ANATOMY
IN
ART

S. HARTLEY

ANATOMY IN ART:

A Practical Text Book

FOR THE

ART STUDENT IN THE STUDY OF THE HUMAN FORM.

TO WHICH IS APPENDED

A DESCRIPTION AND ANALYSIS

OF THE

ART OF MODELLING,

AND A CHAPTER

ON THE LAWS OF PROPORTION AS APPLIED TO THE HUMAN FIGURE,

BY

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Contents.

Preface.

THE purpose of this volume is to present a simple and direct method of studying the external anatomy to the art student who is engaged in the study of the human form, either in action or repose.

In carrying out a project which, in the main, is but the embodiment of a series of lectures delivered before the Art Students' League of New York, in its early days, I have incorporated the illustrations from the celebrated work by Fau, "Anatomy and Artists," and likewise drawings from Schadow's work on "Proportion." To these have been added reproductions from photographs to suitably illustrate the text.

J. S. H.

New York, October, 1891.
145 West 55th St.

Introduction.

FOR artistic purposes the isolated study of anatomy without exclusive reference to the surface of the living figure is surgical, as it were, dead and comparatively useless.

A certain amount of mastery in drawing and familiarity with the surface character and general construction of the living figure should be a necessary preliminary to penetrating beneath the skin, in order to realize what motive power produces and causes the surface forms to constantly change and vary in different actions and still retain their distinctive character. Therefore, drawing or modelling from the surface should precede the special study of construction or artistic anatomy.

The purely anatomical should always be subordinated to the artistic or external expression of the form. One of the best methods of studying the construction, character and use of the masses of bone and muscle which constitute the external appearance of the human figure is during the period that the model is in action.

A class devoted especially to the study of the model in action would afford more real and substantial knowledge of the general construction and motive power of the human figure, for artistic purposes, in a less space of time, than any other

method. Knowledge obtained in this way would be eminently practical, and would be retained in the memory.

It is only in profound sleep that the muscles are entirely relaxed and limp. The moment the brain becomes active the nerve centers are excited, the blood increases in circulation, and the muscles are inflated and alive with energy.

Various methods are used in art schools for the study of anatomy. Any method that associates it inseparably with the living model would be a profitable one to pursue.

CHAPTER I.

The Skeleton.

The skeleton is the frame-work and foundation of the human figure.

On it are placed the muscles and from it all actions take place. In its construction the skeleton combines the two great qualities of strength and compactness.

Each part fits in and supports the other, at the same time being so arranged as to allow full scope for all the movements required. One side is the counterpart of the other. The absence or distortion of any bone will immediately force itself on the attention of the observer by the injury to and interference with that balance and symmetry so characteristic of the human structure.

The whole skeleton contains 200 bones, not counting some smaller bones that do not affect the surface.

The most important of these is the combination of bones (each vertebra is a separate bone) which together form the spine or backbones.

SPINE.

The spine is a long, flexuous and flexible column (flexible because it can be bent in all directions; flexuous because each vertebra is so formed that it can be caused to rotate on the vertebra placed immediately underneath it, thus allowing a twisting or rotary movement to the back on either side as much as the opposing muscles will permit).

The spine is composed of 33 bones called vertrebræ, exclusive of those that form the skull.

They are divided into five groups:

The cervical,	7	—neck vertebræ.
Dorsal,	12	—to which the ribs are attached.
Lumbar,	5	—the strongest, to support the chest.
Sacrum,	5	—back part of pelvis.
Coccyx,	4	—not showing on surface.

The two last named are condensed in the adult into two bones.

The general outline of the spine as seen from the profiles is a graceful curve somewhat in the shape of the letter S. In the standing pose this line is preserved always in the model, as the muscles are attached to the spine and follow its surface movements.

In all the many actions of the trunk the spine is always distinctly marked in the center of the back.

In the upright position in the muscular subject, and generally in women, it is indicated by a continuous depression from the seventh cervical to the sacrum. The two bones last mentioned are invariably on the surface in every action.

When the body is bent over forward every vertebra can be counted between the seventh cervical and the pelvis, and appear like prominences on the surface. In many children and in thin adults the vertebræ can be seen distinctly in the upright pose.

The principal vertebræ anatomically are the atlas that supports the skull and the axis on which the skull rotates (neither of these is seen on the suface), and the seventh cervical or prominent vertebra, which is the first and only neck bone that appears on the surface, and which, owing to its long spinous process, is invariably and distinctly marked in the back.

The spinous processes serve for the attachment of the mass of muscles called the erector of the spine, etc., which affords strength and power to the back.

THE SKULL,

Called the superior spinal process, is composed of twenty-two bones:

The cranium, 8.
The face, 14.

Of which it is only necessary to describe those that affect the surface, viz.:

CRANIUM.

Parietal or summit, 2 bones—which govern the form of the top of the skull.
Frontal, 2 bones—the forehead.
Temporal, 2 bones—the sides over the orifice of the ear.
Occipital—back part of the skull.

THE FACE.

The bones of the face noticeable on the surface are:

The malar, 2—bones of the cheek.
Nasal, 2—commencement of the bridge of the nose.
Sides of the nose, 2.
Upper jaw bone, 2.
Lower jaw bone, 1.

All the bones of the cranium govern the form of the head and are distinctly seen in the absence of hair.

The cranium bones terminate at the eyebrows—temporal and cheek bones.

In the face the cheek, nasal and outer border of the lower jaw bone are exposed to the surface. The surface form of the upper jaw bone, the side of the chin, and chin are also governed by the bone formation as the muscles follow their contours.

In the nose the bone formation terminates at the commencement of the bridge, the balance of the nose being made up by cartilage which gives its flexible character.

RIBS.

The ribs are elastic arches of bone, twelve in number on either side. The first seven are connected behind to the seven upper dorsal vertebræ of the spine and in front to the sternum or breast bone, so making a complete circuit around the chest.

The next three are called the false ribs, and are attached behind to the eighth, ninth and tenth dorsal vertebræ and in front to the seventh rib and the sternum by cartilages.

The two floating ribs are attached only to the eleventh and twelfth dorsal vertebræ and float freely in the walls of the abdomen.

The ribs increase in length from the first to the seventh and diminish from the seventh to the twelfth. The seventh to the tenth rib inclusive govern the appearance of the surface.

The cartilages of the false ribs show like prominences on the surface and form what is called the arch of the ribs. The two floating ribs are not seen on the surface in ordinary actions.

This increase of the ribs in the center gives greater space for the heart, lungs and breathing apparatus to work in.

TABLEAU DU PRIX DES VOITURES A L'HEURE

par cinq minutes.

	VOITURES A			
	2 FR. L'HEURE.	2 FR. 25 C. L'HEURE.	2 FR. 50 C. L'HEURE.	3 FR. L'HEURE.
	fr. c.	fr. c.	fr. c.	fr. c.
5 minutes. . . .	» 20	» 20	» 25	» 25
10 minutes. . . .	» 35	» 40	» 45	» 50
1/4 D'HEURE. . . .	» 50	» 60	» 65	» 75
20 minutes. . . .	» 70	» 80	» 85	1 »
25 minutes. . . .	» 85	» 95	1 05	1 25
1/2 HEURE.	1 »	1 15	1 25	1 50
35 minutes. . . .	1 20	1 50	1 50	1 75
40 minutes. . . .	1 35	1 50	1 70	2 »
3/4 D'HEURE. . . .	1 50	1 70	1 90	2 25
50 minutes. . . .	1 70	1 85	2 10	2 50
55 minutes. . . .	1 85	2 05	2 30	2 75
1 HEURE.	2 »	2 25	2 50	3 »

N. B. La première heure se paye toujours entière; mais, d'après l'article 6 du décret réglementaire (V. ci-dessous), le temps excédant la première heure est payé proportionnellement à sa durée.

Le tarif du prix de la course et de l'heure, adopté par chaque loueur de voitures de place ou de remise, devra être affiché dans l'intérieur de ses voitures et délivré à chaque voyageur.

Ce tarif ne pourra jamais dépasser les fixations du tableau précédent, ni supprimer aucune des catégories de prix qui y sont indiquées.

Quel que soit le tarif applicable au service spécial d'une voiture de remise, lorsqu'elle stationnera ou chargera sur la voie publique, le cocher ne pourra rien exiger au delà des prix fixés ci-dessus pour les voitures de place.

DISPOSITIONS RÉGLEMENTAIRES INHÉRENTES AU TARIF.

§ 1er. Les cochers sont tenus de se rendre au domicile du voyageur pour y charger. Lorsque le temps employé pour leur déplacement et l'attente du voyageur excède 15 minutes, le tarif à

l'heure est appliqué à partir du moment où la voiture a été louée.

§ 2. Lorsqu'un cocher s'est rendu à domicile et n'est pas employé, il lui est payé la moitié du prix d'une course ordinaire, si le temps employé pour le déplacement et l'attente ne dépassent pas un quart d'heure; le prix entier d'une course, si le temps excède un quart d'heure.

§ 3. Les cochers loués à la course ont le droit de suivre la voie la plus courte ou la plus facile; ils ne peuvent prétendre qu'au prix de la course, lorsque, sans s'écarter de l'itinéraire, ils sont requis de déposer pendant le trajet un ou plusieurs voyageurs. Ils ont droit au prix de l'heure lorsque, ayant été loués pour une course, ils sont requis de changer l'itinéraire le plus direct pour se rendre à destination, ou lorsque les voyageurs font décharger des colis placés à l'extérieur de la voiture.

§ 4. Les cochers loués à l'heure doivent suivre l'itinéraire indiqué par le voyageur.

§ 5. Les cochers loués à la course et les cochers loués à l'heure (sauf les cas où ces derniers sont requis par les voyageurs d'aller au pas) doivent faire marcher leurs chevaux de manière à parcourir 8 kilomètres à l'heure pour les voitures de place et 10 kilomètres pour les voitures de remise.

§ 6. La première heure est due intégralement, lors même qu'elle ne serait pas entièrement écoulée. Le temps excédant la première heure est payé proportionnellement à sa durée.

§ 7. Les cochers pris à la course ou à l'heure avant minuit 30 minutes, qui arrivent à destination après cette heure, n'ont droit qu'au prix fixé pour le jour, pour la course ou pour la première heure.

Les cochers pris à la course ou à l'heure, avant six heures du matin en été et sept heures en hiver, ont droit au tarif de nuit pour la course et la première heure, quand bien même ils arriveraient à destination après ces heures.

§ 8. De six heures du matin à dix heures du soir en hiver et minuit en été, les cochers ne seront tenus de franchir les fortifications, pour conduire des voyageurs dans les bois de Boulogne et de Vincennes ou dans les communes contiguës à Paris, qu'autant qu'ils auront été pris à l'heure.

Ils ne seront pas tenus de franchir les fortifications après dix heures du soir en hiver et minuit en été, ni de conduire en aucun temps des voyageurs dans les communes dont le territoire n'est pas contigu à Paris.

Le transport dans ces communes, de même que le transport dans les autres, après dix heures du soir en hiver et minuit en été, est réglé de gré à gré.

finger bones or phalanges, are fourteen in number, three for each finger and two for the thumb.

PARTS SHOWING ON THE SURFACE.

When the whole arm is straight the portions of bone showing on the surface are the inner condyle of the humerus and the ulna, or elbow bone, which also is exposed to the surface on the little finger side of the wrist. The radius shows at one end only, viz., the thumb side of wrist. Its upper end is covered by muscles.

When the arm is bent both condyles of the humerus are thrust to the surface, and in conjunction with the ulna or elbow, imparts a very bony quality to the elbow joint in that action.

When the arm is thrust backwards the upper end of the humerus is thrust forward and gives a hard bony quality to the front parts of the deltoid underneath and in front of the acronion process.

The bones of the palm and fingers are shown on the surface on the back always. The carpal bones are shown distinctly when the wrist is bent; they then form the arch of the wrist.

When the wrist is not bent the two outer wrist bones only affect the surface.

PELVIS OR HAUNCH BONE.

The pelvis, so-called from its resemblance to a basin, is strong and massive in its construction.

It is a bony ring interposed between the lower end of the spine, which it supports, and the lower extremities, on which it rests. It is composed of four bones.

The ossa innominata, two in number, which bind it on either side and in front, and the sacrum and coccyx, which complete it behind.

The ilium is the upper line or crest of the pelvis. The great oblique muscles are attached to it and bag over it. The line of the ilium is always preserved and distinctly marked on the surface of the model from its front commencement to its termination behind and in conjunction with the sacrum forms the back part of the pelvis.

The male pelvis is narrow, long and strongly formed. The female pelvis broader, shallower and more elastic.

THIGHS AND LEGS.

Femur.

The femur or thigh bone is the longest, thickest and strongest of the long bones in the skeleton and almost perfectly cylindrical in the greater part of its extent.

In the erect posture it is vertical, being separated from its fellow above by the pelvis, and it inclines downwards and inwards gradually so as to approach its fellow towards the lower part for the purpose of bringing the knee joint near the line of gravity of the body.

The degree of this inclination varies in different persons, and is greater in the female than in the man on account of the greater width of the pelvis. It has, like the humerus, two species of joints. On the upper it articulates with the pelvis by a ball and socket, and on the lower it has a hinge joint where it articulates with the tibia; the ball and socket joint at the pelvis allows great freedom to the movements of the thigh bone in the pelvis and of the pelvis on the thigh bone. The hinge joint at the knee provides great strength and power of resistance to the knee joint.

The great trochanter is a large irregular eminence, quadrilateral in appearance, situated on the outer side of the neck of the bone. It is about three-quarters of an inch lower than the head. This prominence in action constantly changes the outline of the hip. In the standing side supporting the weight of the trunk the bone is forced outwards, forming a positive prominence. On the thigh hanging from the pelvis and not supporting the weight of the body, the bone is shown into a depression, so that in all its surface movements it has an important influence on the form of the thigh.

TIBIA AND FIBULA.

The tibia occupies the front and inner side of the leg, and articulates with the femur at the knee joint and with the astralagus at the ankle joint. It forms the inner ankle bone. In the male its direction is vertical and parallel with the bone in the opposite leg, but in the female it has a slight oblique direction downwards and outwards to compensate for the oblique direction of the femur or thigh bone inwards.

The fibula is situated on the outer side of the tibia. It is

much smaller, and in proportion to its length is the most slender of all the long bones. Its upper extremity is small and is placed below the knee joint and excluded from its formation. The lower extremity inclines a little forward, projects below the tibia and forms the outer ankle bone. The inner ankle is always higher.

The fibula articulates with the tibia above and with the astralagus below.

THE PATELLA OR KNEE CAP.

This is a flat triangular bone situated in front of the knee joint which it protects. It is attached by a strong ligament to the tibia below and above to the extensor muscles of the thigh.

The bones of the foot are like those of the hand divided into three sections—the tarsus, metatarsus and phalanges.

The tarsus is composed of seven bones, the most important of which are the os calcis and astralagus. The os calsis is the largest and strongest, and is situated at the lower and back part of the foot and forms the heel. It serves to transmit the weight of the body to the ground and forms a strong lever for the muscles of the calf.

The astralagus, the next largest bone of the tarsus, occupies the middle and upper part of the tarsus supporting the tibia and fibula.

The scaphoid is shown in the inside of the foot.

The metatarsal bones are five in number, and assist the tarsus in forming the arch of the foot.

The phalanges of the foot in number and general arrangement resemble those of the hand—there being two in the great toe and three in each of the others.

PORTIONS OF THIGH, LEG AND FOOT BONES SHOWING ON THE SURFACE.

In the standing position the great trochanter and the inner condyle of femur show on the surface. The knee cap is always on the surface. The outer tuberosity of the tibia and inner condyle and all of the outer surface of its shaft terminating below where it forms the inner ankle are exposed.

The fibula shows only at either extremity—just below the knee joint and at the lower end, where it forms the outer ankle.

The bones of the foot similarly to those of the hand are all exposed on the top. When the knee is bent both condyles of the femur or thigh bone and of the tibia or shin bone are thrust to the surface. The knee cap when the knee is bent always shows clean and sharp, so that the knee joint like the elbow joint in this action is completely governed by the bone formation.

ADAM'S APPLE.

The elevation of the throat known as Adam's apple is the upper and outer point of the thyroid cartilage of the throat; it is the organ of the voice, and is more developed in man than in woman.

FRONTAL SINUS.

The prominence on the forehead just above the root of the nose called the frontal sinus is formed somewhat like a box having an aperture inside which, to a certain extent, governs the sound of the voice. It acts as a sounding board, making the voice stronger or weaker, according to its size. It is larger in the man than in the woman, and in children is very small, which will account for their shrill voices.

LIGAMENTS.

The bones are kept in their positions by ligaments of an elastic nature, which allow great latitude of movement in all necessary directions.

CONDYLES, PROPORTIONS, ETC.

The lower end of the humerus—the upper arm bone—the femur or thigh bone and the upper end of the tibia or shin bone, terminate in what are called condyles, which are much thicker than the shafts of the bone, and are always seen on the surface of the model.

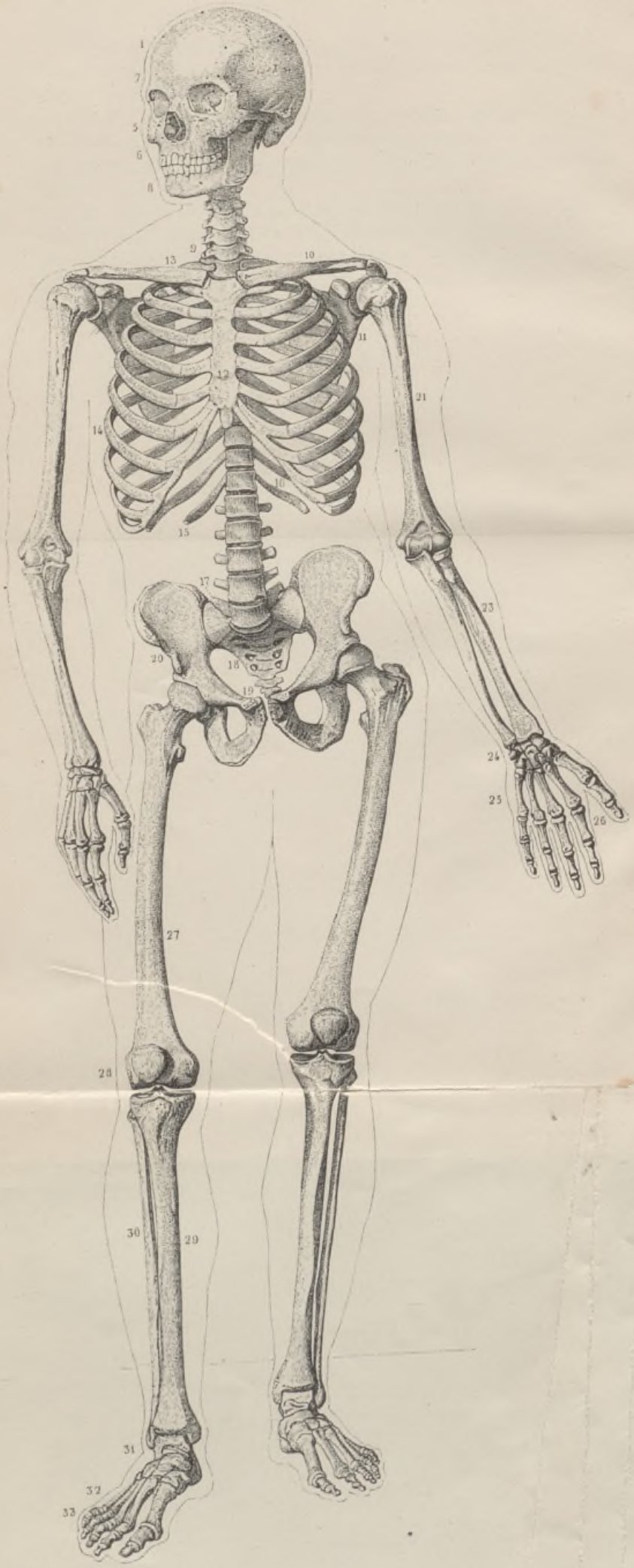
The skeleton provides always the proportions of the figure, with slight allowance for padding between the joints, between each vertebra and articulations of the long bones and under the heel and foot.

The height from the apex of the skull to the sole of the feet is given by the skeleton.

The bones appear on the surface partially from the top to the bottom of the skeleton, as mentioned in each part described in this lecture.

In all the lectures devoted to muscular anatomy it will be necessary to refer to and describe the portions of the skeleton appropriate to each part of the anatomical structure under discussion.

Too much importance cannot be attached to the study of the skeleton in connection with the study of the human figure for artistic purposes. In every action the bones change their positions, especially the long bones, so that to a great extent the direction of their lines govern the action.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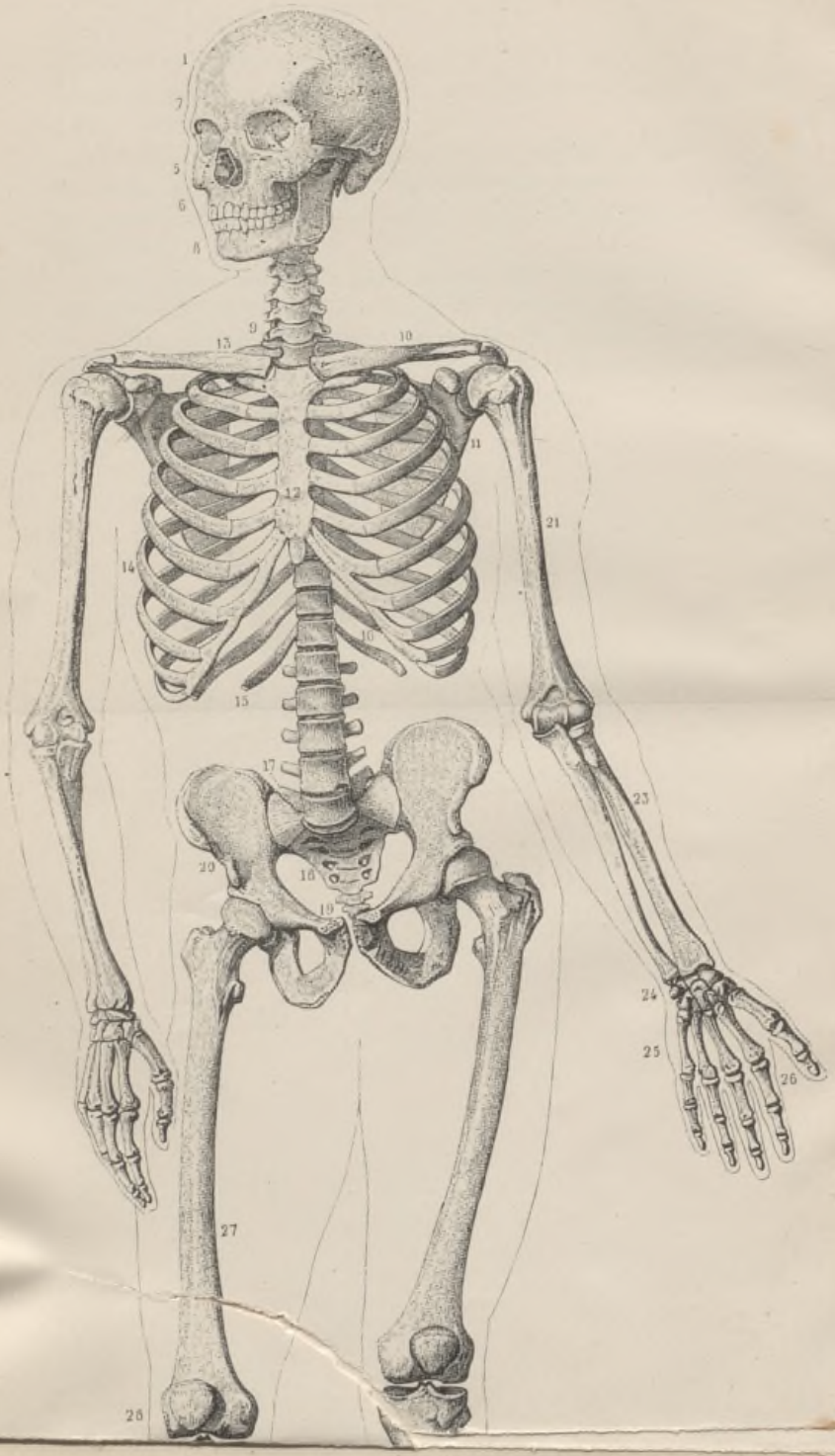
Pl. 1.



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Pl. 2.

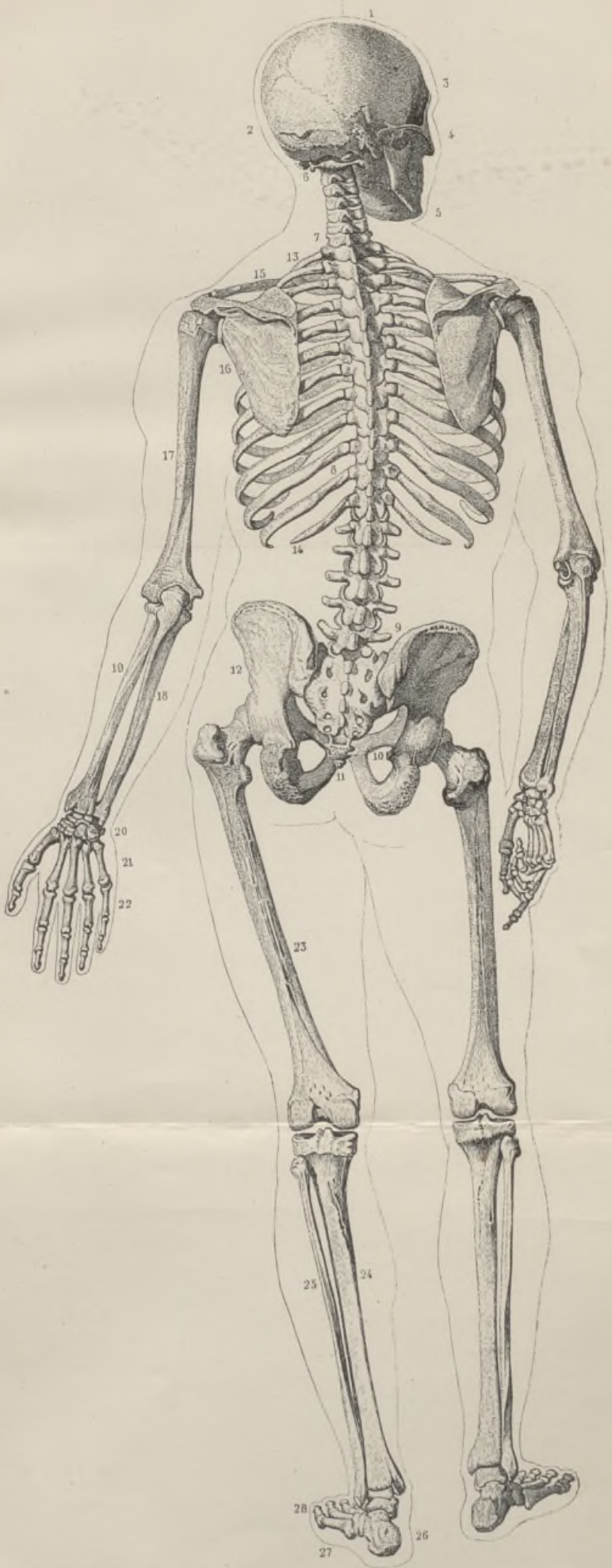


PLATE I.

SKELETON.

Front view.

1. Frontal.
2. Parietal.
3. Temporal.
4. Occipital.
5. Malar.
6. Maxillary.
7. Nasal.
8. Mandible.
9. Last cervical vertebra.
10. Clavicle.
11. Scapula.
12. Sternum.
13. First rib.
14. Seventh rib.
15. Twelfth rib.
16. Second dorsal vertrebra.
17. Fifth lumbar vertebra.
18. Sacrum.
19. Coccyx.
20. Ilium.
21. Humerus.
22. Ulna.
23. Radius.
24. Carpus.
25. Metacarpus.
26. Phalanges.
27. Femur.
28. Patella.
29. Tibia.
30. Fibula.
31. Tarsus.
32. Metatarsus.
33. Phalanges.

NOTE:—The dotted lines, which are shown on the top of the head and under the heel in plates 1 and 2, indicate the direction of the line of gravity.

PLATE II.

SKELETON.

Back view.

1. Parietal.
2. Occipital.
3. Temporal.
4. Malar.
5. Mandible.
6. First cervical vertebra.
7. Seventh cervical vertrebra.
8. Twelfth dorsal vertrebra.
9. Fifth lumbar vertebra.
10. Sacrum.
11. Coccyx.
12. Ilium.
13. First rib.
14. Twelfth rib.
15. Clavicle.
16. Scapula.
17. Humerus.
18. Ulna.
19. Radius.
20. Carpus.
21. Metacarpus.
22. Phalanges.
23. Femur.
24. Tibia.
25. Fibula.
26. Tarsus.
27. Metatarsus.
28. Phalanges.

PLATE III.

SKELETON.

Side view.

1. Frontal.
2. Parietal.
3. Temporal.
4. Occipital.
5. Malar.
6. Nasal.
7. Maxillary.
8. Mandible.
9. First cervical vertebra.
10. Seventh vertebra.
11. Ilium.
12. Sacrum.
13. Coccyx.
14. Clavicle.
15. Sternum.
16. Scapula.
17. First rib.
18. Last rib.
19. Humerus.
20. Ulna.
21. Radius.
22. Carpus.
23. Metacarpus.
24. Phalanges.
25. Femur.
26. Patella.
27. Tibia.
28. Fibula.
29. Tarsus.
30. Metatarsus.
31. Phalanges.

