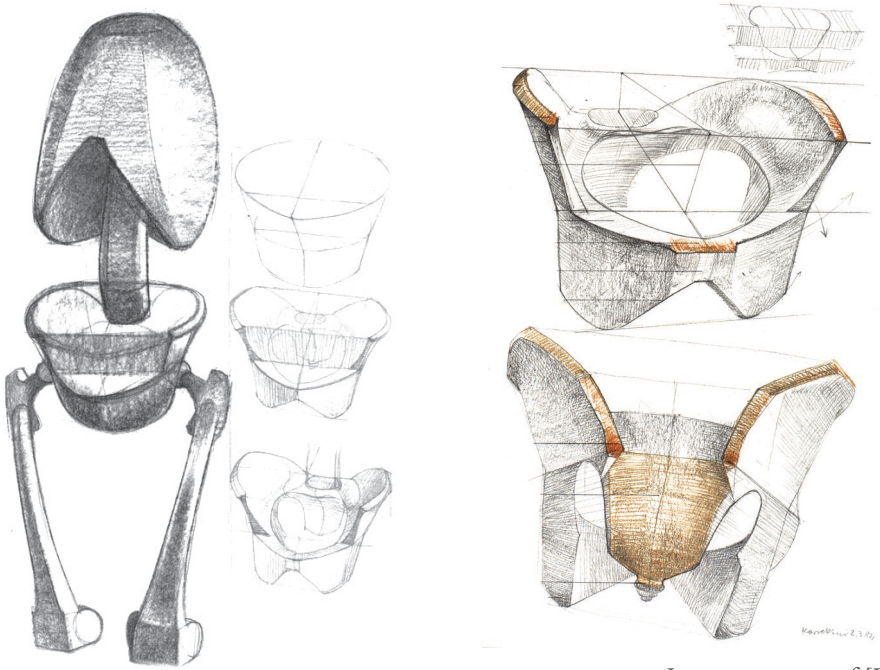
This plate by Andrew Loomis presents alternatives to the standard 7 1/2 head figure described by Richer. Throughout history artist have varied the overall proportion of their figures to make them more or less heroic. For example, certain of Michaelangelo's figures are known the be 10 to 11 heads tall.

Mass Conception

The task of constructing a human figure from scratch is a daunting one. The sheer amount of detail in the figure make it difficult to know where to being when building the figure. To make the task more approachable the arrangement of forms can be simplified into major shapes and planes. A collection of simple shapes is much easier to visualize and model than the complex intertwining of muscles and tendons. Once the larger planes and forms are correctly placed then the process of detailing muscle, tendon and veins can begin.

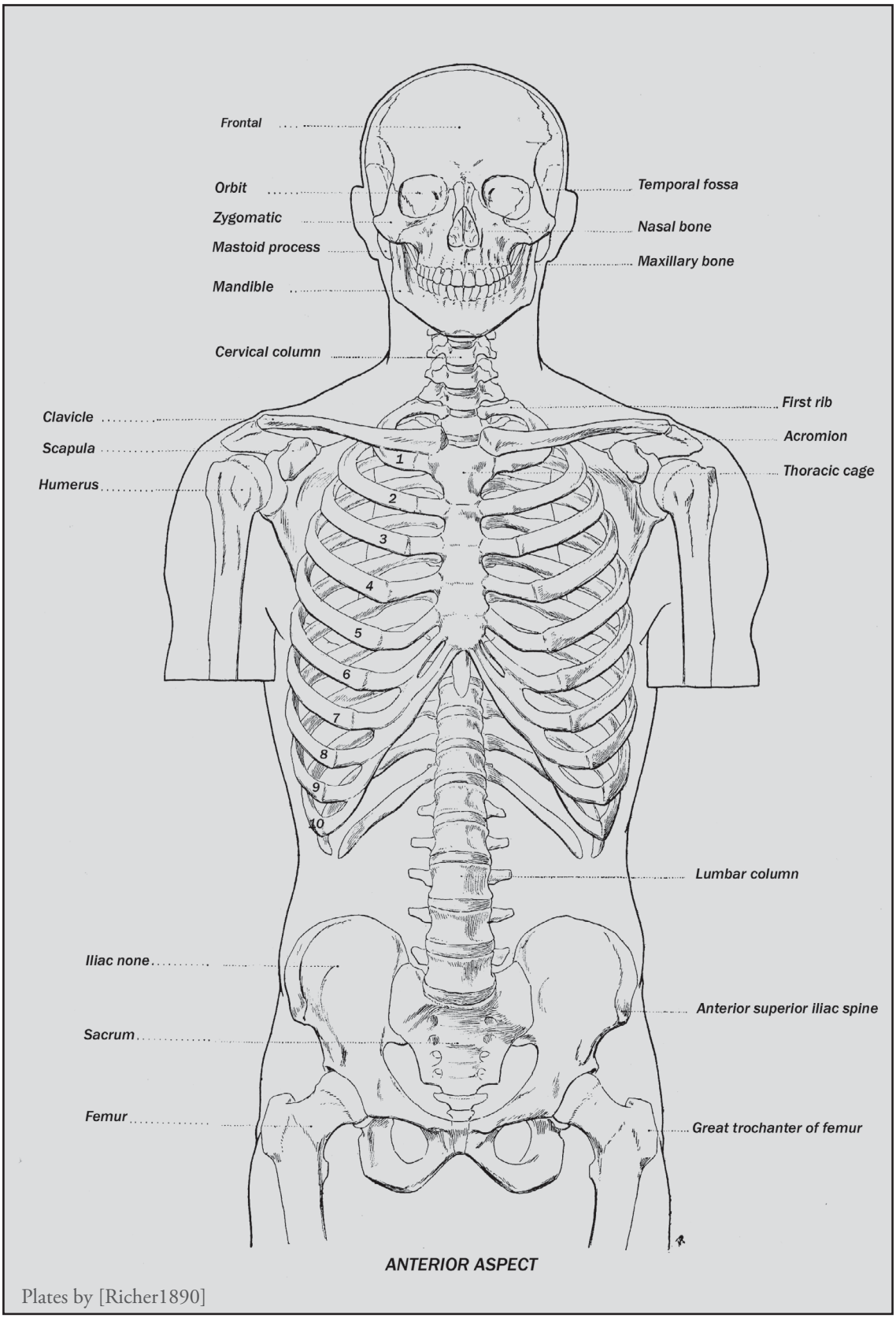
In addition to making the task of modeling easier, simplifying the complex shapes of the skeleton and body helps the artist to understand the construction and function of the individual pieces. An excellent resource that breaks the figure down into comprehensible shapes is Gottfied Bammes' Die Gestalt des Menschen (Human Form). The following images are taken from this masterwork.



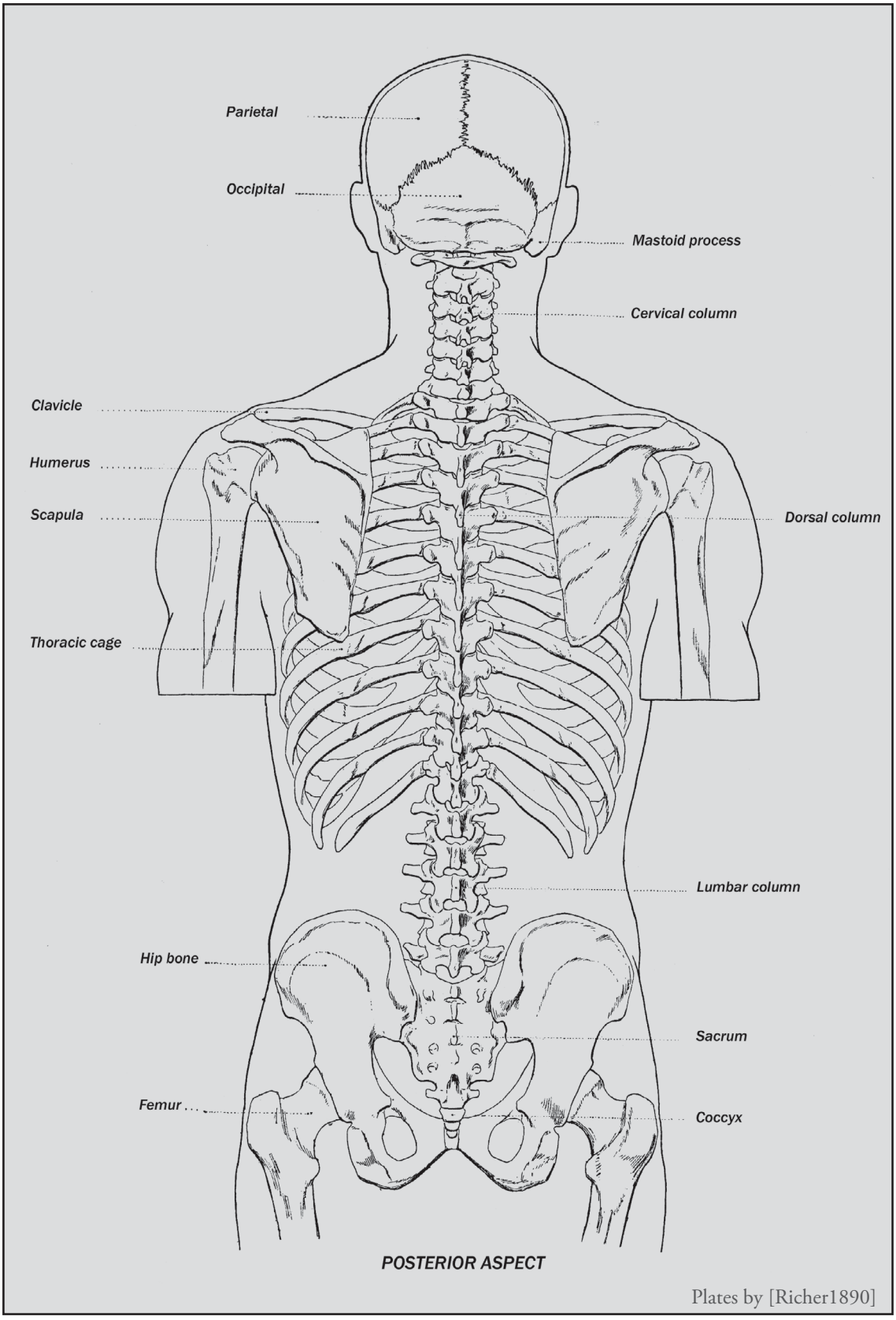


Images courtesy of [Bammes1969]

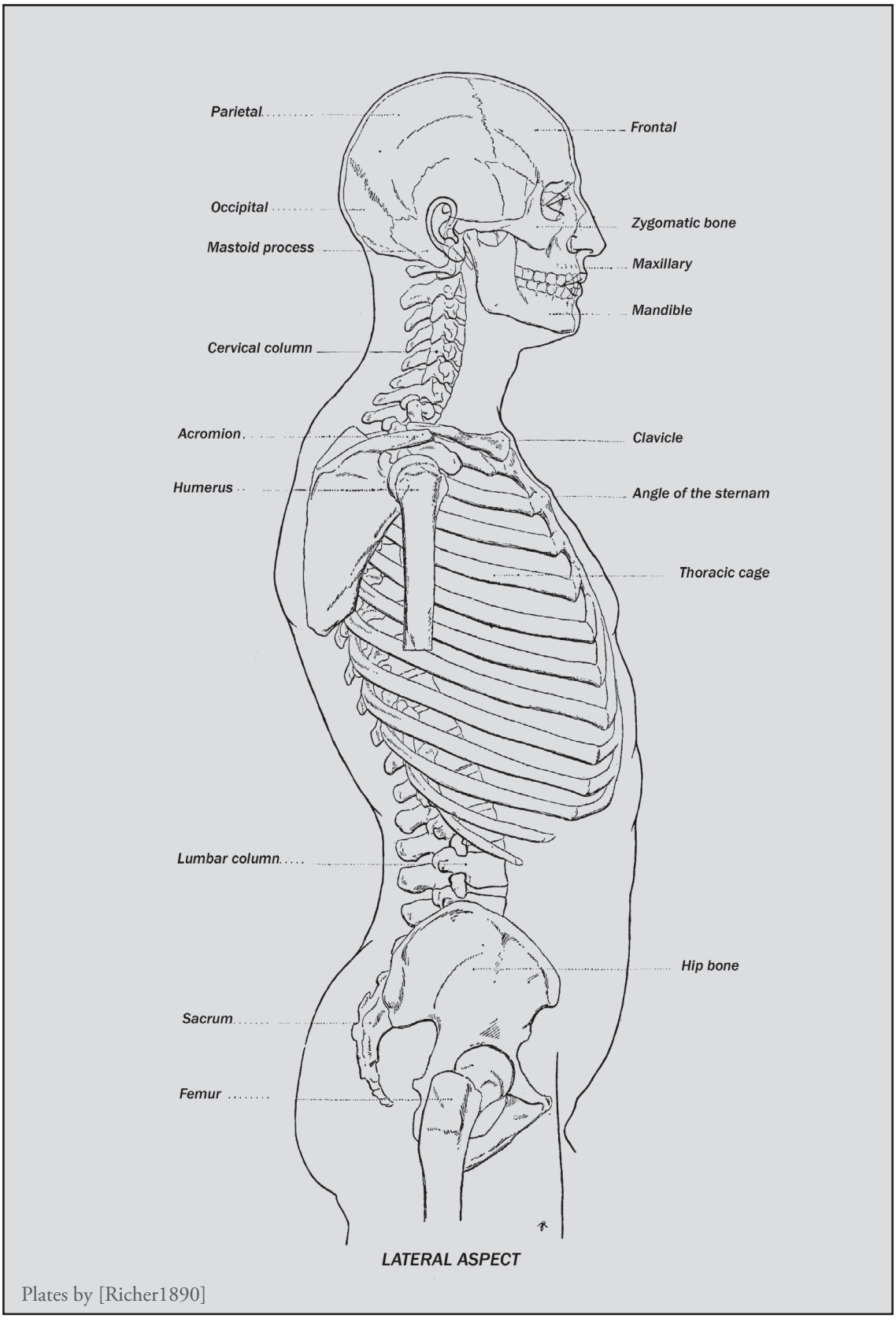
Skeleton



Plates by [Richer1890]



Plates by [Richer1890]



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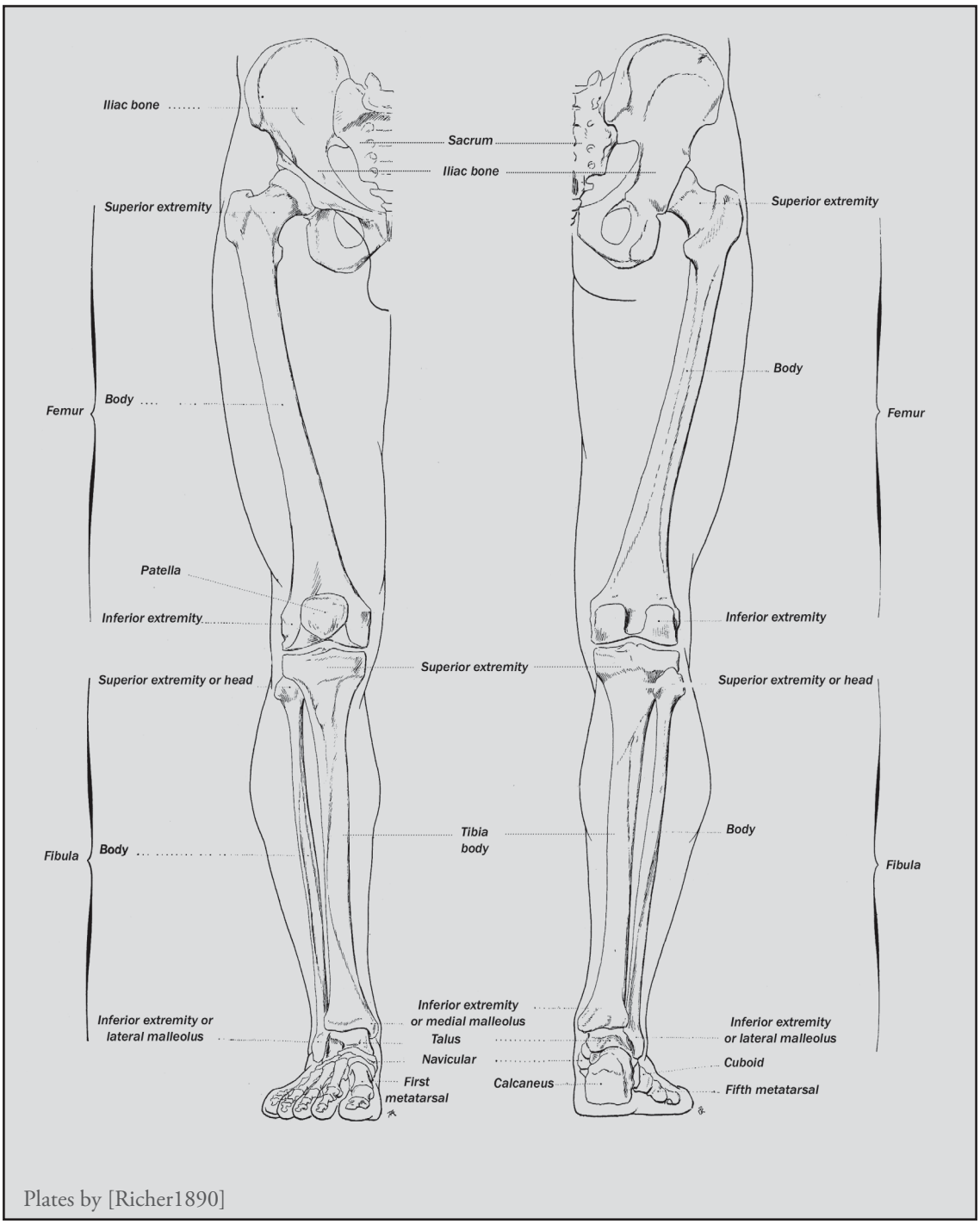