PLATE IV.

JOINTS.

Articulations of the shoulder, of the jaw, of the vertebræ, and of the upper limb.

FIG. 1.

A. Clavicle.
B. Scapula.
C. Humerus.
1. Articular surface of the internal extremity of the clavicle.
2. Coraco-clavicular ligament.
3. Coraco-acromial ligament.
4. Scapulo-clavicular fibrous capsule.
5. Scapulo-coracoid ligament.
6. Coraco-humeral ligament.
7. Scapulo-humeral fibrous capsule.
8. Tendon of the infra-scapular muscle.
9. Tendon of the biceps muscle.
10. Tendon of the long portion of the triceps muscle.

FIG. 2.

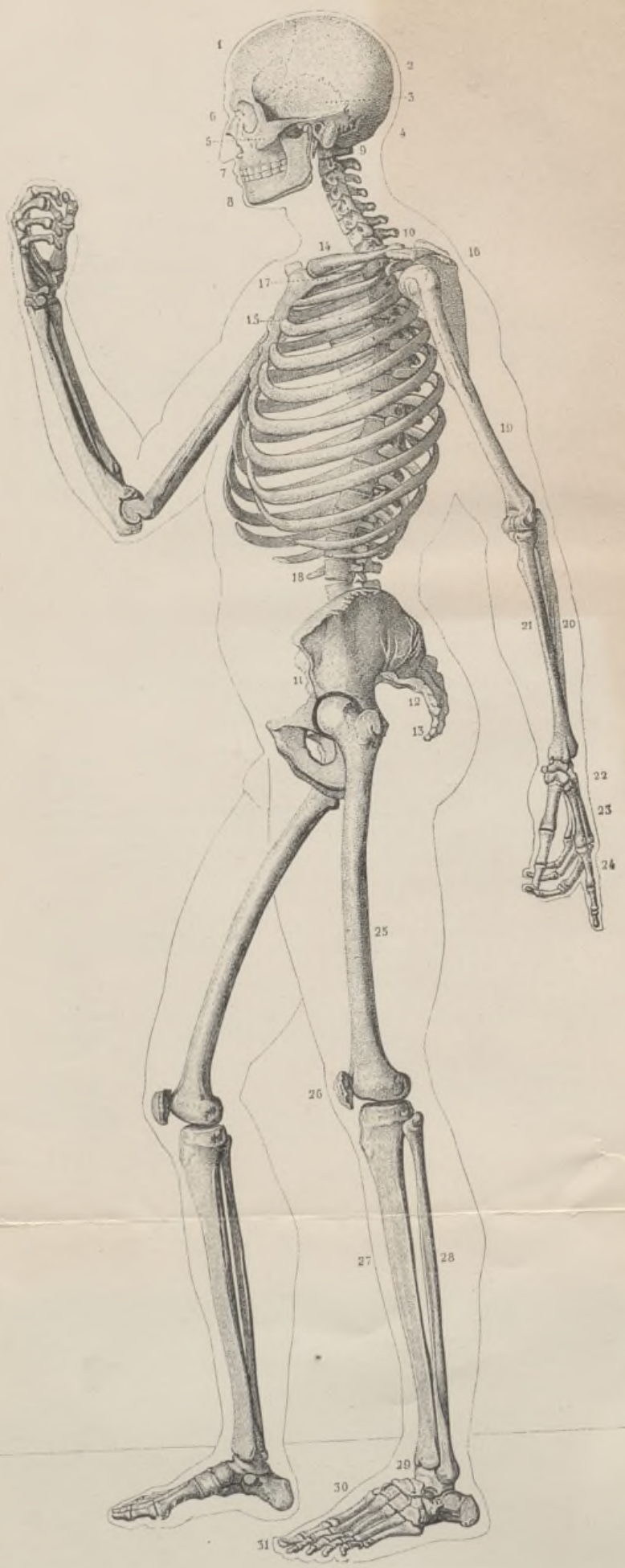
A. Clavicle.
B. Scapula.
C. Humerus.
1. Articular surface of the clavicle.
2. Coraco-clavicular ligament.
3. Scapulo-clavicular capsule.
4. Scapulo-coracoid ligament.
5. Capsule of the joint.
6. Attachments of the supra-spinatus, infra-spinatus, and teres minor muscles.
7. Tendon of the long portion of the triceps.

FIG. 3.

A. Inferior portion of the cranium.
B. Ramus of the jaw.
1. External lateral ligament.
2. Stylo-maxillary ligament.

FIG. 4.

A. Inferior portion of the occipital.
B. Atlas.
C. Axis.
1. Anterior cervical ligament.
2. Anterior ligament, connecting the atlas to the occipital bone.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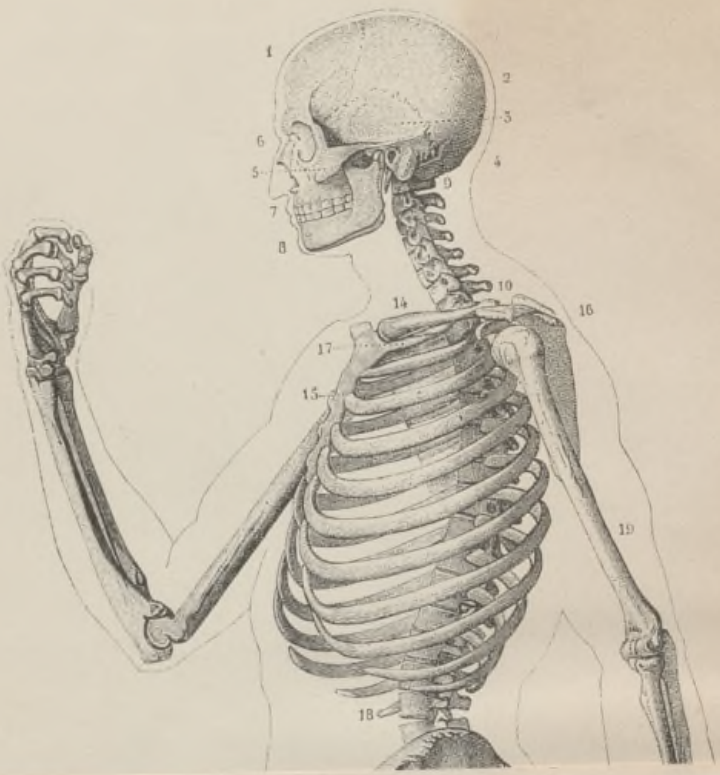
Pl. 3.



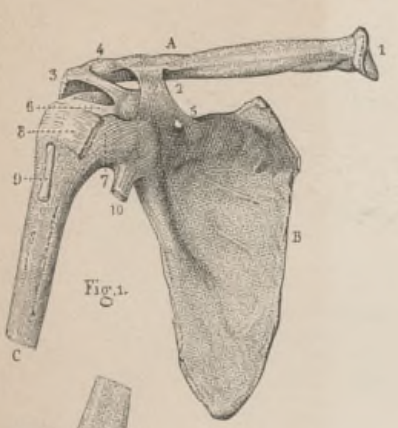
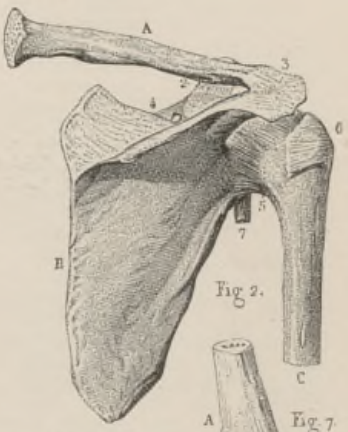


Fig. 1.



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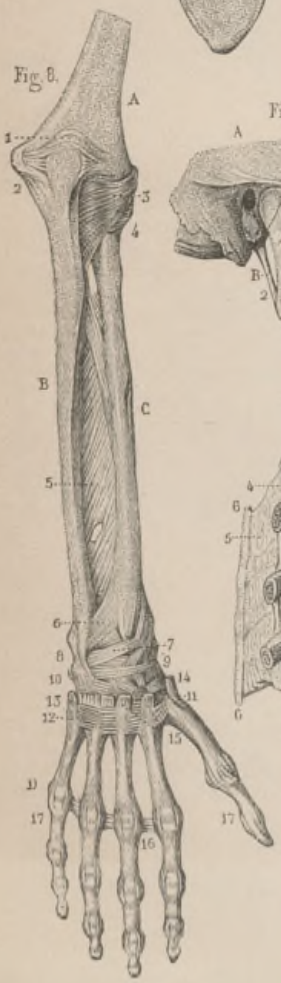


Fig. 8.

Fig. 3.

Fig. 4

Fig. 7.

Fig. 5.

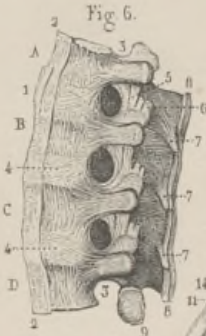


Fig. 6.

3. Fibrous capsule, connecting the atlas to the axis.
4. Capsules of the articular processes of the second, third, fourth and fifth vertebræ.
5. Divided tendons of the long muscles of the neck.

FIG. 5.

A, B, C, D. Bodies of the seventh, eighth, ninth and tenth dorsal vertebræ.
1, 1. Common anterior vertebral ligament.
2, 2. Inter-articular discs, or inter-vertebral fibro cartilages.
3. Costo-vertebral ligaments.
4. Inferior costo-transverse ligaments.
5. Inter-spinous dorsal ligaments.
6, 6. Supra-spinous dorsal ligaments.

FIG. 6.

A, B, C, D. Bodies of the first, second, third and fourth lumbar vertebræ.
1. Pillar of the diaphragm.
2. Anterior common vertebral ligament.
3. Radiated ligament.
4, 4. Inter-vertebral discs.
5. Articulo-transverse ligaments.
6. Tendon of the lumbar portion of the transverse spinous muscle.
7, 7, 7. Inter-spinous ligaments, and tendons of the long muscles of the back.
8, 8. Supra-spinous ligaments.
9. Articular capsule.

FIG. 7.

A. Humerus.
B. Ulna.
C. Radius.
D. Hand-bones.
1. Anterior ligament of the articulation of the wrist.
2. Internal lateral ligament.
3. External lateral ligament.
4. Tendon of the biceps.
5. Interosseous ligament.
6. Anterior inferior ulno-radial ligament.
7. Great anterior radio-carpal ligament.
8. Internal lateral ligament.
9. External lateral ligament.
10. Ligaments of the carpus.
11. Fibrous capsule, uniting the trapezium to the first metacarpal bone.
12. Palmar interosseous ligaments.
13. Tendon of the posterior ulnar muscle.
14. Tendon of the long abductor muscle of the thumb.
15. Transverse metacarpal ligament.
16. Articular ligament and capsule of the thumb.
17. Index finger and fibrous sheath of the tendons.
18. Medius. The tendons of the superficial and deep flexors have been exposed by dissection.
19. Ring finger, with the tendons removed.
20. Little finger, with the metacarpo-phalangeal capsule open.

FIG. 8.

A. Humerus.
B. Ulna.
C. Radius.
D. Bones of the hand.
1. Posterior humero-ulnar ligament.
2. Internal lateral ligament of the elbow.
3. External lateral ligament.
4. Annular ligament in which the radius moves.
5. Interosseous ligament.
6. Posterior ulno-radial ligament.
7. Great posterior radio-carpal ligament.
8. Internal lateral ligament of the wrist.
9. External lateral ligament.
10. Ligament of the carpus.
11. Fibrous capsule of the first metacarpal bone.
12. Dorsal interosseous ligament.
13. Tendon of the posterior ulnar muscle.
14. Tendon of the long abductor of the thumb.
15. Tendons of the radial muscles.
16. Transverse metacarpal ligament.
17. 17. Fingers, ligaments and capsules.

PLATE V.

JOINTS.

Articulations of the pelvis and of the lower limb.

FIG. 1.

A. Iliac bone.
B. Sacrum.
C. Last lumbar vertebra.
D. Femur.
1. Inter-articular disc.
2. Ilio-lumbar ligament.
3. Anterio sacro-iliac ligament.
4. Sacro-sciatic ligament.
5. Anterior sacro-coccygeal ligament.
6. Cross ligaments of the pubis.
7. Subpubic ligament.
8. Articular fibro-capsule, with its strengthening fasciculus.
9. Tendon of the rectus muscle.
10. Gluteus medius.
11. Gluteus minimus.
12. Triceps.

FIG. 2.

A. Iliac bone.
B. Sacrum.
C. Coccyx.
D. Femur.
1. Posterior sacro-iliac ligament.
2. Great sacro-sciatic ligament.
3. Posterior sacro-coccygeal ligament.
4. Sub-pubic ligament.
5. Fibrous capsule.
6. Attachment of the gluteus minimus.
7. Attachment of the gluteus medius.
8. Attachment of the biceps and the semi-tendinosus.
9. Attachment of the third adductor.

FIG. 3.

A. Femur.
B. Tibia.
C. Fibula.
D. Patella.
1. Section of the triceps muscle.
2. Patellar tendon.
3. Internal lateral patellar ligament.
4. External ligament.
5. External lateral ligament of the joint.
6. Internal lateral ligament.
7. Tendon of the aponeurosis of the fascia lata.
8. Interosseous ligament.
9. Tendon of the third adductor.
10. Tendon of the biceps.
11. Tendon of the internal muscles of the thigh.

FIG. 4.

A. Femur.
B. Tibia.
C. Fibula.
1. Posterior superficial ligament.
2. Internal lateral ligament.
3. External lateral ligament.
4. Posterior fibulo-tibial ligament.
5. Interosseous ligament.
6. Attachment of the third adductor.
7. Attachment of the gastrocnemius internus and plantaris gracilis.
8. Attachment of the popliteus.
9. Attachment of the biceps.
10. Attachment of the soleus.
11. Attachment of the peroneus longus.

FIG. 5.

A. Malleolus internus.
B. Malleolus externus.
C. Calcaneum and tendo-achillis.
1. Interosseous ligament.
2. Posterior ligament of the lower peroneo-tibial articulation.
3. Posterior peroneo-astragalian ligament.
4. External lateral ligament of the joint.
5. Internal lateral ligament.
6. Sheath of the common flexor tendon of the toes.
7. Sheath of the tibialis posticus.
8. Sheath of the tendons of the peronei muscles.

FIG. 6.

A. Tibia.
B. Fibula.
C. Scaphoid.
D. Calcaneum.
E. Astragalus.

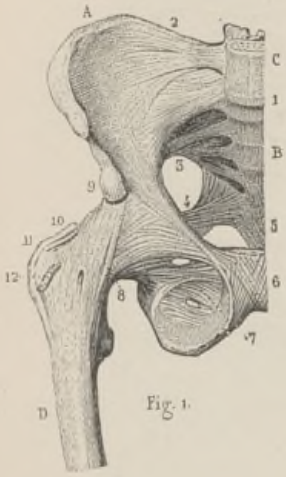


Fig. 1.

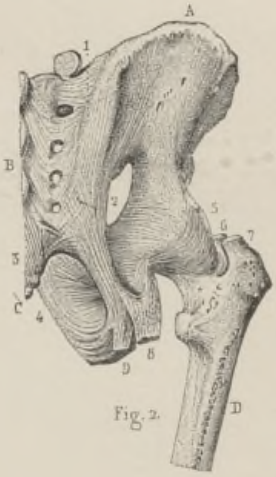


Fig. 2.

Fig. 5.

Fig. 3.

Fig. 4

Fig. 6.

Fig. 7.

1. Interosseous ligament.
2. Inferior fibulo-tibial ligament.
3. Anterior tibio-tarsal ligament.
4. Internal lateral ligament.
5. External lateral ligament.
6. Fibulo-astragalar ligament.
7. Ligaments of the tarsus.
8. Transverse metatarsal ligament.
9. Attachment of the tibialis anticus muscle.
10. Attachment of the peroneous brevis muscle.
11. Attachment of the adductor of the great toe.
12, 12, 12. Tendons of the long extensors of the toes; their sheaths; and the articulation of the fourth toe open.

FIG. 7.

A. Calcaneum.
B. Malleolus externus.
1. Lower calcaneo-cuboid ligament.
2. Groove for the long proper flexor of the great toe.
3. Groove for the common long flexor of the toes.
4. Cuneo-metatarsal ligament.
5. Transverse metatarsal ligament.
6. Attachment of the tibialis posticus.
7. Attachment of the tibialis anticus.
8. Attachment of the peroneus longus.
9. Attachment of the peroneus brevis.
10. Attachment of the adductor of the little toe.
11. Attachment of the short flexor of the little toe.
12. Attachment of the adductor and the short flexor of the great toe.
13. Attachment of the oblique adductor of the great toe.
14, 14, 14. Toes; sheaths and tendons of the long flexor. The articulation of the fourth toe is open.

CHAPTER II.

General Principles Governing the Muscular Anatomy.

The study of anatomy is a necessary training for the understanding of the various actions which the human figure is capable of making.

For artistic purposes this study need not go deeper than the superficial anatomy, viz., the muscles that govern the appearance of the surface, so that all there is any necessity for knowing is what muscles and bones are on the surface or which affect the appearance of the surface.

Before proceeding with any description of the muscles, it is necessary to give some explanation of the laws under which the muscles act and what a muscle consists of, so that it can be understood in what manner a muscle performs its functions, and also a few other fundamental laws which are important in connection with the study of the human figure.

The great principle running through and governing the muscular system is the principle of antagonism.

All muscles have their antagonistic or complementary muscles (as we may call them).

There is one set of muscles to lift and another to pull down. The elevators are the antagonists of the depressors. The flexors or contractors are the antagonists of the extensors. The pronators of the supinators, and so on, throughout the entire muscular system. Each muscle—or mass of muscles—having its opponent, which performs the contrary action.

The deltoid, trapezius and elevator of the spine of the shoulder blade raise the arm. The latissimus dorsi, large pectorals and teres major depresses the arm. (In action strongly developed when pulling down anything or in lifting the body from the ground.)

The rectus femoris (center muscle of knee cap), sartorius and gracilis, acting from the pelvis, raise the thigh and leg.

The glutæus maximus, also acting from the pelvis, depresses the thigh and swing it backwards. Both these actions are illustrated in the action of walking.

All the muscles of the back part of the human structure are the antagonists of the front part. They act generally in masses.

When a muscle is in action at the same time as its opponent, the two muscles strike the medium between their respective powers, as, for instance, the head is kept in the erect position by the antagonistic muscles of the front and back of the neck, equally strained.

The sterno-cleido-mastoids in front prevent the head from falling backwards, whilst the splenius and trapezius situated in the back of the neck and attached to the occipital portion of the skull prevent the head falling forward.

The muscles of the back and front of torso keep the trunk erect on the pelvis. The muscles of the front and back of the thigh acting together preserves the equilibrium of the body on the knee joints, and the muscles of the front and back of leg perform the same office for the ankle joints, so that the whole human figure is kept erect on the sole of the feet.

Muscles are composed of fibrous layers of different qualities, coarse or fine, according to the strength required, and have the power of contracting or relaxing as they are controlled by the nervous system acting from the will power. In the strongest muscle the fibers are coarse, and the more delicacy is required, the finer the fibrous quality of the muscle.

Ordinarily the extremities of these muscular bundles of fibers are united to tendons which penetrate into the mass of the muscle and sometimes continue through its entire length. This is illustrated in the calf muscles and triceps of the arm.

In each contraction the muscles swell and become harder.

All movements are performed through the contraction of the muscles.

The contraction takes place in the fibers of the muscle, pulling first the tendon and then the bone to which the tendon is attached.

The will first conceives the action and sets the muscles in motion. The muscles acting on the tendon and the tendon on the bone forces the bone to perform the desired action.

The will conceives and the sensation of desire is conveyed through the nerves to the muscles spontaneously.

Hesitation is caused by conflicting actions of the mind on the nervous system so that decision is not arrived at.

The muscles are active.

The ligaments or tendons and bones are passive.

The muscles of the extremities are generaly almost parallel with the bones whose movements they control, and to which they are attached.

This disposition intended to give the members as little volume as possible weakens partly the muscular force, but nature has employed various artifices to obviate this inconvenience, and sometimes the principal organs are wrapped around the bone and sometimes they pass over bony eminences and act in the same manner as the cord of a pulley.

Examples: In the vastus externus and internus muscles of the knee cap which are attached to and wrapped around the femur and act with great force on the leg.

The strongest lever in the muscular system is exemplified by the rectus of the spine, which in lifting any weight works over the arch of the spine with great power.

EQUILIBRIUM.

Art students frequently make mistakes in the action of the model through ignorance of the principle that governs the equilibrium or balance of the figure. Therefore, a few rules which will serve to guide the understanding.

The center of gravity or equilibrium is a point in a body placed in such a manner that the body can be sustained with steadiness. That is to say, that the body is equally balanced in every direction on the part or parts that support it.

The center of the gravity is the center of weight; when the figure is perfectly upright the point of gravity is from the center (front or front view) of the apex of the skull descending through the middle of the nose, pit of the throat sternum, navel, os pubis, and to the ground directly between the feet.

From the side the line of gravity would descend from the center of the skull and of neck and inside of the lumbar vertebræ and between the os pubis and sacrum, striking down the center of the thigh and leg to the ground.

This center is always changing according to the action of the

body, and therefore is called unstable gravity, but in all actions it is always the center of gravity. The plumb bob is an example.

In the action of walking the thigh bones work backwards and forwards in their sockets in the pelvis—the right leg advancing with left arm and the left leg with the right arm—the arms swinging alternately in front and behind, thus always preserving the balance of the body.

This balance can be more forcibly illustrated by the actions of a tight-rope performer who generally carries a long pole with which to preserve his equilibrium when walking on such a limited surface. When there is too much weight on one side he depresses the pole on the opposite side, by this means constantly preserving the center of gravity.

In the action of running the foot in advance always comes down on the ground under the center of gravity. The foot is placed on the ground and the body swings over it, repeating the action with the other side. In jumping, both feet must necessarily touch the ground under the center of weight, otherwise the result will be a tumble or slide.

Good illustrations for the study of this principle of balance are the actions of walking up and down stairs.

In going up the body goes forward and makes the impression, on one's mind, of pulling up the legs. In coming down the body pulls backwards and the impression is reversed.

Quiet actions can be illustrated by the person standing with both feet together and then holding an Indian club or any weight in one hand with the arm extended fully and the other hanging quietly by the side. The body will swing over immediately to the opposite side of the extended arm, and the longer the arm is held out the more the body will swing over as the arm feels heavier.

Other illustrations: Balancing on one foot; extension of arms to preserve balance; simple action of folding arms with head bent forward (in side view body swings backward in order to support additional weight of arms and head); one arm extended, the other resting on the thigh; supporting a weight on shoulders, right and left center; the various movements in swinging Indian clubs, etc.

In pushing and pulling the weight is transmitted or supported by the object acted on.

CHAPTER III.

Head, Face and Neck with Combined Expression of the Face and Body.

The anatomy of the human figure is the structure through which the mind expresses emotion.

A human being in a natural condition expresses feelings spontaneously in the face and throughout the whole anatomical system.

There is to a limited extent a law which governs the natural play and movement of the muscles, but it can only apply to their mechanical physical actions.

The same muscles are used in everybody to express the same or similar actions and emotions, but the various methods of expressing the different emotions and feelings differ in degree as individuals differ in physical construction, temperament, and the mind that creates, feels and controls the external expression.

The mental always governs the physical. In the self-governing condition which civilization is presumed to produce, people are more or less under constant restraint and study to repress all outward signs of any, or, at least, the violent, passions, and this control is carried so far in some people that they habitually make no external manifestations of what is going on in their minds.

Naturally, however, there is direct sympathy between the expression of the mind, the face, and muscular system throughout.

This is effected by what are called the sympathetic nerves.

Violent passion that distorts the face naturally would excite every muscle in the body and the action would be harmonious throughout.

When a person clinches the hand in passion the other does not hang idly by the side. When the face is stern and vindictive there is a corresponding energy expressed throughout the whole frame. In children we have good examples of natural feeling flowing full and unrestrained. In them it almost becomes a caricature so fully is the expression carried out.

A child cries, laughs, and gives way to passion with the utmost abandon until it is taught to control itself.

Of course in all the many expressions of the mind as shown in the face and body there is a wonderful variety of ways of expressing each one. How to depict any expression would depend upon the natural feeling of the artist. Every true artist must necessarily be a law unto himself.

All purely physical expressions as in pulling, pushing, lifting, etc., are more or less alike. That is so far that the same muscle is always used to perform a certain action subject to variation in form and development according to the comparative strength of the individual.

THE GENERAL CHARACTER AND APPEARANCE OF THE HEAD AND NECK.

The bone structure governs the character and surface appearance of the whole head.

Taking the line formed by the eyebrows and cheek bones, and continuing upwards and backwards to the hair, and in the absence of hair to the junction of the skull with the neck behind the bone prevails almost exclusively. Above the bridge of and along the sides of nose, the larger part of the cheek bones and the outline of the lower jaw bone which is exposed on the surface from ear to ear are all bony in character.

The form of the upper lip is always governed by the shape of the upper jaw bone, projecting or retreating according to

the under construction. The chin also shows the bony influence.

Between the cheek and jaw bones the space is occupied by muscles which are short and mostly flat, and as they run direct from bone to bone they give that square positive character of planes peculiar to the face.

In females and in some males and children the fatty deposits produce a rounded and softening effect.

The surface appearance of the neck is muscular except immediately in front where the cartilage of the larynx ("Adam's apple") appears.

The neck is divided into four distinct planes or masses. The sterno-cleido-mastoid on either side. The mass formed by the splenius trapezius and other deeper muscles occupying the back and the Adam's apple or cartilage of the larynx in front of the neck.

OCCIPITAL FRONTALIS.

The occipital frontalis is a broad, thin membraneous fibrous layer, skinny and muscular, that covers the whole of the forehead and skull from the occiput to the eyebrows.

It consists of two muscular strips separated by an intervening fibrous membrane, called an aponeurosis, covering the whole of the skull, and out of which the hair grows.

The occipital portion arises from the outer two-thirds of the superior curved line of the occiput, which is the termination of the skull behind.

The frontal portion occupies the space on the forehead immediately over the eyebrows. It is a thin substance, of a square or quadrilateral form, and is firmly connected to the skin. Its internal fibers continue into the pyramidal nasi, and are also blended with the fibers of the corrugator supercilii and orbicularis of the eye.

The muscular tendenous structure of the aponeurosis is loosely connected with the skull (pericranium) by a quantity of loose cellular tissue which allows of a considerable degree of movement of the scalp—so much so, that some persons by bringing alternately into action the muscles behind and in front can move the entire scalp backward and forward at will.

The frontal portion of the muscle raises the eyebrows and the skin over the root of the nose, at the same time throwing the

skin of the forehead into transverse wrinkles. By the intermingling of its fibers with those of the muscles surrounding the eye it helps in the above action to expose the globe of the eye, and assist in giving expression to the emotions of delight, admiration, surprise, stupefaction, etc.

In the actions of terror, suffering, anger, and during meditation, the action of the frontalis is seconded by the orbicularis of the eye.

ORBICULARIS OF THE EYE.

This muscle surrounds the circumference of the orbit and eyelids.

It arises from the internal angular process of the frontal bone and from the nasal process of the superior maxillary, and from the border and anterior surface of the tendon in the inner corner of the eye. When the entire muscle is brought into action, the skin of the forehead, temple and cheek is drawn inwards toward the inner angle of the eye and the eyelids are firmly closed. When the action is performed passively, as in sleep, it gives that smoothness and calm immobility to the features which is only seen at that time. It is the antagonist of the elevator of the eyelid, frontalis and corrugator supercilii.

ELEVATOR OF UPPER EYELID.

The elevator palpebræ is the direct antagonist to the orbicularis of the eye. It raises the upper eyelid and exposes the globe of the eye. It arises from inside the orbit and is attached by a broad thin tendon to the upper eyelid. This muscle is only felt by its action and is not seen on the surface.

EYE MUSCLES.

To the ball of the eye behind these are four muscles attached in such a manner that acting singly they will turn the eye upwards and downwards, inwards and outwards.

The movement of circumduction, as in looking around a room, is performed by these muscles acting alternately.

CORRUGATOR SUPERCILII.

The corrugator supercilii draws the eyebrows downwards and inwards, producing the vertical wrinkles of the forehead.

It arises from the inner extremity of the superciliary ridge of the nasal bone, and is inserted into the middle of the orbicularis above the eye.

In meditation or anger—knitting the eyebrows—its action materially affects the surface.

COMMON ELEVATOR OF UPPER LIP AND NOSTRIL.

The common elevator of the upper lip and nostril is a thin muscle placed by the side of the nose.

It arises from the upper part of the nasal process on the upper jaw bone, and passing downwards, divides into two slips, one being inserted into the cartilage of the nostril, the other into the upper lip. Its most important action is on the nostril, which it has the power of dilating to a considerable extent, as in panting from fatigue or terror.

This muscle also exercises much influence over the features, and is the principal agent in the expression of contempt. It is very strongly developed in the horse, which uses it in snorting, etc.

DEPRESSOR OF THE NOSTRILS.

The depressor of the wing of the nose is the direct antagonist of the above, drawing the wings of the nose down after the use of the above expressions. It arises from the fossa of the maxilla, and is inserted into the back of the nostril. The attachment of the elevator and depressor of nostril are distinctly marked on the surface and form the apex of the wing of the nostril.