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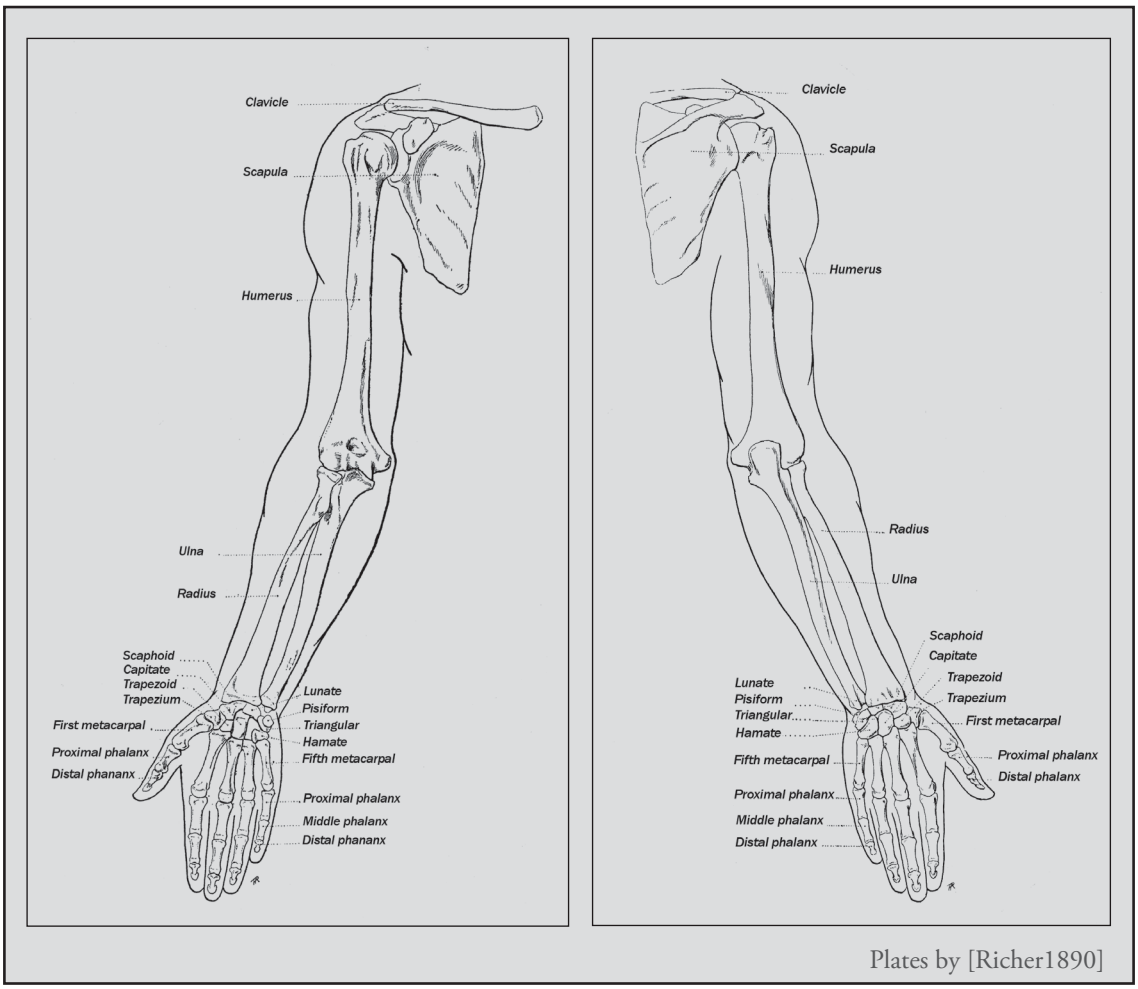
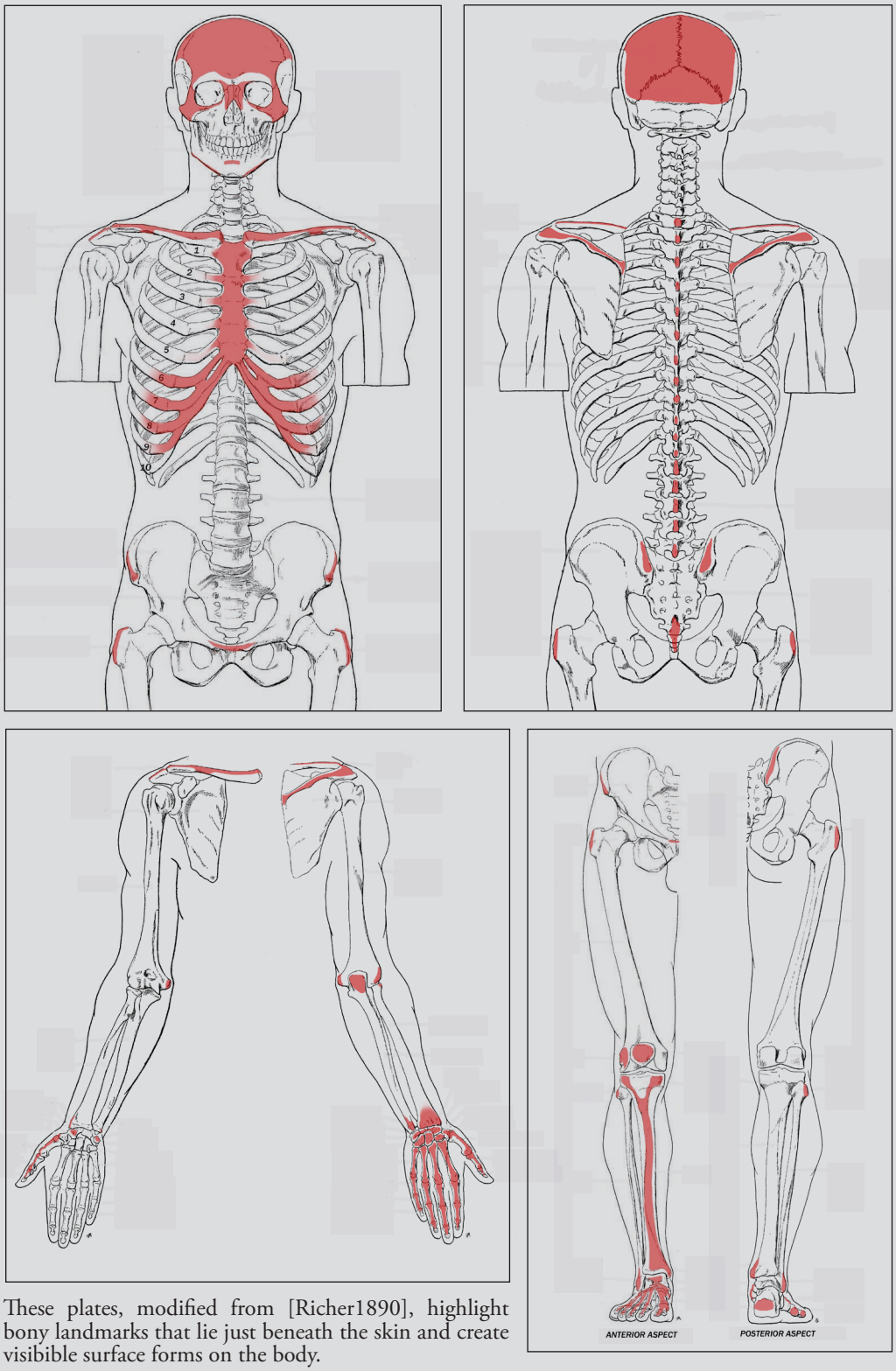


Plates by [Richer1890]

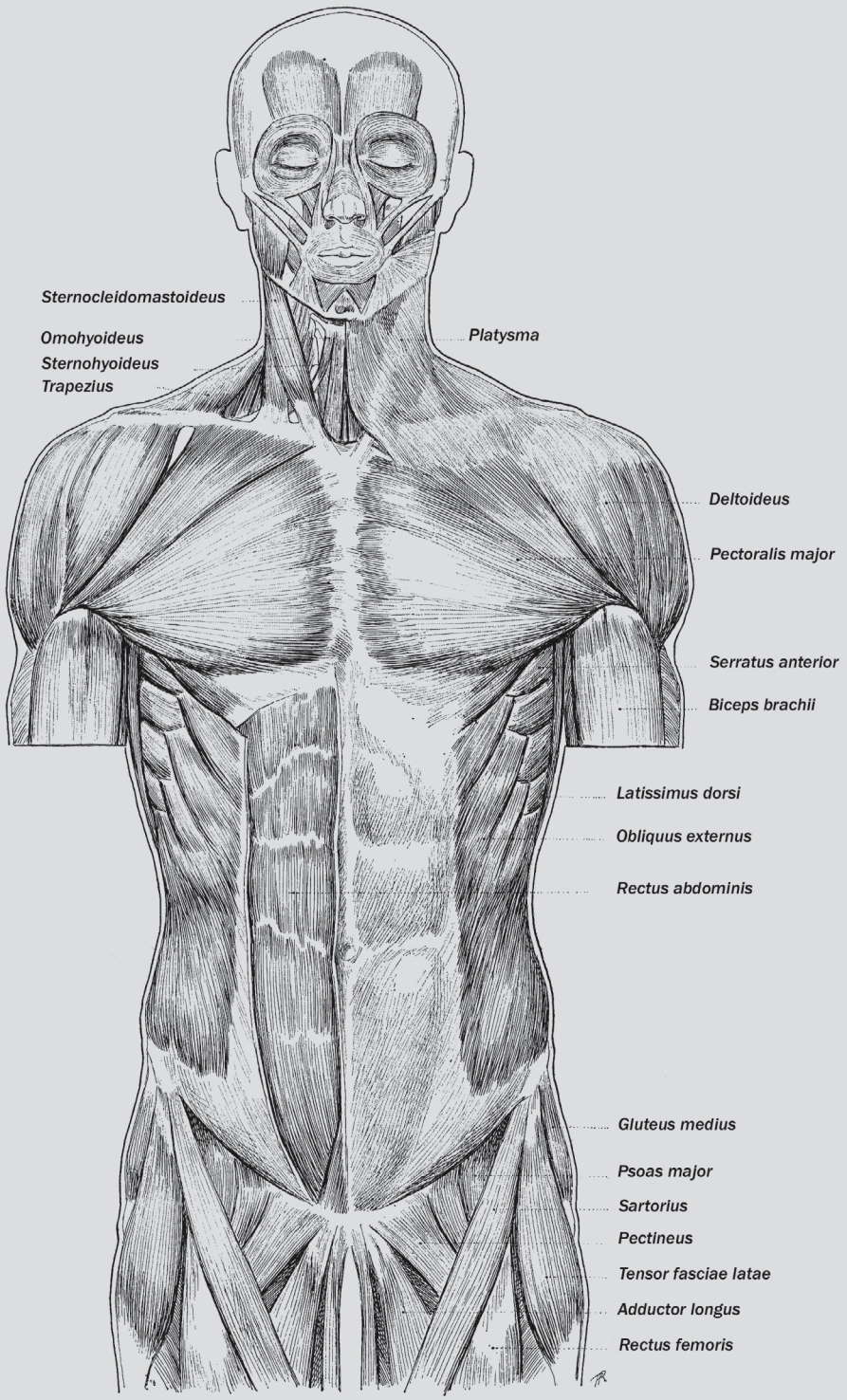
Bony Landmarks



These plates, modified from [Richer1890], highlight bony landmarks that lie just beneath the skin and create visibible surface forms on the body.

Notes

Lecture 2: the Torso



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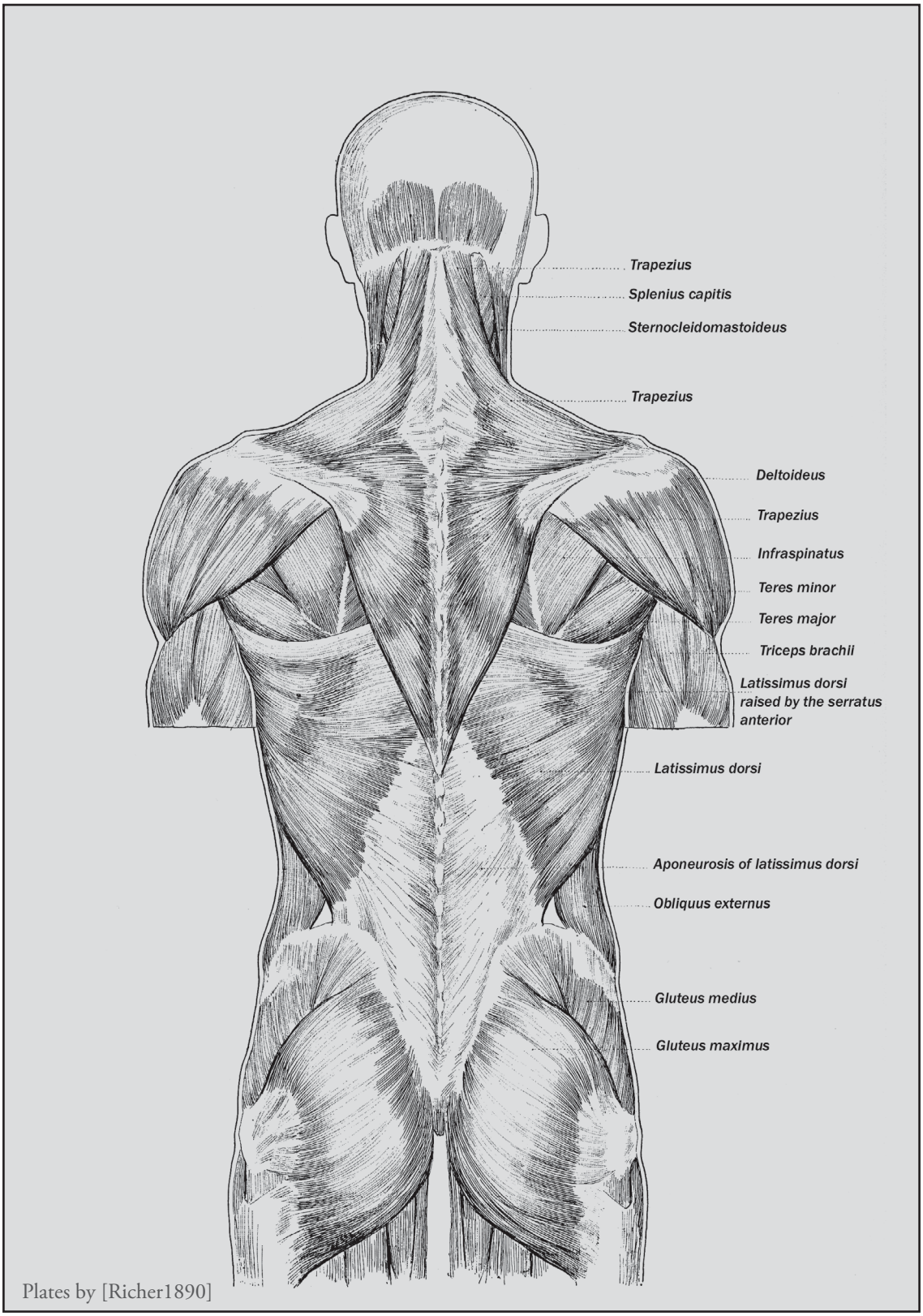

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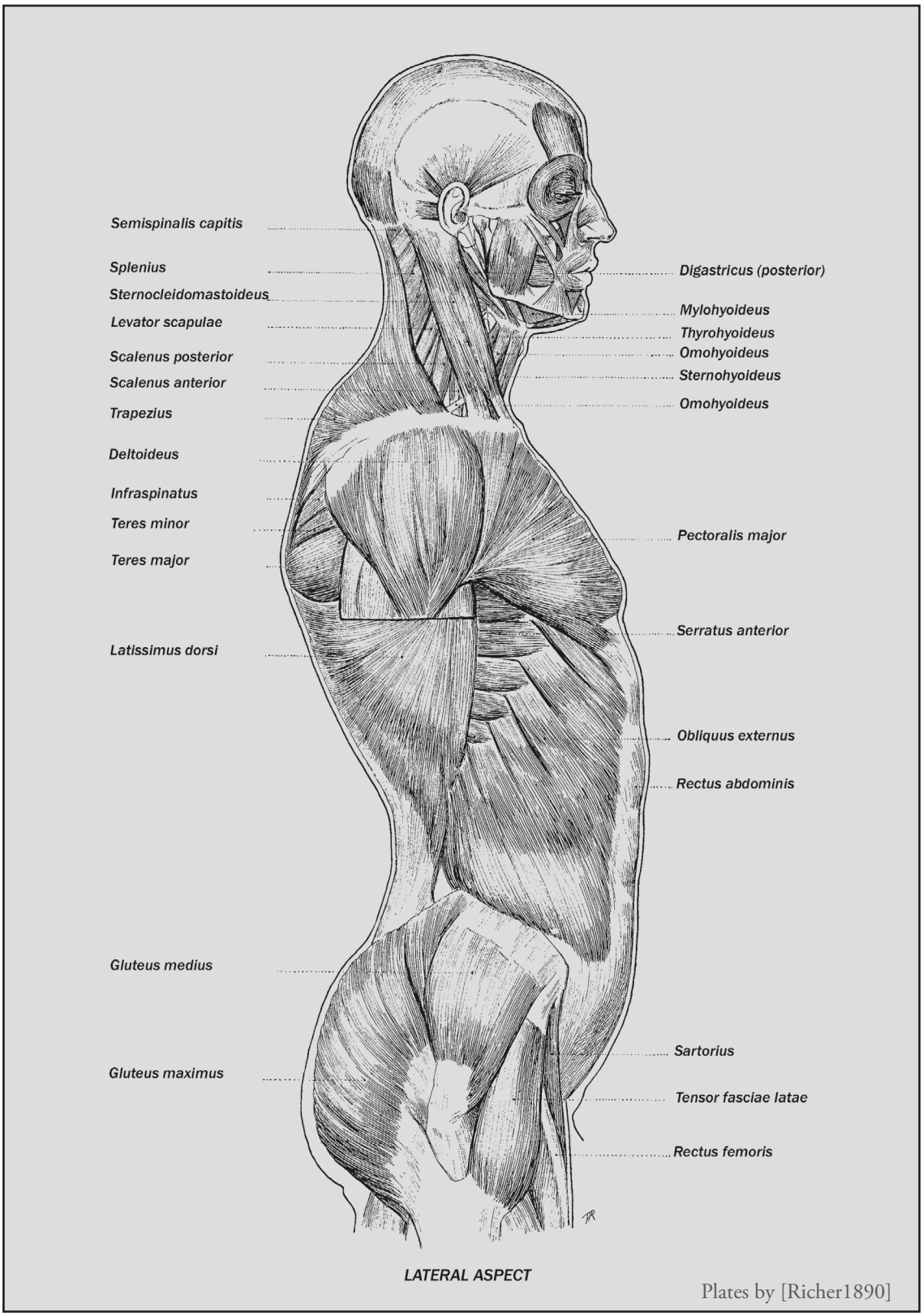


Plates by [Richer1890]

Important Landmarks

Ribcage
- Pit of the neck
- Epigastric depression
- 7th cervicle vertebrae

Pelvis
- Anterior superior iliac spine
- Posterior superior iliac spine
- Sacral triangle

Scapula
- Spine of scapula
- Acromion process

Forms

Ribcage and Pelvis

- The torso is a large mass and has a collection of powerful muscles to articulate it.

- To flex and rotate the ribcage with the pelvis the primary movers are: in front, the rectus abdominis, the 'six pack' muscle; and on the front/sides, just above the hip bone, the external obliques, the 'love handle' muscles.

- The back has columns of muscles running from the inside of the rear of the pelvis (in the sacral triangle), up the spine and attaching onto the vertebrae and inner border of the ribs. These muscles, known as spinal erectors, counteract the pulling motion of the rectus abdominis.

- The spinal erectors appear as round columns of muscles when the back is arched and flatten out and lie against the ribs and spine when the back is rounded.

Clavicle and Scapula

- Together the clavicles and scapulas make a bony clamp that grabs onto the top of the ribcage on each side.

- These two bones attach together at the point of the shoulder where the outside end of the clavicle (the thin S-shaped bone on the top-front of the ribcage) connects by ligaments to a square protrusion that projects from the spine of the scapula (the acromion process).

- The only solid attachment of this bony group to the rest of the skeleton is at the pit of the neck, where the inner end of the clavicle attaches to and articulates with the sternum.

- The scapula has no movable attachments to the skeleton. It floats free along the back of the ribcage, being articulated by a complex set of muscules that will be described in detail in the lecture.

- But, as a preview, the intimidating list of scapular muscles are the: trapezius, deltoid, teres major, teres minor, infraspinatus, supraspinatus, rhomboids, and the serratus anterior.

- Of these, the trapezius muscle covers the most surface area. The muscle is kite shaped and lies centered on the upper back at the level of the shoulders. Below of the centreline, the muscular kite has a triangular tail that narrows to a point as it decends down the spine to the base of the ribcage. To the left and right of the centreline, the trapezius attaches into the upper border of the scapular spine. It then wraps around the shoulder attaching into the acromion process of the scapula and then into the outer 1/3 of the clavicle in front.

Articulators of the Upper Arm

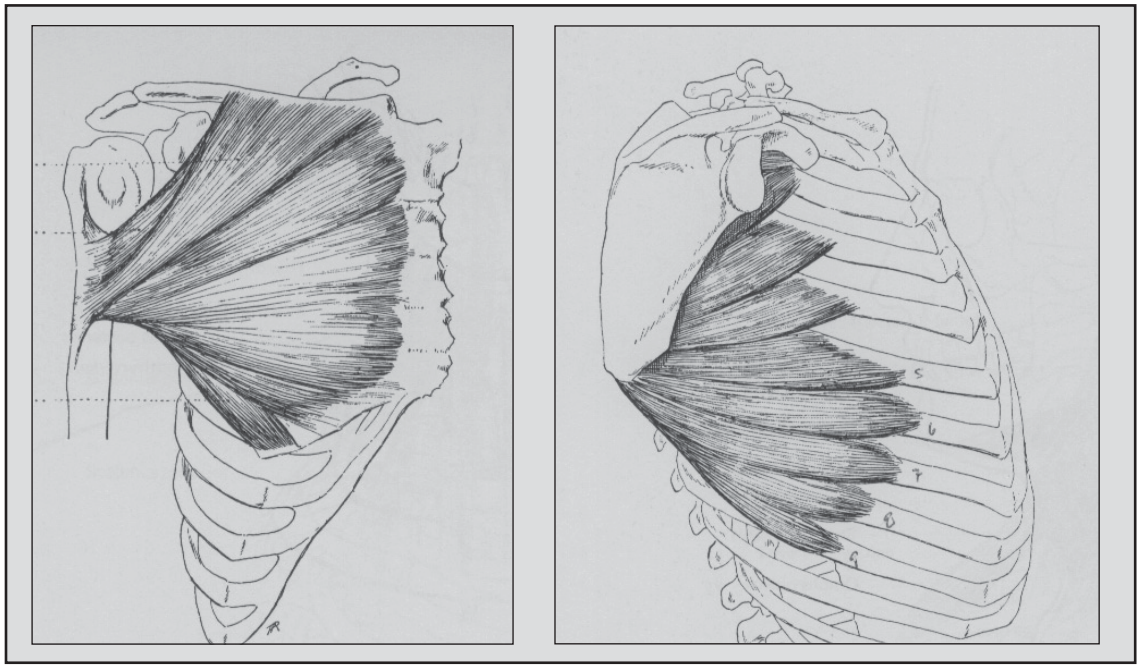
- The pectorialis major muscles ('pecs', the chest muscles), are square-ish masses of muscle that originate from the inner 2/3 of the clavicle, the length of the sterum, from the top down to the level of the fifth rib, and proceed outward, thinning to the point and inserting a third of the way down the upper arm on the outside.

- The pecs, pull the arm forward and also help to rotate it inward.

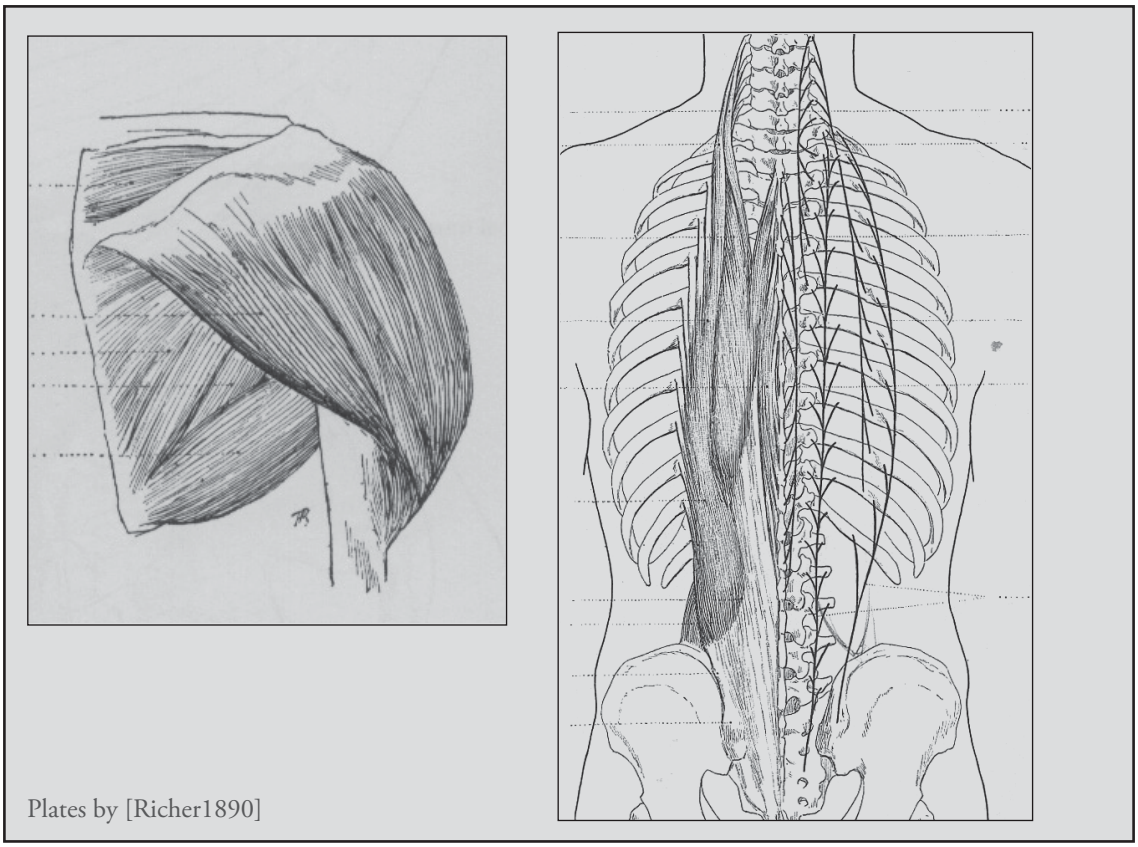
- The deltoid, describe in more detail in the arm lecture, sit outside the pecs and mass themselves over the top of the upper arm and shoulder. They help to raise the arm to the front, side and back.

- Along the back there is the latissimus dorsi (lats), a large sheetlike muscles that covers much of the lower half of the back. It overlays the spinal erectors, but because it is so thin and sheet-like, it does not mask their form.

- The lats transition from a large flat sheet into a thin strap of muscle as it proceed upward and wraps around the side of the ribcage before inserting into the upper arm, where it helps to make the rear of the armpit.



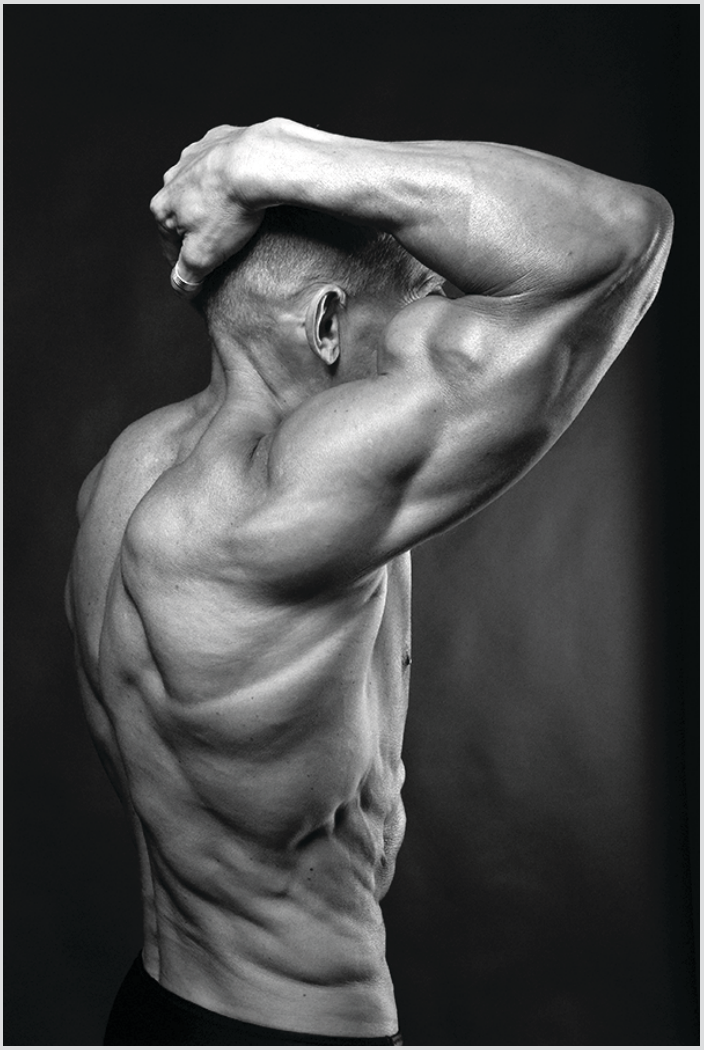
(l) plate showing the twist in the pectoralis major as it inserts into the humerus
(r) plate showing the origin and insertion of the serratus anterior



Plates by [Richer1890]

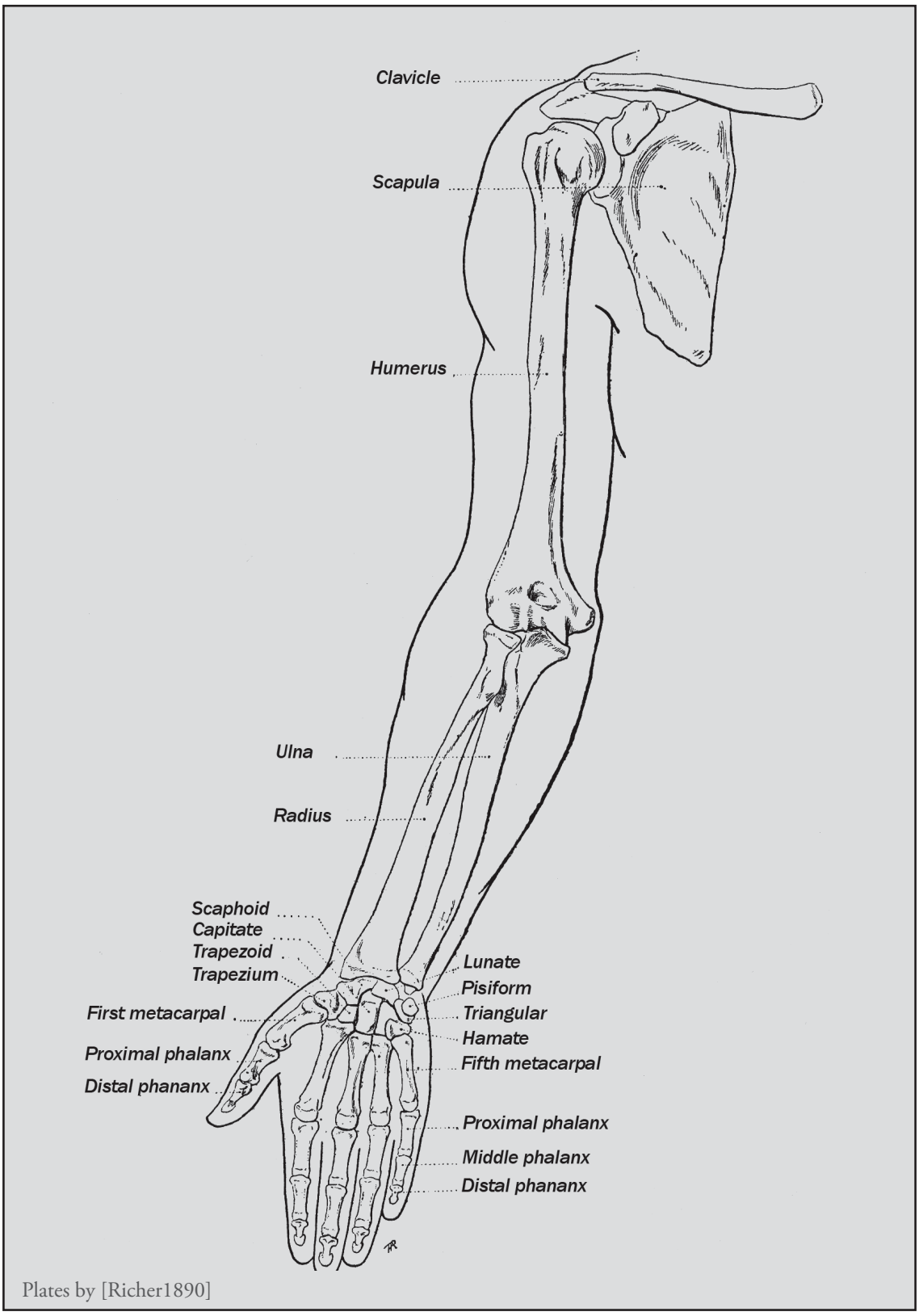
(l) plate showing the muscles of the scapula (trapezius and latissimus dorsi are removed)
(r) plate showing the spinal erectors along with a scematic of their origin and insertions

Examples



Examples

Lecture 3: Arms



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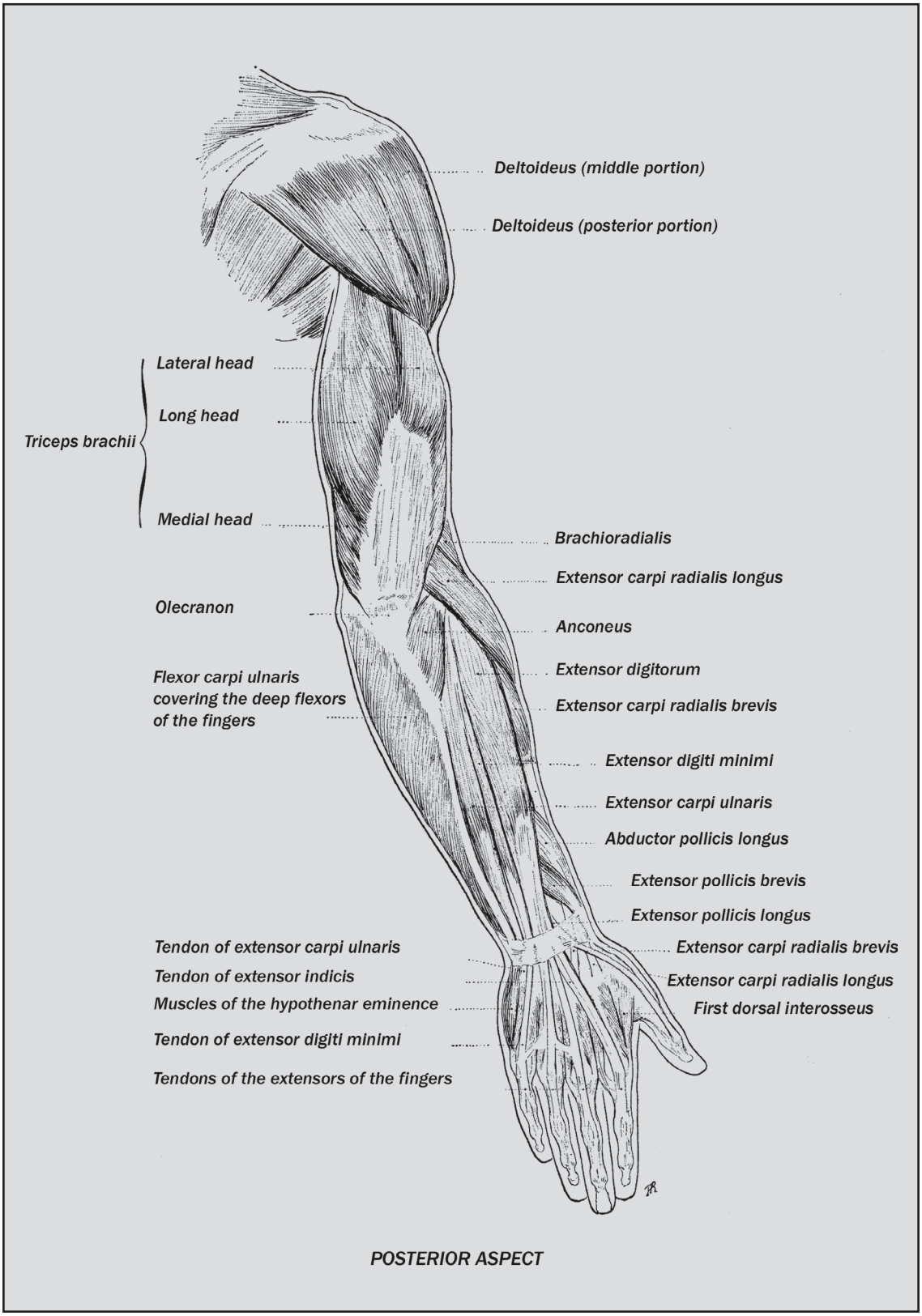
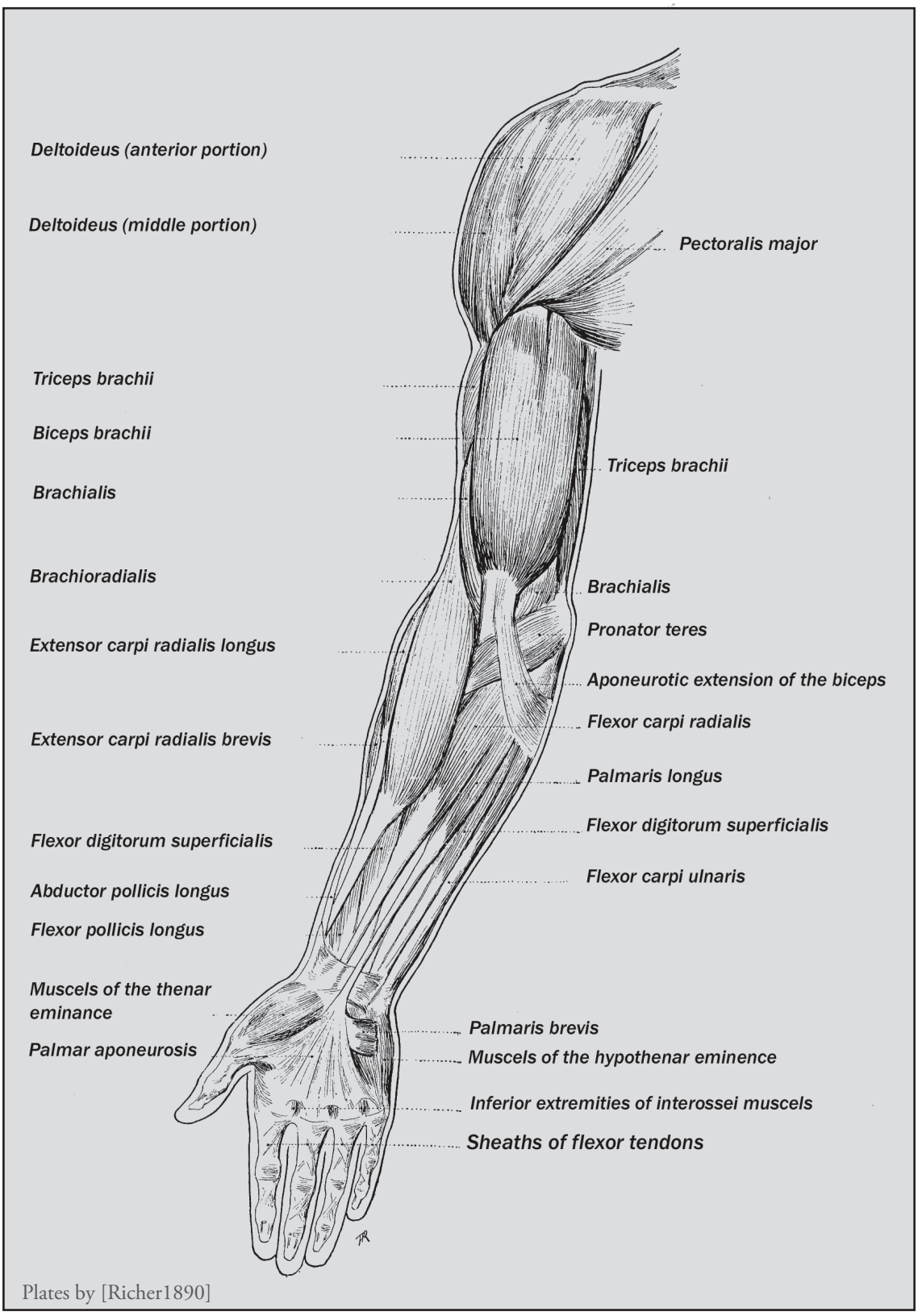