PROPER ELEVATOR OF THE UPPER LIP.

The proper elevator of the upper lip arises from the lower margin of the orbit, and is inserted into the orbicularis of the mouth. The line running from back of the nostril to corner mass of the mouth shows the attachment of this muscle in conjunction with the common elevator of upper lip.

ZYGOMATICS.

The larger and smaller zygomatic muscles arise from the malar bone, and are both inserted into the corner of the orbicularis of the mouth, and combined with the elevators raise the upper lip. The zygomatics drawing the mouth outwards, as in laughing.

RISORIUS.

The proper laughing muscle is the risorius, as its name implies. It is a very small thin muscle and arises from the fascia at the top of the masseter, and is attached to the outer angle of the mouth, which it pulls directly outwards and in conjunction with the zygomatics pulls upwards. In the action of laughing the orbicularis of the mouth is pulled upwards and outwards, flattening the muscle on the upper lip and causing the elevators of the mouth to swell up and in conjunction with fat to overlap or protrude over their attachment to the orbicularis.

DEPRESSORS OF THE UNDER LIP.

The depressor of the under lip and depressor of the outer angle of the under lip are the antagonists of the elevators of the angle of the mouth and zygomatics. Acting with these muscles they will draw the mouth directly backwards. They both arise from the lower jaw bone and are inserted into the fibers of the orbicularis of the mouth.

ORBICULARIS OF THE MOUTH.

The orbicularis oris is the muscle which surrounds the orifice of the mouth. It is connected directly with the maxillary bones and septum of the nose, and is the direct antagonist of all the muscles which converge towards and are attached to the lips from the various parts of the face.

Its ordinary action is to close the mouth by squeezing the lips together, and in its forcible action it wrinkles the skin to which it is firmly attached.

BUCCINATOR.

The buccinator arises from the lower and upper jaw at the three molar teeth, and is attached to the orbicularis oris at the corner of the mouth. It controls and compresses the cheek so that during the process of mastication the food is kept under the direct pressure of the teeth.

The buccinator ordinarily, as in repose, is shown by a plane or depression immediately back of the attachments of the muscles to the corner of the mouth.

The muscle is elastic and in action swells out, especially in the act of blowing, when it assumes a decided rounded elevation, puffing ont also part of the muscles that surround it.

MASSETER.

The masseter is a short, thick muscle. It consists of two portions, inner and outer, and arises by a thick tendon from the malar or cheek bone.

It passes downwards and backwards, and is inserted into the angle of the jaw. The inner portion is the strongest, but the outer half is the part that governs the appearance of the surface form. In action, assisted by the pterygoid muscles, which are behind it, the masseter compresses the jaw and grinds the teeth over one another as in chewing food. The action of the muscle has its effect on the expression of the face, grinding the teeth in anger, and adding by its contraction to the expression of firmness and decision.

TEMPORAL.

The temporal muscle covers the temporal bone, from which it arises, and proceeding forwards and downwards inside of the malar or cheek bone is inserted by a strong tendon to the coronoid process of the lower jaw bone as far forward as the last molar tooth. It assists in closing the jaw. About one-fourth of the front part above the ear and between the hair and termination of the frontal bone of the forehead is always shown in action when the jaws are compressed or moving.

AUREM MUSCLES.

Placed over the temporal muscle are three very small muscles, which are situated on the top and either side of the ear.

These muscles in some persons are developed so strongly as to enable them to move their ears at will.

In quadrupeds they are quite powerful, and turn the ears backwards and forwards, as in the horse, mule, dog, etc.

In man they are, as a rule, undeveloped from disuse, and do not affect the appearance of the surface.

MUSCLES OF THE NECK.

Sterno-Cleido-Mastoid.

The sterno-cleido-mastoid (from sternum clavicle and the mastoid process) is a large thick muscle which passes obliquely across the side of the neck.

It is thick and narrow at its central part, and broader and thinner at each extremity.

It arises by two heads from the sternum and clavicle and is inserted by a strong tendon into the outer surface of the mastoid process, and by a thin fibrous membrane into the outer two-thirds of the superior curved line of the occiput (the termination of the skull behind).

When acting together the two muscles depress the head on the neck and the neck on the chest. When acting singly it turns the head, and combined with the splenius, draws it to the shoulder of the same side.

The mastoids prevent the head from falling backward, and in conjunction with the splenius and trapezius, behind of which they are the antagonists, keep the head erect on the neck and shoulders.

SPLENIUS.

The splenius muscles are of the second layer, but govern the form of the back of the neck. They arise principally from the seventh cervical—last vertebra of the neck—and the six upper dorsal or rib vertebræ, and are attached to the lower border of the occiput. These muscles, in conjunction with the trapezius, prevent the head from falling forward, and assist in turning the head.

TRAPEZIUS.

The trapezius—or monk's-hood, called so from its shape—is a flat triangular muscle placed immediately beneath the skin and covers the upper part of the neck and shoulders. It arises from all the dorsal vertebræ and the seventh cervical and is inserted into all of the upper border of the spine of the shoulder blade, the outer third of the collar bone and into the border of the occiput. The splenius and trapezius are the antagonists of the sterno-cleido-mastoids, but acting in conjunction with them keep the head firmly posed on the neck. In opposition they will pull the head backwards and prevent it falling forwards.

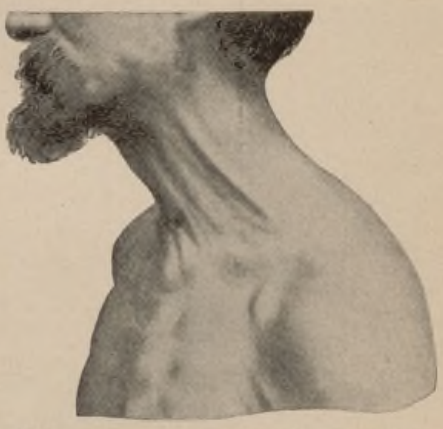
They also assist the mastoids in turning the head.

HYOIDS.

The hyoid muscles, which cover the front of throat, depress the larynx and hyoid bones. They arise from the sternum and clavicle, and are attached to the hyoid bones. In swallowing they are shown distinctly in action.

PLATYSMA MYOIDES.

The platysma myoides is a broad thin plane of muscular fiber placed immediately beneath the skin and intimately connected with it. It arises from the clavicle and acromion process and from the fascia of the pectrales, deltoid and trapezius, and is inserted into and above the lower jaw up to the angle of the mouth. This muscle is the antagonist of all the muscles that close the jaws.



It pulls down the jaws and the angle of the mouth on both sides.

It requires resistance to develop its action on the surface. It then shows by strong ridges running at right angles to the fibers of the other muscles occupying the sides of the neck.

It is sometimes called the horse muscle, as it is very strongly developed in that animal. It is comparatively weak in man. In fly time the horse uses it very extensively to shake off those pests. It wrinkles the neck in a vertical direction.

It helps in rendering the expression of melancholy by depressing the corners of the mouth.

CONCERNING THE TERMS ORIGIN AND INSERTION.

The origin of a muscle is the point from which it works.

The insertions are attached to the portions which are put in action.

The term origin of a muscle is meant to imply its most fixed and central attachment—nearly always to a bone—and

the term insertion—also to a portion of the skeleton—the movable point upon which the force of the muscle is directed. But the origin is fixed absolutely in very few of the muscles, and changes from one end to the other according to the action. As a rule the muscles of the face have permanent origins, and the rest of the body changeable origins—for instance, in climbing, the muscles of the trunk exert their force on the pelvis, whereas in walking and running, lifting, etc., the action of the trunk is governed from the pelvis. In the arms this reversible action is very marked. In quiet or violent actions the emotions would be expressed according to temperament and education.

Pl. 6.

Fig. 1.

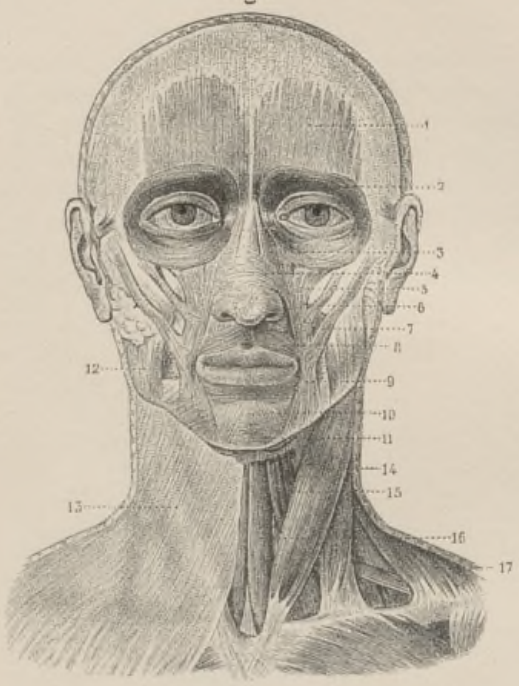


Fig. 2.

Fig 3.

PLATE VI.

HEAD.

Face and Profile.

FIG. 1.

1. Frontal portion of the occipito-frontalis muscle. (*a.*)
2. Orbicular muscle of the eye-lids.
3. Common elevator of the nose and upper lip.
4. Triangular of the nose; the pyramidal is above it.
5. Proper elevator of the upper lip.
6. Smaller zygomatic.
7. Larger zygomatic.
8. Orbicular of the lips.
9. Triangular of the chin.
10. Square muscle of the chin.
11. Elevator of the chin.
12. Masseter muscle. (See fig. 3.)
13. Latissimus colli muscle. (See fig. 2.)
14. Sterno-cleido mastoideus. (*b.*)
15. Sterno-thyroideus. (*c.*)
16. Sterno-hyoideus. (*d.*)
17. Trapezius. (See fig. 8.)

FIG. 2.

1. Anterior auricular.
2. Superior auricular.
3. Posterior auricular.
4. Parotid gland.
5. Risorius muscle of Santorini.
6. Latissimus colli. (*e.*)

FIG. 3.

1. Frontal portion of the occipito-frontal muscle. (See fig. 1.)
1'. Occipital portion of the same muscle. (*f.*)
2. Temporal. (*g.*)
3. Orbicular of the eyelids.
4. Common elevator of the wing of the nose and of the upper lip.
4'. Proper elevator of the upper lip.
5. Triangular of the nose.
6. Small zygomatic.
7. Great zygomatic.
8. Orbicular muscle of the lips.
9. Buccinator.
10. Triangular muscle of the chin.
11. Square muscle of the chin.
12. Masseter. (*h.*)
13. Sterno-cleido mastoid. (See fig. 1.)
14. Digastric. (*i.*)
15. Mylo-hyoid. (*j.*)
16. Sterno-hyoid. (See fig. 1.)
17. Omo-hyoid. (See fig. 1.)
18. Thyro-hyoid. (*k.*)

ATTACHMENTS AND FUNCTIONS.

(*a.*) ATTACHMENTS. To the epicranian aponeurosis, interlacing with the orbicular muscle of the eyelids; also to the dorsal aponeurosis of the nose, and continues with the pyramidalis muscle.

(*b.*) ATTACHMENTS. 1°. To the mastoid process and to the superior occipital curved line.

2°. To the internal part of the clavicle, and to the superior and anterior part of the sternum.

FUNCTIONS. When one of these muscles acts alone, it turns the head on the opposite side; but when the two muscles are contracted, the head is flexed on the chest.

(*c.*) ATTACHMENTS. 1°. To the lower edge of the hyoid bone.

2°. To the upper edge of the scapula, behind the curved notch.

FUNCTIONS. To lower the hyoid and draw it aside and backwards.

(*d.*) ATTACHMENTS. 1°. To the lower edge of the body of the hyoid bone.

2°. To the inner extremity of the clavicle and to the upper part of the sternum.

FUNCTIONS. To depress the hyoid.

(*e.*) ATTACHMENTS. 1°. To the lower jaw and to the skin of the face.

2°. To the skin of the front, and upper part of the breast.

FUNCTIONS. To wrinkle the skin of the neck and to depress the mouth by drawing it outwards.

(*f.*) ATTACHMENTS. Backwards, to the two external thirds of the superior occipital curved line, and to the mastoid region of the temporal bone.

2°. It interlaces with the orbicular muscle of the eyelids, continues with the pyramidalis, and unites with the dorsal aponeurosis of the nose. The two parts are reunited by the epicranian aponeurosis.

FUNCTIONS. It wrinkles the forehead horizontally, and puts the hairy scalp and the skin of the forehead into action.

(*g.*) ATTACHMENTS. 1°. To all the temporal fossa and to the superficial temporal aponeurosis.

2°. To the coronoid apophysis of the lower jaw.

FUNCTIONS. To elevate and draw back the lower jaw.

(*h.*) ATTACHMENTS. 1°. To the lower border of the zygomatic arch.

2°. To the external face of the ramus and to the angle of the lower jaw, and to the outer part of the coronoid process.

FUNCTIONS. To elevate the lower jaw.

(*i.*) ATTACHMENTS. 1°. To the mastoid process.

2°. To the base of the lower jaw, near the symphysis of the chin, and to the hyoid bone.

FUNCTIONS. To depress the lower jaw and to elevate the hyoid bone.

(*j.*) ATTACHMENTS. 1°. To the mylo-hyoidean line.

2°. To the hyoid bone.

FUNCTIONS. As the preceding.

(*k.*) ATTACHMENTS. 1°. To the thyroid cartilage of the larynx.

2°. To the body and to the greater horn of the hyoid.

FUNCTIONS. To lower the hyoid, and to elevate the thyroid cartilage.

CHAPTER IV.

Front and Sides of the Trunk.

The front and side of the trunk—bounded by the collar bones above and the pelvis at the lower extremity—is composed of seven masses exclusive of the deltoids.

First, two pectoral or chest muscles.

Second, the mass on either side formed by the seventh to the tenth rib inclusive.

Third, the masses of the three combined oblique muscles underneath the ribs.

Fourth, the abdominal mass occupying the center of the trunk from the pectorals to the os pubis.

The last mass in repose being generally divided by a depression showing a line of ligament from the pit of the stomach to the navel.

In action, as in climbing, the line of depression will continue down to the os pubis.

The three serrati, or breathing muscle, which appear under the arm pit, can be considered simply as a detail in the masses No. 2 formed by the four ribs on either side.

SKELETON.

The portions of the skeleton that appear on the surface are the collar bones, the whole of the top and most of the front surface of which is uncovered by muscle and is exposed on the surface from the pit of the throat to its outward termination on the spine of the shoulder blade.

The sternum or breast bone is shown by a depression in the muscular subject. The joints of the three pieces are indicated by elevations and runs; the bone continues from the pit of the throat to the triangular piece at its lower end, which is called the pit of the stomach.

At the termination of the main portion of the breast bone just above the pit of the stomach commences the cartilage which forms the arch of the ribs; this, in combination with the seventh to the tenth rib inclusive, always governs the external appearance.

The last portion of the skeleton that affects the surface in front and side of the torso is the crest of the ilium or top edge of the pelvis, which appears on the surface all the way from the front to its termination behind. In thin subjects the bone is very pronounced in all the portions spoken of above, and is especially so in the majority of children.

SUPERFICIAL MUSCLES.

The superficial muscles in the front and sides of the trunk are the pectorals or chest muscles, the muscles of the abdomen, the obliques and the serratus magnus or breathing muscles.

PECTORALIS MAJOR.

ANTAGONIST TO THE RHOMBOIDS, LATISSIMUS DORSI AND TRAPEZIUS.

The pectoralis major, or surface chest muscle, is a broad, thick triangular muscle covering the upper and front part of the sternal half of the clavicle and either side from one-half of the sternum as low down as the cartilage of the sixth and seventh ribs.

It generally covers the whole of the upper part of the sixth rib and continues over and is attached to the seventh rib, and by a sort of fascia or fibrous skin is attached to the external oblique.

This muscle is divided into three sections. The top arising from the inner two-thirds of the clavicle, the middle section from the upper two-thirds (about) of the sternum, and the lowest section from the lower third of the sternum and the sixth and seventh ribs.

The fibers of these three divisions converge toward its insertion, giving it a radiating appearance.

Those from the clavicle pass obliquely downwards and outwards; the middle section passes horizontally, and the lower passes upwards and outwards. As these three sections converge to their insertion the upper part overlaps the middle and

the middle the lower portion. They twist around each other so that the portion that is lowest in front becomes highest at the point of insertion, which is by a tendon two inches thick into the front bicipital groove on the outside of the humerus.

The action of this muscle in conjunction with the latissimus dorsi is to pull down the arm when it is raised by the deltoid to the side of the chest, and if acting singly it will pull the arm in front of the chest. The last action will give a very square character to the pectoral in the male subject.

SOME PECULIARITIES OF THE PECTORAL AND STERNUM.

In muscular subjects the two pectorals are separated generally at only small intervals by the sternum.

The fibers of the muscles intersect each other across the bone, and when the muscles are large and powerful the masses on either side almost touch each other, so that there is simply a depression between them. In a thin person most of the sternum is seen.

The joint of the first to the second, and the divisions in the second piece in the sternum, which generally have a rugged, bony character in man, are indicated in a plump, well-formed woman's chest by a soft prominence, diamond shape in form. The bones are covered and softened with fat. Of course in a thin woman the bony characteristics would prevail.

In a man the mammalic glands in an undeveloped condition fill up the corner under the nipple. The glands soften, but at the same time give a squarer character to the male chest. In the woman these glands are developed to a great extent, and change entirely the outer appearance of the pectoral in that section, swelling out into the round globular form, which is one of the distinctive differences between the two sexes.

OBLIQUE MUSCLES.

Antagonist of the Pectorals.

The external or descending oblique muscle covers the side of the trunk and fore part of the abdomen.

It is the largest and most superficial of the three flat oblique muscles, which together form the mass between the tenth rib and the rim of the pelvis.

Its muscular portion occupies the side ; its skinny or aponeurosis the front part of the abdomen. It arises from the eight lower ribs and the muscles between them.

Above it is attached to the pectorals, and below its fibres are attached to the crest of the ilium (pelvis), Ponpart's ligament, which is a ligament running from the outer termination of the crest of the pelvis to the os pubis, to both of which points it is firmly attached. It intersects five times with the serratus magnus and lower down three times with the latissimis dorsi.

There are two other muscles underneath which form part of the mass above the crest of the ilium :

The internal oblique, whose fibers are at right angles with the surface muscle ; and the transversalis, which runs horizontally across.

The two last muscles are attached above only to the cartilages of the six lower ribs and below are attached to the crest of the ilium—rim of the pelvis—Ponpart's ligament and os pubis the same as the surface oblique ; so that the ribs are only covered by the surface oblique and always show through it in every action.

Below the ribs, the three muscles combined form a large mass which bags over the side of the pelvis on the standing side or that side of the pelvis that is supporting the weight of the body.

The actions of the obliques is to raise the pelvis, thigh and leg from the ground and swing them forward as in the act of walking. The combined muscle on either side will also bend the body sidewise. In carrying a weight on one side the obliques on the opposite side acting from the pelvis will help the trunk to sustain the weight.

RECTUS ABDOMINIS.

Antagonist of the Rectus Spinæ and other Muscles of the Back.

The rectus abdominis which extends along the whole front of the abdomen is divided into two parts by a ligament which forms a line called the linea alba. It is much broader and thinner in the upper part, which is inserted into the cartilages of the fifth, sixth and seventh ribs, and below it arises from the os pubis.

This muscle is divided by tendonous intersections which vary in number from two to five and are called transverse lines. One is usually situated opposite the navel and two above that point and sometimes one below. These intersections pass transversely and obliquely across the muscle in a zig-zag course, rarely passing completely across, and sometimes only about one-half, and are intimately adhesent to the sheath thrown out by the obliques inside and outside. This sheath completely envelopes the abdominal muscles, giving them additional strength.

The actions of these muscles when acting from the os pubis is to pull the trunk forwards and downwards, and when acting from the ribs they pull the front of the pelvis forwards and upwards, as in climbing. The abdominis also assist the obliques to swing the pelvis forward as in the act of walking or running.

These contrary actions is an illustration of the changeability of the fixed point or origin of a muscle.

These muscles are the direct antagonists of the recti spinæ and other muscles of the back.

ABDOMINAL.

There is a small muscle in the shape of a pyramid, hence its name pyramidalis, which arises from the os pubis, and proceeding upwards terminates in a small point which is inserted into the central line or linea alba of the abdomen.

This muscle is the tensor of the central ligament, and in the action of hanging by the hands or in climbing it strains the ligament so that the lower mass of the abdomen is divided into two.

The abdominal muscle assists in respiration, expelling the air by pressing in. This action is caused principally by the ribs being raised by the serrati muscles, which causes them to strain, distend and flatten the abdominal muscles.

SERRATUS MAGNUS.

ANTAGONIST OF THE RHOMBOIDS AND LATISSIMUS DORSI.

Is a broad, thin muscle situated on the outer side. It arises by nine fleshy digitations from the upper border and outer surface of the eight upper ribs—the second rib having two. All of the muscle converges upwards and between the shoulder blade and the ribs, and is inserted into the whole length of the inner margin of the posterior border of the scapula or shoulder blade. Its actions are to draw the ribs up in the action of

inspiration. It is the most important external muscle used in ordinary breathing.

This muscle in addition acting from the ribs draws the base of the scapula forward, and so raises the point of the shoulder by raising the acromion process and collar bone. In this action it assists the trapezius in supporting a weight upon the shoulder, and is strongly developed.

Ordinarily only three serrations show underneath the pectoral at the arm pit. When the arm is raised, four and sometimes five serrations show like small elevations on the surface of the ribs, and are very frequently mistaken for the ribs.

THE MUSCLES OF INSPIRATION.

There are a number of muscles which assist the action of the diaphragm in inspiration. The principal muscles that assist in the ordinary action of breathing are the serratus magnus (the serratus magnus described above is the only one whose action is marked on the surface), the intercostals and the scaleni—all of which raise the ribs.

When a need for more action exists, as in running, wrestling or other violent actions, the surface and smaller pectorals, situated underneath, are used, and the powerful action of forced inspiration takes place. The sub-clavius, a muscle placed between the collar bone and first rib, also assists by pulling up the ribs.

In running, the shoulder blades are fixed and the arms braced so that all the muscles of inspiration can be used.

The ribs are pulled up by the muscles of inspiration described above, and forcibly pulled down by the muscles of the abdomen, viz., the recti and obliques which act from the pelvis.

The ordinary action of expiration is passive, the resilience or rebounding property of the ribs, and the elasticity of the lungs being sufficient to produce it. This action causes the descent of the viscera covered by the diaphragm.

DELTOID.

ANTAGONIST TO THE PECTORALS, LATISSIMIS DORSI AND ALL OTHER MUSCLES CONTROLLING THE ACTIONS OF THE SCAPULA.

Is a thick, triangular muscle which forms the convexity of the shoulder.

It surrounds the shoulder joint, in the greater part of its extent covering it in front, back and outer side.

It arises from the outer one-third of the upper surface of the clavicle, and from the upper part of the acromion process; which is formed by the outer termination of the collar bone on the outer end of the spine of shoulder blade; and also arises from the whole length of the lower border of the spine of the scapula.

From this origin the fibers are united by a thick tendon which is inserted into a rough prominence on the outer side of the humerus, one-half way down the shaft.

It is divided into three masses or planes. The front mass assists the pectoral to pull the arm in front of the body; the center or side mass raises the arm at right angles with the body and neck; and the back mass assists the rhomboids, trapezius and latissimus, etc., in pulling the arm backwards towards the spine; so that the three sections of the muscles are to a certain degree independent of and act antagonistically to each other.

The fibers of the deltoid are intersected by thin tendons in several places, which affect the surface appearance materially in various actions.

PLATE VII.

TRUNK.

Front view.

A. Lower jaw.
B. Clavicle.
C. Sternum.
D. Anterior and superior iliac spine.
E. Pubis.
1. Latissimus colli. (*a.*)
2. Digastric. (See pl. 6.)
3. Sterno-cleido mastoid. (See pl. 6.)
4. Sterno-hyoid. (See pl. 6.)
5. Omo-hyoid. (See pl. 6.)
6. Trapezius. (See pl. 8.)
7. Deltoid. (See pl. 12.)
8. Great pectoral. (*b.*)
9. Serratus magnus. (See pl.
10. Latissmus dorsi. (See pl.
11. Great oblique muscle. (See pl. 9.)
12. Rectus abdominis. (*c.*)
13. Pyramidalis. (*d.*)
14. Tensor of the fascia lata. (See pl. 16.)
15. Sartorius. (See pl. 17.) The corresponding muscle is covered by the aponeurosis. 15.
16. Pectineus. (See pl. 13.)
17. Testicular cord.

ATTACHMENTS AND FUNCTIONS.

(*a.*) ATTACHMENTS. 1°. To the skin of the front and upper part of the breast.

2°. To the lower jaw and the skin of the face.

FUNCTIONS. To lower the mouth, to draw it outwards, and to wrinkle the skin of the neck.

(*b.*) ATTACHMENTS. 1°. To the internal edge of the clavicle, to the front face of the sternum, to the cartileges of the second, third, fourth, fifth and sixth ribs, to the body of the sixth, and to the abdominal aponeurosis.

2°. To the front edge of the bicipital groove of the humerus.

(*c.*) ATTACHMENTS. 1°. To the cartilages of the fifth, sixth, and seventh ribs and to the sternum.

2°. To the upper edge of the pubis, between the spine and the symphysis.

FUNCTIONS. A flexor of the chest on the pelvis and reciprocally; it supports the abdominal cavity.

(*d.*) ATTACHMENTS. 1°. To the linea alba.

2°. To the front of the rectus.

FUNCTIONS. An accessory of the preceding.

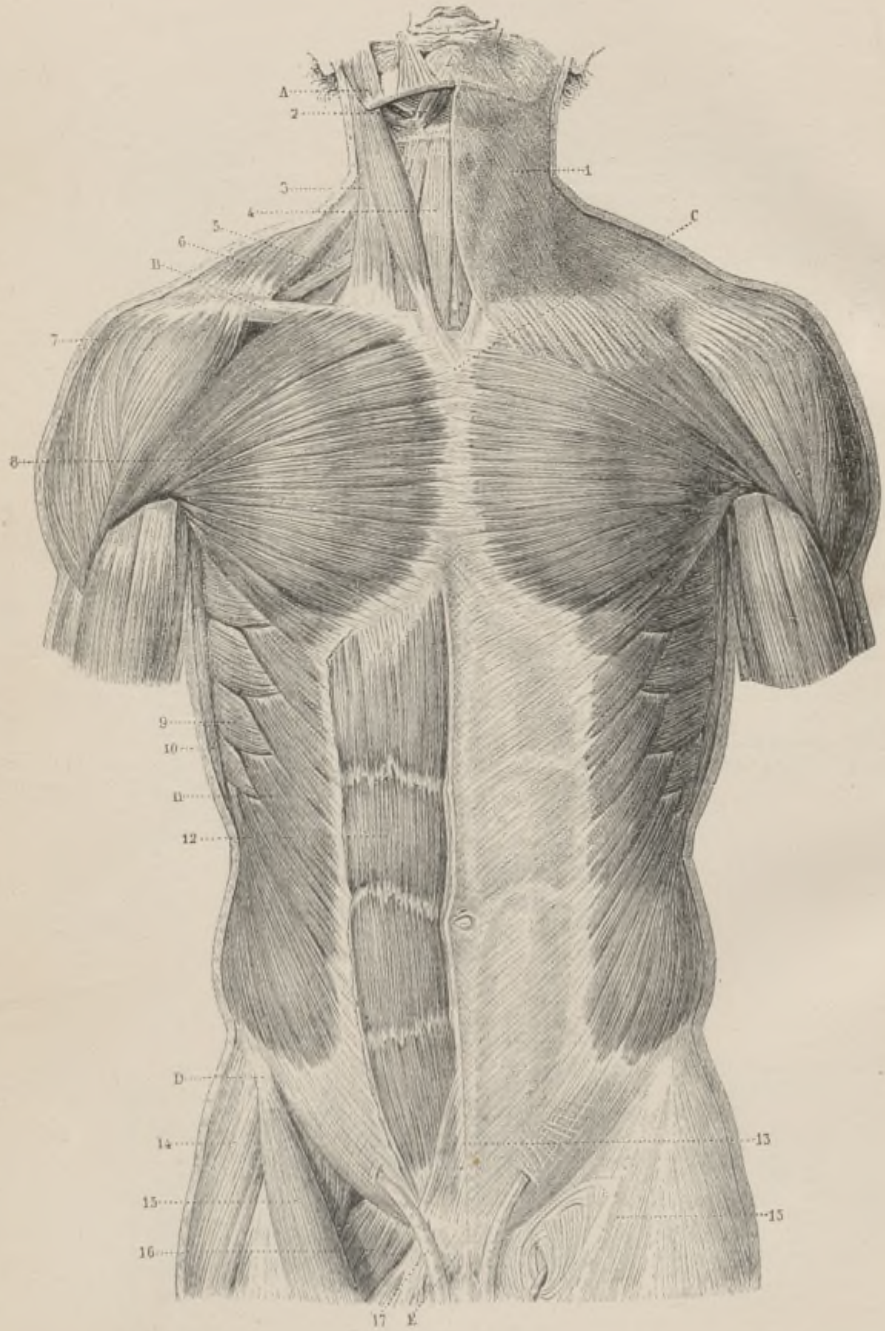
PLATE VIII.

TRUNK.