POSTERIOR ASPECT



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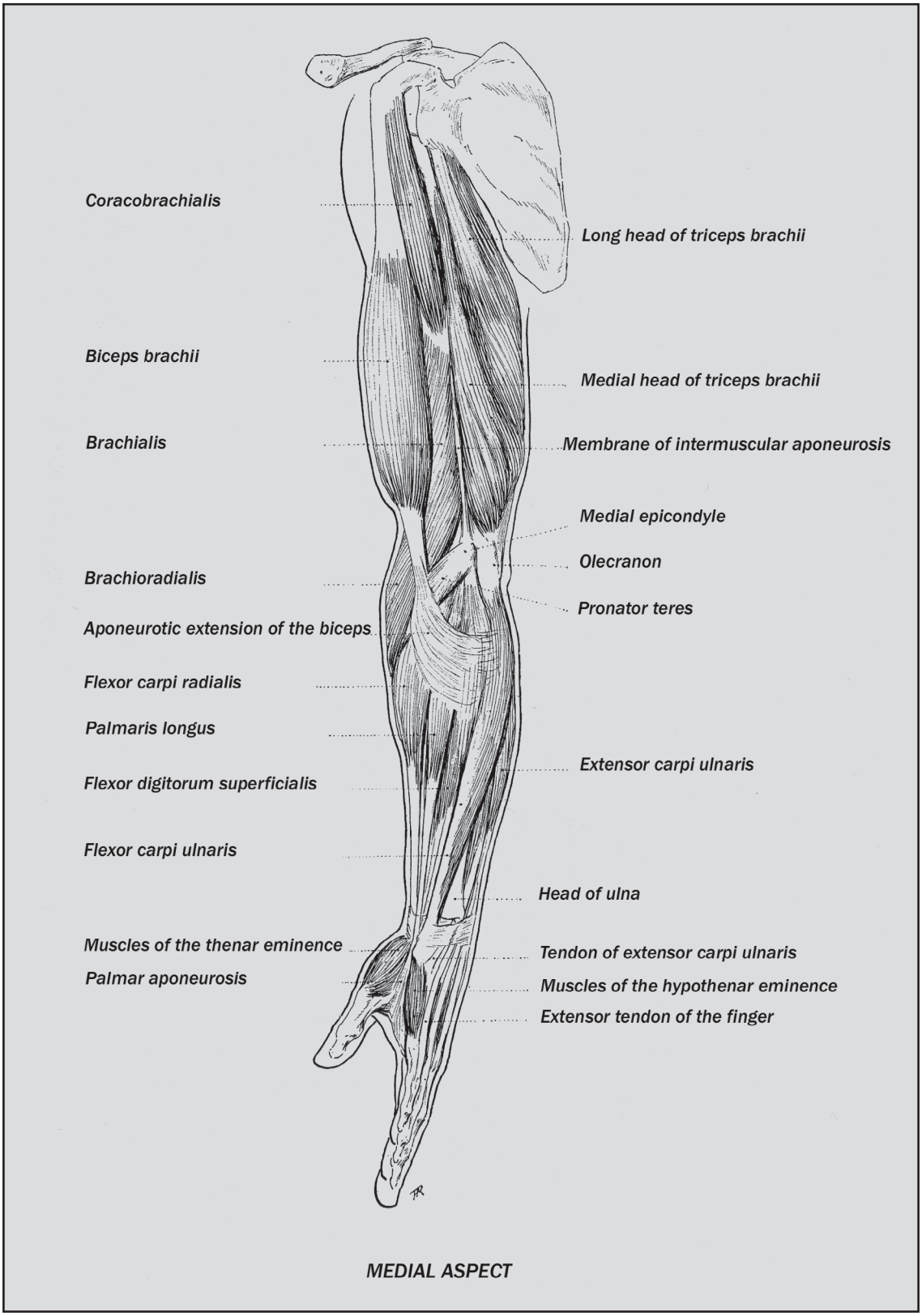
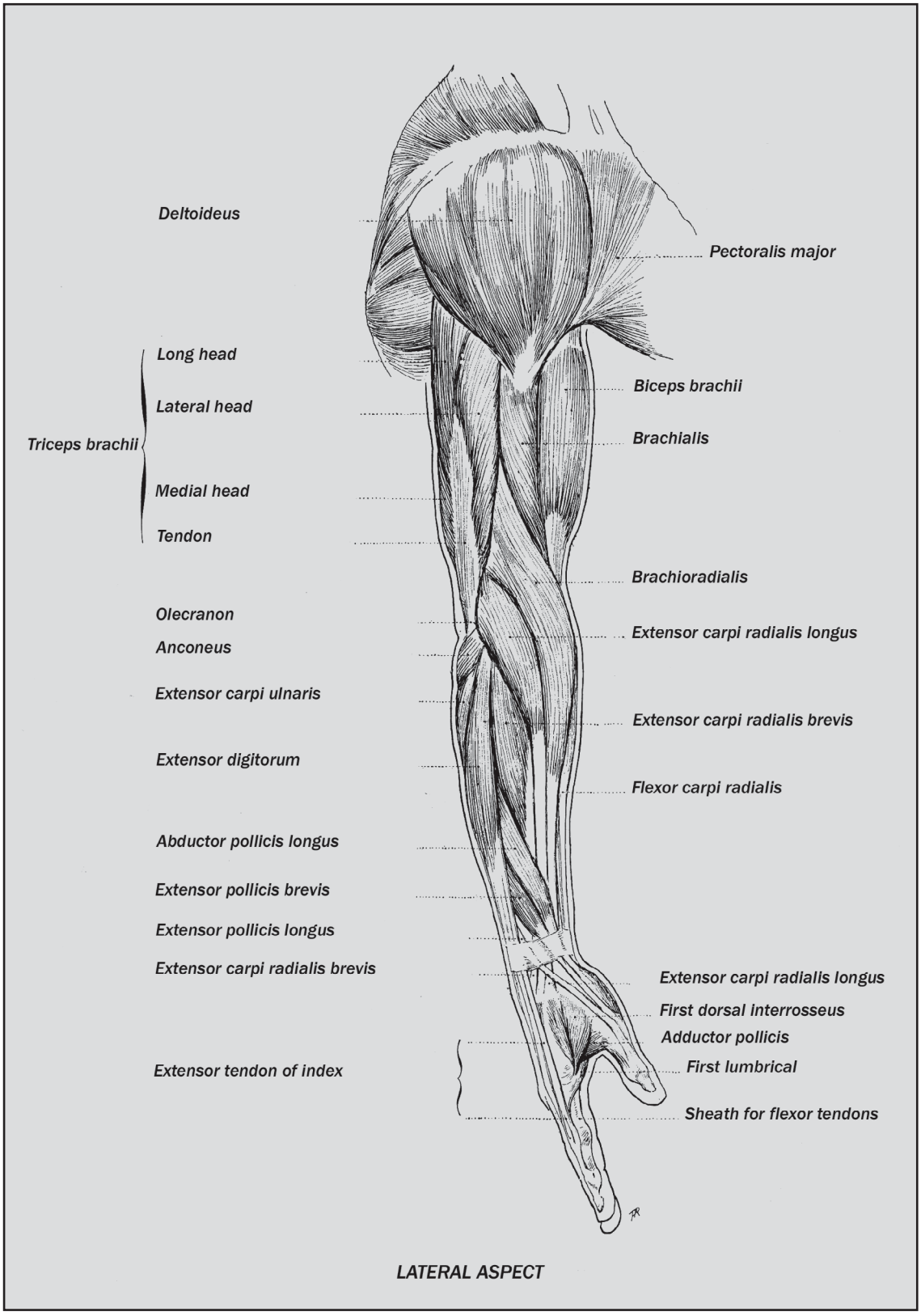




Arms and torso showing the difference in definition between tension and relaxation

Important Landmarks

Elbow
- Medial and Lateral Epicondyles
- Olecranon

Forearm
- Ulnar furrow

Wrist
- Head of the Ulna
- Head of the Radius

Forms

Shoulder

- The deltoid muscle has three heads and is the teardrop shape mass on the outside of the shoulder.
- It grabs the outside of the shoulder girdle and wraps around in the front and the back, originating from the outer 1/3 of the clavicle in front, the acromion process of the scapula on the side, and the spine of the scapula in the back.
- The mass of the three heads converge to a point approximately three fingers wide half way down the humerus (bone of the upper arm).
- In muscular individuals, the deltoid appears round and stout, often showing striated definition and separation of the three heads when under tension.
- In slight individuals, the muscle is relatively thin and the majority of the shape of the shoulder is established by the underlying bony mass of the shoulder joint (the head of the humerus inserting into the cup formed by the glenoid cavity of the scapula).
- Again in slight individuals, the shape of the shoulder becomes two bumps when viewed from the front. The top bump takes the shape of the shoulder joint, the lower bump is produced by the convergence of the fibres of the three heads at their insertion point on the outside of the humerus.

Armpit

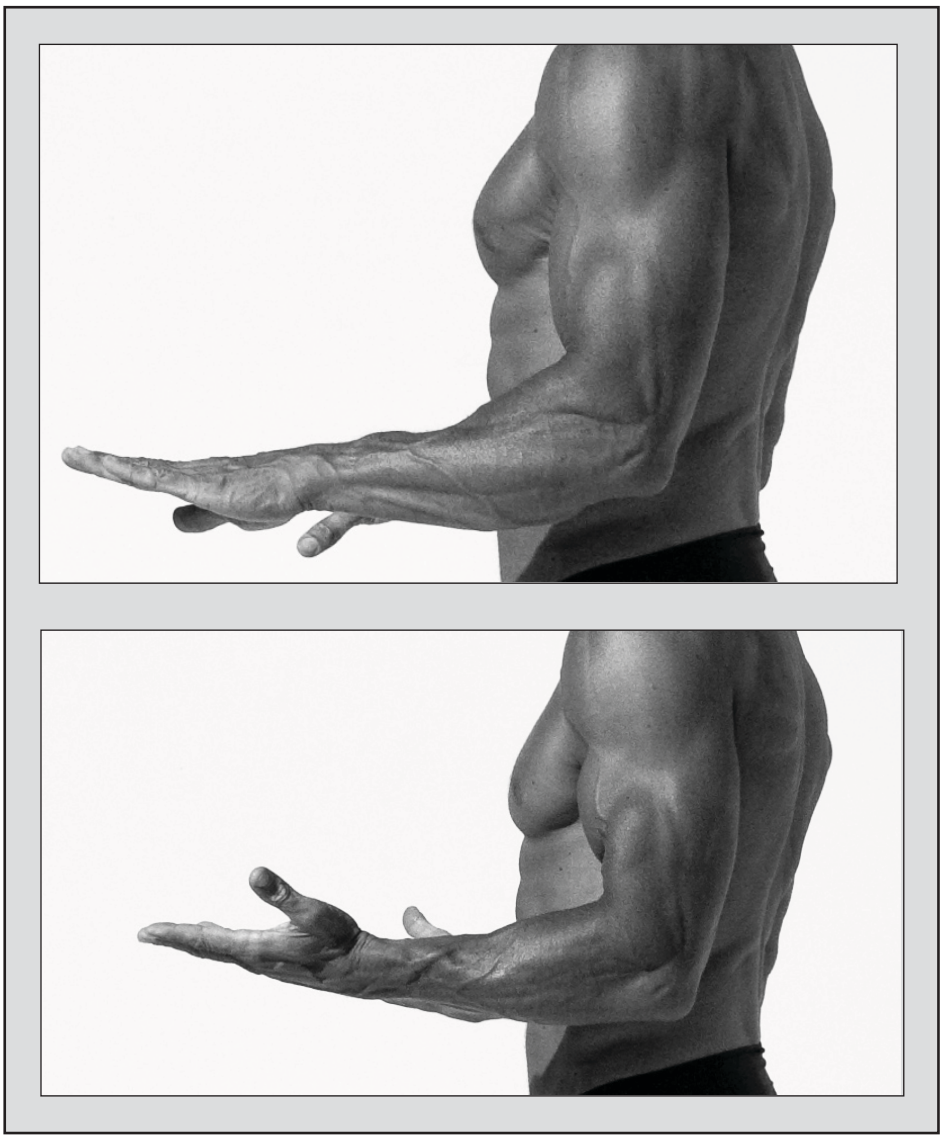
- Underneath the arm is the armpit, a feature of considerable complexity because of the number of muscles that make up the region.
- The muscles of the armpit (technically called the axilla) are: in the front, the pectoralis major of the chest; above, biceps muscle of the arm (more accurately, the coracobrachialis, a small muscle that will be explained in lecture); in the rear, the latissimus dorsi and teres major; and below the wall of the chest (showing the 'fingers' of the serratus anterior in lean individuals).

Upper Arm

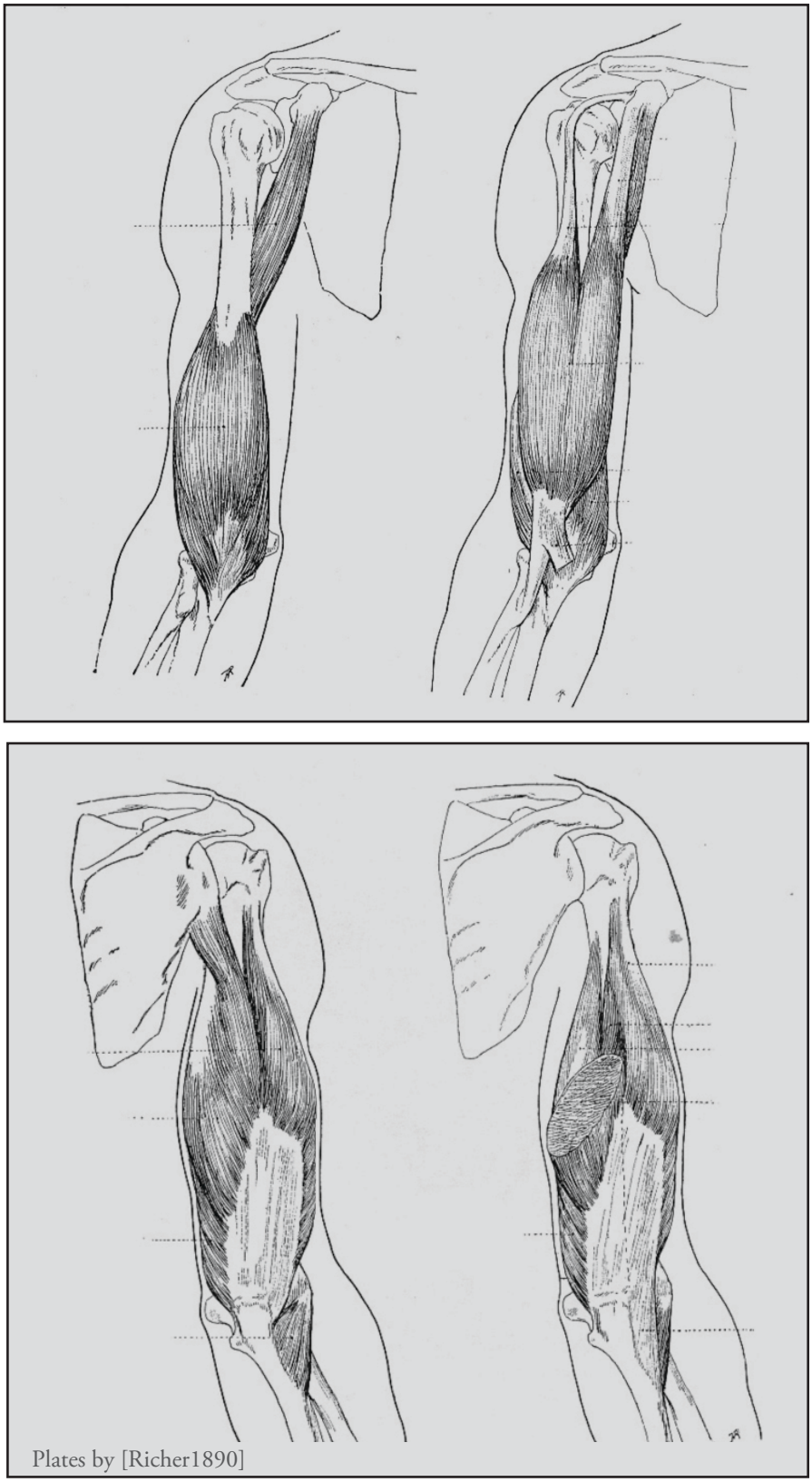
- Upper arm has two primary muscular groups: the muscles of the front which flex the arm, and the muscles of the back which extend the arm.
- The muscles of the front are, of course: the biceps, the 'hero' muscle of the front arm; but also the coracobrachialis, which lies underneath the biceps muscle, half way up the arm, and attaches into the armpit; on the outside, the brachialis, which appears from the side as a thin rectangular mass which separates the biceps and the triceps.
- The back of the arm is formed by the triceps muscle, which as the name suggests has three heads.
- The main shape of the triceps is a horseshoe, with the middle of the horseshoe being the large common tendon which lies on the back of the arm and inserts into the elbow. The tendon does not bulge in tension.
- The first of the triceps heads, the long head, sits on the inside of the arm and runs up to the armpit, inserting underneath the rear deltoid.
- The second head lies on the outside back of the arm. The main mass is short but a long tail of muscle runs along the common tendon down to the elbow.
- The third head is mostly hidden underneath the main tendon, but pokes out just above the elbow on the inside.

Lower Arm

- Divided into flexors and extensors
- The extensor muscles originate from the outside point of the elbow (lateral epicondyle of the humerus) and run along the outside of the forearm down to the back of the hand
- Extensors show a large amount of definition and each muscle should be learned and treated individually
- Flexors originate from the inside of the elbow (medial epicondyle of the humerus) and run along the inside of the forearm transitioning from muscle into tendon 2/3 of the way down the forearm
- Flexors generally appear as a common mass and can be treated as a single mass.
- Two 'special' forearm muscles, the brachioradialis and the extensor carpii radialis longus, create a mass that sits above the elbow on the outside and then loops around the other extensors to the front. These two muscles are often sculpted as a common mass except in extreme tension when they will show individual definition.

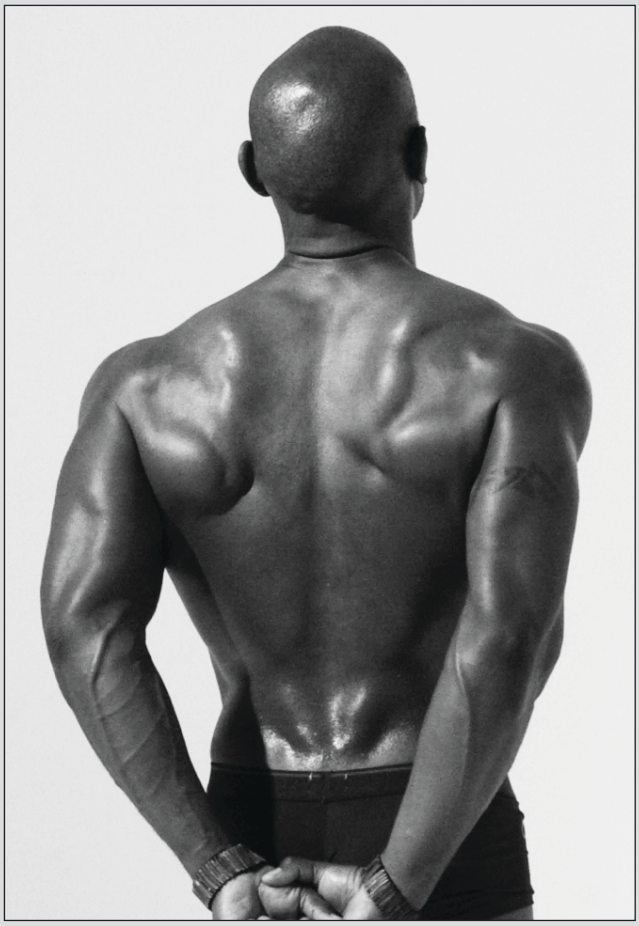


Change in the length of the biceps during pronation (palm down) versus supination (palm up).

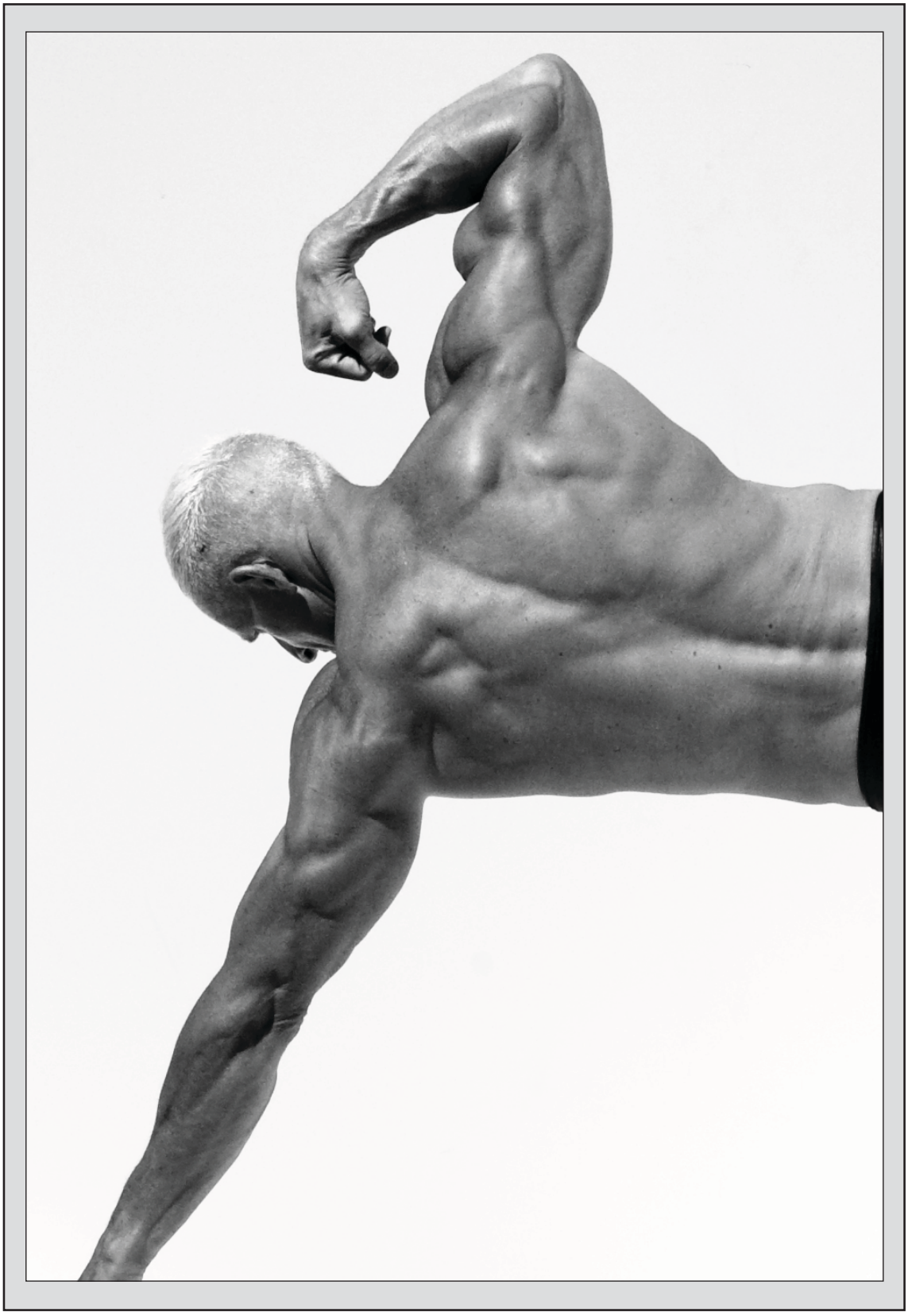


Plates showing the layering of the biceps on top of the bachialis (above) and the orientation of the three heads of the triceps (below)