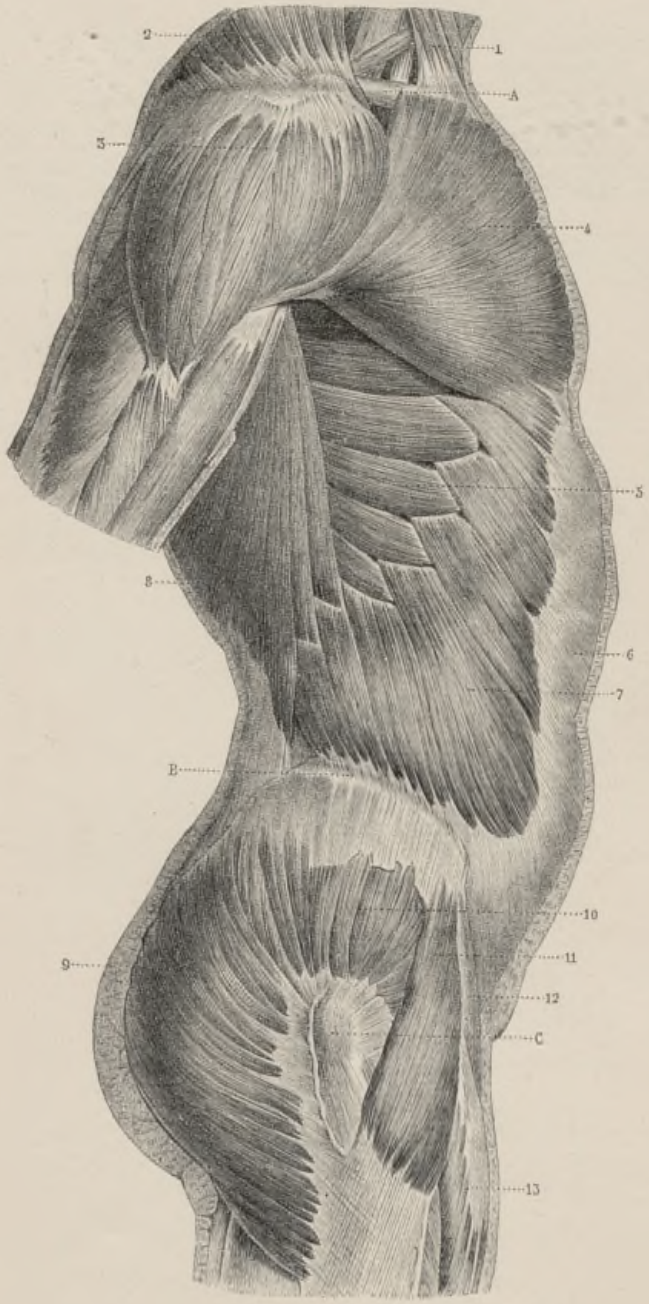
Side view.

A. Clavicle.
B. Crest of the ilium.
C. Great trochanter.
1. Lower extremity of the sterno-cleido mastoid. (See pl. 6.)
2. Lower extremity of the trapezius. (See pl. 8.)
3. Deltoid. (See pl. 12.)
4. Pectoralis major. (See pl. 7.)
5. Serratus magnus. (*a.*)
6. Rectus abdominis covered with the aponeurosis. (See pl. 7.)
7. Great oblique. (*b.*)
8. Dorsalis magnus. (See pl. 8.)
9. Gluteus maximus. (See pl. 15.)
10. Gluteus medius. (See pl. 17.)
11. Tensor of the fascia lata aponeurosis. (See pl. 17.)
12. Sartorius. (See pl. 16.)
13. Rectus femoris. (See pl. 13.)

Pl. 7.



Pl. 8.



ATTACHMENTS AND FUNCTIONS.

(*a.*) ATTACHMENTS. 1°. To the ten first ribs.

2°. To all the external edge of the scapula. The first digitation of this muscle is fixed on the two first ribs, and the eight other digitations, on the second, third, fourth, fifth, sixth, seventh, eighth, ninth and tenth ribs, and cross with the digitations of the great oblique muscle.

FUNCTIONS. To carry the scapula and the upper limb forward and backward; to dilate the chest.

(*b.*) ATTACHMENTS. 1°. To the external face and to the lower edge of the seven or eight last ribs. The four or five superior digitations cross with those of the *serratus magnus*, and the others with those of the great dorsal.

2°. To the front half of the iliac crest and to the external edge of the abdominal aponeurosis.

FUNCTIONS. To flex the chest on the pelvis and *vice versa*, and to support the abdominal cavity.

CHAPTER V.

Back.

MUSCLES ON THE BACK OF THE TRUNK.

The back of the human trunk is occupied by five masses on either side.

The first is composed of the thickest and most muscular portion of the trapezius, which occupies the place above the shoulder blade, between the deltoid and the neck, and always governs the outline viewed from the front and back in that vicinity.

Second—The scapula and its muscles.

Third—The erector spinæ, comprising all the muscles that occupy the space on either side of the spine, from the shoulder blades down to the pelvis.

Fourth—The muscular portion of the latissimus dorsi, which gives the outline on the side of the trunk, from the shoulder blade down to the mass of the obliques.

Fifth—The three oblique muscles combined which continue the outline of the trunk, viewed from front and back down to the rim of the pelvis.

The general character of the back is muscular.

SKELETON.

The bony portions are given by the spine, which shows from the seventh cervical or last vertebra of the neck, down to the sacrum which forms the back part of the pelvis.

The posterior border, and the spine of the scapula or shoulder blade, and the rim and back terminations of the main portion of the pelvis or haunch bone.

In the muscular, stout subject, both male and female, the spine appears all the way down from the seventh cervical

(which is invariably a prominence) to the sacrum (or back of pelvis) as a depression.

In a thin person, particularly in children, the vertebræ show like prominences in the depression.. When the body is bent forwards, all of the vertebræ of the spine are forced out on the surface, and give a more pronounced bony character to the back. Sometimes, also when the body is bent forwards, the two floating ribs are forced to and are shown on the surface.

EXTERNAL MUSCLES OF THE BACK. ERECTOR OF THE SPINE—TRAPEZIUS TRIANGULAR—LATISSIMUS DORSI—SCAPULA—RHOMBOIDS.

The erector of the spine comprises a number of muscles arising from the crest of the ilium—upper rim of the pelvis—the sacrum, five lumbar and neck vertebræ, and the base of the skull behind. It fills up the groove on either side of the spine, and is attached to all the ribs and rib vertebræ. The longissimus dorsi, as its name implies, is the longest muscle of this mass, and has also the most bulk. The external form of the back, along the spine, is governed exclusively by this mass of muscles, which combined is called the erector of the spine.

ACTIONS.

Its action is principally, as its name implies, to keep the body erect on the pelvis, the muscles exerting their power from the back portion of the pelvis. It also bends the trunk backwards when necessary to counterbalance any weight in front, or when there is any great abdominal development.

In climbing, the muscles of the erector exert their power from the skull vertebræ and ribs, and pull up the pelvis and lower extremities with the trunk. In this action it assists the front muscles of the trunk. The erector of the spine is the direct antagonist of the rectus abdominis, the latter pulling the chest forwards, the rectus spinæ pulling it backwards.

TRAPEZIUS TRIANGULAR.

This muscle is also included in the muscles of the neck.

It is a broad, thin muscle, placed immediately underneath the skin. It arises from the occiput seventh cervical, and all

the twelve dorsal vertebræ. It is inserted into the outer one-third of the clavicle, the upper margin of the acromion process, and into all of the upper border of the spine of the scapula. Its most muscular portion occupies the space above the spine of the scapula, and between the deltoid and the neck, and governs the form and outline in that portion of the shoulder.

ACTIONS.

Its ordinary action is from the occiput and seventh cervical, which raises the shoulder blade and with it the arm.

When the trapezius acts from the shoulder blade and vertebræ, it pulls back the head. Acting from the vertebræ it assists the rhomboids in pulling back the shoulder blades to the spine. It is the antagonist of the pectorals or chest muscles, and the latissimus dorsi.

LATISSIMUS DORSI.

The latissimus dorsi is a broad, thin muscle which covers the lumbar and lower half of the dorsal regions. It arises from the six lower dorsal vertebræ underneath the trapezius, from the five lumbar vertebræ, and from the sacrum.

This muscle converges outwards and upwards in a lateral direction to the pit of the arm curves around the edge of the teres major, twists on itself, and is inserted into the humerus above the insertion of the pectoralis major. The latissimus dorsi is also connected with the surface obliques, covering the ribs. It serrates with the obliques three times just below the serrations of the serratus magnus or surface breathing muscles.

For about one-third of the distance from its attachment to the spine, it is only membrane, so that the longissimus or erector of the spine, although lying underneath, governs exclusively the form along the spine.

The outer two-thirds of the latissimus is muscular. Its thickest portion lies directly on the sides of the trunk, and governs the outline of that portion of the body between the shoulder blade and the mass formed by the three oblique muscles. It is the direct antagonist of the deltoid and trapezius.

ACTIONS.

When the arm is raised the latissimus dorsi will pull it down to the side of the body. This action, however, of the latissimus ordinarily is passive, as the arm will drop from its own weight. The action of the latissimus is noticeable when resisting the action of the trapezius, which raises the arm above the right angle until it touches the head. The development is still much greater when the arms are raising the body from the ground, or when lifting a weight. In both of the last actions the muscle is powerfully exerted.

SCAPULA.

The portion of the scapula, or shoulder blade beneath the spine, is filled with muscles called the infra spinatus (beneath the spine) and the teres major and minor.

All of these muscles arise from the outer border, and all of the outside surface of the blade of the scapula.

The infra spinatus and teres minor are attached to the tuberosity of the humerus on the outside. The teres major is attached to the inside of the shaft of the humerus, below the attachment of the latissimus dorsi. The cavity on the top of the spine of the scapula is filled up by the supra spinatus (above the spine) which also has the same attachment to the inside of the humerus.

All these muscles bind the scapula firmly to the humerus, and cause them to be united in nearly all their movements.

The muscles of the scapula are the antagonists of the deltoid and pectoral muscles.

ACTIONS.

To bind the arm to the shoulder blade, and to pull the arm backwards. In this action they resist the pectoral muscles which pull the arms in front of the chest.

RHOMBOIDS.

The rhomboids are the two muscles that firmly connect the scapula to the spine. They arise from the seventh cervical, and from the four upper dorsal (or rib) vertebræ, and are inserted into all of the posterior border of the scapula.

They are the antagonists of the pectorals. The pectorals pull the arm and shoulder blade forwards, the rhomboids pull

them backwards to the spine. In this action they are assisted by the trapezius.

ELEVATOR OF THE ANGLE OF THE SCAPULA.

This is a thin muscle arising from three or four cervical vertebræ, and is inserted into the border of the upper angle of the scapula (this angle is the portion of the blade of the scapula that appears above its spine).

ACTIONS.

The elevator raises the angle of the scapula after the trapezius (acting from the skull and seventh cervical) has raised the arm above the right angle with the body, and of course is its antagonist.

In carrying weights on the shoulder it is always used.

This muscle does not affect the surface appearance, except by its action on the shoulder blade.

ACTIONS OF THE COMBINED MUSCLES OF THE TRUNK.

The combined actions of the abdominal and oblique muscles in front of the trunk and their antagonists, the erector of the spine and latissimus behind, all acting from the pelvis, keep the body erect on the pelvis.

A good action for the study of the muscles of the trunk is in lifting a weight from the ground ; the abdominal and oblique muscles pulling the body forwards and downwards, and the erector of the spine and latissimus dorsi pulling the body and weight upwards and backwards into the erect position.

This action will also illustrate the uses of the arm muscles, and in fact will exemplify the actions of the various masses of muscles back and front, throughout the whole anatomical structure.

In the act of climbing, the actions of the muscles of the trunk are reversed. The pelvis and lower extremities being acted on and pulled up by the erector spinæ and latissimus dorsi, whose power is exerted from the arm, skull, scapula, all the vertebræ and the ribs in the back of the trunk, and in front and sides ; the abdominal and oblique muscles act from the ribs on the os pubis and crest of the pelvis, and the pectoral muscles act from the upper arm.

PLATE IX.

TRUNK.

Back view.

A. Seventh cervical vertebra.
B. Spine of the scapula.
C. Iliac bone.
D. Great trochanter.
1. Occipital.
2. Sterno-cleido mastoideus.
3. Splenius.
4. Trapezius. (*a.*)
5. Deltoid. (See pl. 12.)
6. Triceps. (See pl. 11.)
7. Infra spinatus. (*b.*)
8. Teres minor. (*c.*)
9. Teres major. (*d.*)
10. Rhomboid. (*e.*)
11. Latissimus dorsi. (*f.*)
12. Fleshy sacro-lumbar masses, composed of the muscles called sacro-lumbar, longissimus dorsi, and transverse spinous. (*g.*)
13. Great oblique. (See pl. 9.)
14. Gluteus maximus. (See pl. 15.)
15. Gluteus medius. (See pl. 17.)
16. Tensor of the aponeurosis. (See pl. 17.)

ATTACHMENTS AND FUNCTIONS.

(*a.*) ATTACHMENTS. 1°. To the inner third of the superior occipital curved line, to the external occipital protruberance, to the posterior cervical ligament, to the spinous processes of the sixth and seventh cervical vertebræ, to the ten first, and sometimes to all the dorsal vertebræ.

2°. To all the edge of the scapular spine, to the back edge of the acromion, to the external third of the posterior edge of the clavicle.

FUNCTIONS. Its lower part lowers the shoulder, and its upper part elevates it. The shoulder being fixed, the muscle inclines the head backwards.

(*b.*) ATTACHMENTS. 1°. To the two internal thirds of the infra-spinous fossa, and to the aponeuroses.

2°. To the middle part of the greater tuberosity of the humerus.

FUNCTIONS. Rotator of the arm outwardly and backwardly.

(*c*). ATTACHMENTS. 1°. To the infra-spinous fossa near the external edge of the scapula, and to the aponeuroses.

2°. To the lower part of the great tuberosity of the humerus.

FUNCTIONS. The arm is lightly separated from the trunk.

(*d.*) ATTACHMENTS. 1°. To the posterior part of the lower angle of the scapula, and to the aponeurotic partitions.

2°. To the lower edge of the bicipital groove of the humerus.

FUNCTIONS. It lends to the arm a rotatory movement on itself which carries it backwards and towards the trunk.

(*e.*) ATTACHMENTS. 1°. To the lower part of the posterior cervical ligament, to the spinous processes of the seventh cervical vertebræ and the five first dorsals.

2°. To the lower part of the inner edge of the scapula.

FUNCTIONS. The scapula is drawn inwards, backwards and upwards.

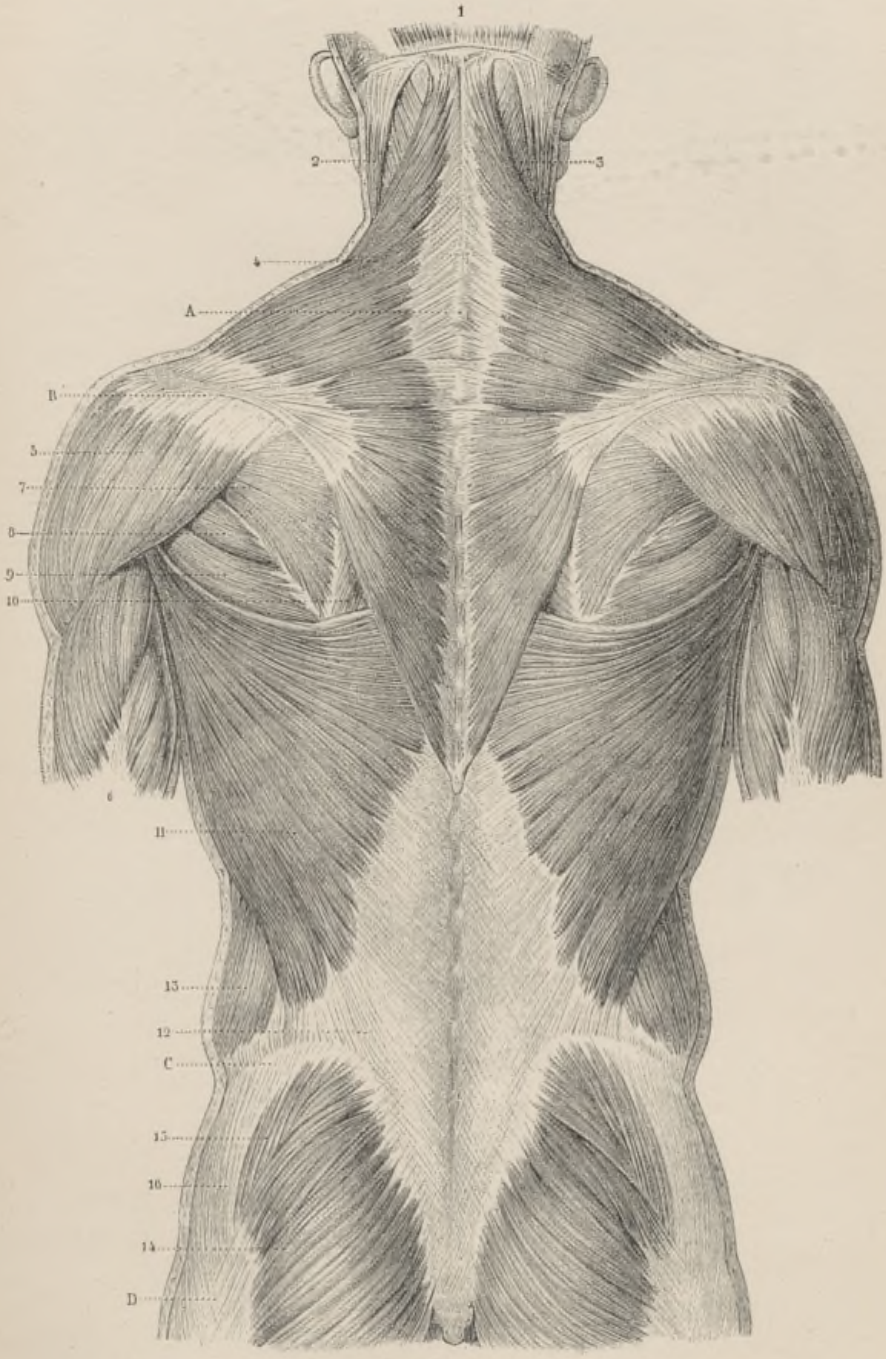
(*f.*) ATTACHMENTS. 1°. To the spinous processes of the six or seven last dorsal vertebræ, the lumbar and sacral vertebræ, and the four last false ribs.

2°. To the bottom of the bicipital groove of the humerus.

FUNCTIONS. It carries the arm nearer to the body, downwards and backwards. It can act on the thorax when the arm is fixed.

(*g.*) ATTACHMENTS. 1°. To a common aponeuris, to the back part

Pl. 9.



of the iliac crest, to the angles of the twelve ribs, to the transverse processes and to the vertebral plates from the lower part of the sacrum to the third cervical vertebra.

2°. To the angles of the ribs, to the transverse processes of the four or five last cervical vertebræ, to the dorsal and lumbar vertebræ, and to the spinuous processes of all the vertebræ.

FUNCTIONS. To maintain the vertebral column during extension, to carry the trunk directly backwards, or to give it at the same time a motion to the right or the left, to lower the ribs.

CHAPTER VI.

The Arm.

THE ARM BONES.

Acromion Process.

The angular and bony appearance of the outer edge of the summit of the deltoid is made by the acromion process, which is the outer termination of the collar bone, placed on the top of the outer termination of the spine of the shoulder blade.

These two ends of bones, always in conjunction, appear in every action, and affect that portion of the shoulder.

HUMERUS.

The head of the humerus is pushed forward when the arm is thrust backwards, and makes itself felt by giving a harder and more bony character to the surface in front of and underneath the acromion process, although it is always covered by muscle.

The only portions of the bone that appear directly on the surface are at the elbow joint. The inner condyle of the humerus appears in every position of the arm. When the arm is straight, as when hanging by the side of the body, the inner condyle only is seen. When the fore-arm is bent on the upper, both condyles are forced out to the surface, and in conjunction with the portion of the ulna forming the elbow, imparts a very bony quality to the elbow joint in that action.

ULNA AND RADIUS.

The stationary bone of the fore-arm called the ulna, projects to the surface at both ends. At one end it forms the elbow, on the other it appears at the little finger side of the wrist.

The shaft of the ulna is indicated by the line of the separation between the extensor and flexor masses, commencing above at the anconeus.

The radius or movable bone of the fore-arm, appears on the surface only at its termination on the thumb side of the wrist. Occasionally in an extremely thin person, as in some children, the other end will appear in some actions.

WRIST AND HAND BONES.

When the hand is extended or bent backwards, the pisiform on the little finger side, and the scaphoid on the thumb side are the only wrist bones that affect the appearance of the surface; but when the wrist is bent, all of the seven wrist bones together take part in forming the arch.

The palm, thumb and finger bones are not covered by any muscle, so that the back of the hand has always a bony quality.

UPPER ARM.

The upper arm is divided into three masses:

The deltoid or shoulder muscle.

The biceps occupies the front, and the triceps the back of the arm.

The flat spaces between the biceps and triceps in the inside and outside of the upper arm are occupied by the brachialis flexor.

LOWER ARM.

The lower arm is divided into two masses:

The extensors and supinators combined form the mass on the outside or back of the arm, and the flexors and pronators occupy the inside or palm side.

The outer or extensor mass is subdivided into two masses, viz., the long extensor and surface supinator, both of which arise from the shaft of the humerus above its outer condyle, and form one mass. The second division comprises all the remaining muscles of the extensor mass, which arises by one common tendon from the outer condyle of the humerus, with the exception of the thumb extensors, which arise from the ulna and radius.

The whole of the muscles comprising the flexor mass on the inside or palm side of the lower arm, arise from the inner

condyle of the humerus. Each muscle in the two opposing masses is situated by the side of or opposite to its antagonist; so that they can always be considered as pairs.

The supinator longus lies by the side of its antagonist in the opposing mass, the pronator radii teres, commencing both masses on the thumb side, above where the tendon of the biceps is inserted into the lower arm.

The long and short extensor carpi radialis are opposite to the flexor carpi radialis on the thumb side of the wrist and arm underneath the thumb extensors.

The common extensor of the fingers is placed opposite the flexor of the palm, and the deep flexor of the fingers.

The extensor carpi ulnaris lies by the side of its opponent, the flexor carpi ulnaris, both of them terminating their respective masses on the little finger side of the wrist.

The extensor muscles of the thumb which arise from the lower arm bones form a part of the main mass of extensors, and are the antagonists of the abductor and flexor masses of the thumb.

THE HAND.

The character of the hand is muscular in the inside or palm, and also on the outer sides of the little finger and thumb, and bony on the back of the palm, and on the backs of all the fingers and thumb.

The palm of the hand is occupied by three masses:

First—The abductor and flexors of the thumb.

Second—The mass formed by the abductors and flexors of the little finger.

Third—The mass of the muscles and tendons occupying the middle of the palm and the spaces between the metacarpal or palm bones.

UPPER ARM—(2).

In the upper arm the muscles are large and simple, and are four in number.

DELTOID, BICEPS, BRACHIALIS FLEXOR AND TRICEPS.

The deltoid has already been described in the muscles of the front of the trunk, but as it is the muscle that controls immediately the actions of the arm, it is also necessary to include it in a description of the arm muscles.

It arises from the outer third of the clavicle, from the acromion process and from all the under border of the spine of the scapula. All of the fibers of the muscle converge to a thick tendon which is inserted into a rough prominence in the middle of the outer side of the shaft of the humerus. It is divided into three planes or masses, each of which in a manner act independently of each other. The back mass assists the rhomboids and trapezius to pull the arm backwards. The front mass acting with the pectoral pulls it forward and the center is directly influential in raising the arm directly from the side. The deltoid is the antagonist of the pectorals in front and rhomboids and latissimus dorsi behind, and also of the muscles covering the scapula on shoulder blade.

BICEPS.

The biceps or two-headed muscle, occupies the front part of the upper arm from the deltoid to the elbow joint, and is the most powerful muscle next to the deltoid of this region. It arises by two heads. The long head glides over the top of the humerus and springs from the acromion process. The short head arises from the corocoid process of the scapula. The body of the muscle narrows and flattens as it terminates in a flat tendon which is inserted into the back part of the tuberosity of the radius.

BRACHIALIS ANTICUS OR FLEXOR.

The brachialis flexor is a broad muscle which covers the elbow joint and the lower half of the front of the humerus. It arises from the lower half of the outer and inner surfaces of the humerus and commences above at the insertion of the deltoid which it embraces by two angular processes. It converges to a thick tendon which is inserted into a rough depression on the under surface of the coronoid process of the ulna (the stationary bone of the lower arm).

The front part of the muscle lies underneath the biceps. The two sides of the muscle form the planes which separate the biceps and triceps both in the inside and outside of the arm.

The biceps and brachialis are the direct antagonists of the triceps.

ACTIONS.

The two muscles combined are the flexors of the forearm. The biceps pulling up the radius and the brachialis flexor the

ulna. The biceps acts also as a supinator, helping to turn the radius so that the back of the hand is underneath or supinated. In the act of supination or turning the hand palm down, the ligament of the biceps is twisted around the radius and pulls down the body of the muscle.

TRICEPS.

The triceps or three-headed muscle is situated on the back of the arm extending over the whole length of the posterial surface of the humerus. It governs the form exclusively on the back of the arm from the deltoid to the elbow.

It arises by three heads:

The middle or scapula head arises below the glenoid cavity (the articulation of the humerus with scapula), and the two other heads from the surface of the humerus along the outsides of the shaft.

The common tendon of the triceps commences about the middle of the back part of the muscle, proceeds downwards, receiving attachments from the portions of the muscle on either side, and is inserted into the back part of the upper surface of the olecranon process (that portion of the ulna which forms the elbow). It is the antagonist to the two flexor muscles.

ACTIONS.

The triceps is the great extensor muscle of the forearm.

When the forearm is bent by the biceps and brachialis flexor, it is straightened or drawn into a right line with the upper arm by the triceps.

LOWER ARM.

The lower arm is divided into two masses—the flexors and pronators occupying the inside and the extensors and supinators the outside of the forearm.

FLEXOR MASS.

Pronator radii teres.
Flexor carpi radialis. Flexor of the wrist.
Palmaris longus. Flexor of the palm.
Flexor carpi ulnaris. Flexor of the wrist.
Flexor profundus digitorum. Flexor of the fingers.

All of the muscles composing the flexor mass take their origin from one common tendon, which is attached to the inside condyle of the humerus.

The pronator radii teres is inserted into a rough ridge at the middle of the outer side of the shaft of the radius.

Flexor carpi radialis is inserted into the base of the metacapal bone of the index finger—indicated by the tendon next to the thumb.

FLEXOR OF THE WRIST.

Palmaris longus is inserted into the annular ligament (a band passing around the wrist), expanding to end in the palmar fascia. The tendons of the palmaris and the flexor carpi radialis show distinctly in nature.

Flexor carpi ulnaris lies along the ulna or little finger side of the arm, and is inserted into the pisiform bone, the wrist bone next to the ulna.

The flexor profundus digitorum lies underneath the other muscles, and is the largest of the superficial muscles. It provides the four tendons in the inside of the palm. These tendons do not show on the surface except by their action in flexing the fingers.

The flexor mass is the direct antagonist of the extensors.

ACTIONS.

To flex the fingers on the palm which, assisted by the flexor muscles of the thumb and other portions of the palm, causes the hand to grasp any object and hold it firmly.

EXTENSOR MASS.

Radial Region.

The second mass is composed of the surface supinator and three extensor muscles: supinator longus; extensor radii teres; common extensor of the fingers; extensor anconeus; extensors of thumb extensor carpi ulnaris.

This mass is subdivideed into two portions, each possessing two muscles. The second mass, however, includes, near the wrist, the three additional thumb extensors.

The two muscles forming the upper and outer division of this mass are the supinator longus and the long extensor carpi

radialis. Both of these muscles arise from the external condyloid ridge of the humerus (that portion of the shaft immediately above the outer condyle.) The supinator arises from the upper two-third of the ridge, and is inserted into the base of the styloid process of the radius. It is the most superficial muscle of the two.

The long extensor, carpi radialis, is placed partly underneath the preceding muscle, and arises from the lower third of the condyloid ridge of the humerus, and is inserted into the base of the metacarpal bone of the index finger. It runs along the outer border of the radius, and its tendon goes beneath the extensor tendons of the thumb.

SECOND SUB-MASS.

The common extensor of fingers; extensor carpi ulnaris; anconeus; extensors of thumb.

The common extensor of fingers and extensor carpi ulnaris arise by one common tendon from the outer condyle of the humerus. The common extensor of the fingers is situated in the center of the extensor mass in the back of the forearm.

Proceeding towards the wrist, just below the middle of the fore-arm, it divides into three tendons which pass under the annular ligament. The tendons then converge—the middle tendon divides into two, and all are inserted into the second and third phalanges of the fingers.

The tendons of the middle and ring fingers are connected together by thin slips of tendon. The index and little fingers have additional tendons.

The tendon only of the extensor minimi digiti—the muscle that supplies the special tendon for the little finger—appears on the surface on the back of the hand.

The special tendon for the index finger on the surface appears as part of the tendon, supplied by the common extensor of the fingers.

EXTENSOR CARPI ULNARIS.

The extensor carpi ulnaris is the most superficial muscle of the ulna or little finger side of the arm.

In addition to its origin from the common tendon attached to the outside condyle of the humerus, it arises from the middle third of the posterior border of the ulna, below the anconeus,

and, passing through the annular ligament, is inserted into the base of the little finger.

ANCONEUS.

The anconeus is a small muscle, triangular in shape, situated below the elbow joint, between the extensor and flexor carpi ulnaris. It arises from the back part of the outer condyle of the humerus, and is attached to the side of the elbow bone and upper third of posterior border of the shaft of the ulna. It appears to be a continuation of the triceps, and assists that muscle in extending the forearm on the upper.

All the extensor mass are the antagonists of the flexor mass, and act directly on the fingers, extending them after they have been bent by the flexors.

In holding weights, etc., the flexors and extensors assist each other.

EXTENSOR MUSCLES OF THE THUMB.

The thumb has three especial tendons provided by extensor muscles which arise from the ulna and radius, and are inserted as follows: One into the metacarpal bone of the thumb, another into the base of the first phalanx, and the third into the base of the last phalanx of the thumb.

These extensor muscles straighten the thumb and bend it backwards, and in conjunction with the abductor and flexor muscles especially provided for the thumb (and forming the thumb mass in the inside of the palm), allow it great freedom and independence in its actions. In the palm, besides the mass of the thumb muscles, there are two others; the one on the little finger side is made up of the special abductor and flexor muscles of the little finger, and the third mass is formed of the flexor muscle of the fingers and the muscles that fill in the spaces between the palm or metacarpal bones.

In addition to the above, each finger in the inside is provided for every joint with a small flexor muscle.

COMBINED ACTIONS.

In carrying a weight—a pail of water for instance—the arm naturally drops perpendicularly downwards, the weight held by the hand being supported directly from the shoulders;

the strain is direct from the muscles of the shoulder region; the principal force, however, is exerted from the deltoid, which controls the main actions of the arms.

All the muscles of the arm would be used in supporting any weight.

The deltoid and scapula muscles would hold the humerus in its socket in the scapula, and the muscles of the upper arm below it would exert all their strength in holding the upper and lower arm bones together at the elbows. The flexor muscles of the lower arm would grasp the object, and the opposing mass of extensors would be straining to hold the wrist and finger bones and radius together, and both masses would assist in pressing together the bones joining each other at the elbow.

The form of the biceps is affected by the changes in the position of the radius.

The biceps is attached to the back part of the radius or movable bone of the lower arm, and when the radius is pronated, which action throws the thumb side of the hand to the inside of the arm and the palm downwards, the ligament of the biceps is twisted around the radius, and consequently pulls down the body of the muscle to which it is attached.

ACTIONS OF THE FINGERS.

The two middle fingers, owing to their tendons being united above the first knuckles, act together, and it requires a positive strain to make them act independent of each other.

The index and little fingers act independent of each other; the index completely and the little finger partly so.

The hand is of course very extensively used in accordance with the expression of the face. But any analysis of this subject, involving, as it would, not only the actions peculiar to everybody, but, in addition, the characteristic expressions of various nationalities and temperaments would be foreign to the purpose of these lectures.

See the chapter on the head and combined expression of the face and body.

ANNULAR LIGAMENT.

All of the tendons that act on the hand and fingers pass through and underneath a strong fibrous band which arches

over the wrist bones, so that the tendons are in a manner confined and forced first to expend their force on the band which acts as a fulcrom to control their actions to clinch the hands or to straighten them out.

See illustrations.

PL. 10.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

PLATE X.

UPPER LIMB.

Front view.

FIG. 1.

A. Clavicle.
1. Pectoralis magnus. (See pl. 7.)
2. Section of the trapezius. (See pl. 8.)
3. Deltoid. (See pl. 12.)
4. Biceps. (*a.*)
5. Triceps. (See pl. 11.)
6. Brachialis flexor. (*b.*)
7. Supinator longus. (See pl. 12.)
8. First radial extensor. (See pl. 12.)
9. Second radial extensor. (See pl. 12.)
10. Pronator teres. (*c.*)
11. Great palmar. (*d.*)
12. Small palmar. (*e.*)
13. Common superficial flexor. (See pl. 12.)
14. Ulnaris anticus. (See pl. 11.)
15. Long flexor of the thumb. (*f.*)
16. Square pronator. (*g.*)
17. Annular ligament of the carpus.

FIG. 2.

1. Palmar aponeurosis.
2. Short abductor of the thumb. (*h.*)
3. Cutaneous palmary muscle. (*i.*)
4. Sheaths of the tendons.

FIG. 3.

1. Bicipital groove of the humerus.
2. Fleshy body of the biceps.
3. Tendon of the short portion penetrating into the bicipital groove.
4. Tendon of the long portion.
5. Inferior tendon, fixed to the bicipital tuberosity of the radius.
6. Aponeurotic expansion cut to show the ulnar attachment of the brachialis anticus.
7. Coraco brachialis. (*j.*)
8. Triceps brachia.
9. Anterior brachial.
10. Its lower attachment.
11. Section of the pectoralis major.
12. Section of the deltoid.

FIG. 4.

1. Section of the palmaris gracilis. The palmar aponeurosis is divided.
2. Adductor of the little finger. (*k.*)
3. Short flexor of the thumb. (*l.*)
4. Opposing muscle of the thumb. (See pl. 12.)
5. Adductor of the thumb. (*m.*)
6. Short flexor of the little finger. (*n.*)
7. Tendons of the superficial and deep flexors.
8. First dorsal interosseous. (See pl. 11.)
9. First lumbricalis. (*o.*)

ATTACHMENTS AND FUNCTIONS.

(*a.*) ATTACHMENTS. 1°. The long portion is attached to the summit of the coracoid process by a tendon common to it with the coraco-brachialis muscle. The short portion, after passing through the fibrous canal, is attached to the upper margin of the glenoid cavity.

2°. To the posterior part of the bicipital tuberosity of the radius, and to the aponeurosis of the fore-arm by its aponeurotic expansion.

FUNCTIONS. Flexor of the fore-arm on the arm and reciprocally; carries the hand in supination.

(*b.*) ATTACHMENTS. 1°. To the humerus, below the deltoid impression, to its internal and external aspects, and to its interior, internal and external edges.

2°. To the ulna, below the coronoid process.

FUNCTIONS. Flexor of the forearm on the arm.

(*c.*) ATTACHMENTS. 1°. To the coronoid process of the ulna, to the inner condyle and lower part of the inner edge of the humerus, and to the aponeuroses.

2°. To the middle portion of the external surface of the radius.

FUNCTIONS. To turn the radius on the ulna. (Pronator.)

(*d.*) ATTACHMENTS. 1°. To the inner condyle of the humerus, and to the aponeuroses.

2°. To the second metacarpal bone, and to the trapezium; sometimes to the third metacarpal.

FUNCTIONS. To flex the arm on the forearm, and to carry it a little inwards.

(*e*). ATTACHMENTS. 1°. As the preceding.

2°. To the anterior annular ligament of the carpus, and to the palmar aponeurosis.

FUNCTIONS. Tensor of the palmar aponeurosis, and flexor of the arm on the forearm.

(*f.*) ATTACHMENTS. 1°. To the three upper fourths of the radius, to the adjoining portion of the interosseous ligament, and to the anterior margin of the bone.

2°. To the anterior portion of the upper end of the last phalanx of the thumb.

FUNCTIONS. Flexor of the second and of the first phalanx, and also of the metacarpal bone of the thumb.

(*g.*) ATTACHMENTS. 1°. To the lower fourth of the inner edge, and to the anterior surface of the ulna.

2°. To the lower fourth of the external margin, of the inner margin, and first side of the radius.

FUNCTIONS. To turn the radius on the ulna. (Pronator.)

(*h.*) ATTACHMENTS. 1°. To the annular ligament, to the scaphoid, and frequently to an aponeurotic expansion of the long abductor.

2°. To the external portion of the superior extremity of the first phalanx of the thumb.

FUNCTIONS. To separate the thumb from the forefinger.

(*i.*) ATTACHMENTS. 1°. To the inner margin of palmar aponeurosis, to the anterior annular ligament of the carpus.

2°. To the skin.

(*j.*) ATTACHMENTS. 1°. To the coracoid process with the long portion of the biceps.

2°. To the edge and inner aspect of the humerus towards its middle portion.

FUNCTIONS. Draws the bone inside and forwards.

(*k.*) ATTACHMENTS. 1°. To the pisiform bone.

2°. To the inner side of the first phalanx of the little finger.

FUNCTIONS. To moderately flex the little finger, which it separates from the ring finger.

(*l.*) ATTACHMENTS. 1°. To the trapezium, to the annular ligament, and to the os magnum.

2°. To the external sesamoid bone of the joint, and to the first phalanx of the thumb.

FUNCTIONS. To flex the first phalanx of the thumb.

(*m.*) ATTACHMENTS. 1°. To the front edge of the third metacarpal, to the os magnum, to the trapezium, and the trapezoides.

2°. To the internal side of the first phalanx of the thumb.

FUNCTIONS. To draw the thumb near to the index finger.

(*n.*) ATTACHMENTS. 1°. To the unguiforme and to the annular ligament.

2°. To the internal side of the first phalanx of the little finger.

FUNCTIONS. Flexor of the little finger.

(*o.*) These little muscles are accessory to the flexors.

PL. 11.

Fig 3.

Fig. 4

Fig. 2.

Fig. 1.

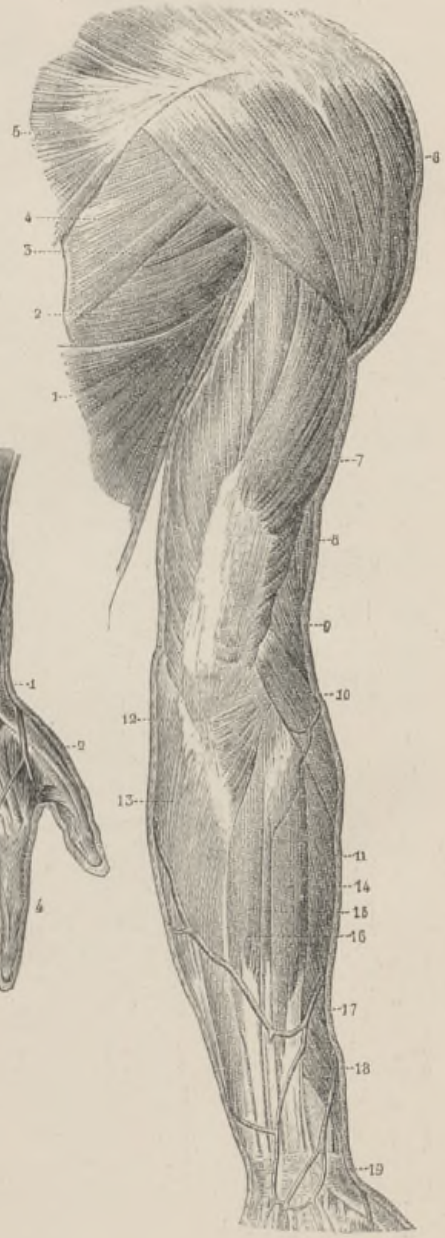


PLATE XI.

UPPER LIMB.

Back view.

FIG. 1.

1. Portion of the large dorsal. (See pl. 8.)
2. Teres magnus. (See pl. 8.)
3. Teres minor. (See pl. 8.)
4. Infraspinatus. (See pl. 8.)
5. Portion of the trapezius. (See pl. 8.)
6. Deltoid. (See pl. 12.)
7. Triceps. (*a.*)
8. Brachialis anticus. (See pl. 10.)
9. Supinator longus. (See pl. 12.)
10. First external radial. (See pl. 12.)
11. Second external radial. (See pl. 12.)
12. Anconeus. (*b.*)
13. Ulnaris anticus. (*c.*)
14. Extensor communis digitorum. (*d.*)
15. Extensor proprii minimi digitis. (*e.*)
16. Ulnaris posticus. (*f.*)
17. Abductor pollicis longus. (See pl. 12.)
18. Abductor pollicis brevis. (See pl. 12.)
19. Annular ligament of the wrist.

FIG. 2.

1. Annular ligament.
2. Tendon of the long extensor of the thumb. (*g.*)
3. Tendons of the extensors.
4. Fibrous sheaths of the tendons.

FIG. 3.

1. External portion of the triceps or vastus externus.
2. Middle, or long portion of the same muscle.
3. Its superior fasciculus.
4. Inner portion, or vastus internus and common tendon of the muscle.

FIG. 4.

1. Tendon of the second external radial.
2. Tendon of the first external radial.
3. Tendon of the short extensor of the thumb.
4. First dorsal interosseous muscle. (*h.*)
5. Adductor pollicis. (See pl. 10.)
6. Opponens and adductor minimi digiti. (See pl. 10.)
7. Tendons of the extensors.
8. Little uniting tendinous bands.

ATTACHMENTS AND FUNCTIONS.

(*a.*) ATTACHMENTS. 1°. By its middle or long portion below the glenoid cavity of the scapula, and to the upper part of the external edge of the bone. By its external portion or vastus externus, to the posterior face of the humerus, above the osseous groove, and to the outer edge of the bone. By its outer portion or vastus internus, to the posterior face of the humerus, below the groove, and to the internal edge of the bone.

2°. To the upper and lower part of the olecranon.

FUNCTIONS. To extend the forearm or the arm.

(*b.*) ATTACHMENTS. 1°. To the back part of the inner condyle.

2°. To the triangular space of the posterior face of the ulna.

FUNCTIONS. Extensor of the forearm on the arm.

(*c.*) ATTACHMENTS. 1°. To the inner condyle of the humerus, to the inner margin of the olecranon, and to the aponeuroses.

2°. To the pisiform bone, and to the fifth metacarpal.

FUNCTIONS. To flex the hand on the forearm, and to incline it towards the ulna.

(*d.*) ATTACHMENTS. 1°. To the outer condyle of the humerus, and to the aponeuroses.

2°. To the second and third phalanges of the four last fingers.

FUNCTIONS. Extensor of the four last fingers.

(*e.*) ATTACHMENTS. 1°. To the outer condyle of the humerus, and to the aponeuroses.

2°. To the fourth tendon of the common extensor.

FUNCTIONS. Extensor of the little finger.

(*f.*) ATTACHMENTS. 1°. To the external condyle of the humerus, and to the posterior surface and posterior edge of the ulna.

2°. To the upper end of the fifth metacarpal bone.

FUNCTIONS. To extend the hand or the forearm and to incline it back towards the ulna.

(*g.*) ATTACHMENTS. 1°. To the ulna, to the interosseous ligament and to the aponeuroses.

2°. To the upper end of the last phalanx of the thumb.

FUNCTIONS. Extensor of the thumb, and especially of the last phalanx.

(*h.*) ATTACHMENTS. 1°. To the internal edge of the first metacarpal and the external face of the second.

FUNCTIONS. Abductor of the forefinger.

PLATE XII.

UPPER LIMB.

Side view.

FIG. 1.

1. Portion of the trapezius. (See pl. 8.)
2. Pectoralis magnus. (See pl. 7.)
3. Deltoid. (*a.*)
4. Infraspinatus. (See pl. 8.)
5. Teres minimus. (See pl. 8.)
6. Teres magnus. (See pl. 8.)
7. Dorsalis longus. (See pl. 8.)
8. Biceps. (See pl. 10.)
9. Brachialis anticus. (See pl. 10.)
10. Triceps. (See pl. 11.)
11. Long supinator. (*b.*)
12. Palmaris grandis. (See pl. 10.)
13. Anconeus. (See pl. 11.)
14. First external radial. (*c.*)
15. Second external radial. (*d.*)
16. Extensor longus communis digitorum. (See pl. 11.)
17. Extensor proprii minimi digiti and ulnaris posticus. (See pl. 11.)
10. Palmaris minimus. (See pl. 10.)
11. Superficial flexor of the toes. (*h.*)
12. Ulnaris anticus. (See pl. 11.)
13. Carpal ligament.
18. Long adductor of the thumb. (*e.*)
19. Short extensor of the thumb. (*f.*)
20. Carpal ligament.

FIG. 2.

1. Tendon of the long extensor of the thumb. (See pl. 11.)
2. Opponens pollicis. (*g.*)
3. First dorsal interosseous. (See pl. 11.)
4. Adductor pollicis. (See pl. 10.)

FIG. 3.

1. Deltoid. (See pl. 1.)
5. Pectoralis grandis. (See pl. 7.)
3. Biceps. (See pl. 10.)
4. Brachialis anticus. (See pl. 10.)
5. Coraco-brachialis. (See pl. 10.)
6. External portion of the triceps. (See pl. 11.)
7. Round pronator. (See pl. 10.)
8. Long supinator. (See pl. 12.)
9. Palmaris grandis. (See pl. 10.)
10. Palmaris minimus.
11. Ulnaris anticus.
12. Carpal ligament.

FIG. 4.

1. Adductor of the little finger. (See pl. 10.)
2. Section of the cutaneous palmar muscle. (See pl. 10.)
3. Short abductor of the thumb. (See pl. 10.)

PL. 12.

Fig 1.

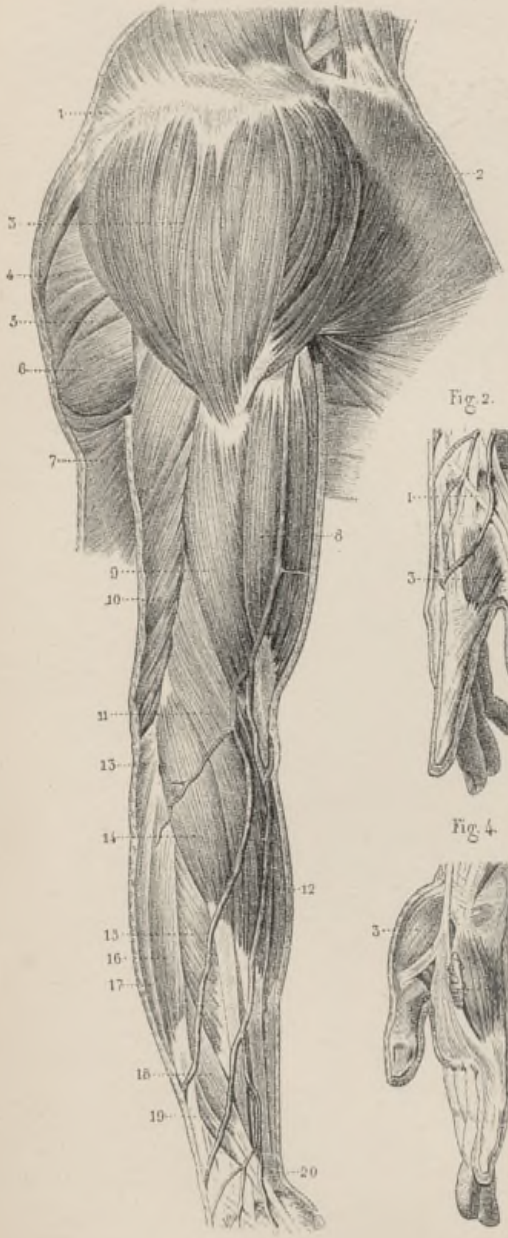


Fig 2.

Fig 4.

Fig 3.

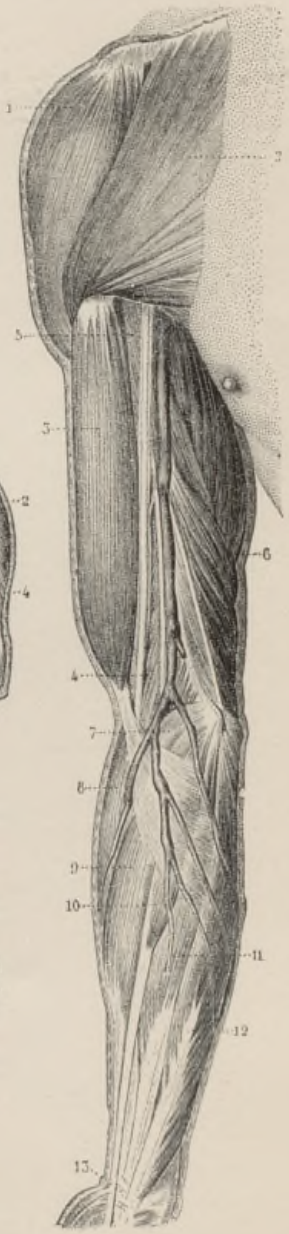


Fig. 1

Fig. 2

Fig. 3

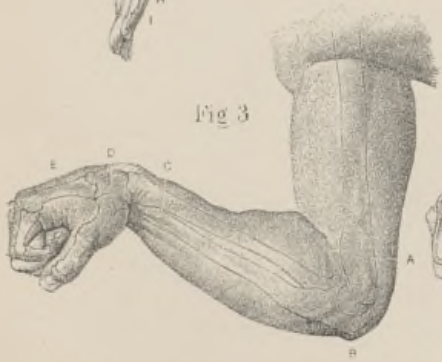


Fig. 4

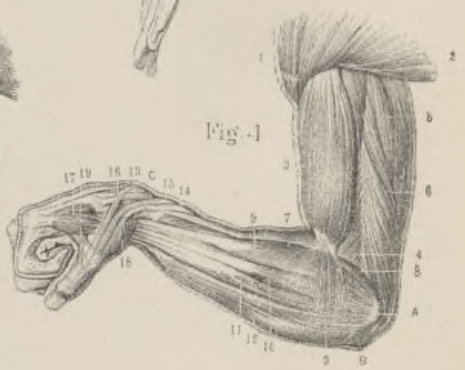


PLATE XIII.

FIG. 1.

A. Collar bone.
B. Humerus.
C. The cubit.
D. Radius.
E. Carpus.
F. Metacarpus.
G. First phalanges.
H. Second phalanges.
I. Third phalanges.

FIG. 2.

A. Acromio-clavicular articulation.
B. Inner condyle of the humerus.
C. Olecranon process.
D. Lower end of the ulna.
E. Pisiform bone.
1. Deltoid. (See pl. 12.)
2. Great pectoral. (See pl. 10.)
3. Biceps. (See pl. 13.)
3'. Its aponeurotic expansion.
4. Brachialis flexor muscle. (See pl. 13.)
5. Coraco brachialis muscle. (See pl. 13, fig. 3.)
6. Outer portion of the triceps. (See pl. 14.)
7. Long supinator. (See pl. 15.)
8. The round pronator. (See pl. 13.)
9. The great palmar, or flexor carpi radialis. (See pl. 13.)
10. Palmaris longis. (See pl. 12.)
11. Superficial flexor of the fingers.

ATTACHMENTS. 1°. To the inner condyle of the humerus by the common tendon of the superficial muscles, to the coronoid process of the ulna, to the anterior margin of the radius, to the aponeuroses.

2°. To the second phalanges of the four last fingers.

12. Flexor carpi ulnaris. (See pl. 14.)
13. Ligament of the carpus.
14. Adductor of the little finger. (See pl. 13.)
15. Section of the cutaneous palma. (See pl. 13.)
16. Short abductor of the thumb. (See pl. 13.)

FIG. 3.

A. Humerus.
B. Olecranon.
C. Radius.
D. Carpus.
E. Metacarpus.

FIG. 4.

A. Inner tuberosity of the humerus. (Condyle.)
B. Olecranon.
C. Lower end of the radius.
1. Deltoid muscle.
2. Extremity of the great pectoral muscle.
3. Biceps.
3'. Its aponeurotic expansion.
4. Brachialis flexor.
5. Coraco brachialis.
6. Triceps.
7. Long supinator.
8. Round pronator.
9. Flexor C. radialis
10. Palmaris longus.
11. Superficial flexor of the fingers.
12. Flexor carpi ulnaris.
13. Ligament of the carpus.
14. Long abductor of the thumb.
15. Short extensor of the thumb.
16. Long extensor of the thumb.
17. First dorsal interosseous.
18. Opponens of the thumb.
19. Abductor of the thumb.

NOTE.—In copying Fig. 2, the student may as well omit the superficial veins; the aponeurosis, which has been removed, lies between these veins and the muscles.

PLATE XIV.

FIG. 1.

A. The ulna.
B. The radius.
C. The humerus.
D. The scapula.
E. The collar bone.

FIG. 2.

A. The ulna.
B. The radius.
C. The humerus.
1. Flexor ulnaris.
2. Superficial common flexor.
3. Long palmar.
4. Great palmar, flexor radialis
5. Long supinator.
6. Biceps.
6'. Its aponeurotic expansion.
7. Brachialis flexor.
8. Triceps.
8'. Its inferior tendon.
9. Ceraco-brachialis.
10. Great pectoral.
11, and 11*. Deltoid.
12. Teres major.
13. Sub-scapular.
14. Latissimus dorsi.
15. Serratus magnus.

FIG. 3.

A. Cubit.
B. Radius.
C. Humerus.
D. Scapula.
E. Collar bone.

FIG. 4.

D. Spine of the scapula.
1. Anconeus muscle.
2. Anterior cubital.
3. Posterior cubital.
4. Proper extensor of the little finger.
5. Common extensor of the fingers.
6. Short extensor of the thumb.
7. Long abductor of the thumb.
8. 2° Radialis externus.
9. 1° Radialis externus.
10. The long supinator.
11. Brachialis flexor.
12. Biceps.
13. Triceps.
13'. Its inferior tendon.
14. Deltoid.
15. Latissimus dorsi.
16. Teres major.
17. Teres minor.
18. Infra spinatus.
19. Rhomboidens.
20. Trapezius, of which a portion has been removed to show the position and action of the supra-spinatus muscle.

ATTACHMENTS AND FUNCTIONS.

(*a.*) ATTACHMENTS. 1°. To the lower edge of the spine of the scapula, to the external edge of the acromion, and to the external third of the anterior edge of the clavicle.

2°. To the deltoid impression on the humerus.

FUNCTIONS. Complex action; but when all the parts act at the same time, the arm is elevated and carried outwardly.

(*b.*) ATTACHMENTS. 1°. To the lower third of the external edge of the humerus.

2°. To the base of the styloid process of the radius.

FUNCTIONS. Supinator of the hand and flexor of the forearm.

(*c.*) ATTACHMENTS. 1°. To the external condyle and the lower part of the external edge of the humerus, and to a common tendon with the muscles of the back region of the forearm.

2°. To the back part of the upper extremity of the second metacarpal bone.

FUNCTIONS. Supinator and extensor of the hand on the forearm.

(*d.*) ATTACHMENTS. 1°. To the external condyle of the humerus.

2°. To the upper extremity of the third metacarpal.

Pl. 14.

Fig. 1

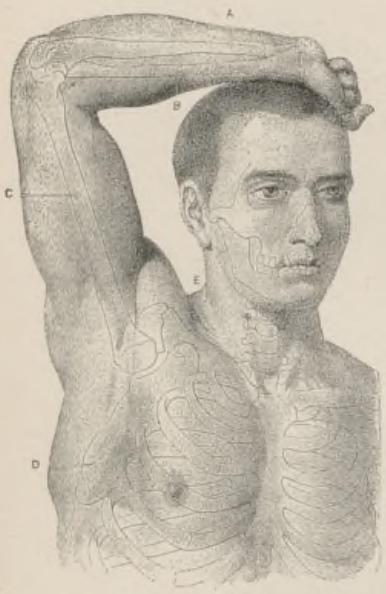


Fig. 2

Fig. 3

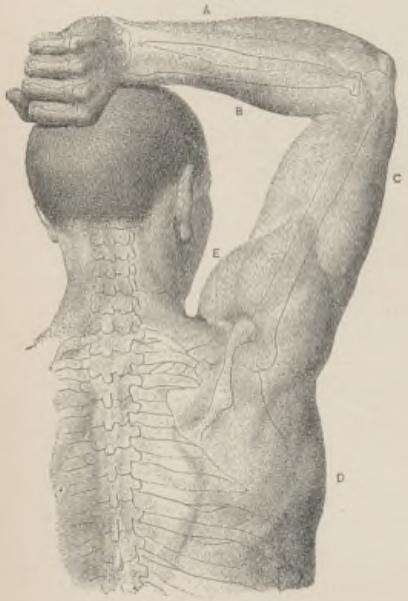
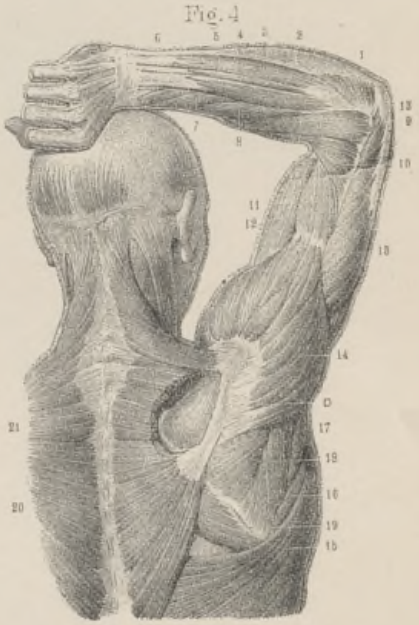


Fig. 4



(*e.*) ATTACHMENTS. 1°. To the ulna and the radius behind, and to the interosseous ligament.

2°. To the upper extremity of the first metacarpal.

FUNCTIONS. Extensor of the first phalanx of the thumb.

(*f.*) ATTACHMENTS. 1°. To the ulna, the radius, and the interosseous ligament.

2°. To the upper extremity of the first metacarpal.

FUNCTIONS. Extensor of the first phalanx of the thumb.

(*g.*) ATTACHMENTS. 1°. To the trapezium and to the annular anterior ligament of the carpus.

2°. To the outer edge of the first metacarpal.

FUNCTIONS. To oppose the thumb to the other fingers.

(*h.*) ATTACHMENTS. 1°. To the epitrochlea or internal condyle of the humerus, to the coronoid process of the ulna, and to the forward edge of the radius.