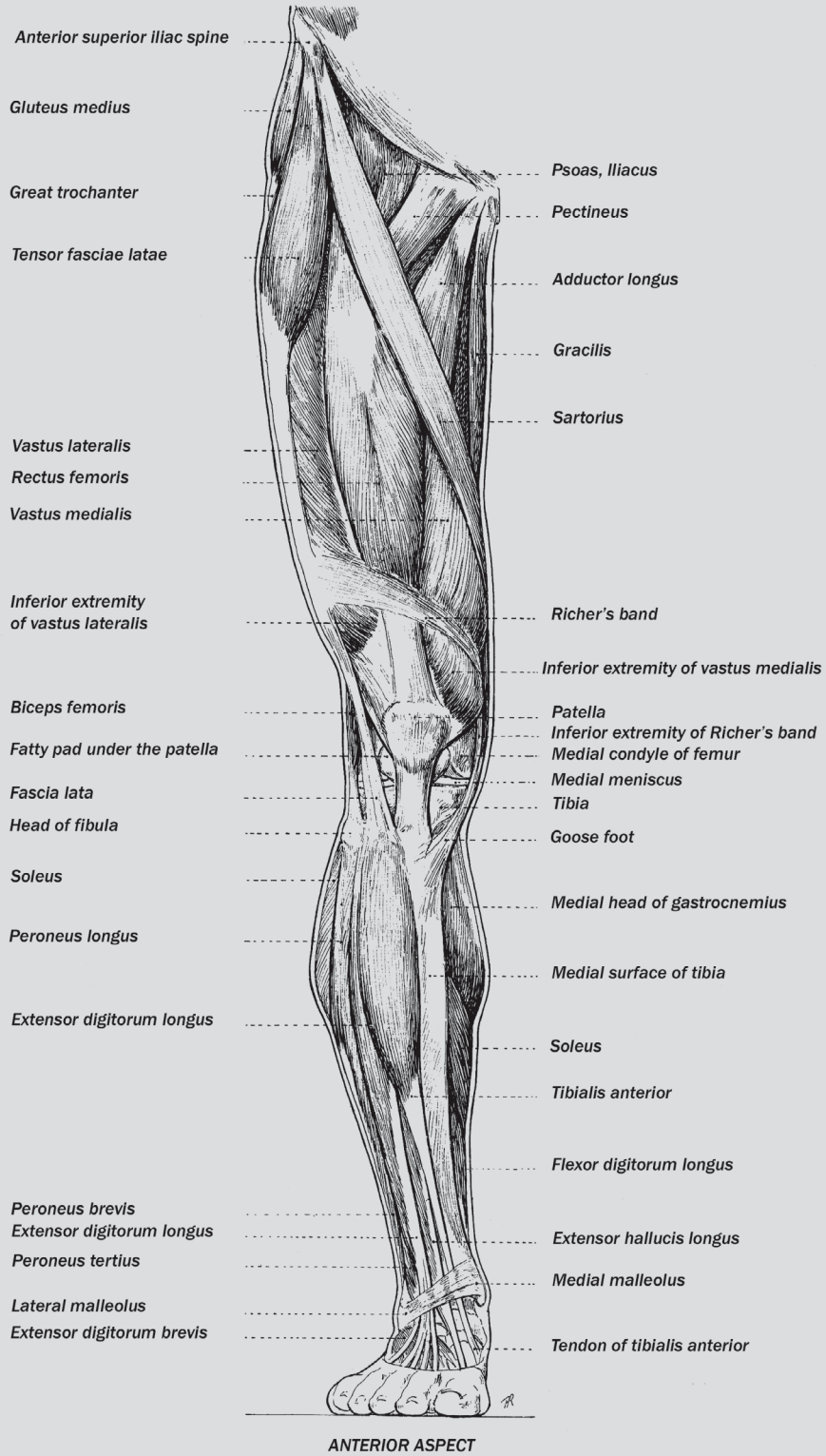
Examples



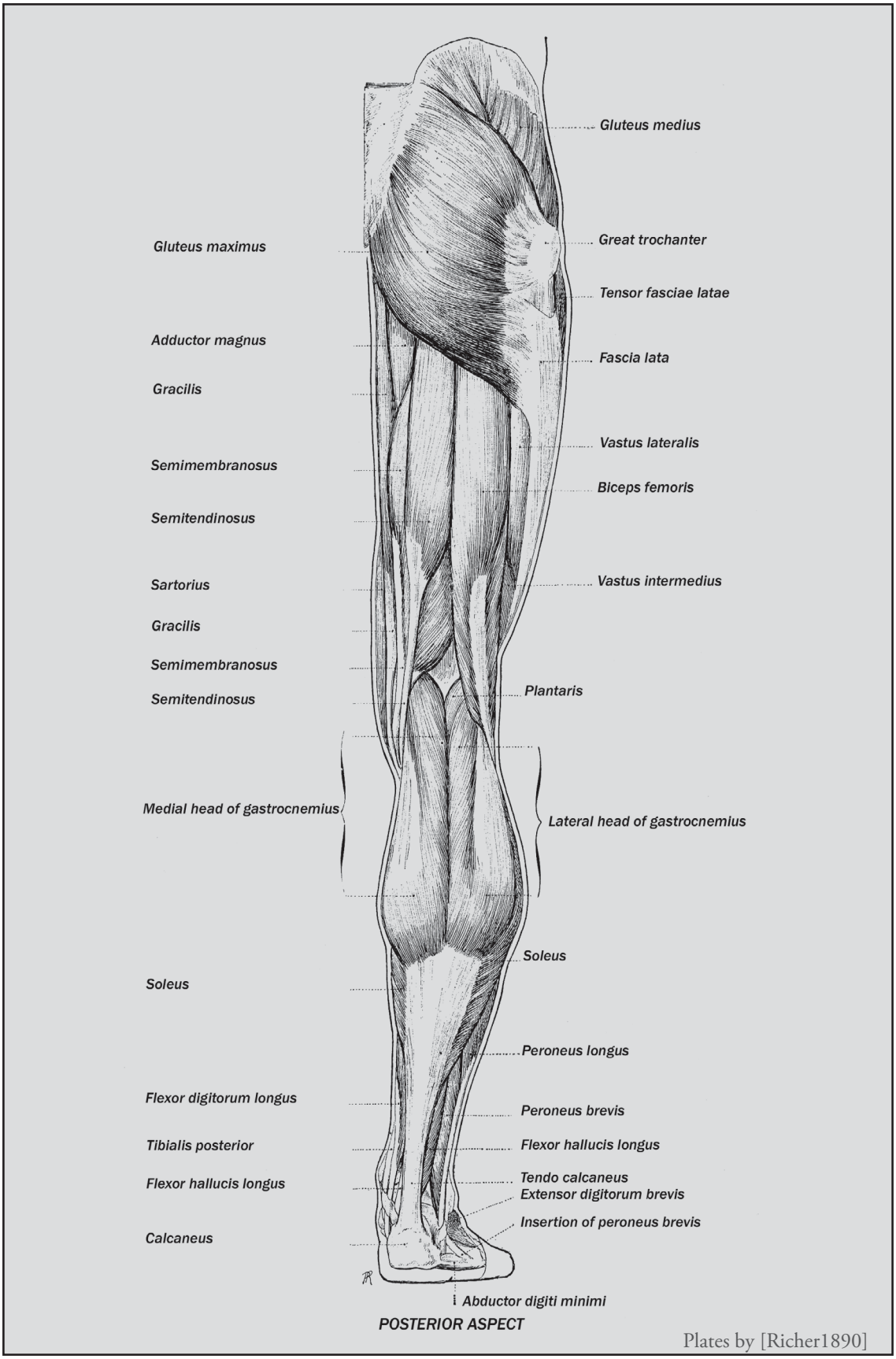
Practical Exercise

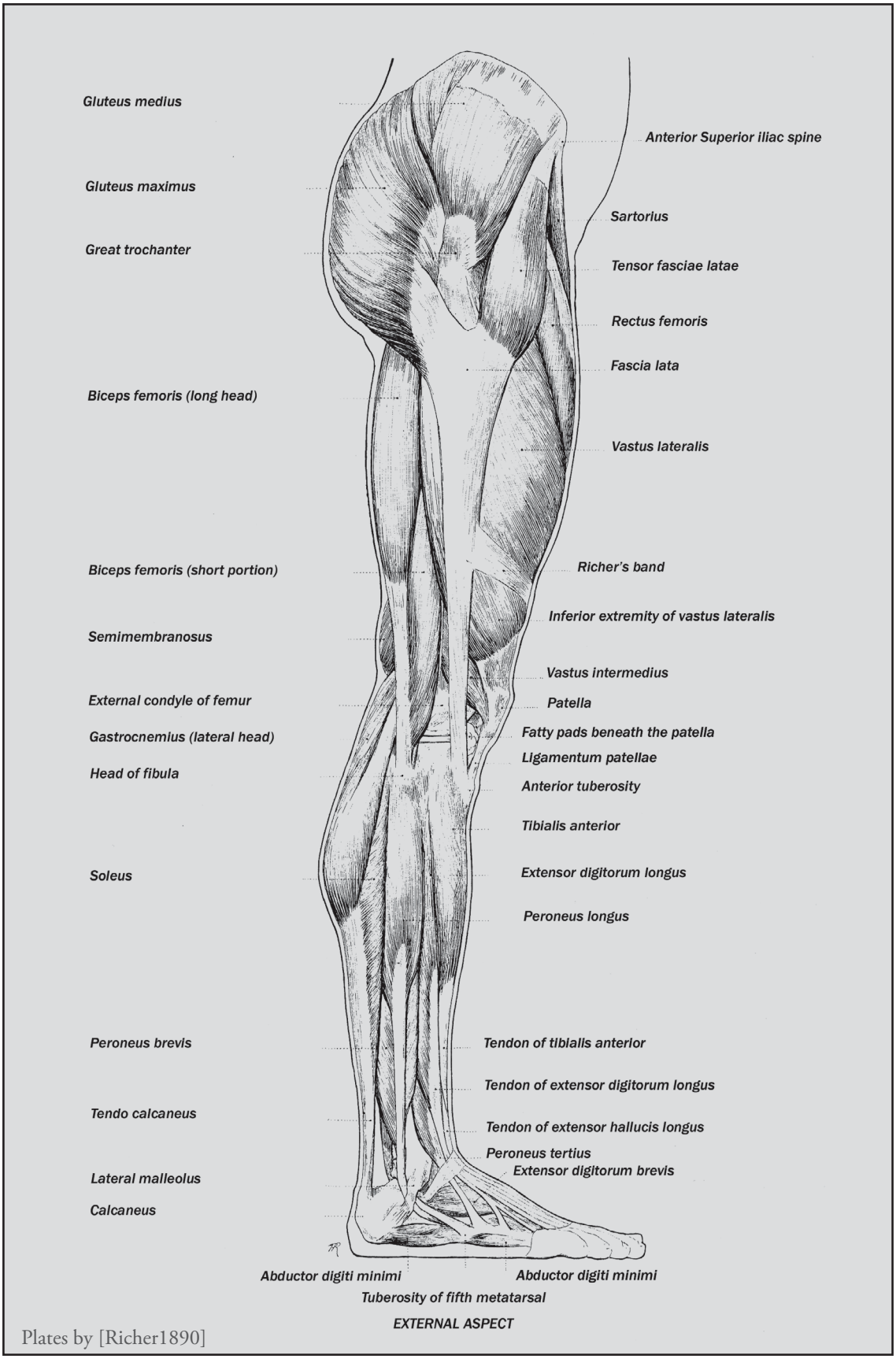


Lecture 4: Legs



Plates by [Richer1890]





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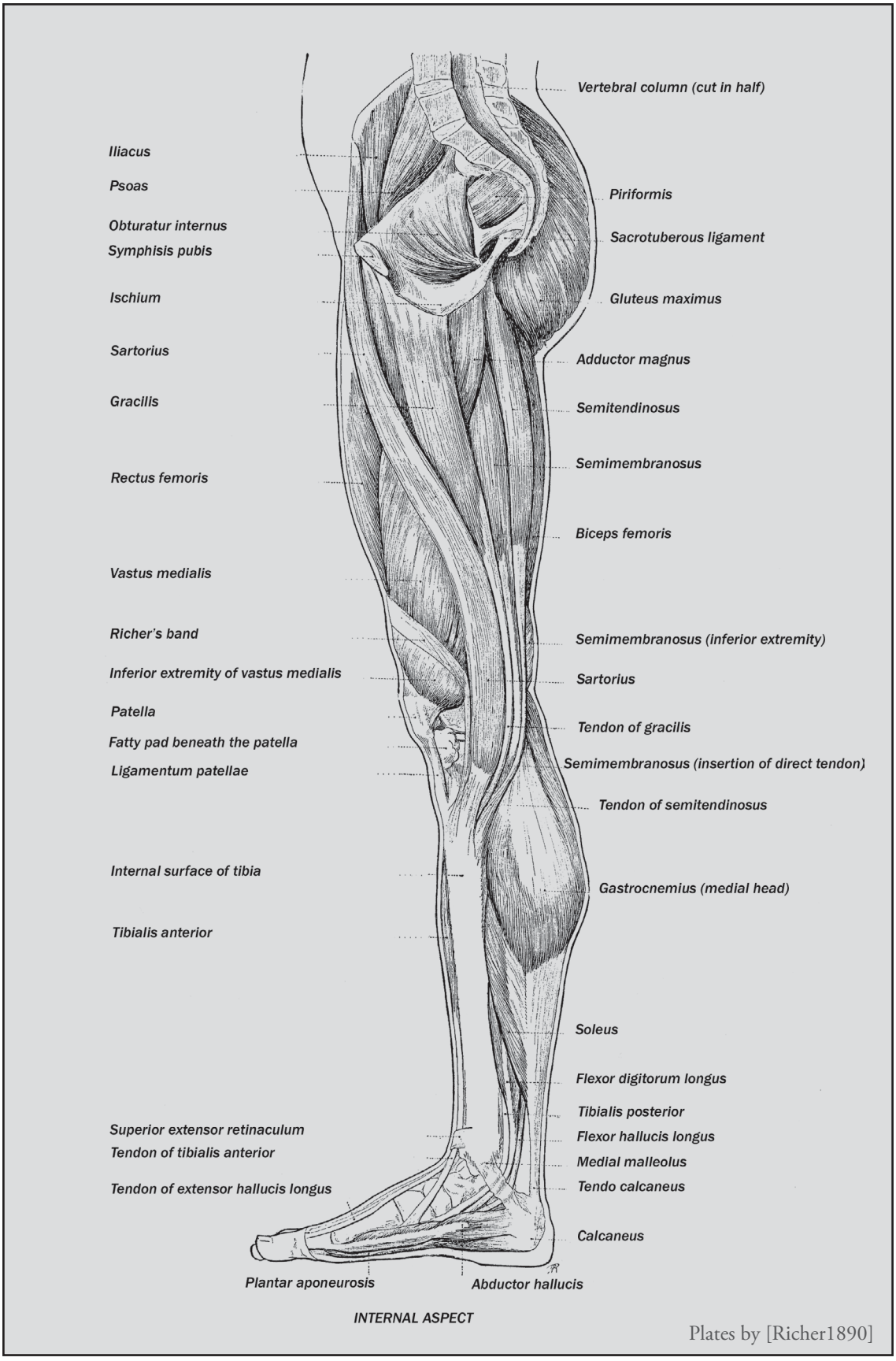


Plates by [Richer1890]

Forms

Pelvic Muscles

• Because the legs have to support the mass of the entire upper body, they require a powerful set of muscles to attach them to the pelvis.

• The muscles that attach the legs to the hips are the gluteal muscles of the butt. They are divided into two the gluteus maximus and the gluteus medius.

• The gluteus maximus attaches into the sacral triangle in back and wraps around to the side of the leg attaching approximately 1/3 of the distance down from the hip to the knee. This muscle, along with fat along the lower border, forms the mass of the butt as we know it.

• Above the gluteus maximus attaching into the crest of the hip is the gluteus medius.

• Used to pull the leg out to the side (abduct), this muscle creates a large bulge above the greater trochanter (bony projection of the femur), which appears as a a bump at the bottom of the depression formed by the gluteus medius above, and the gluteus maximus behind.

• In front of the gluteus medius is another muscle that helps to raise the leg to the front and side, it is called the tensor facia lata.

• The tensor facia lata is a tear-drop shaped muscle whose top point attaches to the hip in front (anterior superior iliac spine) and the mass sits down the side of the leg just in front of the greater trochanter.

• The lower edge of the tensor facia latae lies about at the same level as the bottom of the gluteus maximus.

Quadriceps

• As the name suggests, there are four head to the quadriceps muscle. But, like the triceps, one of the heads is mostly hidden underneath the others. Effectively this leaves three 'quad' muscles: on the inside the vastus medialis; in front, the rectus femoris; and on the outside, the vastus lateralis.

• These three muscles approach the knee from three different angles before inserting into one common tendon that passes over the knee cap and into the lower leg (tibia) just above the kneeling point.

• The vastus medialis starts halfway up the thigh and is a tear-drop shaped muscles that thickens as it decends before attaching into the common tendon at the level of the knee cap.

• The rectus femoris is muscle shaped like an elongated triangle which stretches from a point just below the hip to its insertion into the common tendon at a point nearly level with the midpoint of the vastus medialis.

• The vastus lateralis lies on the side of the leg and is squashed under a thickened tendinous band called the iliotibial tract. The majority of the muscle shows in front of this tendinous band and a small portion squishes out behind the band towards the rear of the leg.

Hamstrings

• The hamstrings muscles form the mass of the back of the legs. They flex the knee and also help to keep the pelvis upright.

• This mass is separated into two sides, on the outside the biceps femoris which attaches to the lower leg via a tendonous insertion onto the head of the fibula. On the inside of the leg, there is a separate pair of flexor muscles that insert low down on the inside of the knee.

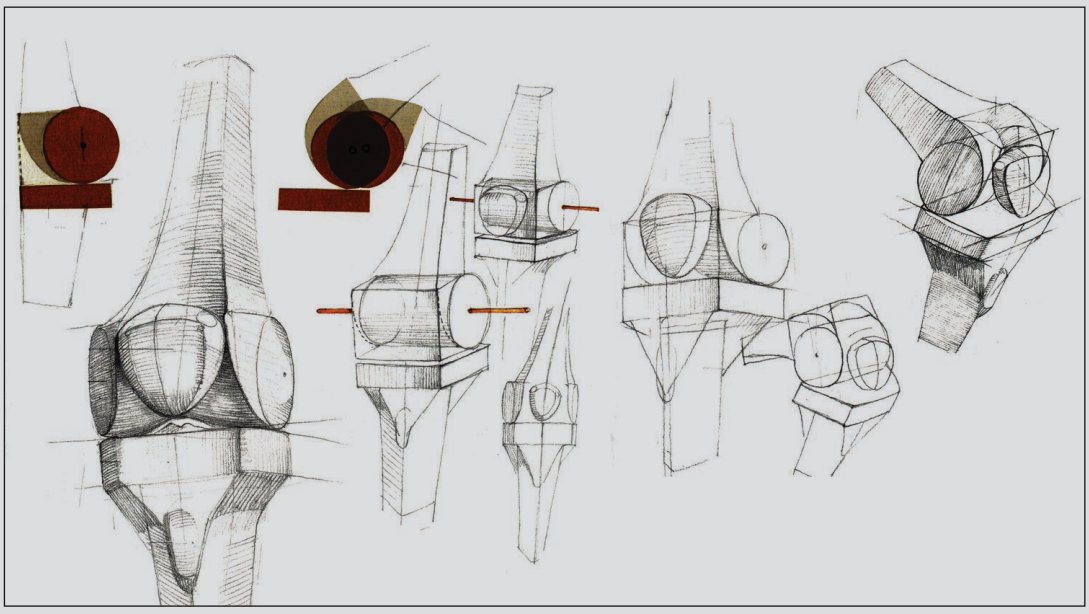
• In practice the muscles of the hamstrings merge and create an elongated oval mass moving diagonally down the back of the upper leg from inside to outside. This nonuniform mass is created by the variation in the length of the muscles and tendons of the hamstring muscles.

Inner Leg

- A number of muscles occupy the space on the inside of the leg between the quadriceps in front and the hamstring in the back. These are the adductor muscles of the thigh.
- They rarely show individual definition, but instead create a single ovoid mass that attaches into the lower inside of the pelvis and descend to the inside of the knee.
- The tendons of the adductors contribute to the fleshy bulge on the lower inside of the knee.