2°. To the second phalanges of the four last fingers.

FUNCTIONS. Flexor of the first and second phalanges.

PLATE XV.

FIG. 1.

A. Scapula.
B. Collar bone.
C. Humerus.
D. Ulna.
E. Radius.
F. Carpus.
G. Metacarpus.
H. First phalanges.
I. Second phalanges.
J. Third phalanges.

FIG. 2.

A. Scapula.
B. Collar bone.
C. Olecranon process.
D. Radius.
1. Trapezius muscles. (See pl. 11.)
2. Great pectoral. (See pl. 10.)
3. Deltoid. (See pl. 12.)
4. Muscles of the scapula. (See pl. 11.)
5. Biceps. (See pl. 13.)
6. Brachialis flexor. (See pl. 13.)
7. Triceps. (See pl. 14.)
8. Long supinator.
   ATTACHMENTS. 1°. To the lower third of the external margin of the humerus.
   2°. To the base of the styloid process of the radius.
9. Great palmar muscle, or flexor carpi radialis. (See pl. 13.)
10. First external radial muscle, or extensor carpi radialis longior.
    ATTACHMENTS. 1°. To the external condyle of the humerus, and to the upper part of the external edge of the humerus, and to a tendon common to it with the muscles of the posterior region of the forearm.
    2°. To the back part of the upper extremity of the second metacarpal bone.
11. Second external radial muscle.
    ATTACHMENTS. 1°. To the outer condyle of the humerus by the common tendon, and to the aponeuroses.
    2°. To the upper end of the third metacarpal bone. (For the inferior insertions of these muscles, see pl. 14, fig. 4.)
12. Anconeus muscle. (See pl. 14.)
13. Long common extensor of the fingers. (See pl. 14.)
14. Proper extensor of the little finger. (See pl. 14.)
15. Posterior ulnar muscle. (See pl. 14.)
16. Long abductor of the thumb.
    ATTACHMENTS. 1°. To the ulna, the radius, the interosseous ligament, and to an aponeuroses.
    2°. To the upper end of the metacarpal bone.
17. Short extensor of the thumb.
    ATTACHMENTS. 1°. To the ulna, to the radius, and to the interosseus ligament.
    2°. To the upper end of the first phalanx of the thumb.
18. Ligament of the carpus.
19. Tendon of the long extensor of the thumb. (See pl. 14.)
20. Opposing muscle of the thumb.
    ATTACHMENTS. 1°. To the trapezium, and to the anterior annular ligament of the carpus.
    2°. To the outer edge of the first metacarpal bone.
21. First dorsal interosseal muscle. (See pl. 14.)
22. Abductor of the thumb. (See pl. 13.)

FIG. 3.

A. Humerus.
B. Olecranon process of the ulna.
C. The radius.
D. The carpus.
E. The metacarpus.

FIG. 4.

A. The olecranon.
B. Lower end of the ulna.
1. Deltoid muscle.
2. Biceps.
3. Brachialis flexor.
4. External portion of the triceps.
5. Long supinator.
6. First radial extensor.
7. Second radial extensor.
8. Long common extensor of the fingers.
9. Proper extensor of the little finger.
10. Posterior or cubital extensor.
11. Anconeus muscle.
12. Anterior or flexor cubital muscle.
13. Long abductor and short extensor of the thumb.
14. Abductor of the little finger.
15. Cutaneous or short palmar muscle, cut across.
16. Annular ligament of the carpus.

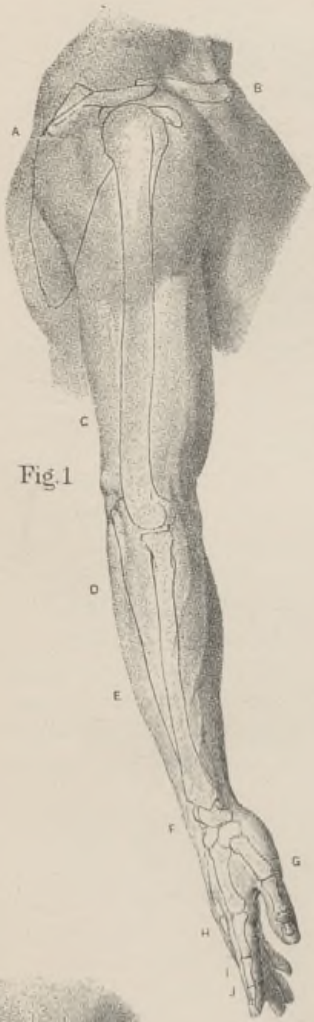


Fig. 1

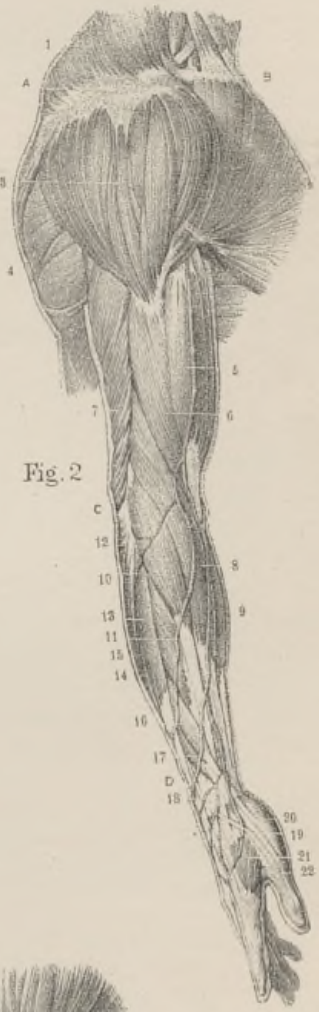


Fig. 2

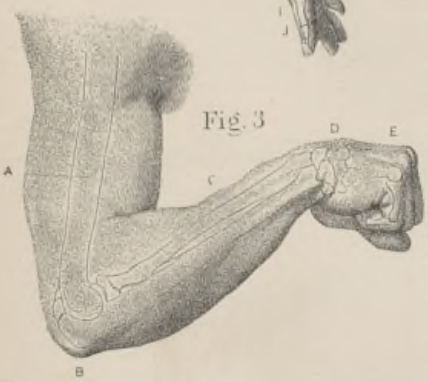


Fig. 3

Fig. 4

CHAPTER VII.

The Thigh and Leg.

The general appearance of the thigh is muscular, and of the leg bony in front and muscular behind.

THE THIGH.

The front and sides of the thigh are occupied by two masses which are separated by the sartorius or tailor's muscle. The adductor mass occupies the inside of the thigh and the three knee cap muscles (the extensors of the leg) the front and most of the outside.

The back of the thigh is also composed of two masses:

First, the prominence of the nates or buttocks formed by the gluteus muscles and tensor of the fascia. The second mass underneath occupying the space between the buttocks and the knee joint is composed of the biceps and the two other flexor muscles of the leg.

THE LEG.

The leg is divided into three masses:

First, the tibialis anticus, the flexor of the foot, and the extensor muscles of the toes, which occupy the front. The latter is also a flexor of the foot.

Second, the peronaeus or extensors of the foot, which cover the fibular region on the outside.

Third, the calf muscles which occupy the back of the leg.

SKELETON.

The portions of the skeleton that appears on the surface of the thigh, leg and foot.

PELVIS.

The rim of the pelvis, which marks the line of separation between the trunk and the lower limbs, always appears on the

surface from its front to its termination behind where it conjoins with the sacrum, which bone constitutes the back part of the pelvis.

The back termination of both wings of the pelvis is always denoted by depressions or dimples. The two dimples in conjunction with the sacrum make a triangular form common to the termination of every spine.

FEMUR.

The tuberosity of the femur or thigh bone, called the great trochanter, is the first portion of the thigh bone to appear on the surface. It is seen in every position assumed by the model, either forming a prominence on the standing side, which is supporting the weight of the body, or falling into a depression in the reverse action. The two trochanters give the greatest width across the thigh or hips.

At the knee joint both condyles of the femur are partly seen in the standing position, and when the knee is bent the condyles are forced to the surface in such a manner that their profiles can generally be distinctly seen. The thrusting forward of the head of the tibia or shank bone, and the straining of the patella, or knee cap, intensifies the bony quality of the knee joint in this action of bending.

TIBIA.

The large bone of the leg (the tibia) is seen on the surface from the knee joint, showing a plane of about an inch or 1½ inches wide of the shaft of the bone down to its lower termination, where it forms the inner ankle. It imparts a hard quality peculiar to the front of the leg, in contradistinction to any other limb.

THE FIBULA.

The small bone on the outside of the leg, the fibula, is seen only at either extremity—very softly at its top below the knee joint and very distinctly below where it provides the outer ankle.

BONES OF THE FOOT.

The tarsus and metatarus, which form the arch of the foot, are exposed to the surface on the top, in a similar manner to the bones on the back of the hand, imparting a bony quality

to that region which is softened only by the ligaments of the extensor muscles of the foot and toes which pass over it.

The largest of the tarsus bones, viz., the os calcis, is always shown distinctly. It forms the heel.

The under portion of the os calcis, from its thick padding, always appears softer than the upper part, to which the tendon achilles is attached.

The sole of the foot, like the palm of the hand, is muscular; it varies somewhat in character from the hand on account of its extremely thick skin, which serves as a buffer to prevent any hard shock to the system from sudden concussion with the ground in the various actions of locomotion.

THIGH.

Extensor mass of leg.
Abductor mass of thigh.
Sartorius.
Buttocks and tensor of fascia.
Fexor mass of leg.

THE KNEE CAP MUSCLES.

The mass that extends the leg (quadriceps extensor) is composed of three muscles (as seen on the surface): Rector femoris, vastus externus and internus.

THE RECTOR FEMORIS

Is the center muscle of the knee cap and arises by two tendons, one from the anterior inferior spinous process of the ilium, and the other from a groove above the brim of the acetabulum (the socket of the femur). The muscle then proceeds down the center of the thigh and is attached to the top of the patella or knee cap.

THE VASTUS EXTERNUS

Arises by a broad aponeurosis (a fibrous membrane) from the anterior body of the great trochanter, and to the whole length of the linea aspera or the back part of the shaft of the femur, and is inserted into the outer side of the patella.

THE VASTUS INTERNUS

Arises from the whole of the surface of the femur to within

the lower fourth of the bone, and is inserted into the inner side of the knee cap.

The knee cap muscles, or extensors of the leg, are the antagonists of the mass of flexors behind the thigh.

ACTIONS.

The knee cap muscles extend the leg on the thigh, and, by supporting the femur on the head of the tibia, holds the entire weight of the body on the knee joint.

The rector femoris also assists in swinging the lower extremities forward, in the act of walking—acting from the pelvis.

ABDUCTORS.

The mass on the upper part of the inside of the thigh is composed of abductor muscles which arise from the ramus of the pubes and the tuberosity of the ischium.

This mass very rarely sub-divides in any ordinary action.

The gracilis is a thin muscle which gives the inside edge of the mass, and is inserted into the upper part of the inner surface of the shaft of the tibia below the tuberosity.

The adductor longus forms the outside of the mass, and is inserted along with three other adductor muscles into the inside of the shaft of the femur all the way down to the inner condyle.

ACTIONS.

These muscles draw or adduct the knees powerfully together. In horse-back riding they are especially used, the flanks of the horse being grasped between the knees by the action of these muscles.

The gracilis assists the sartorius in flexing the leg and drawing it inwards. It is also an adductor of the thigh.

SARTORIUS.

This is the ribbon-like muscle that divides the above two masses. It arises from the front termination of the rim of the pelvis and upper half of the notch below, and is inserted by a broad fascia into the upper part of the inner surface of the shaft of the tibia.

The sartorious is the antagonist of the extensor muscles of the knee cap. Its action is to flex the leg on the thigh, and, continuing to act, flexes the thigh on the pelvis. It is called

the tailor's muscle because of their fashion of sitting Turkish-fashion while sewing. The muscle is, in tailors, constantly strained and consequently strongly developed. It also assists in swinging the thigh forward in the act of walking.

THE TENSOR OF THE THIGH

Is a short flat muscle, arising from the ilium between the origins of the sartorius and the gluteus medius and is inserted about one-fourth down the thigh into the fascia lata.

The tendon of the facia, of which this is the muscle, is inserted into the the head of the tibia.

It is an antagonist to the gluteus muscles.

ACTIONS.

The tensor rotates the thigh inwards and helps to steady the pelvis on the head of femur. It also assists in raising the the thigh. The tendon of the fascia helps to hold the tibia and femur together and thus steadies the thigh on the leg.

THE BUTTOCKS

Or prominence of the nates is composed of the gluteus maximus and medius.

GLUTEUS MAXIMUS

Is a very broad, thick and fleshy muscle which forms the prominence of the nates. Its large size is one of the most characteristic points in the muscular system of man.

It arises from the superior curved line of the crest of the pelvis, and immediately behind it from the posterial surface of the sacrum and from the sides of the cocyx (the terminating vertebræ of the spine). The fibers are directed obliquely downwards and outwards, those forming the upper and larger portion of the muscle terminate in a thick tendon which passes across the great trochanter and is inserted into the fascia lata covering the outer side of the thigh. The lower portion of the muscle being inserted into the vastus externus and the adductor magnus.

GLUTEUS MEDIUS

Is a broad, thick, radiating muscle situated in the outer surface of the pelvis. It arises from the outer surface of the ilium, and is inserted by a strong tendon into the oblique line which traverses the outer surface of the trochanter.

The two gluteus muscles are antagonistic to the extensors of the leg.

ACTIONS.

The mass of gluteus muscles, acting from the femur on the pelvis, will support it and the whole trunk on the head of the femur—which is especially obvious in standing on one leg. They will draw the thigh and leg backwards, and acting from the femur, as in walking, assist to swing the body forwards. They also assist in other actions.

FLEXOR MASS OF THIGH OR HAMSTRING MUSCLES. —BICEPS SEMI-MEMBRANE.—SEMI-TENDON.

The biceps is the outside and largest muscle of the mass, and arises by two heads. The long one arises from the ischium, and the short head from the shaft of the femur, and is inserted into the head of the fibula and fascia of the knee joint and tibia.

The semi-tendon, remarkable for the great length of its tendon, arises from the ischium, and is inserted into the inner surface of the shaft of the tibla below it's head.

The semi-membrane arises from the ischium, and is inserted into the inner and back part of the inner tuberosity of the tibia.

The three hamstring muscles are the antagonists of the extensor muscles of the leg.

ACTIONS.

To flex the leg on the thigh after the leg has been extended by the knee cap or extensor muscles, which occupy the front. These muscles also assist the extensor and abductor masses in keeping the body erect on the knee joints.

They also assist the gluteus mass in swinging the thigh backwards.

LEGS.

The tibialis anticus, extensor propia policis.

Extensor longus digitorum, peronaeus tertius.

Peronaeus longus and brevis, gastrocnemius and soleus.

The front portion of the leg is occupied by the tibialis anticus, peronaeus tertius, and the extensor muscles of the toes.

The tibialis anticus lies along the outside of the shaft of the tibia or shin bone from the upper two-thirds of which it arises.

It is inserted by a strong tendon into the cuneiform bone and base of the metatarsal of the great toe.

The peronaeus tertius arises from the lower fourth of the front surface (on the outer side) of the fibula, and it's tendon is inserted into the base of the metatarsal bone of the little toe.

The long extensor of the toes lies on the outer side of the tibialis anticus, and arises from the outer tuberosity of the tibia and from the upper three-fourths of the fibula, and terminates in four tendons which are inserted into the second and third phalanges of the four lesser toes.

The extensor of the big toe arises between the above muscle, and the tibialis anticus from the middle half of the fibula, and is inserted into the base of the last phalanx of the big toe.

The four muscles composing the above mass on the front of the leg are the antagonists of the peronius, calf and muscles of the plantar region.

ACTIONS.

To flex the foot on the leg—the muscles all act from the tibia and fibula, and pull up the foot towards the two leg bones; the extensor muscles of the toes pull or bend the toes upwards, as in the act of walking, and acting further assist in flexing the foot on the leg.

FIBULA REGION.

Peronaeus longus, peronaeus brevis.

The long peronaeus arises from the head and upper two-thirds of the shaft of the fibula. It runs by a tendon down the side of the cuboid bone, and then crosses obliquely the sole of the foot, and is inserted into the base of the phalanx of the big toe.

The short peronaeus arises from the middle third of the shaft of the fibula, passes through a sheath on the outer side of the os calcis (heel bone), and is inserted into the base of the metatarsal bone of the little toe.

The above peronaeus muscles are the antagonists of the tibialis anticus and extensor muscles of the toes.

ACTIONS.

The peronaeus longus and brevis extend the foot on the leg, in conjunction with the calf muscles.

CALF MUSCLES.

Gastrocnemius—Soleus.

The gastrocnemius is the most superficial muscle, and forms the greater part of the calf. It arises by two heads, which are attached to the condyles of the femur by two tendons, and uniting with the tendon of the soleus form together the tendon achilles.

The soleus (called from its resemblance to a sole fish) is placed immediately underneath the surface muscle, both sides appearing on the surface. It arises from the back part of the head of the fibula, and from the upper half of the posterior surface of its shaft and the upper half of the posterior border —oblique line—of the tibia, it then connects with the tendon achilles, its fibres connecting along the sides of the tendon nearly to its lower end.

The tendon achilles, the common tendon of the calf muscles, is the thickest and strongest tendon in the whole body, and commences about the middle of the leg, gradually becoming contracted below into a tendon which is inserted into the lower part of the posterior tuberosity of the os calcis—the bone forming the heel.

The calf muscles are the antagonists of the mass of muscles immediately in front of the leg.

ACTIONS.

In walking, the muscles acting on the os calcis will raise the heel, and with it the whole body from the ground; the body being thus supported on the raised foot, the opposite limb can be carried forwards.

THE FOOT.

The foot has a special set of muscles called the muscles of the plantar region. They can be divided into three groups similar to the muscles occupying the palm of the hand.

The mass of abductors which act on the great toe.

Second mass on the little toe side.

Third, the muscles occupying the space between the great and little toe.

The action of all these muscles is to directly flex the toes on the sole of the foot, as in the act of walking, which causes the

toes to grasp the ground. In walking over rocks with the naked feet the action is distinctly marked.

A good method to show the actions of all the locomotary muscles is to cause the model to walk up a pair of low steps.

First, the foot grasps the step, all of the muscles of the leg then act from the foot on the leg bones, the knee cap in front and condyles of femur behind. Then the thigh muscles acting from the knee joint and knee cap on the pelvis, powerfully assisted by the glutaeus muscles raise the whole body until it becomes perfectly erect on the two feet.

FASCIA LATA.

All of the thigh is enveloped by a fibrous under-skin called the fascia lata, which is attached above to poupart's ligament, crest of the ilium (pelvis) to the sacrum and cocyx and below to all the prominent points of the knee joints.

The fascia is thickest where it receives a fibrous expansion from the gluteus maximus and at the knee joint where it receives fibrous expansions from the sartorius, gracilis, semi-tendon and knee cap muscles. It gives a thick padding to the gluteus maximus, which is the superficial muscle of the buttocks. The fascia goes into the bone separating the vastus externus and the biceps.

ANNULAR LIGAMENTS.

All of the tendons of the muscles of the leg, with the exception of those forming the calf, pass through a fibrous band, similar to the annular ligament of the wrist, which confines them at the ankle and on which their power is exerted before any portion of the foot, except the heel, is put into action.

PLATE XVI.

LOWER LIMB.

Inner view.

FIG. 1.

A. Forward and upward iliac spine.
B. Spine of the pubis.
C. Patella.
D. Tuberosity of the tibia.
1. Psoas.
2. Iliac.
3. Gluteus medius. (See pl. 17.)
4. Tensor of the aponeurosis of the fascia lata. (See pl. 17.)
5. Sartorius. (See pl. 16.)
6. Rectus cruris. (*a*)
7. Vastus externus and vastus internus. (*b*.)
8. Pectineus. (*c*.)
9. First adductor. (*d*.)
10. Rectus internus. (See pl. 16.)
11. Third adductor. (See pl. 16.)

FIG. 2.

1. Tibialis anticus. (*e*.)
2. Long common extensor of the fingers. (*f*.)
3. Soleus. (See pl. 15.)
4. Peroneus longus lateralis. (See pl. 17.)
5. Long extensor of the great toe. (*g*.)
6. Peroneus anticus. (See pl. 17.)
7. Soleus. (See pl. 15.)
8. Long common flexor of the toes. (See pl. 16.)
9. Short common extensor. (See pl. 17.)
10. Adductor of the great toe. (See pl. 16.)
11. Annular tarsal ligament.

ATTACHMENTS AND FUNCTIONS.

(*a*.) ATTACHMENTS. 1°. To the forward and upward iliac spine and above the cotyloid cavity.

2°. To the upper edge of the patella.

FUNCTIONS. To extend the leg on the thigh, and to flex the thigh on the pelvis.

(*b*.) ATTACHMENTS. 1°. To the base of the great trochanter, and in front of this eminence to the oblique line which reunites the trochanter to the linea aspera; to the whole of this line; to an oblique line which goes from the nect of the femur to the linea aspera; to the linea aspera itself, and to the internal, external, anterior, and lateral edges of the femur.

2°. To the upper and lateral edges of the patella, and to the aponeurosis of the knee. (The reunion of this muscle and the preceding constitutes the real triceps of the thigh, which erroneously has been considered as two distinct muscles.)

FUNCTIONS. To extend the leg on the thigh.

(*c*.) ATTACHMENTS. 1°. To the spine and the crest of the pubis, and in front of this crest.

2°. To the line which goes from the small trochanter to the linea aspera.

FUNCTIONS. Flexor of the thigh, which it turns inward.

(*d*.) ATTACHMENTS. 1°. To the spine of the pubis and below it.

2°. To the middle part of the linea aspera.

FUNCTIONS. Adductor of the thigh, which it rotates slightly on the pelvis a little outwards.

(*e*.) ATTACHMENTS. 1°. To the external condyle of the tibia, to the oblique line of the anterior condyle, to the three upper fourths of the external face of the bone, and to the interosseous ligaments.

2°. To the tubercle of the first cuneiform and the first metatarsal.

FUNCTIONS. Carries the inter-

Pl. 16.

Fig. 1.

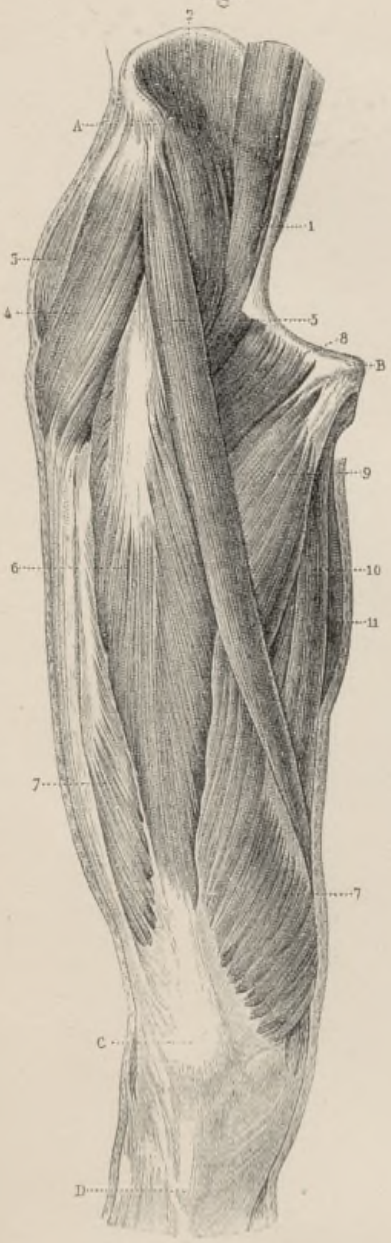


Fig. 2.

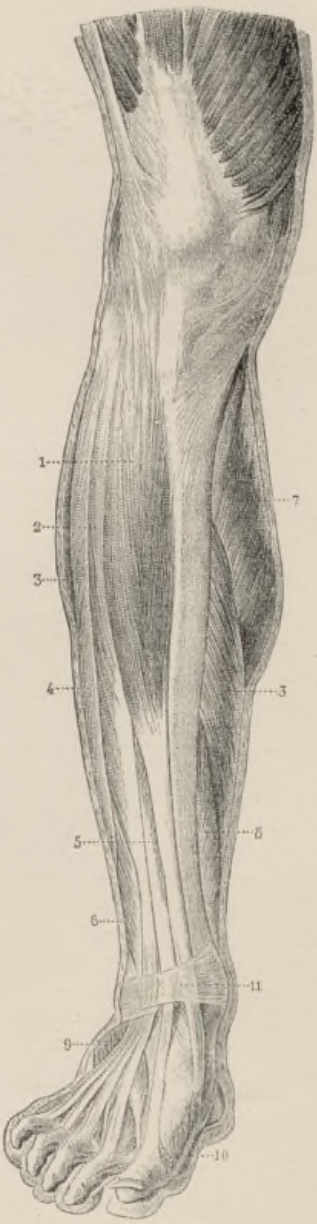


Fig.1

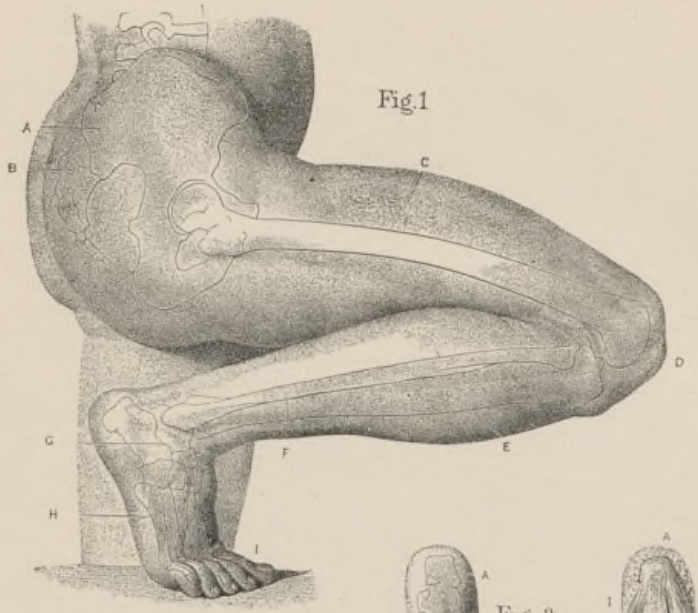
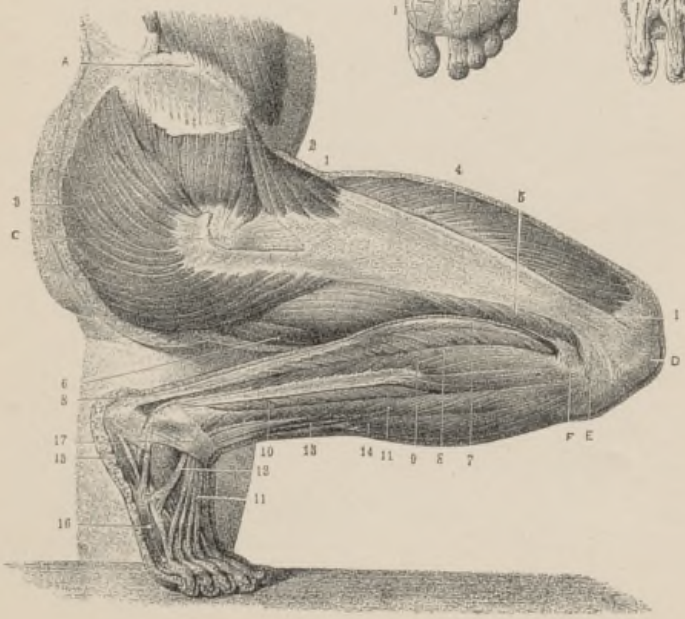


Fig. 3

Fig. 4

Fig. 2



nal face of the foot outwards and flexes it on the leg.

(*f*.) ATTACHMENTS. 1°. To the external condyle of the tibia, to the front half of the internal face of the fibula, and to the interosseous ligament.

2°. To the second and third phalanges of the four last toes.

FUNCTIONS. Extensor of the four last toes, and flexor of the foot on the leg.

(*g*.) ATTACHMENTS. 1°. To the internal face of the fibula, and to the interosseous ligament behind the long common flexor.

2°. To the posterior extremity of the phalanx of the great toe.

FUNCTIONS. Extensor of the toe, and flexor of the foot on the leg.

PLATE XVII.

FIG. 1.

A. Coxal bone.
B. Sacrum and coccyx.
C. Femur.
D. Rotula.
E. Tibia.
F. Fibula.
G. Tarsus.
H. Metatarsus.
I. Phalanges.

FIG. 2.

A. Iliac crest.
C. Great trochanter.
D. Rotula.
E. External tuberosity of the tibia.
F. Head of the fibula.
1. Tensor of the aponeurosis of the thigh.
1'. Aponeurotic band.
2. Gluteus medius.
3. Gluteus maximus.
4. Triceps.
5. Biceps.
6. Semi-tendinosus.
7. Gastro-cnemii.
8. Soleus muscle.
9. Peroneus longus.
10. Peroneus brevis.
11. Long common extensor of the toes.
11'. Tendons of this muscle.
12. Anterior, or third peroneal muscle.
13. Long extensor of the great toe.
14. Tibialis anticus.
15. Short common extensor of the toes.
16. Abductor of the little toe.
17. Annular ligament of the tarsus.

FIG. 3.

A. Calcaneum.
B. Astragalus.
C. Scaphoid.
D. First cuneiform bone.
E. Second cuneiform.
F. Third cuneiform.
G. Cuboid.
H. Metatarsus.
I. Phalanges.

FIG. 4.

A. Calcaneum.
1. Short common flexor of the toes.

ATTACHMENTS. 1°. To the calcaneum, and to the plantar aponeurosis.

2°. To the margins of the second phalanges of the four last toes.

1'. Plantar aponeurosis, cut across.
2. Abductor of the great toe. (See pl. 20.)
3. Short flexor muscle of the great toe.

ATTACHMENTS. 1°. To the inferior surface of the calcaneum, and to the two last cuneiform bones.

2°. To the metatarso-phalangean articulation of the great toe.

4. Tendon of the long proper flexor of the great toe. (See pl. 20.)
5. Abductor of the little toe. (See pl. 21.)
6 and 7. Short flexor of the little toe, and interosseal muscle.
8. Lumbricales muscles.

PLATE XVIII.

DEEP LAYER OF THE THIGH, UPPER AND LOWER FACES OF THE FOOT.

FIG. 1.

A. Anterior and superior iliac spine.
B. Head of the femur, in its capsule.
C. Spine of the pubis.
D. Patella.
1, 1. Extremities of the rectus anticus or middle portion of the triceps. (See pl. 13.)
2. Extremities of the psoas and iliac muscles. (See pl. 16.)
3, 3. External and internal portions of the triceps. (See pl. 13.)
4. Glutens medius. (See pl. 17.)
5. Glutens minimus. (*a.*)
6. Pectineus. (See pl. 13.)
7. First adductor. (See pl. 13.)
8. Second adductor. (*b.*)

FIG. 2.

A. Malleolus internus.
B. Malleolus externus.
1. Annular ligament of the tarsus.
2. Tendons of the long extensors of the toes. (See pl. 13.)
3. Tendon of the long extensor of the great toe. (See pl. 13.)
4. Tendon of the tibialis anticus. (See pl. 13.)
5. Tendon of the peroneus anticus. (See pl. 17.)
6. Pediosus. (See pl. 17.)
7. Adductor of the little toe. (See pl. 17.)
8. Adductor of the great toe. (See pl. 16.)
9. Interosseous.
10. Anterior transverse metatarsal ligament.

FIG. 3.

A. Calcaneum.
B. Plantar aponeurosis divided.
1, 1. Short common flexor of the toes. (*c.*)
2. Adductor of the great toe. (See pl. 16.)
3. Short flexor of the great toe.
4. Tendon of the long common flexor of the great toe. (See pl. 16.)
5. Adductor of the little toe. (See pl. 17.)
6. Short flexor of the little toe.
7. Lumbricales.

ATTACHMENTS AND FUNCTIONS.

(*a.*) ATTACHMENTS. 1°. From the inferior curved line of the external face of the iliac bone to the base of the cotyloid cavity.

2°. Before the great trochanter.

FUNCTIONS. To carry the thigh outwards and backwards.

(*b.*) ATTACHMENTS. 1°. From the symphysis pubis to the subpubic foramen.

2°. To the median part of the linea aspera of the femur in its superior third.

FUNCTIONS. As indicated by the name.

(*c.*) ATTACHMENTS. 1°. To the calcaneum, and to the plantary aponeurosis.

2°. To the edges of the second phalanges of the four last toes.

FUNCTIONS. Flexor of the two first phalanges of the four last toes.

(*d.*) ATTACHMENTS. 1°. To the inferior face of the calcaneum and to the two last cuneiform bones.

2°. To the metatarso-phalangeal articulation of the great toe.

FUNCTIONS. Flexor of the first phalanx of the great toe.

Fig. 1.

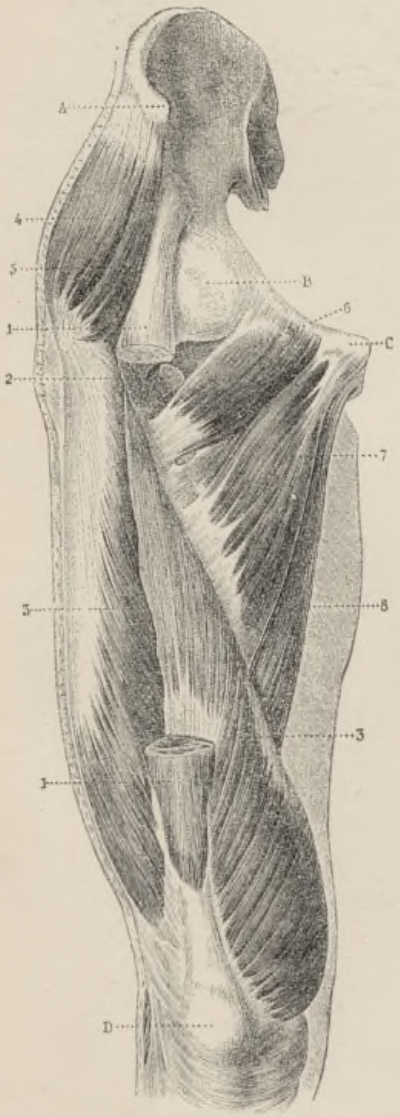
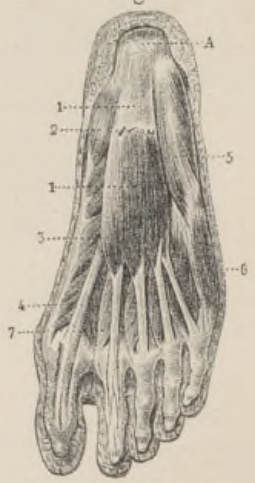


Fig. 2.

Fig. 3.



PL. 19.

Fig. 1

Fig. 2.

PLATE XIX.

LOWER LIMB.

Back view.

A. Sacrum.
B. Coccyx.
C. Iliac crest.
D. Great trochanter.
1. Gluteus medius. (See pl. 17.)
2. Tensor of the fascia lata aponeurosis. (See pl. 17.)
3. Gluteus maximus. (*a.*)
4. Biceps. (*b.*)
5. Triceps. (See pl. 14.)
6. Semi-tendinosus. (*c.*)
7. Semi-membranosus. (*d.*)
8. Rectus internus. (See pl. 16.)
9. Third adductor. (See pl. 16.)
10. Sartorius. (See pl. 16.)
11. Plantaris gracilis. (See fig. 2.)
12. Gastrocnemii. (See fig. 2.)

FIG. 2.

A. Malleolus internus.
B. Malleolus externus.
1. Plantaris gracilis. (*e.*)
2. Gastrocnemii and tendons of Achilles. (*f.*)
3. Soleus. (*g.*)
4. Long common flexor of the toes. (See pl. 16.)
5. Tendon of the tibialis anticus. (See pl. 16.)
6. Long peroneus lateralis. (See pl. 16.)
7. Short peroneus lateralis. (See pl. 17.)

ATTACHMENTS AND FUNCTIONS.

(*a.*) ATTACHMENTS. 1°. To the superior curved line of the iliac bone as far as its crest, to the crest of the sacrum, to the lateral borders of this bone and from the coccyx to the ligaments, and to the aponeurosis of the fascia lata.

2°. To the rugosities which exist between the great trochanter and the linea aspera.

FUNCTIONS. To carry the thigh outwards and backwards, and to turn the foot outwards.

(*b.*) ATTACHMENTS. 1°. By its long portion to the ischial tuberosity, and by its short portion to the aponeurosis.

2°. To the external face of the head of the fibula, and to the condyle of the tibia.

FUNCTIONS. Flexor of the leg, which it turns outwards; it also flexes the thigh on the leg.

(*c.*) ATTACHMENTS. 1°. To the ischial tuberosity.

2°. To the internal tuberosity of the tibia.

FUNCTIONS. To flex the leg on the thigh, and to depress the thigh on the leg.

(*d.*) ATTACHMENTS. 1°. To the ischial tuberosity.

2°. To the internal tuberosity of the tibia, and above the external condyle of the femur.

FUNCTIONS. As the preceding.

(*e.*) ATTACHMENTS. 1°. Above the external condyle of the femur and to the fibrous capsule of the articulation.

2°. To the calcaneum.

FUNCTIONS. Accessory to the soleus and to the gastrocnemii.

(*f.*) ATTACHMENTS. 1°. To the impressions situated above the condyles of the femur.

2°. To the calcaneum by the tendon of Achilles.

FUNCTIONS. To extend the foot on the leg, and the leg also on the thigh.

(*g.*) ATTACHMENTS. 1°. To the posterior part of the head of the fibula, to the external edge, and to the posterior face, to the middle part of this bone, and to the inner edge of the tibia.

2°. To the calcaneum by the tendon of Achilles.

FUNCTIONS. To extend the foot on the leg.

PLATE XX.

LOWER LIMB.

Front view.

FIG. 1.

A. Anterior and superior iliac spine.
A. Articular surfice of the pubis.
B. Sacrum and coccyx.
C. Internal condyle of the femur.
D. Patella.
1. Psoas muscle. (*a.*)
2. Iliac. (*b.*)
3. Gluteus maximus. (See pl. 15.)
4. Sartorius. (*c.*)
5. Pectineus. (See pl. 13.)
6. First adductor. (See pl. 13.)
7. Rectus anticus. (See pl. 13.)
8. Internal portion of the triceps or vastus internus. (See pl. 13.)
9. Rectus internus. (*d.*)
10. Third adductor. (*e.*)
11. Semi-tendinosus. (See pl. 15.)
12. Semi-membranosus. (See pl. 15.)

FIG. 2.

A. Patella.
B. Internal condyle of the femur.
C. Tibia.
1. Lower portion of the vastus internus.
2. Lower portion of the sartorius.
3. Lower portion of the rectus internus.
4, 4. Lower portion of the semi-tendinosus and of the semi-membranosus.
5. Gastrocnemius, tendo achillis, and plantaris gracilis. (See pl. 15.)
6. Soleus. (See pl. 15.)
7. Long common flexor of the toes. (*f.*)
8. Tibialis posticus. (*g.*)
9. Long flexor of the great toe. (*h.*)
10. Tibialis anticus. (See pl. 13.)
11. Adductor of the great toe. (*i.*)
12. Annular tarsal ligament.

ATTACHMENTS AND FUNCTIONS.

(*a.*) ATTACHMENTS. 1°. To the lateral parts of the body, to the intervertebral discs of the twelfth dorsal vertebræ, and to the five lumbar vetebræ, at the base of their transverse processes.

2°. To the little trochanter.

FUNCTIONS. To extend the thigh on the pelvis, to carry it inwardly, and to turn it outside. It flexes the trunk on the thigh when this last is fixed.

(*b.*) ATTACHMENTS. 1°. To the cavity and to the iliac crests at the base of the sacrum, to the anterior iliac spines, to the notch which separates them, and to the coxo-femoral joint.

2°. To the little trochanter with the preceding.

FUNCTIONS. To flex the pelvis on the thigh and reciprocally.

(*c.*) ATTACHMENTS. 1°. To the anterior and superior iliac spine, and to the notch which separates it from the lower spine.

2°. To the internal part of the crest of the tibia, above the anterior tuberosity.

FUNCTIONS. Adductor of the thigh, which it flexes on the pelvis at the same time that it flexes the leg on the thigh.

(*d.*) ATTACHMENTS. 1°. To the pubis and its descending branch.

2°. To the internal condyle of the tibia, above the semi-tendinosus.

FUNCTIONS. Adductor and flexor of the leg on the thigh.

(*e.*) ATTACHMENTS. 1°. To the tuberosity of the ischium, to the ascending branch of this bone, and the descending branch of the pubis.

2°. To the linea aspera of the femur as far as the internal condyle.

FUNCTIONS. To adduce and rotate the thigh outwardly.

(*f.*) ATTACHMENTS. 1°. To the oblique line of the tibia, and to the middle part of its posterior face.

PL. 20.

Fig. 1.

Fig. 2.

Pl. 21.

Fig. 2.

Fig. 1.

2°. To the last phalanges of the four last toes.

FUNCTIONS. Flexes the four last toes.

(*g.*) ATTACHMENTS. 1°. To the upper part of the posterior face of the tibia, to the posterior face and to the posterior part of the internal face of the fibula, to the posterior part of the interosseous ligament.

2°. To the tubercle of the scaphoid and to the first cuneiform.

FUNCTIONS. To extend the foot on the leg and to carry it inwards.

(*h.*) ATTACHMENTS. 1°. To the two inferior thirds of the posterior face of the fibula, to the lower part of the interosseous ligiment.

2°. To the last plalanx of the great toe.

FUNCTIONS. Flexor of the great toe.

(*i.*) ATTACHMENTS. 1°. To the calcaneum, to the annular ligament, to the plantar aponeurosis.

2°. To the internal part of the first phalanx of the great toe.

FUNCTIONS. Adductor.

PLATE XXI.

LOWER LIMB.

Outer view.

FIG 1.

A. Iliac crest.
B. Great trochanter.
C. Patella.
D. External condyle of the tibia.
1'. Tensor muscle of the aponeurosis of the fascia lata. (*a.*)
1. Large band of this aponeurosis.
2. Gluteus medius. (*b.*)
3. Gluteus maximus. (See pl. 15.)
4. Sartorius. (See pl. 16.)
5. Rectus anticus. (See pl. 13.)
6. Triceps. (See pl. 14.)
7. Biceps. (See pl. 15.)

FIG. 2.

A. External condyle of the tibia.
B. Head of the fibula.
C. Malleolus externus.
1. Tibialis anticus muscle. (See pl. 13.)
2. Gastrocnemii. (See pl. 15.)
3. Soleus and tendon of Achilles. (See pl. 15.)
4. Peroneus longus lateralis. (*c.*)
5. Peroneus brevis lateralis. (*d.*)
6, 6'. Long common extensor of the toes and its tendons. (See pl. 13.)
7. Peroneus anticus. (*e.*)
8. Pediosus. (*f.*)
9. Adductor minimi digitis. (*g.*)
10. Annular ligament of the tarsus.

ATTACHMENTS AND FUNCTIONS.

(*a.*) ATTACHMENTS. 1°. To the upper part of the external lip of the iliac crest, and to the anterior and superior iliac spine.

2°. To the aponeurosis of the *fascia lata*, which is inserted under the tibialis anticus, to the external part of the anterior tuberosity of the tibia.

FUNCTIONS. Holds the aponeurosis.

(*b.*) ATTACHMENTS. 1°. To the three inferior fourths of the external face of the iliac bones, from the iliac crest to the inferior curved line, or fascia lata.

2°. To the upper edge of the great trochanter.

FUNCTIONS. Carries the thigh backwards and outwards, and turns the foot outwards; holds the fascia lata aponeurosis.

(*c.*) ATTACHMENTS. 1°. To the external condyle of the tibia, to the external face of the head of the fibula, to the anterior and pos-

terior edges, and to the external face of this bone.

2°. To the hinder extremity of the first metatarsal.

FUNCTIONS. Extensor of the foot, which it turns outwards.

(*d.*) ATTACHMENTS. 1°. To the anterior and posterior borders of the fibula, to the lower part of the external face of this bone, and to the aponeurosis.

2°. To the posterior extremity of the fifth metatarsal.

FUNCTIONS. To turn the foot outwards, and contribute to its extension on the leg.

(*e.*) ATTACHMENTS. 1°. To the lower part of the internal face of the fibula, to the interosseous ligament, and to the aponeurosis.

2°. To the posterior extremity of the fifth metatarsal.

FUNCTIONS. To flex the foot, and, like the preceding, to draw it outside.

(*f.*) ATTACHMENTS. 1°. To the posterior face of the calcaneum.

2°. To the four first toes.

FUNCTIONS. Extensor of the four first toes.

(*g.*) ATTACHMENTS. 1°. To the calcaneum and to the posterior extremity of the fifth metatarsal.

2°. To the posterior extremity of the last phalanx of the little toe.

FUNCTIONS. Draws the little toe outwards.

CHAPTER VIII.

Muscles of the Deeper Layers.

In the preceding lectures it has been my aim to avoid mentioning any bone or muscle which is not on the surface, or which does not produce an immediate effect on the appearance of the surface.

It may now be well to say a little concerning the character and quantity of the muscles composing the under layers, so as to enable you to understand more fully the extent of the strength of the muscular system.

MUSCLES ON EITHER SIDE.

There are some 221 muscles altogether in the human structure, most of which are not seen on the surface.

There are numerous muscles in the deeper layers—muscles and ligaments that bind the bones together and assist the surface layers to perform their variaus functions.

For instance: All the spaces between the ribs, both back and front, are filled in with muscles that assist in raising them in the act of inspiration.

The psoas and other muscles that bind the femur to the pelvis and keep its head in its socket on the side of the pelvis, and numerous other muscles in the deeper layers of the neck, chest, arms, thighs, legs, etc., all of which add volume to and assist the surface masses, although not seen directly on the surface. Therefore it is well to avoid any description of them, as tending to too much complication and confusion, and being not at all necessary for artistic purposes.

To obtain a working knowledge of the surface muscles of the living subject and the various forms and character they assume in their different actions will be sufficiently difficult, and more anatomical knowledge would be superfluous.

ANTAGONISM.

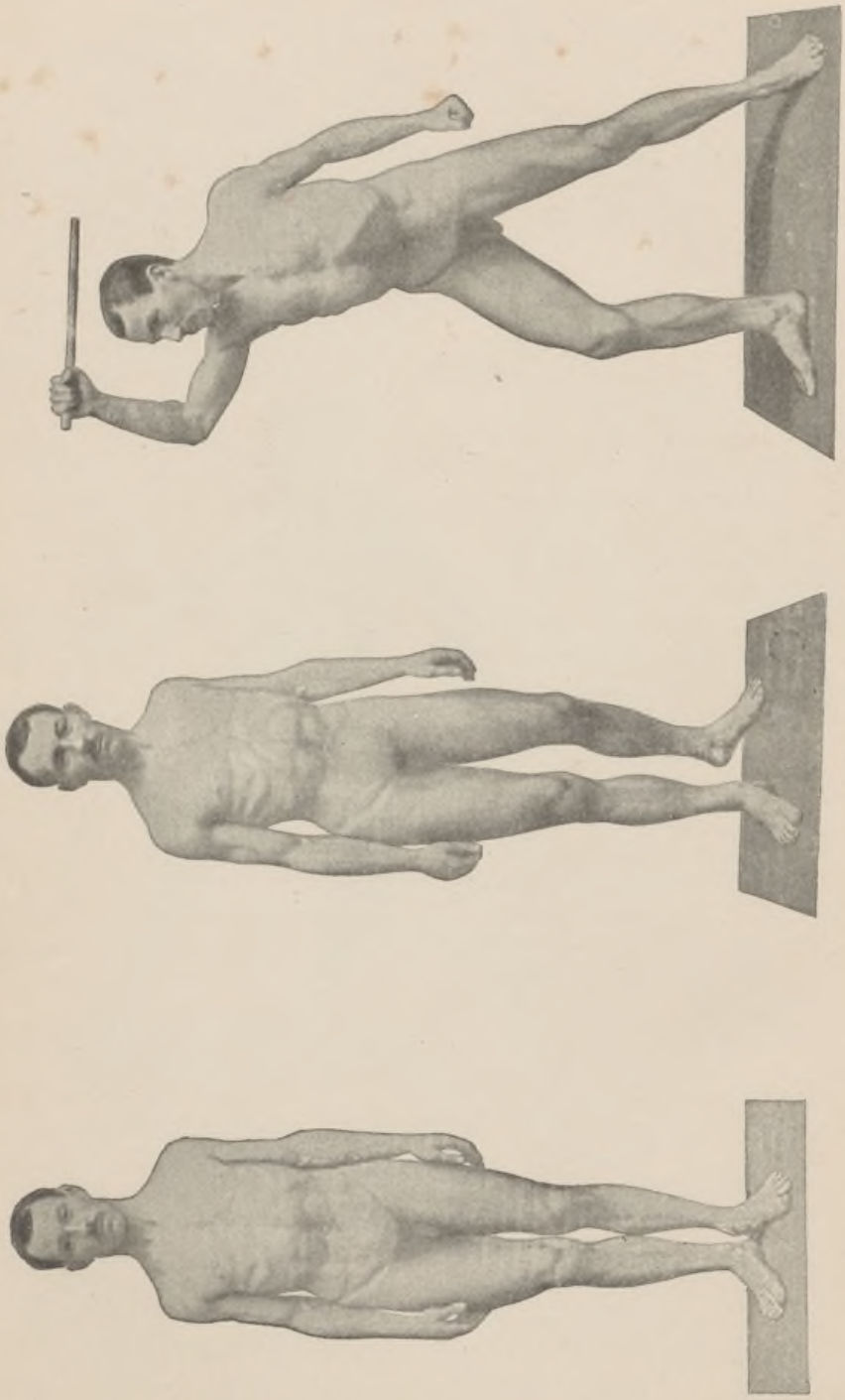
There is one principle that governs muscular anatomy which is of the utmost importance—that is the principle of antagonism. Without keeping this principle in mind one will unavoidably make mistakes.

The muscles are constantly opposing each other in every action.

If the biceps is in action, the triceps is straining against it until it obtains the control. In many actions, however, the antagonistic muscles assist each other either singly or in masses. The simplest and most comprehensive method of studying the anatomy and construction of the human figure, is to consider it entirely as a series of masses in a similar manner to the descriptions given in the preceding lectures. And when you consider that a certain mass will produce a certain action, it will immediately suggest that the opposing mass will do the contrary.

A muscle or mass of muscles in action will contract and increase in bulk in the center. The power of the muscle is there exerted. The opposing muscle, or mass of muscles, will elongate and flatten. This law will be observed in all actions —for instance, in bending forwards; the muscles of the abdomen acting from the os pubis shorten in length but increase proportionately in bulk. The back muscles will all flatten and become longer; when the body is lifted up and backwards the reverse action—the swelling and contraction takes place in the back, the front muscles flattening and lengthening.

In repose the body is seen more as a composition of masses.



In action the individual muscles separate, and the whole surface of the body becomes alive with movement, and consequently more complex in form.

The masses of muscles are used alternately so that a constant strain on one part is avoided. This alternate resting of each mass allows of a more continuous exertion than would otherwise be the case.

CONTINUOUS ACTION.

In pushing, the abdominal and oblique muscles acting from the front of the pelvis on the ribs, pulls the body onto the object pushed—the object, of course, supporting the weight of the body. The knee cap muscles and abductors of the thigh acting from the tibia pull the pelvis forwards.

In pulling, the erector of the spine, latissimus dorsi and other muscles of the back, acting from the back part of the pelvis, forces the body and the object pulled backwards.

The back muscles of the thigh pulls the pelvis downwards and assist in the backward movement of the body.

In both the above actions the exertion of the trunk muscles is continuous, and the actions of the muscles of the thighs and legs alternate in both the front and the back when the object is being moved.

BALANCE OR EQUILIBRIUM.

This is especially of importance, as in all erect actions of the body the equal division of weight on both sides emphasizes the center of gravity.

In the standing pose the center of gravity would be through the center of the leg and ankle that supports the body. If standing on both legs the center of gravity would be from the pit of the throat to the ground exactly between the feet.

If a heavy weight is lifted by the arms in front, the body will be thrown back sufficient to counterbalance the extra weight in front. If the weight in front should be suddenly dropped the body would fall backwards to the ground.

Naturally or instinctively, however, a person will so arrange the position of the legs as to support any additional weight without risk of losing the equilibrium.

Persons under the influence of liquor have frequently very little control of their muscular actions, owing to their will power being in a state of partial paralysis.

THE SKELETON.

The framework and general construction of every human figure depends almost entirely on its bone formation.

The lengths, breadth and depths giving not only the proportions, but a powerful, slender, awkward or graceful character to the physical structure of each individual.

The muscles of all the long bones, with the exception of the tibia or shin bone, cover their shafts completely.

The thigh and upper arms are enveloped with voluminous masses of large muscles, so that the bony quality is confined to either end of each bone.

In the trunk the skeleton governs the character to a great extent—the muscles fitting close to its form.

In the head, chest and back, and many parts of the trunk, the bones control the external appearance.

Each joint in the skeleton is bound with strong, elastic ligaments which keep the bones firmly connected to each other, but yield to the power of the controlling muscles when necessary in different actions, and when the muscles relax return to their original positions.

In the female figure the bony formation is softened by a general distribution of fat over the surface, although the skeleton governs the general construction as in the male.

FAT AND SKIN.

The appearance of the masses of muscle are softened and modified by adipose tissue (fat) and the skin which envelops the whole figure. The divisions between all the muscles are more or less according to the temperament and development of the individual filled up with fat.

In the strong and active male the fatty matter is comparatively small, so that one can distinctly see on the surface the actions of the various muscles. The more muscular the person the less fat there is to fill up the divisions or spaces between the muscles.

Ordinarily in the female the amount of fat on the surface is very large, especially around the shoulders, abdomen, thighs and joints, and on the back along the spine, and this gives that peculiar softness and roundness of form to the female figure in marked contrast to the squareness and rugged character of the

muscular man. Whenever there is fascia on the surface (the facia is underneath the skin) there is always a tendency to fatty deposit; also where there are glands.

Therefore the fat would be deposited in the neck and shoulders on the platysma myoides, on the fascia enveloping the abdominal muscles, on the thigh all around, on all the joints, and on the facia of the latissimus dorsi, which occupies the space over the erector of the spine on the back.

Where the upper portion of the large gluteus (buttocks) blends in with the facia of the thigh and the lower portion of the muscle to the vastus externus (outside muscle of the knee cap), there is generally a larger deposit of fat than elsewhere on the female figure. It varies very much in thickness and extent in each figure. It is sometimes excessively large, and then interferes with the grace of outlne and form, which is generally so beautiful in the female. This character of form on the thigh is never seen in the muscular man, although it is always seen more or less on a fatty man.

The thick fascia of the thigh sometimes affects the surface appearance, creating forms, which cross the directions of the muscles.

On the standing leg, in repose, the superficial fascia collects and forms a roll, which laps over the knee cap. The moment any action takes place the facia is drawn up and the roll disappears.

VEINS.

The surface veins sometimes make quite important changes in the external character of the surface, especially in the arms and legs.

There are two large veins running along the inside and outside edges of the front portion of the biceps; cephalic on the outside and basilic in the inside. The basilic runs down the junction of the biceps and triceps inside. These veins give a square character, especially to the man's biceps.

These two veins unite at the termination of the biceps at the elbow joints, and then throw out branches in all directions over the lower arm and back of the hands. These branches vary in size and direction in each person.

There is one vein running down the whole length of the thigh, leg and foot called the internal saphenous vein, and another vein running down the outside of the back of the leg

called the external or short saphenous. These two veins throw out small veins in all directions at right angles.

Frequently the leg appears to be enveloped in a net work of these branching veins.

A large vein is generally shown on the neck crossing the sterno cleido mastoid muscle, and on the sides of the forehead on the front portion of the temporal muscle. The trunk generally is not affected in form by the veins—although various tones of blues and greens (owing to the veins) influence the color.

SKIN.

The whole figure is enveloped in two species of skin called the epidermis and sub-cuticle.

This combined skin serves to strengthen and protect the system from the action of the air, and also acts as a padding to resist friction and concussion.

The skin affects the surfaces in some part of the figure very materially, especially on the buttocks, where it is very thick, on the sole of the feet, where it acts as a buffer to prevent any shock and injury to the system from sudden or violent concussion, and in the palm of the hands to protect the hands from abrasion in the act of grasping, pulling, etc.

It is thicker on all the exposed parts of the body. On the outside of the arms, legs, etc.

DIMPLES.

A dimple is caused by a portion of the skin becoming attached to a bone or ligament, and the flesh or fat raising the surrounding surfaces so that the attached portion is caused to appear as a depression.

A dimple is found on every person at the terminating point of each wing of the pelvis behind, where it connects with the sacrum.

Dimples are frequently found in the center of the chin, and in some adults and most children on the attachment of the zygomatic and risorius muscles to the sides of the muscle that surrounds the mouth. The attachments being always at each corner of the mouth.

CHAPTER IX.

Certain Laws Governing Proportion.

Proportion is that true relation of one part to another which produces a harmonious whole.

For the human figure we have, to a certain extent, a perfected scale of proportion originated by the Egyptians, and developed by the Greeks, through their close study and familiarity with nature unadorned as exhibited by their athletes in the sacred dances; Olympic, etc., the participators in these dances and athletic games always appearing in a nude condition, and so creating a splendid and exceedingly variable life-class for the benefit of the artists and their critics.