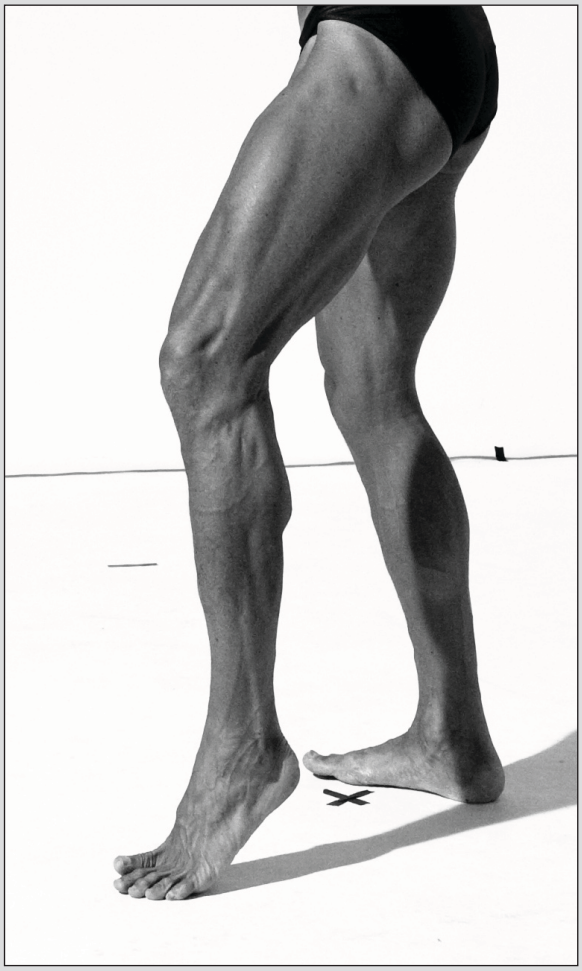
Lower Leg

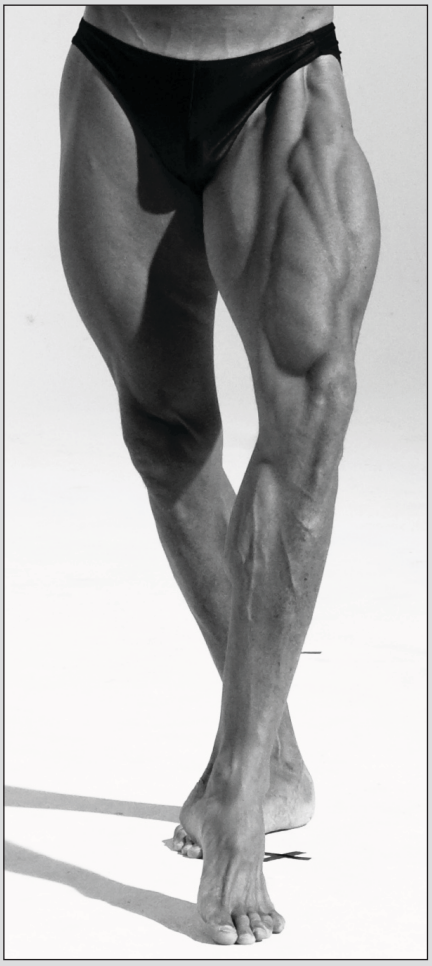
- Lower leg is separated into flexors and extensors much like the forearm.
- On the front of the leg are the muscles that raise the foot (dorsiflex) and extend the toes. They create a mass on the outer front of the tibia, just outside the bony ridge of the shin.
- On the back of the legs are the larger 'calf' muscles that are responsible for extending the foot (plantar flexion). These muscles are large relative to the muscle on the front and account for the bulk of the lower leg.
- The two primary muscles in the back of the lower leg are the gastrocnemius and the soleus. They both attach into the Achilles tendon which inserts into a point on the back of the heel.
- The gastrocnemius is composed of two elongated tear-shaped masses which originate as two muscular columns above the knee joint wedging between the lower end of the inner and outer masses of the hamstrings.
- Halfway down the lower leg, the gastrocnemius bulges and then inserts into a wide flat tendinious sheet, which slowly tapers to become the Achilles tendon. Of the two bulging heads of gastrocnemius, the inner head is lower than the outer.
- The soleus muscles lies underneath the gastrocnemius and shows on both sides of the lower leg. It inserts along the edges of tendinous sheet described above and descends lower than the gastrocnemius, finishing about 2/3 of the way down the lower leg. On the inside it occupies the middle third of the lower leg, on the outside it appears longer but thinner occupying the top 2/3 of the outer part of the lower leg.
- Other smaller muscles exist on the inside and outside of the lower leg that don't greatly influence surface form but do send a significant number of visible tendons to the foot.

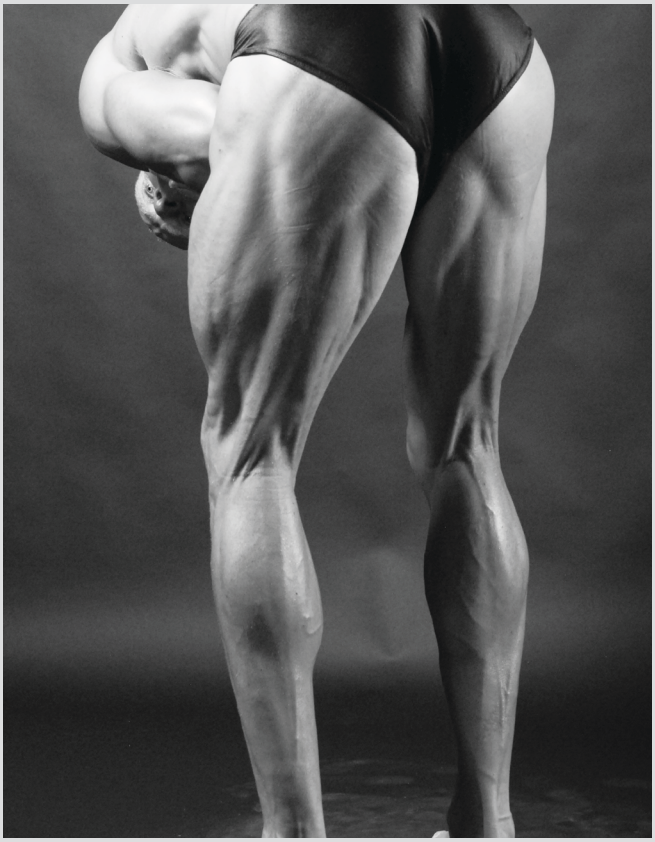


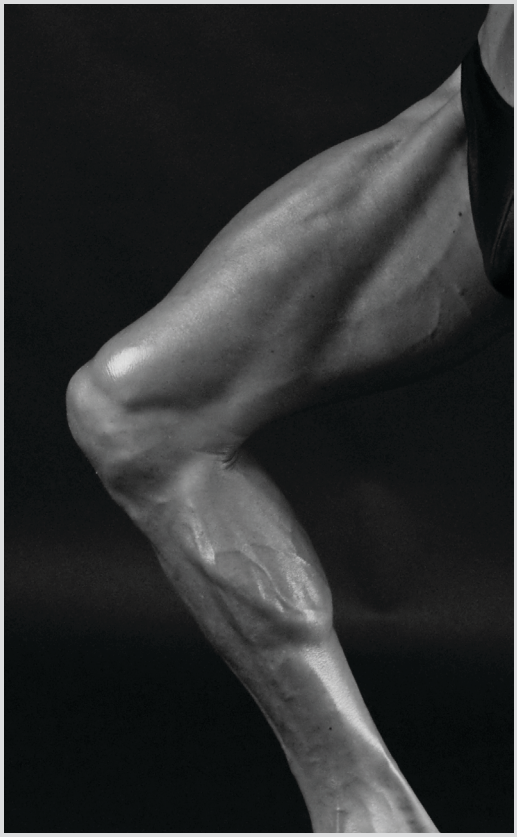
simplification of the knee by [Bammes1969]

Examples

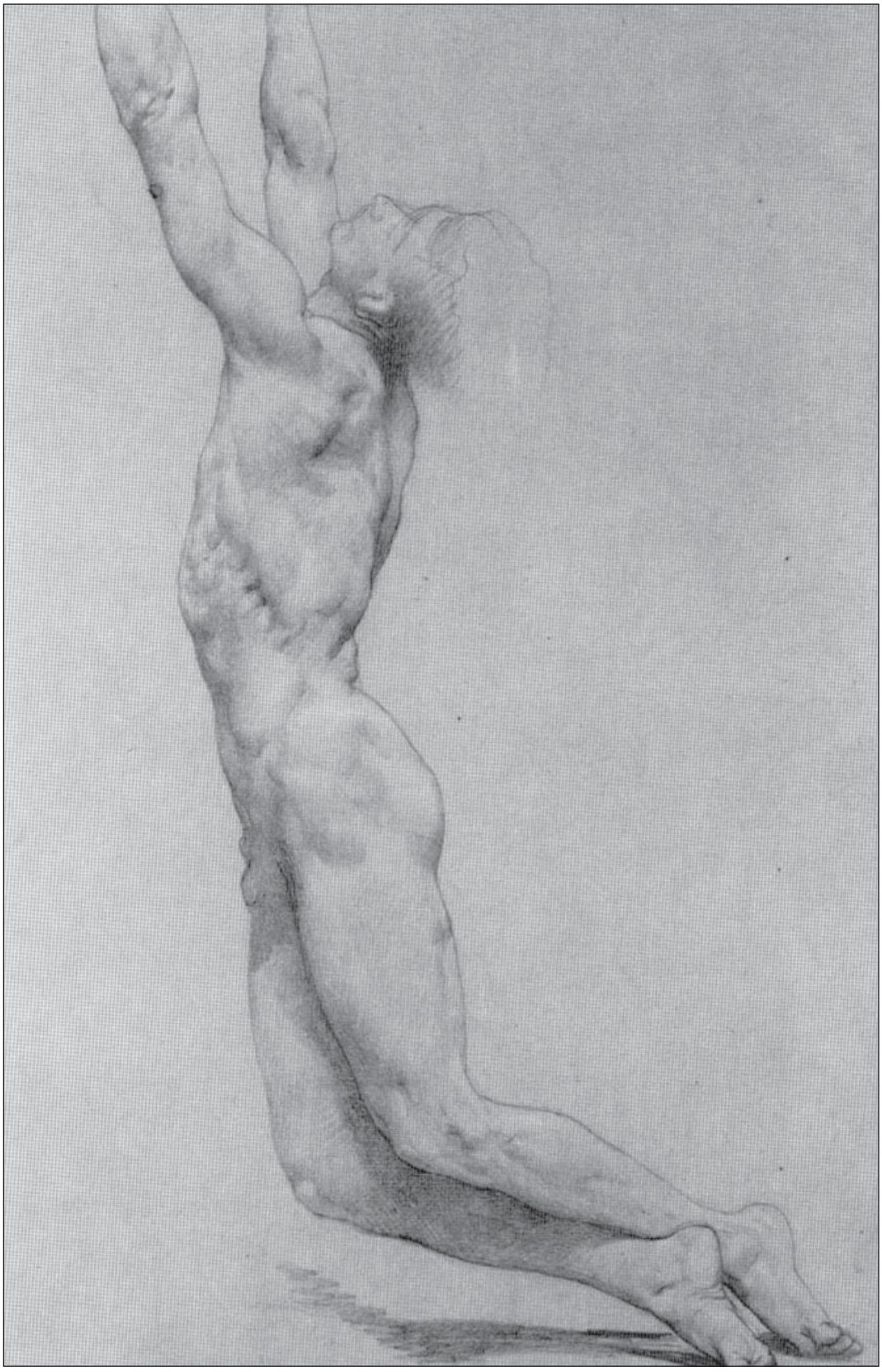




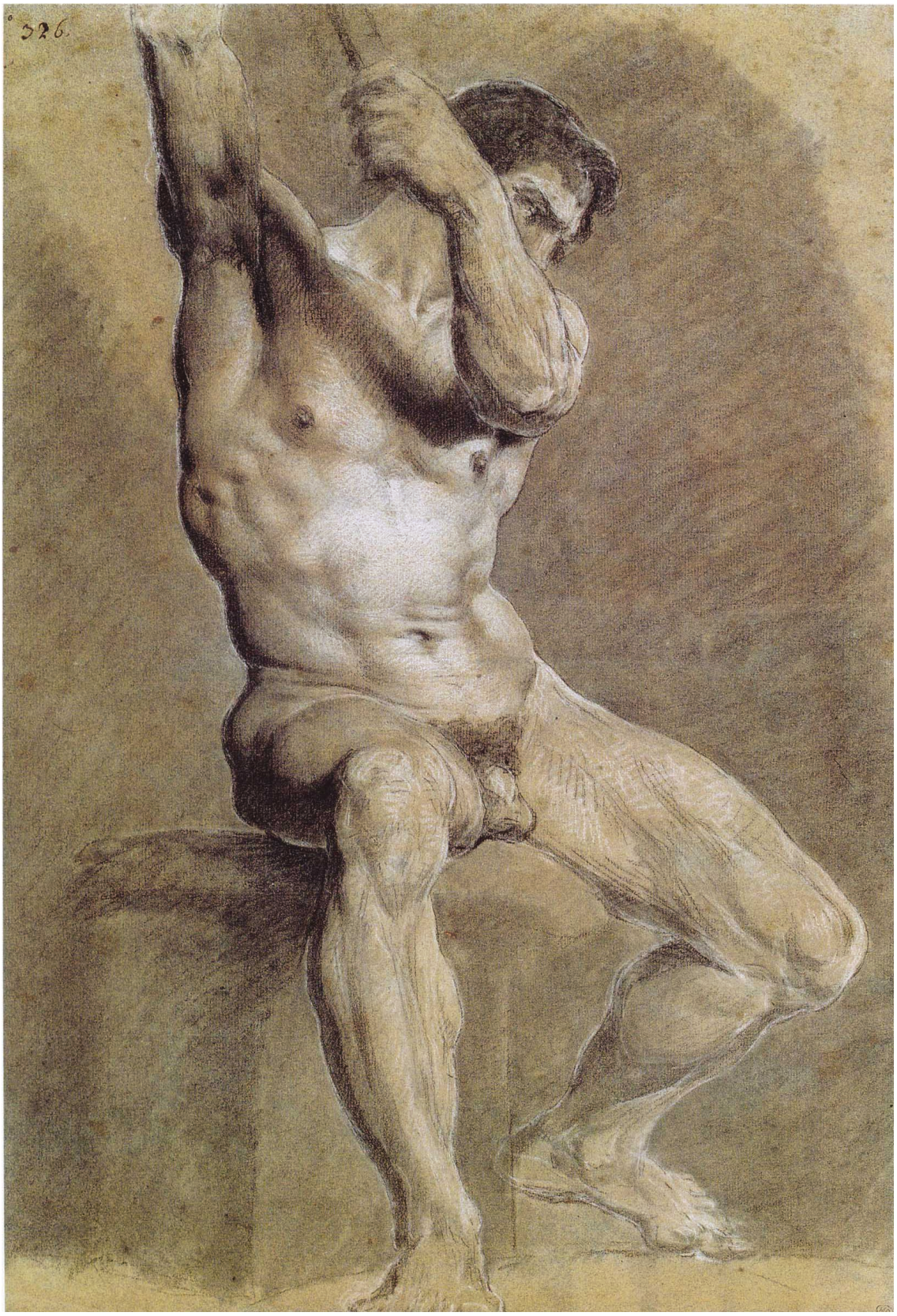




Practical Exercise



Practical Exercise



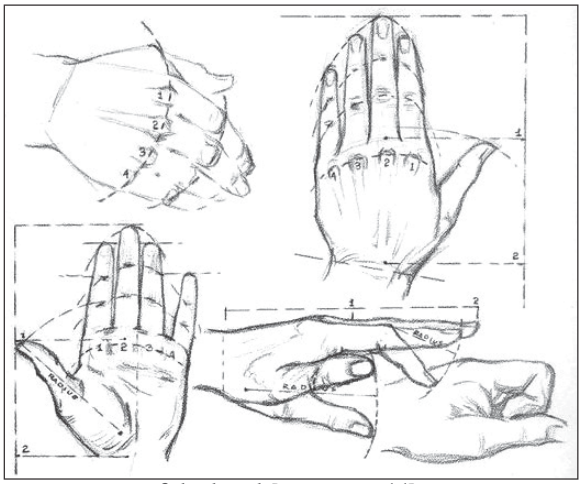
Notes

Lecture 5: Hands and Feet

Hands

Bony landmarks

- Carpals:
    - o Pisiform (below the pinky finger)
    - o Trapezium (below the thumb)
- Head of the Ulna
- Head of the Radius
- Fingers and knucles



construction of the hand [Loomis1944]

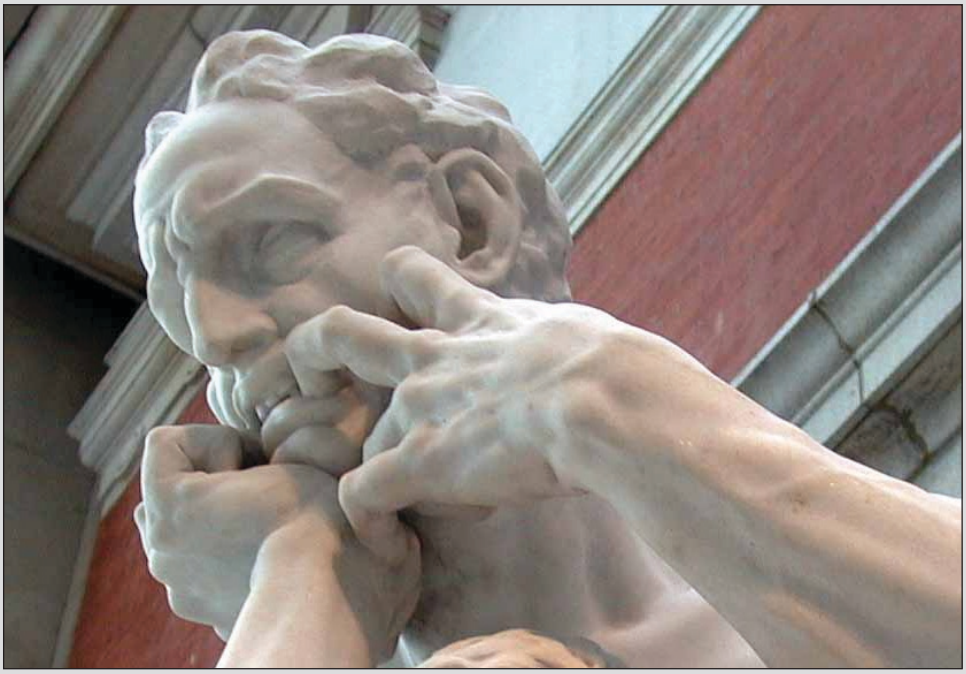
Construction

- Dividing the length of the hand from the end of the radius to the tip of the middle finger give the location for the base of the middle finger.
- The index and ring finger extend to the base of the nail of the middle finger.
- Tip of the pinky finger lies at the level of the knuckle of the fourth finger.
- The knuckles (end of metacarpals) for a crescent shaped arc.
- Beyond the metacarpal joint each finger segement (phalanx) is 2/3 the length of the preceding one.
- Nails are just under half the total length of the last phalanx.
- The palm passes over the metacarpal knuckles of the fingers, and, with the webbing between fingers, extends nearly ½ way up the first phalanx.
- Flexion folds on the palmar side of the fingers are evenly spaced and thus do not reflect the actual proportions of the phalanges (2/3 proportions).
- Origin of the metacarpal of the thumb sits on a plane lower than the metacarpal of the fingers.
- Second knuckle of the thumb lies at the level of the first knuckle of the index finger.

Forms

- Metacarpals of the hand create an arch across the top of the hand.
- A matching depression creates the cup of the palm.
- Bordering the palm on the thumb side is the thenar eminence. This bulge results from a pair of muscles that insert just above the first joint of the thumb and originate at the base of the palm. This pair of muscles creates a single unified mass that occupies proportionately the lower 1/3 of the palm.
- On the outside is the hypothenar eminence created by a similar pair of muscles that attach into the pinkly finger just above the first knuckle. The mass extends down the palm in an elongated wedge where it attaches into the base of the palm.
- Viewing the hand from the top, there is another significant muscle that lies between the thumb and the first finger. It is called the first dorsal interosseus and it originates in the V-shape between the metacarpal bones of the thumb and index finger, and inserts just above the knuckle of the index finger. This is the muscle responsible for the egg-shaped bulge on the top of the hand when the thumb is pressed against the first finger.

Examples



Feet

• The foot owes its load bearing capacity to its mechanical arch that distributes the weight across the padded surface of the sole of the foot.

• The image below presents a simplified approach to constructing the foot and is a good starting point for understanding the larger masses and planes of this often neglected body part.

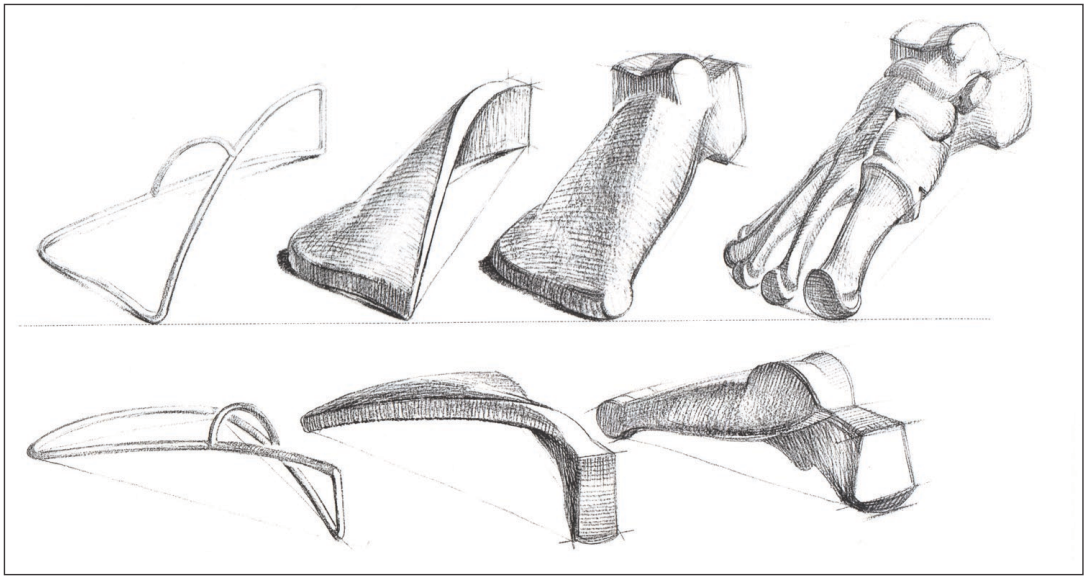
• The bony structure (tarsals and metatarsals) is responsible for the majority of the surface form of the foot as there is little fat or muscle that is subcutaneous on the top of the foot.

• Most obvious bony landmarks of the foot are the inner and outer ankle bones (medial and lateral malleoulus). Notably, the inner bone sits at a level higher than the outer bone - a helpful pneumonic: High Inside (HI), Low Outside (LO). Together these two bones make a clamp that locks onto the high tarsal of the foot (the talus), and creates the joint of extension for the ankle.

• The flexion, extension, and rotation of the ankle is driven by the pull of tendons decending from the muscles of the lower leg and attaching onto the bony structure of the foot. These tendons produce significant surface form when the foot is under tension in any direction. The pattern and flow of the tendons and their insertions should be studied to accurately model and articulate the foot.

• In addition to the tendons decending from the lower leg, there are muscles that reside on the foot to assist in moving the toes. Most noticable is the short extensor muscle of the toes (extensor digitorum brevis) which creates a small oval protrusion in front of the lateral malleolus of the ankle.

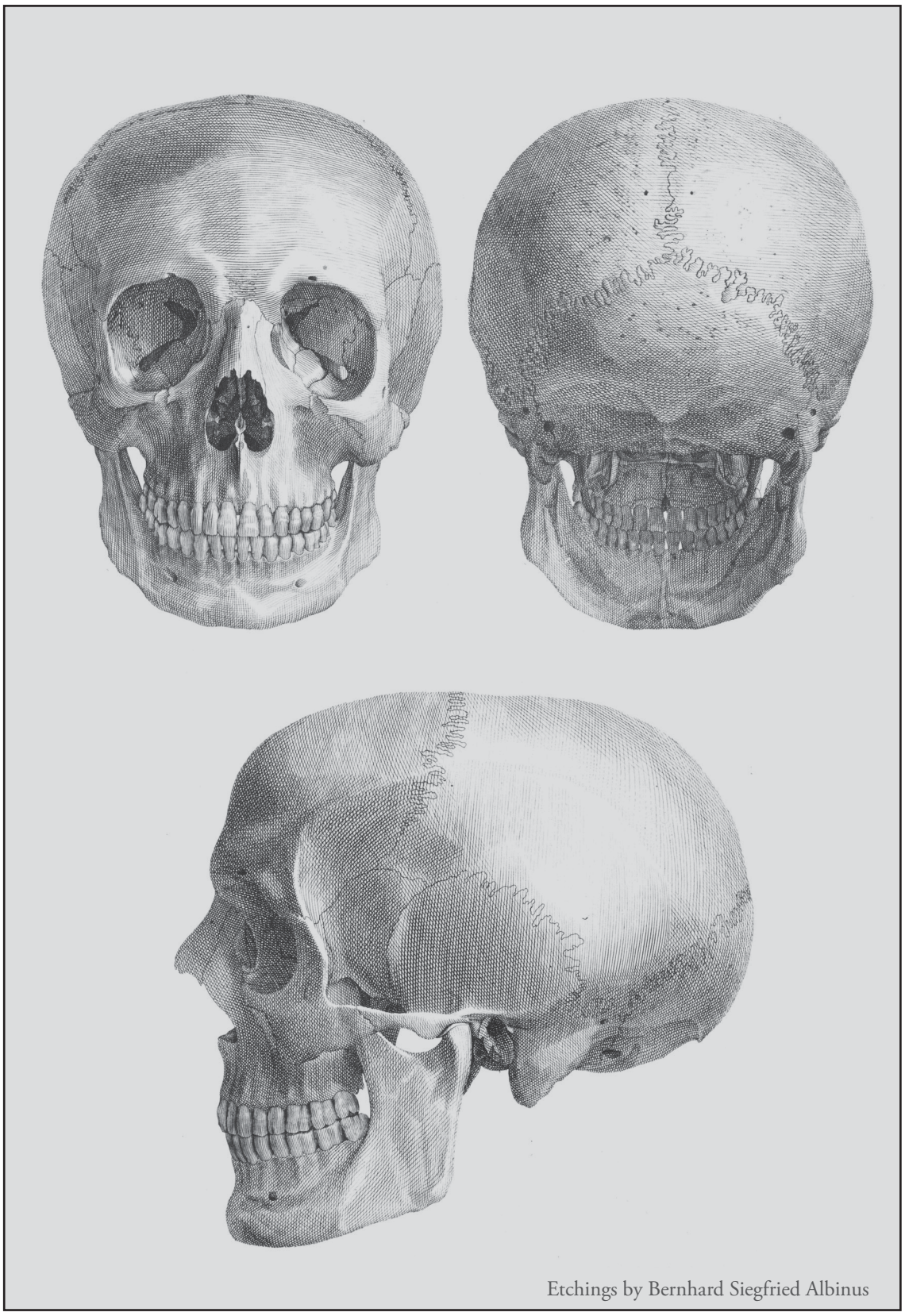
• Additionally there are two abductor muscles, one on the inside and one on the outside of the foot, which attach onto the big and little toe respectively. They create small, elongated, muscular bumps along the length of the foot. Their form is subtle but adds realism of a foot model.



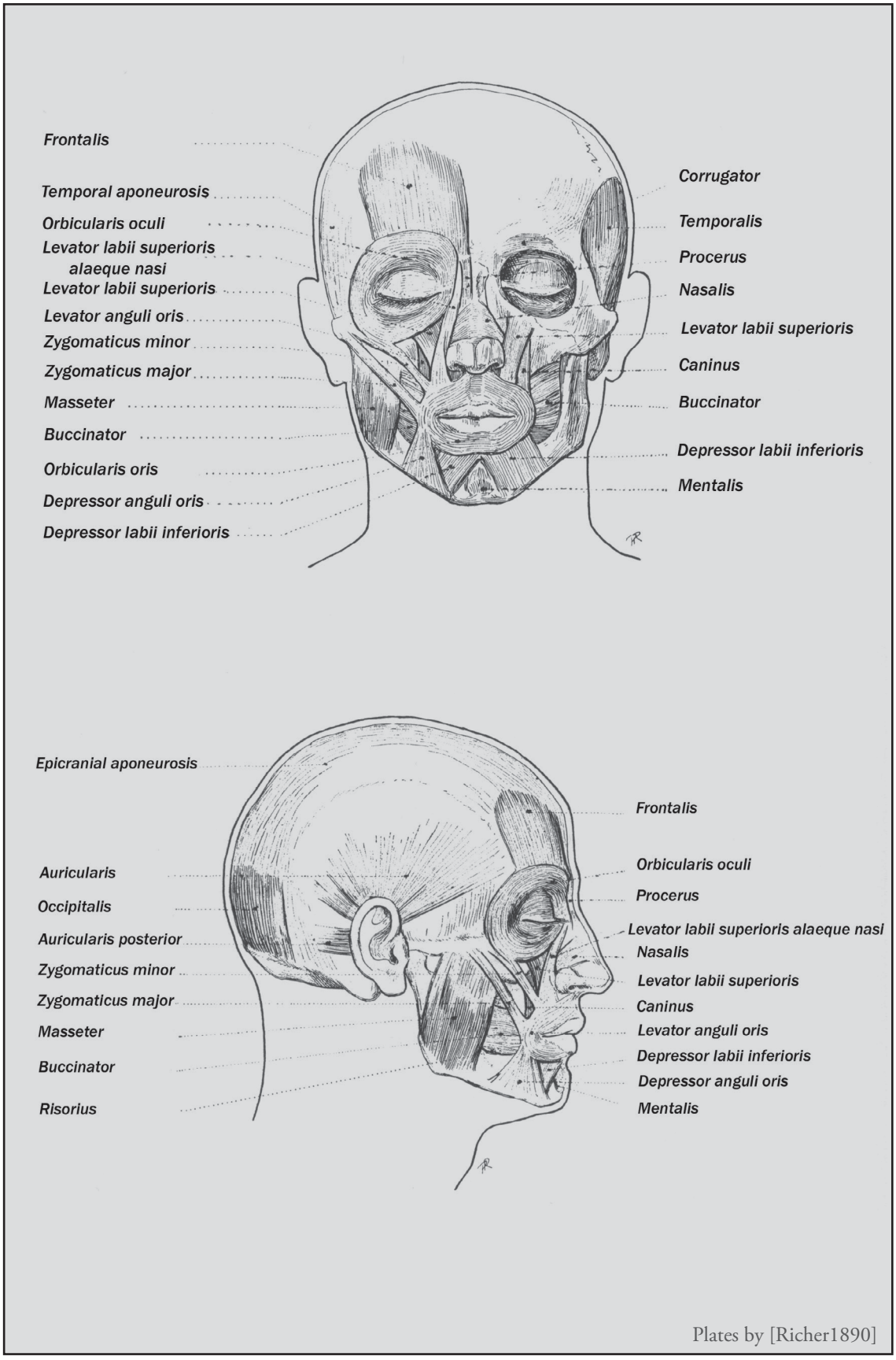
simplification of the planes of the form of the foot by [Bammes1969]

Examples

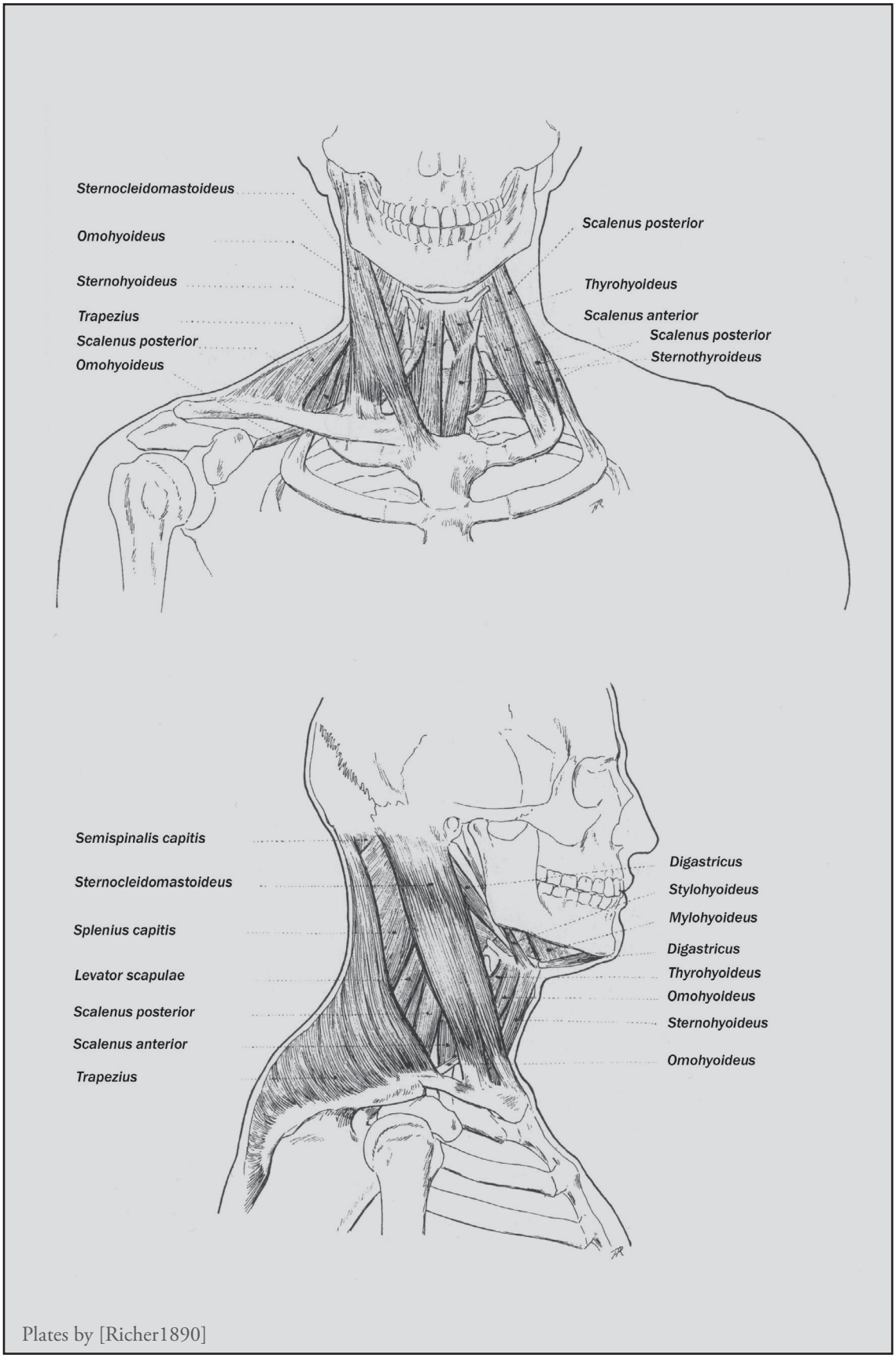
Lecture 6: Head and Neck



Etchings by Bernhard Siegfried Albinus



Plates by [Richer1890]



Plates by [Richer1890]

Forms

Forms of the Head

• Successful construction of a head relies on a solid understanding of the skull underneath. The bony sections of the face must be modelled with a quality that distinguishes them from the fleshy sections.

• Spend time understanding the forms of the skull and how they translate to surface form in the live model.

• The bony shape of the orbital socket should be considered before constructing the eye that it contains. Let the bony landmarks guide the placement of the soft forms and muscles.

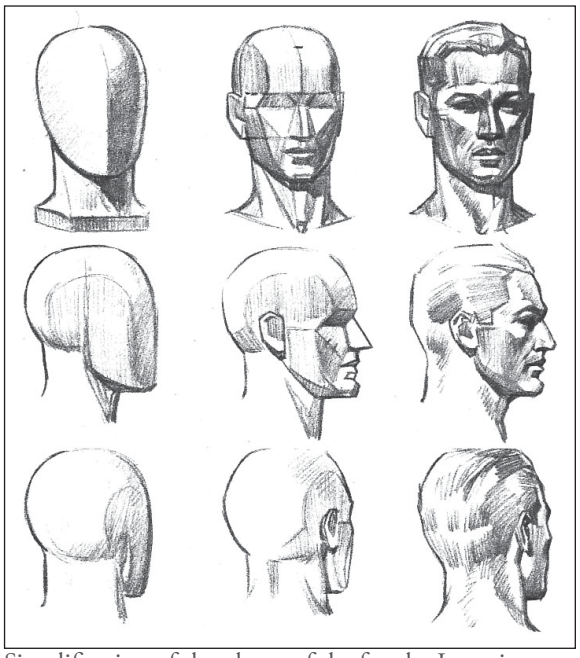
• The widest point of the face generally corresponds to the zygomatic arch, the cheekbone, that runs from underneath the orbital socket and wraps around to the ear like a pair of sunglasses.

• Flowing off the side of the nose diagonally downward is the infraorbital triangle. This is a critical fleshy feature and one that shows much variation between individuals. The 'triangle' is bordered above by the infraorbital furrow, the line that runs diagonally downward from the inner border of the eye, and below by the nasolabial furrow, the fold that separates the cheek area from the mouth area.

• Pay attention to the corner of the mouth where there is a slight ovoid swelling called the 'node'. This is the point of attachment for a number of facial muscles that help pull the corner of the mouth and shows varying degrees of prominence between individuals.

• Understanding the attachments of the muscles of the face and their direction of pull is crucial to modelling facial expressions.

• The face is difficult to model well. There are a number of large and small planes that need to be properly proportioned and correctly placed. Within these planes, the features themselves need to be constructed accurately.



Simplification of the planes of the face by Loomis

Forms of the Neck

• The neck is a column of muscle, bone, fat and cartilage. It projects from the top of the first rib, and like the rib, is lower in the front and lifts diagonally towards the rear where it is marked by the prominence of the 7th cervical vertebra.

• In profile, the front of the neck rise from the depression between the heads of the clavicles and projects forward as it rises. In men, it encounters the bump of the Adam's apple midway to the jaw.

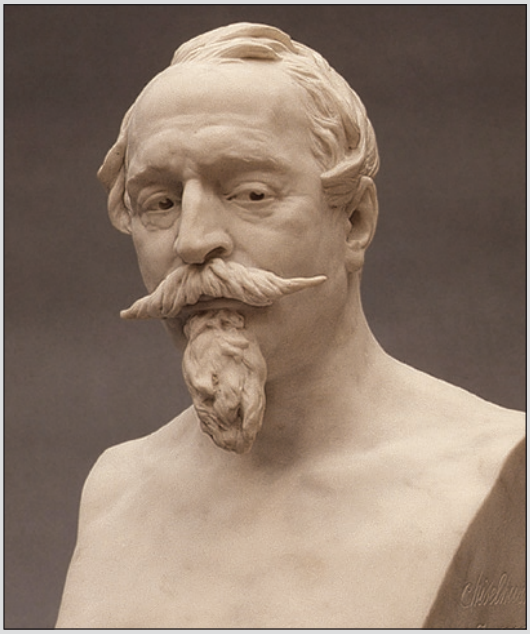
• Near the top of the neck in front, the direction of the profile changes and it starts to project towards the chin. The change in direction is marked by the hyoid bone, a U shaped bone whose contour reflects the overall shape of the front of the neck.

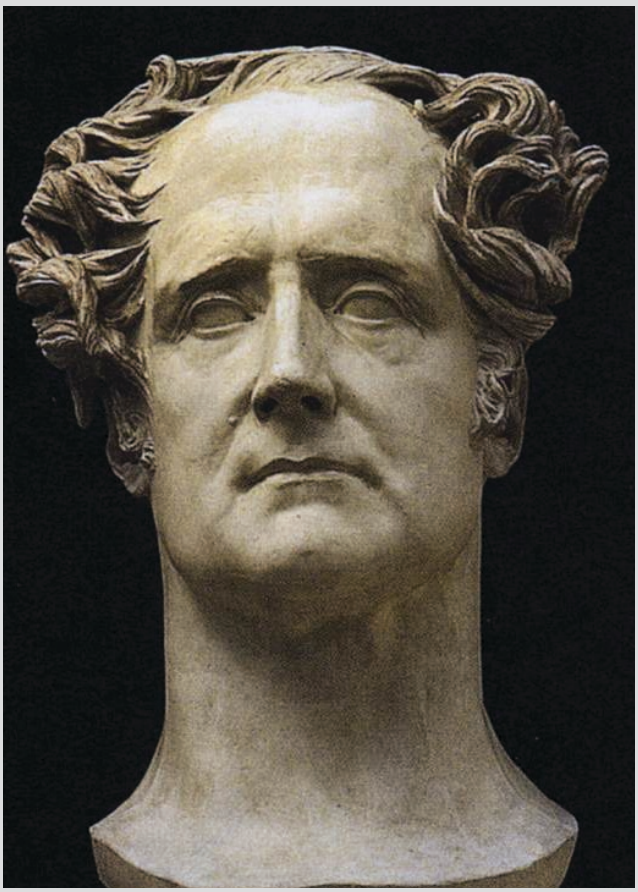
• Wrapping around the side of the neck is the sternocleidomastoid muscle. The structure and function of this muscle should be studied carefully as it is responsible for the majority of surface form in the neck when the head is flexed or turned to the side. Most notably it attaches in two places on the body, the first head attaches in the pit of the neck and the second along a small section of the inner border of the clavicle.

• Around the back of the neck, the trapezius muscle narrows from its wide expanse at the shoulder and tapers up to a final attachment into the back of the skull.

• Other smaller neck muscles influence surface form when the head is tensed in certain directions, but these forms should only be explored once the major forms described above are understood.

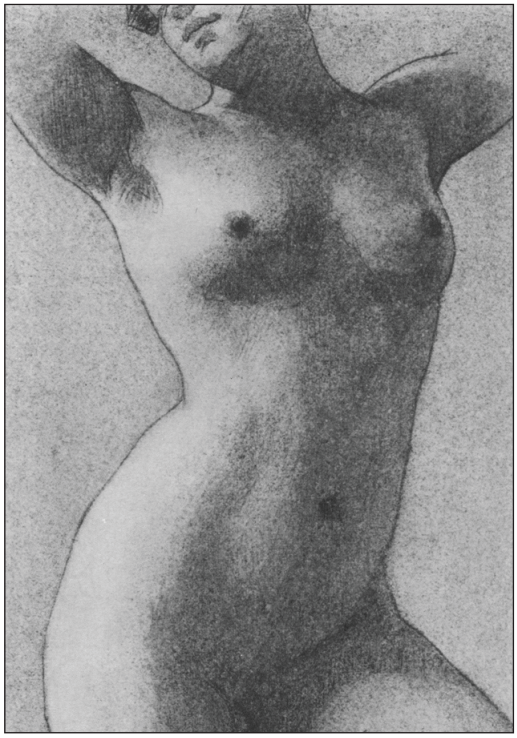
Examples



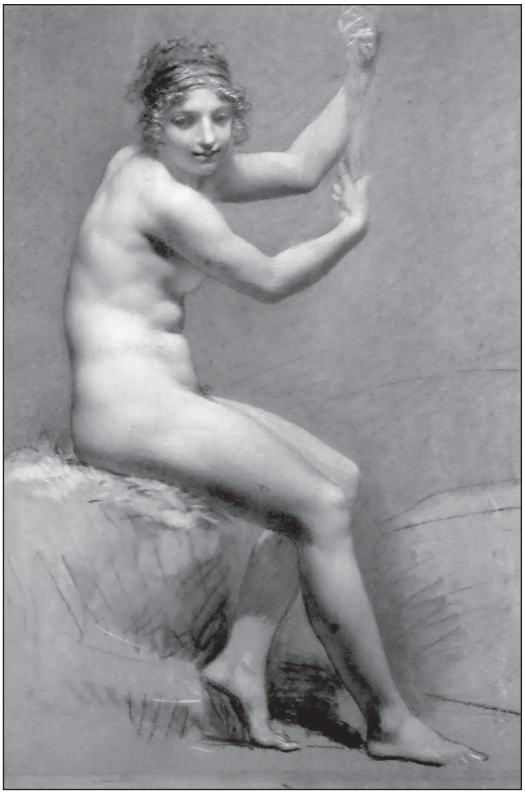


Lecture 7: Gender, Weight and Age

Gender



- Variations in gender are a result of variation in skeletal proportions, areas of fat accumulation, and muscular development.
- Structurally, females have wider, lower hips that are more open in front to accommodate pregnancy. The pelvis also has a greater forward tilt.
- The lateral projection of the greater trochanters from the female pelvis establishes the widest point on the female torso, falling nearly in line with the width of the shoulders.
- To accommodate this wider pelvis, the ulna in the female forearm has a 10-20 degree deviation from vertical.
- The rib cage in females is proportionately smaller when compared to the pelvis.
- The arch between ribs in females is narrower, generally around 60 degrees, versus 90 degrees in males.
- Females tend to carry more fat and less muscle on their bodies giving an overall softening of forms. The diagram by Eliot Golfinger on page 52 shows the difference in fat distribution between men and women.



Weight

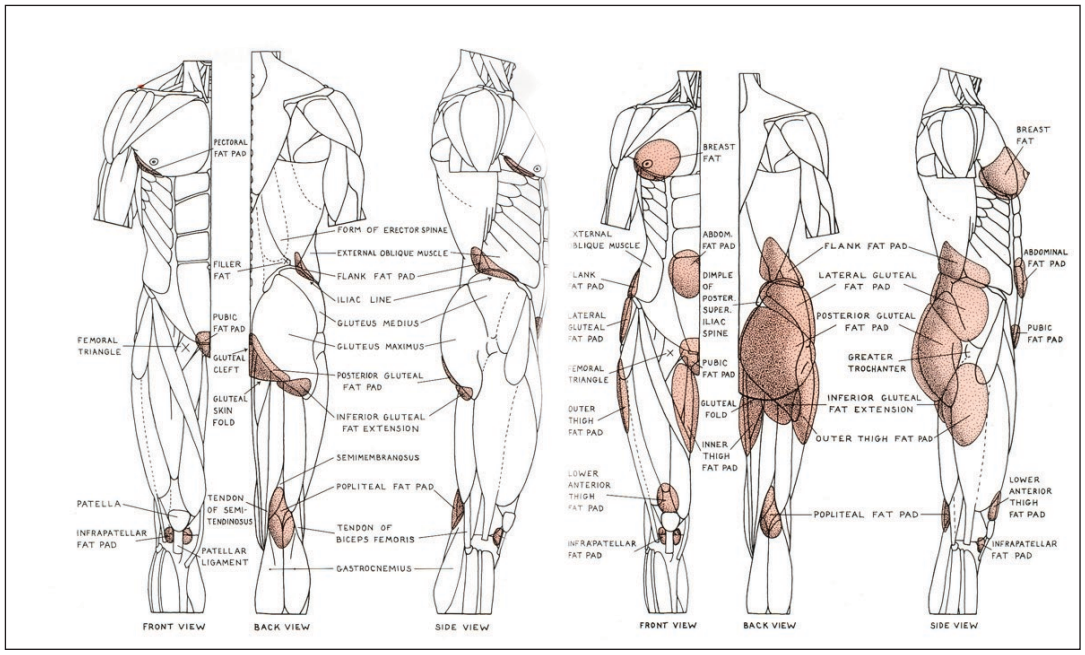


Image courtesy of [Goldfinger1991]

- An increase in fat results in an overall softening of forms, but fat accumulates more readily in certain areas (see above).
- In the obese, the extreme accumulation of fat give a pneumatic effect to the appearance of the body.
- When modelling fat people, care should be taken to layer the bodily mass over a skeleton of regular proportions, because it is only the fleshy proportions that increase in size, not the underlying structure.
- Despite a large accumulation of fat, wrists, ankles, hands and feet retain, more or less, their original shape and proportions.

- Fat accumulation in the face primarily affects the areas of the lower face. The bony prominences of the cheek bones, nose and frontal bone are not appreciably affected.
- Despite sizable fat deposits, the jaw always retains a noticable crease underneath the front of the chin.

Age

- Age has an overall slackening effect on the body, affecting skin, muscle and fat.
- The skin loses its resilience and begins to form bags and folds, showing the effects of years of fighting against gravity.
- In addition to an overall sagging, the skin is inscribed with a network of wrinkles and furrows that run perpendicular to the line of pull of the muscle that moves the skin in that area. For example, the wrinkles of cheek are the result of years of the zygomatic major (the smile muscle) pulling the cheek into compression.
- With age, the muscles atrophy and the body begins to show more of the bony structure underneath. The general weakening of the muscles causes a gradual bowing in posture. In the extreme it gives the elderly a hunched-over appearance.
- In the face, loss of teeth makes the lips retract into the mouth, making the nose and the chin appear to project further from the face.
- The image below, by Stephen Peck, illustrates the common affects of aging on the human face.

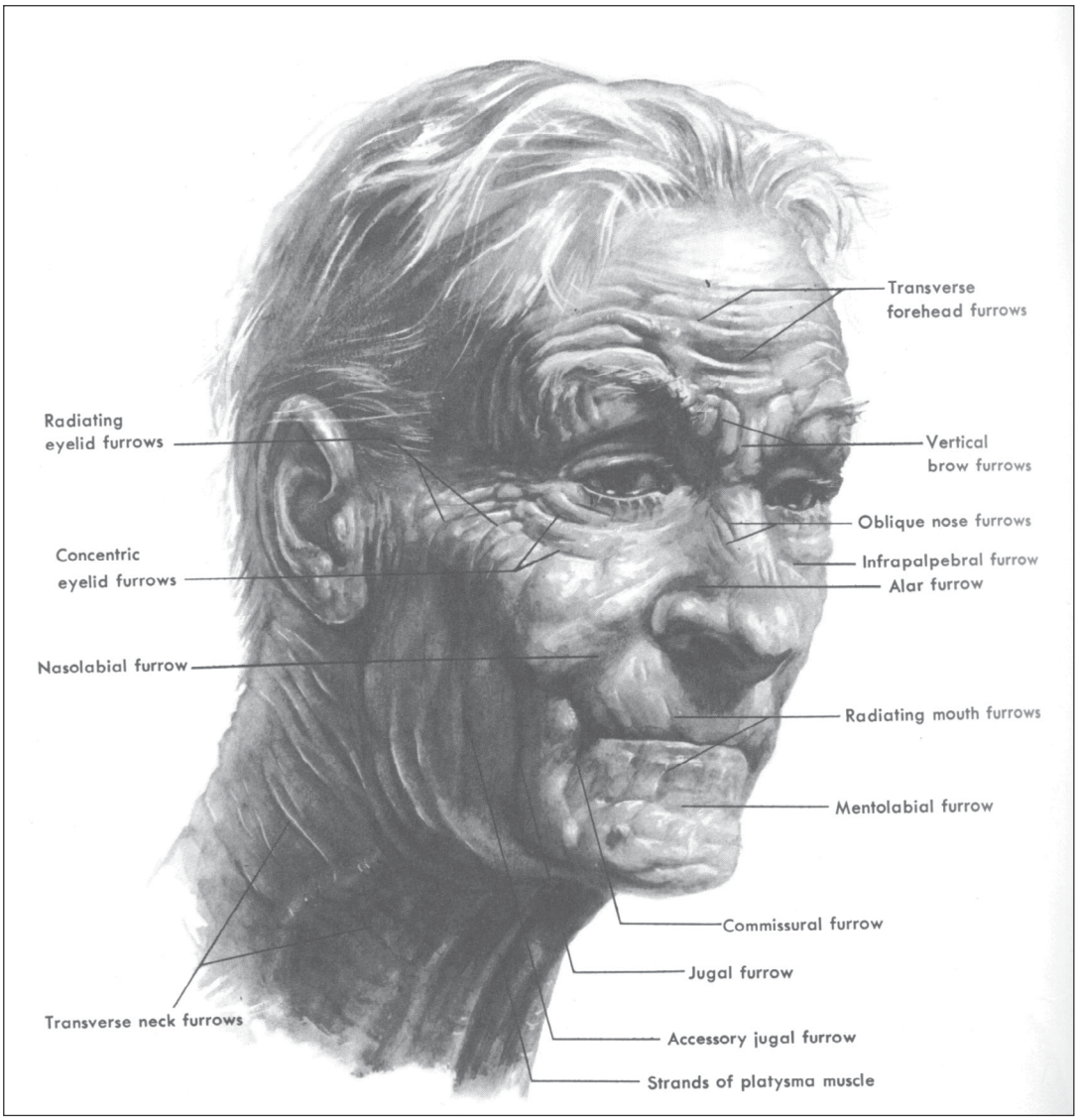
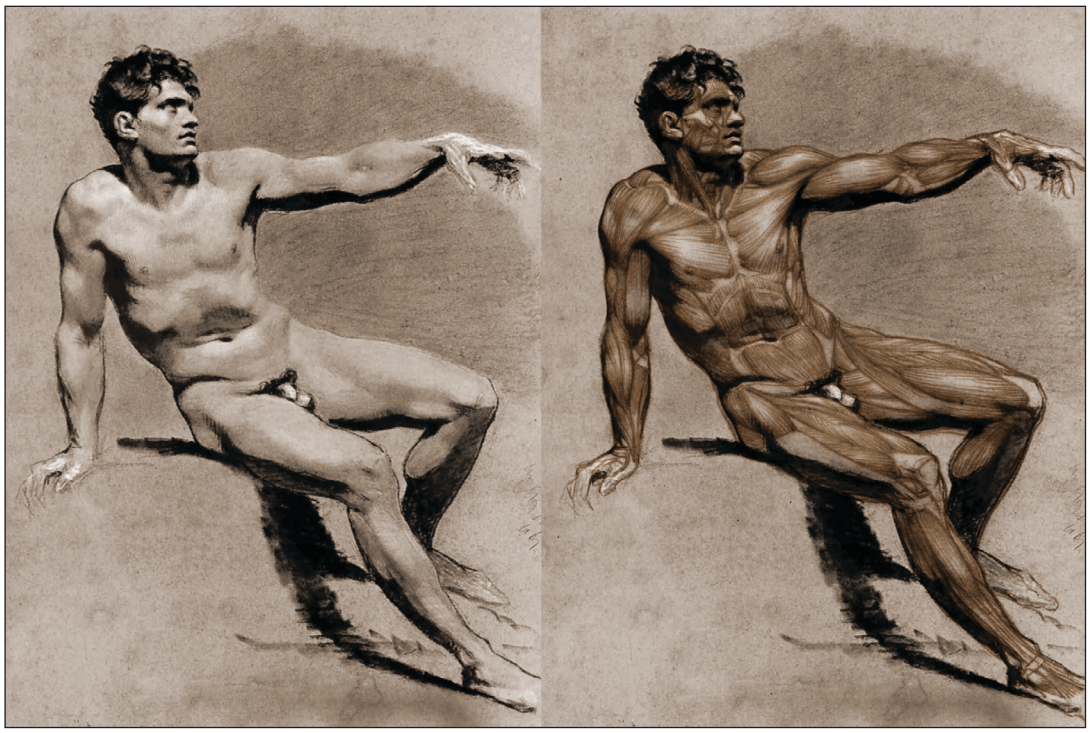


Image courtesy of [Peck1951]

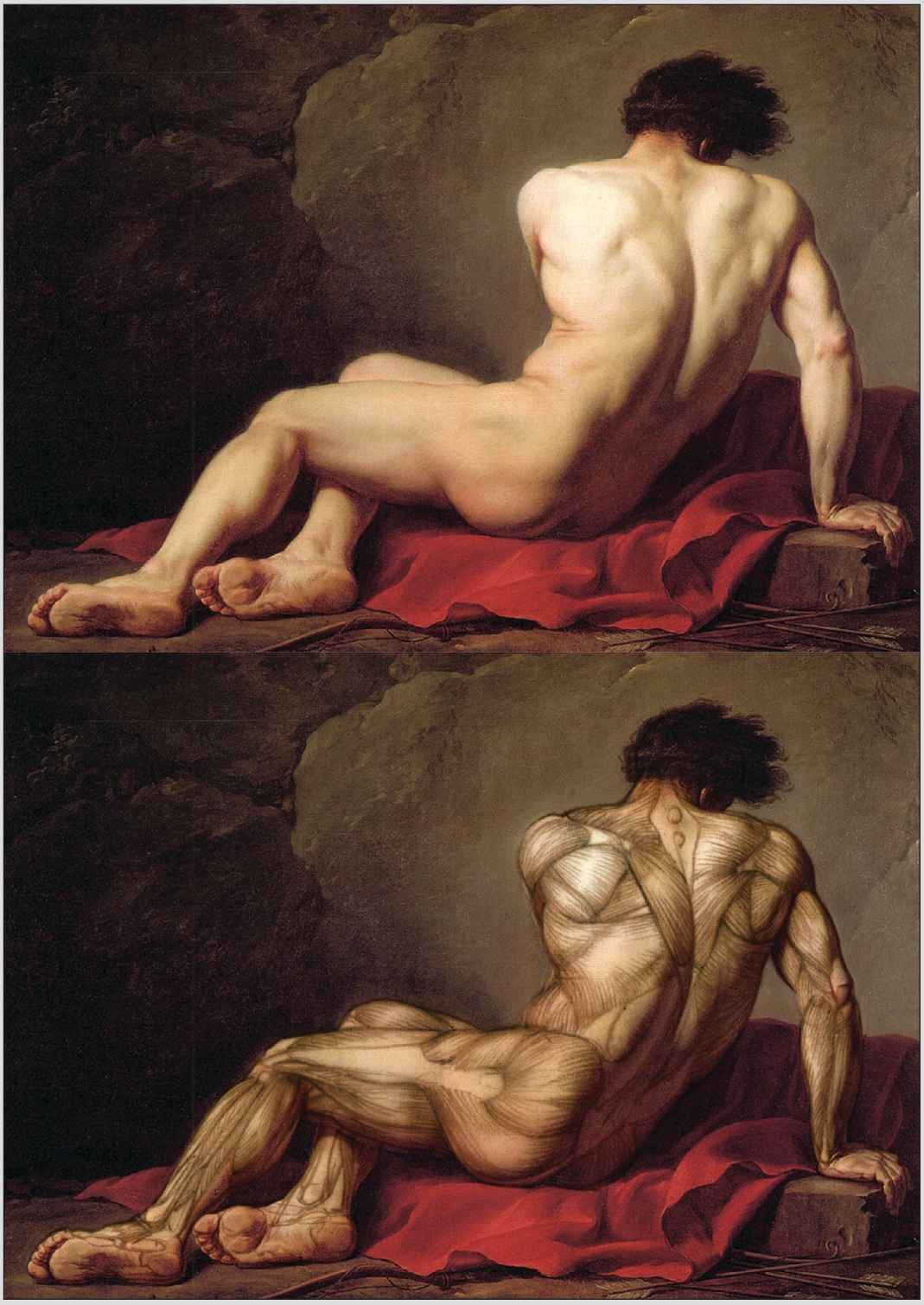
Appendix A
Ecorché

Écorché: French for “flayed” or “without skin”. The word is commonly used to describe the artistic practice of drawing or sculpting a figure without skin to show the interplay of muscles over the skeletal forms underneath. The practice dates back to the 1500s when western artists began showing an interest in the realistic representation of the human figure. Écorché drawings are one of the best ways to study the origins, insertions, and surface forms of the muscle groups.

To begin, choose a photo, sculpture, drawing, or painting that shows good surface anatomy. Then using a thin overlay of tracing paper, start by locating the bony landmarks on the figure. From there workout the flow of muscles from points of origin to points of insertion. Accuracy is important and a good anatomical reference should be used to clarify any forms that are not understood. Continue until the figure is finished. For a nice effect, composite the ecorche drawing over the original image in your favorite 2D program.

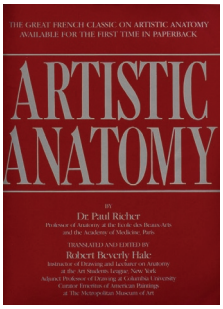


Male Nude by Pierre-Paul Prud’hon (image courtesy of Art Renewal Center). Écorché by Scott Eaton



Male Nude known as Patroclus, by Jacques-Louis David. Image is courtesy of the Art Renewal Center.
Écorché by Scott Eaton

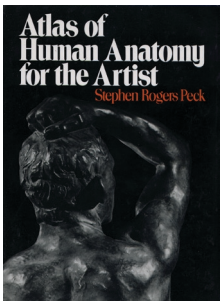
Appendix B
Learning Resources



Anatomie Artistique
Dr. Paul Richer, 1890

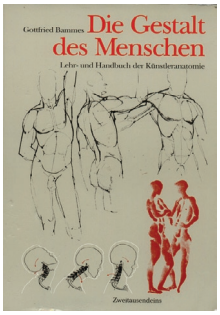
Artistic Anatomy
english edition, translated by Beverly Hale
Watson Guptill, 1971

- Authoritative reference in the field
- Difficult text, but worth the effort
- Clear, accurate plates



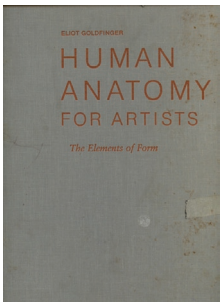
Atlas of Human Antomy for the Artist
by Stephen Rogers Peck
Oxford University Press, 1912

- Classic, must have reference
- Many small illustrations explain difficult concepts
- Lucid text



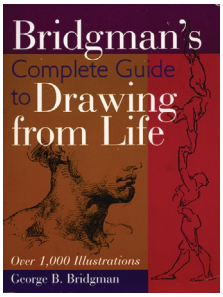
Die Gestalt des Menschen
by Gottfried Bammes,
VEB Verlag der Kunst, 1969

- Constructionist approach to the skeleton and figure
- Excellent simplication of forms
- Highly recommended even if you don't read German



Human Anatomy for Artists
by Eliot Goldfinger
Oxford University Press, 1991

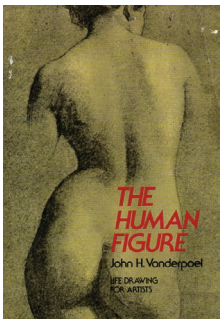
- Contempory
- Exhaustive coverage of musculature
- A must have reference



Bridgman's Complete Guide to Drawing from Life

by George Bridgman
Sterling Publishing, 2001

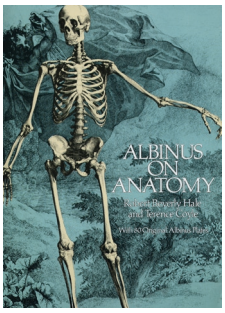
- Constructive, gestural approach to figure drawing
- Excellent for learning the volumes and masses of the figure



The Human Figure

by John H. Vanderpoel
Dover Publications, 1958

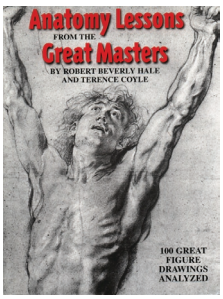
- Excellent explanation of the planes and forms of the figure
- Beautiful drawings
- Difficult, old fashioned text, but worth reading



Albinus on Anatomy

by Robert Beverly Hale and Terence Coyle
Dover Publications, 1988

- Extremely accurate etchings from Albinus circa 1747
- Excellent for investigating the origins and insertions of the muscles
- No explanatory text



Anatomy Lessons from the Great Masters

by Robert Beverly Hale and Terence Coyle
Watson Guptill, 1977

- Uses master drawings to explains various anatomical concepts
- Exhaustive coverage of the body
- Highly recommended for the intermediate and advanced students of anatomy