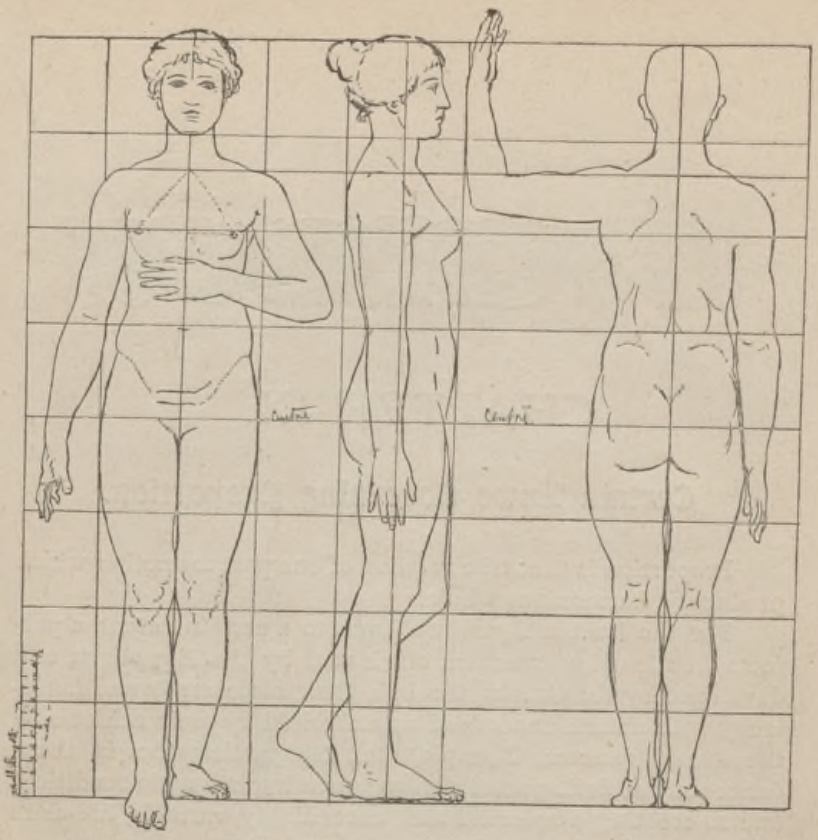
This scale of proportions consisting as it does of measurements must consequently be more or less mechanical, and the artist must use it subject to his own judgment.

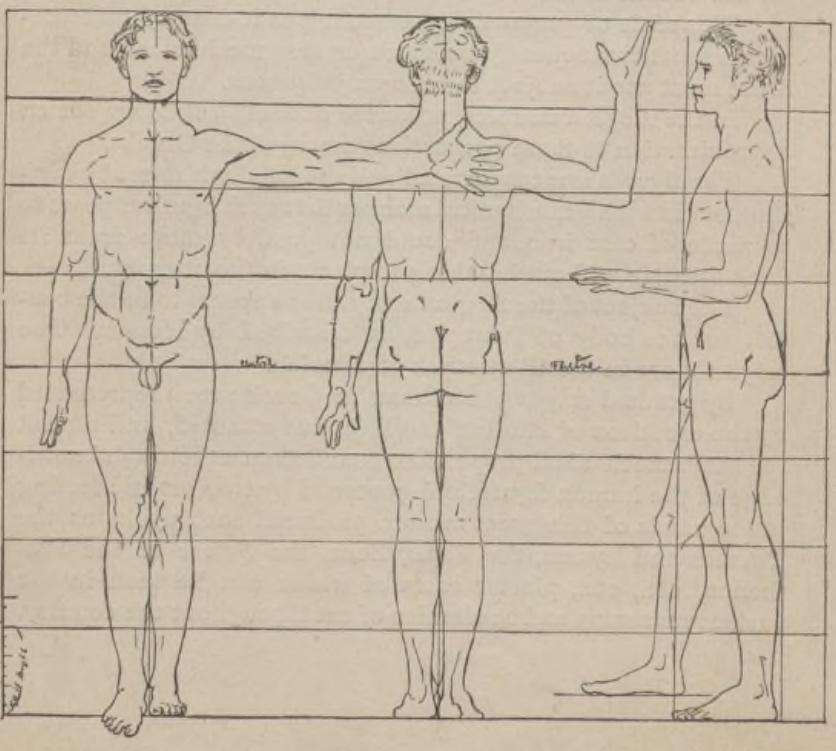
In the Aegina marbles, produced about 600 B.C., we see an approximation to these proportions amongst the Greeks.

The figures are constructed and modeled with great exactness, but in such a mechanical manner that each figure appears to be made of cast iron, and could not possibly move from its fixed attitude without breaking to pieces in the attempt.

The subject of the Aegina sculptures appears to be the contest for the body of Patroclus, as described by Homer. The originals are in the Glyptothek of Munich.

By gradual stages the climax of Greek art as represented by the creations of Phidias, 450 B.C., was attained, and almost the same mechanical proportions founded on a thorough knowledge of the human figure, and governed by true artistic feeling in the hands of this great master, produced such works as the Theseus and Ilyssus, the Fates, Zeus, the Frieze of the Parthenon, etc., etc., plaster casts of which can be seen in the various museums and academies of art throughout the country.





In the following proportions the skeleton always governs the measurements.

One generally measures from bone to bone.

GREEK STANDARD OF PROPORTIONS.

Total height of figure, 8 heads, (that is, skull lengths,) the average male head being 8¾ inches—this would make a 5-foot-10-inch man.

Next to the skull lengths the most important proportion is that the os pubis—which is the termination in front of the lowest part of the pelvis—should invariably be the center of the total length of the whole figure.

Another measurement, given by Flaxman, is to divide the figure into three equal divisions from the acromion process to the bottom of inner ankle.

First, from acromion process to the front termination of the pelvis.

Second, from thence to the top of the patella, or knee cap.

Third, from the top of patella to the bottom of the inner ankle.

The proportion of the thigh with the leg is that from the front termination of the pelvis to the top of the patella is the same length as from the bottom of the patella to the sole of the foot.

The Greeks always added an inch or two more length to the lower limbs in excess of the length of the torso.

In draped figures the stateliness and dignified character depends somewhat on the length of the lower limbs.

Foot length, 11 inches.

Two foot lengths from the ground to the top of the knee cap.

ARM.

From acromion process to elbow—when the arm is straight—1½ heads.

From elbow to first knuckles, 1½ heads. Aside from the size of the head, it is almost an absolute rule that from the acromion process to the elbow is the same length as from the elbow to the first knuckles.

The hand is one face length, or ¾ of a head.

BREADTHS.

Shoulders, between the two acromion processes, 2 heads.
Across the loins, rim of pelvis, 1¼ heads.
Across hips or trochanter, 1½ heads.

DEPTHS.

Shoulders, from pectoral to shoulder blade, 1⅛ heads.
Loins, rim of pelvis, ¾ head from front to back termination.
Gluteus, 1 head.

PROPORTIONS OF THE FEMALE.

The proportions of women are in the lengths the same as in the man, viz.:

The whole figure is 8 head lengths.

The average female head, measuring 8¼ inches from the bottom of the chin to the apex of the skull, would give us a figure 5 feet 6 inches in height, which, if the lower limbs were equal to the length of the torso, would be about the average size of a woman. The Venus de Medici is 5 feet 3 inches, the head of which is 7½ inches in length.

The center of the whole figure is the os pubis or front termiation of the lower part of the pelvis.

Width of shoulders, 2 heads.
Width of hips or trochanters, 1¾ heads.

ARM LENGTHS.

From acromion process to elbow, 1½ heads.
From elbow to first knuckles, 1½ heads.
Length of foot, 1⅛ heads.
Length of leg, 2¼ heads.

The outstretched arms measured from tip to tip of the fingers would be the same in length as the total height of the figure. This proportion is common to both sexes.

From the pit of the throat to the nipple of the breast averages 8¼ inches, or one head length, and the same from nipple to nipple.

The center of the head is the ligament in the corner of the eye—or the center of the eye.

The difference in the proportions of the male and female skeleton is in the widths, and the greater lightness and delicacy

of the bones in the female. The long neck being added to apparently by the sloping collar bones.

These proportions, which represent the ideal era of Greek art after the time of Phidias, Praxitiles, and their immediate followers, began gradually to be disused and art commenced to retrograde, although their influence remained for some centuries longer, as we can see from examples of Greco-Roman art in Pompeii and in Rome.

Nymphs, satyrs, etc., were produced with all kinds of proportions, art becoming more and more degraded until at the Christian epoch Greek and Roman art had become temporarily extinct to the world. Artistic proportions were lost sight of entirely in the dark ages which intervened, until about the 10th century a new religious art commenced, in which we have examples of figures fourteen heads high or four or five heads in length, just as it happened to strike the fancy of the authors of their being.

The artists of the medieval ages very rarely cared for harmonious proportion, but endeavored only to embody their religious ideas, and very often considered that the more abnormal and ugly the construction of their figures, so much greater and effective was the religious idea conveyed.

Although there are many examples in pre-Raphaelite art which show profound feeling of the religious nature peculiar to the period.

About the end of the 14th century, and contemporaneously with the unearthing and discovery of antique sculptures (notably the Belvidere Torso, on which Michael Angelo is said to have founded his art), we observe a return to the old ideas governing construction and proportion, which culminated in the restoration of the Greek standard in the school of Michael Angelo, Donatella, Titiens, Raphael, and all the artists of that great epoch.

Since that time the Greek and Egyptian standard has been taken as a basis by the artists of all Caucasian nations, and as a foundation subject to modification according to individual feeling it affords unlimited room for originality or individuality to build on.

I stated at the commencement of this lecture that proportion was that true relation of one part with another which produces on the mind the effects of a harmonious whole.

It appears to me that the harmony to be produced should depend entirely on the subject.

If an ideally beautiful figure was desired it would be more or less necessary to incorporate these standard proportions which have stood the test of ages. By varying the breadths any variety of character could be obtained with the assistance of nature.

The individuality of the artist would have to govern and harmonize the mechanical basis given by measurements.

In Doré's illustrations of Don Quixote we have examples of how proportions can be subordinated to the idea of given characters. In the tall, lean, lanky, woebegone figure of the Don we feel the caricature of romantic chivalry that it represents. In Sancho Panza we have the direct antithesis of romance. A short, fat, sturdy, simple, commonplace character, redeemed by considerable shrewdness and common sense.

Each character is distinctive, individual and harmonious in itself.

Each portion of the human form is to a certain extent harmonious in itself. It partakes of a character that underlies and permeates the whole body.

A person with a square-built figure will have squarely constructed head, hands and feet. A long head will be on a long body, etc.

Put a long head on a square body, or *vice versa*, and everybody will be immediately struck with the incongruity. The sense of harmony is destroyed.

From my experience in observing nature, I should say that the medium-sized models of both sexes possess the most compact and muscular or the most beautiful forms, as a rule, but the tall men and women are the best in proportion as far as the measurements of the skeleton are concerned. Therefore the receipt for a well-proportioned and compactly-formed figure would be to add the length below the os pubis or standard centerter of an 8-headed figure onto the trunk of a medium-sized model. In other words simply lengthen the thighs and legs until they are in harmonious proportion to the trunk. This especially refers to the female.

The majority of torsos are the same length in tall and short people, so that a number of persons seated together will appear to be of the same height.

The difference in length is below the center of the body. The torso varies very little in length, and the head averages the same length in everybody, according to each sex.

HARMONY.

Amongst the works of sculptures of the Greek period we have numerous illustrations of the harmonious manner in which distinctive character is rendered.

In the fighting gladiator we have the perfect unity of action; every muscle is used and every part is proporately balanced.

The Apollo Belvidere gives us another type representing the mature graceful man, the Grecian type of a Demi God. The Antinous represents more youthful grace and form; every form is soft, but no weakness is felt.

The Discobulus illustrates strength in repose. The Myron Discobulus in the act of throwing the disc, shows strength in action.

In the two Venuses De Milo and De Medicis, both 8 head lengths in measurement, we have the one tall, majestic, heroic; the other petite, soft, and full of grace. Two distinct characters, each harmonious in itself.

DISCORD.

In the human figure we seldom find perfect proportions in lengths and widths. The right side in man especially is generally larger than the left, both in the bones and muscles. The general development depending largely on the occupation. In the male the athlete is, of course, the finest all-round type of purely physical development and the best model for the study of construction and proportion.

Generally the length of the lower extremities in both sexes is too small, and one part will be finely formed in contrast with poorer portions. We see one man with fine arms and meagre body and good lower extremities. One with a magificent torso and poor and meagre lower extremities, and *vice versa*. Although, as a rule, thighs and legs are well developed, owing to their being put to constant use in exercise.

In the female we frequently observe a bony chest, hanging breasts, and the fat unequally distributed over the whole figure. The grace of the female figure and the beauty of its

form depends, to a certain extent, on the equal distribution of the surface fat. You probably have frequently noticed in the female models a large quantity of fat deposited on the side of the hips over the junction of the gluteus with the outside muscle of the knee cap forming the outside of the thigh. This, when too large, bulges out and destroys the graceful curve of the hips and thighs which is characteristic of the finely formed woman. Then there may be too much fat on the neck, deltoid, abdomen, etc., or too little.

It is the province of the artist to discriminate and endeavor to produce the best examples of the truth of nature.

The sculptor in carrying out an ideal figure very freqnently uses a number of models—selecting the best parts from each, and his artistic skill is shown in the harmonious whole which he produces.

The study of art is the study of harmony, but it must be founded on and directed by close literal study and absolute copying of nature.

In the female figure the muscular system generally is, of course, less developed, and the muscular forms less pronounced; but, in addition, the skin itself is thinner and softer, and the fatty layer is thicker, so that this alone would soften the muscular appearance of the form. The feet and hands are less muscular, while the fingers are proportionately narrower. The muscles of the leg and forearm have their muscles relatively longer, and the tendons shorter than in man. All the muscles of the thigh are wider in proportion to their length, as the greater width of the pelvis increases the necessity for larger muscles to balance the trunk or the thigh bones in walking. The muscles of the neck and throat are long and slender.

VARIATIONS IN ACTIONS.

The proportions of the human figure vary somewhat according to the action. When the arm is bent the elbow is forced downward and outwards, giving an increase of about 1½ inches (when the arm is fully bent) to the upper arm—the lower arm not being changed in measurement. If the arms are raised and face looking upwards, the front of the body will be longer than the back. This variation is owing to the action of the vertebræ, which, in the above pose, would be pressed tight against each other behind, while in front the joint between each

vertebræ would be opened in proportion to the capacity for bending backwards. In bending forwards the reverse measurements will occur, the vertebræ pressing on each other in front and opening behind, so that additional length is given to the back; consequently, in bending, the parts become shorter or longer according to their varying positions.

Illustrations of this fact can be given by the model holding up a stick with one hand, which will increase the length of that side at the expense of the other. The simple action of standing and supporting all the weight on one leg, allowing the other thigh and leg to hang from the pelvis—the standing side will appear shorter than the other. The action of playing on the violin or flute are good illustrations of this variation, as also bending and sitting poses.

In the life class, the proportion and character of the model only should be studied.

In studying from the living model or in portraiture the student's attention is particularly called to the proportion of each figure as being one of the characteristic features of its individuality in each case.

This proportion is not only given by the lengths, widths and depths, but by the distinctly different distributions of the masses in each individual.

There is as much difference and as positive an individuality in the formation of each human figure as there is in each face. The same anatomical and physiological laws govern, but the variations in construction on this common foundation are unlimited.

In studying the figure from this basis it is well to observe the distinctive peculiarities of the balance and harmony of the masses in each figure.

In most cases it will be found that on analyzing and comparing one side of the entire figure with the other, that there is a difference in the forms on either side, but that their weight or quantity will impress one as being equally balanced, so that the harmony of the characteristic proportions of each figure is maintained.

In the face this is particularly the case. It is this very inequality in the disposition of the masses on either side of the surface of the human structure that impresses one unconsciously with the feeling of a living, sentient organization, a capacity for active movement. A face which is absolutely correct in drawing is, as a rule, tame and insipid, such as a mentally and physically perfectly balanced human being would be if such a conception were possible.

The Greeks and all great artists since have observed and followed this law of nature.

The glorious head of Zeus by Phidias is an excellent example of this law. Observing it from a distance of several feet, it is apparently in perfect drawing. but on examining more closely it will be seen that the forms on one side vary considerably from those on the other. But as the quantity or weight is equal on either side the appearance of perfect balance and drawing is given.

When a figure is in action one side is generally antagonizing the other, so that this variation in the forms on either side is then very much increased. In the face, however, the muscles on both sides work in sympathy with each other in all spontaneous emotions. Although frequently the muscles on one side will act different to the muscles on the other side, which is partly owing to the size of the individual muscles on either side being very rarely equal in bulk.

THE ART OF MODELLING.

Introductory.

MODELLING is, and has been since the beginning of history, the most important of the arts.

It was, itself, the first historical record. Its products are of all artistic creations the most enduring—and to it we owe all the knowledge we have of the early years of our race, its struggles, and changes, and gradual growth. The artistic and creative instincts which, when united with mental vigor and energy, make what is known as genius, found their first natural expression in the representation of scenes from the everyday life of the period, or in picturing events of unusual interest; and the material which naturally suggested itself for the purpose was the soft, malleable clay, which is found, in some variety, in almost every part of the world, and from which the primitive cooking and other utensils were made. By this medium, and by the use of fingers and whatever rude tools were thought of,

were produced those terra cotta figures in relief and in statuette form which are the earliest specimens of art known to us and the only means by which we have been able to learn much of the progenitors of our race, the manners, customs, and events of their time.

The method of working has developed, from that primitive beginning, through successive ages of inventive ingenuity; each sculptor of talent, as his art grew to larger and more comprehensive proportions, devising some method of lessoning the mechanical difficulties of the work so as to gain greater facility in the production of his ideas. We will not trace the history of that growth and its accompanying changes of manipulation, as our object is to give a brief sketch of the method of working now in use—for the benefit of intending students of the art of modeling, who are unable to obtain the practical training of an art school or of a working master (teacher).

CHAPTER I.

A List of Materials Necessary for Use in Modelling.

1st. Clay: namely, stoneware clay, which being very malleable and easy to keep wet and in good working condition, is used for modelling works which require supports, as busts, statuettes, etc. This clay can be obtained at any pottery.

2d. A stone crock or zinc-lined box to hold the clay, so that it may be kept constantly wet enough to be soft for use.

3d. Cloths, rubber or ordinary, for keeping the work damp when left; or, what is much more convenient for the purpose, a zinc cover which can be made of any desired size by a tinsmith and is the best means of retaining the moisture within. A bowl of water placed beside the work underneath this cover will keep the clay soft and damp for several weeks. (See Plate No. 1).

4th. A modelling-stand with movable top. This may be made from the design (Plate 2).

5th. An easel for reliefs (Plate 3).

6th. A modelling-board, which is a strong wooden frame, in which are fixed cross-pieces of wood of the same thickness as the frame, at a distance of a quarter of an inch apart, so that

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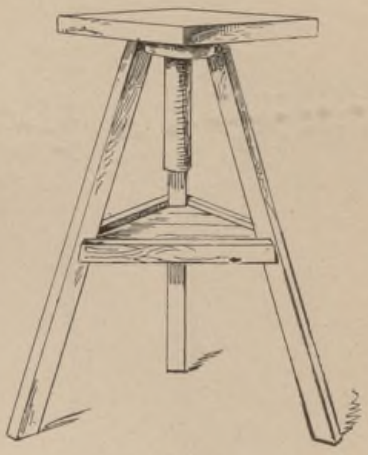

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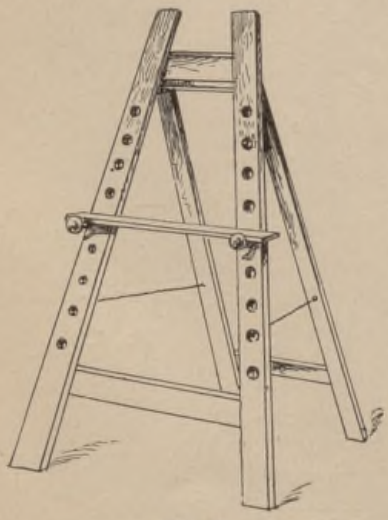

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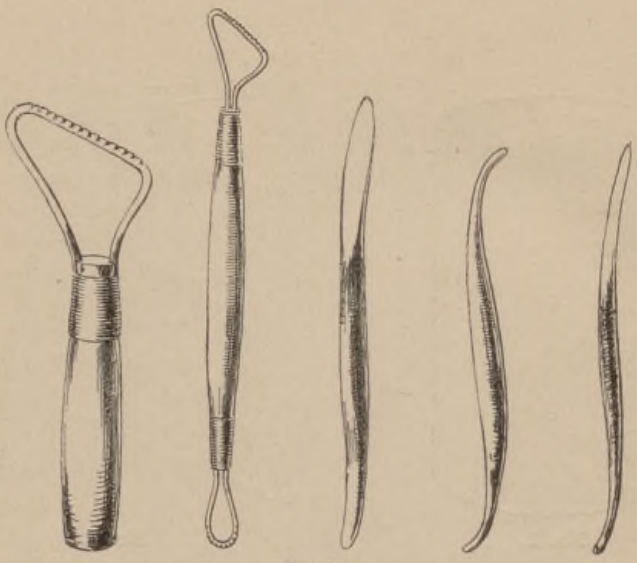

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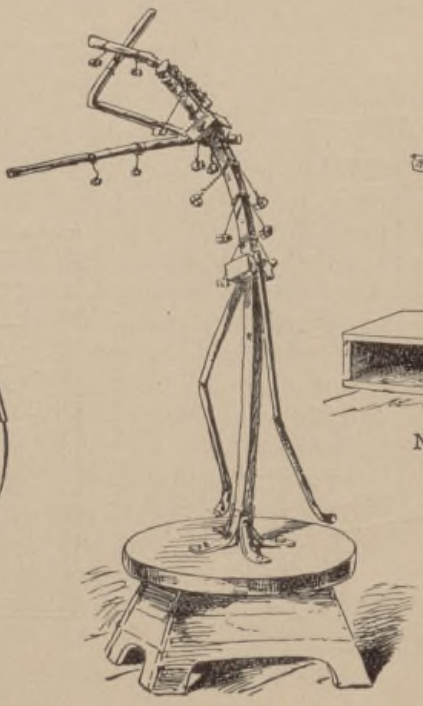

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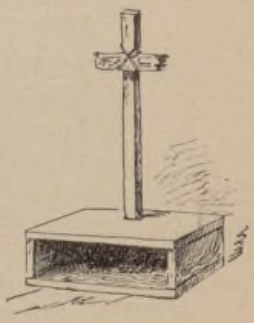

No. 7.

the clay will set in between, and is thus prevented from slipping. A narrow, thick strip of wood is nailed around the edge, which serves to keep in place a deep box that is made to fit the board and serves a cover for the work (Plate 4).

7th. Modelling-tools of wire, which may be procured at stores where artists' materials are kept. Plate No. 5 gives some of the best shapes of these, and also of the boxwood tools which, being more difficult to procure, are generally made by the sculptor himself. The fingers, however, are always the best modelling-tools. Mechanical ones should be used as little as possible.

8th. Callipers for measuring proportions (Plate 6).

9th. Sponge for wetting the clay. A pail of water should be kept constantly at hand while working, as the work must be frequently wet and covered with cloths or air-tight cover before being left.

CHAPTER II.

"The Method of Setting up Work."

For a bust a simple support only is necessary, which may be made in the following way: Take two pieces of half-inch pine wood about a foot square, and, with a 1-inch auger, drill a hole through the center of each; join together at the sides with wood one inch thick and four deep. Take a piece of wood one inch thick and one-and-a-half wide, of a length according to the size of bust, so that the top of the wood will penetrate half-way into the head, cut the lower end so as to fit into the auger holes closely without being too tight, coming through the lower hole Fasten a brace of wood with copper wires to the upright, at the place where the shoulders come, about two inches below the pit of the throat, and the support is complete (Plate No. 7).

Take soft stoneware clay and build it closely up about the support until you have half the thickness required; then let it stand over night, or long enough to allow it to harden sufficiently to form a good solid core or foundation for the outer portion of the bust, which must then be added from the soft clay, shaping it, as you proceed, in the desired form (Plate No. 9).

The support required for a statuette is of different and rather more complicated construction. For a figure, say two-feet-six-inches in height, take a square iron rod, about two feet long and a half-inch in diameter, with three legs or braces at the bottom, with screw-holes in, by which they are fastened securely to a wooden base (this rod can be made by any blacksmith). Take a piece of lead pipe a half-inch thick, fasten it to the top of the iron with copper wires, leaving it long enough to penetrate to the middle of the head. This allows the position of the head to be changed as desired. Fasten a brace of wood across where the shoulders are to come, and another at the widest part of the hips, and, through holes in the upper braces, arrange twisted copper wire or lead pipe so as to extend through the arms. Add similar attachments to the lower braces for the legs. One or two pieces of wood should be attached to the upper brace by copper wires to penetrate the body and support additional weight, although the two braces will generally be sufficient (Plate No. 8). In a large statue many more and stronger supports are needed, owing to the much greater weight of clay used, and they must also be more carefully arranged as to strength and firmness.

CHAPTER III.

The first faculty to be developed in the art student is that of imitation. This being to the greatest extent a mechanical faculty, therefore it is the one which first requires attention and the development of which subjected to, and, later on, controlled by, the artistic feeling, enables the student to acquire the knowledge necessary to produce good works of art. The student must first observe the relative proportions in the object placed before him, comparing, for instance, a finger to the whole hand, an arm, head, etc., in relation to the whole body. It is not only excusable, but necessary for a beginner to take actual measurements of each and every part with callipers or compasses. The eye cannot be relied upon until after considerable practice, until, in fact, it has been taught to see correctly. What the mind's eye sees, the hands can execute, and no more. At the outset, what the student sees, is not of much account, and, it is only after he has made that modest

discovery, that earnest study and progress commences. The rate of advancement depending on the natural powers of observation, and the quick or slow development of them.

The difference between drawing and modelling is substantially this: The draughtsman produces effects by making his own lights and shades on a flat surface which remain fixed. In modelling, the form itself is reproduced in full in clay or other material, and produces its own lights and shades, which vary, as those of any object will, according to the light to which it is subjected. Modelling is drawing in a plastic and substantial material.

CHAPTER IV.

"Modelling from Casts."

The best thing to commence on is a square, strongly-marked cast of a hand or foot. Take a piece of board of convenient size and put up the clay upon it somewhat in the shape of the object to be copied, taking measurements as a guide. Observe the proportions of the width with the length and depth, and block it in roughly in broad square planes or flats. In a foot, one plane in the center from top of instep to the toes, then a simple, square plane on the inside and a broader flat on the outside. The ankle in four planes, front, side, and back. Each toe in three planes, etc. The study of flats, or planes, in modelling is all important, as it is the true secret of the mechanical principle of the art.

The whole human figure from head to foot is composed of a series of flats, small or large, short or long, according to the proportions of the body. Therefore this principal governs all modelling. It is best to commence with the study from casts, as these objects are stationary and not subject to change of form. In a living model a change is constantly going on in form and expression, and considerable training is necessary in copying casts before one can produce any satisfactory result from the living person.

After modelling a hand and foot and different features of the face separately, the eyes, nose, mouth, etc. (the separate features of the head of David are the best for copying, as they are colossal in size and very sharp and distinct in modelling),

always carefully blocking in everything very squarely and even exaggerating the planes. The student might then undertake a mask from the antique (to be obtained at any plaster-cast store). In modelling the face it is important, not only to observe the planes, but also the balance or equilibrium of the masses on both sides. Taking a line through the nose, center of forehead and chin, we find that there is an equal quantity on either side, so that, if it were cut in two through the center, both halves would weigh about the same. The masses may be differently distributed on each side, but the same weight will obtain. In commencing a face, observe carefully the flats or planes, block in the forehead first, the center being about twice as large as the sides, the nose in three flat planes, one through the center and one on each side. Then one down the front of the cheek bone, extending down through the chin, and one large broad plane from the termination of cheek bone or corner of eye, extending backward to the ear and downward to the jaw-bone. After roughly blocking in the face in this way, the minor planes can be studied and put in. In modelling a bust, proceed on the same plan, following the flats and planes and working on the front and sides alternately, keeping always in mind the proportions in length, breadth, etc., and the masses. In beginning any work endeavor to see everything as broadly as possible; ignore detail entirely, and keep going backward from your work to a sufficient distance to allow of your seeing it as a whole; in other words, so that you may take it in all at one glance. By looking at it from the right distance, you can see and correct the balance or drawing much easier and avoid detail. Experience in teaching proves that the student will make much more progress in understanding the principles of modelling and acquire greater facility in handling the material by spending considerable time in simply blocking in roughly from the models, taking from one to three hours on each cast, according to the amount of work upon it, endeavoring in each instance to carry the work as far as possible in a limited time, leaving it in this rough state; then gradually increasing the time and carrying the modelling farther.

CHAPTER V.

Modelling from Life.

The same principle regarding planes or flat surfaces is especially important in working from the living model.

In modelling a bust from nature, place your sitter not less than six feet from you so that you may see the whole head at one glance; if brought nearer, only portions of it can be seen at once, and one part ought never to be modelled without preserving its due relation to the rest, one part being advanced equally with the others. This rule should be kept constantly in mind as the only method by which the harmony of the whole can be preserved. As I stated before, the two sides of a head or face, and in fact the whole figure, when looked at separately, are generally found to be of different forms. It is rarely that we see in nature a face that is in perfect drawing, but, almost all have the appearance of being so, because of the fact that, though the form may be different on either side, the weight is equally distributed, which gives the effect of harmony or correct drawing. Do not look for a likeness immedially, pay attention solely to the proportions and balance of the masses and planes, and the portrait will come without much trouble. With average ability and some study an ordinary likeness can be obtained easily, but to make an artistic portrait requires talent of a high order and a large

amount of experience which can only be gained by a long course of study and practice. The hair is a very important part of the portrait, and must be studied carefully in relation to its effect in contrast with the face. The simplest and the best way of treating it is to study it in masses, always endeavoring to preserve the character of its movement, composition, and flow of lines. The hair constantly changes from brushing, etc., and from its being peculiarly subject to atmospheric influences, so that it has never exactly the same composition one time as another, yet always retains its inherent character. Color has an important influence in its effect on the appearance of form in the face, but the value of this influence can only be learned by experience.

CHAPTER VI.

The Study of Relief.

One of the best methods of developing the faculty of drawing is the study of relief, that is, the reproduction on a flat, clay background, of a head or figure in relief, so as to have the same effect as the thing copied. This is the simplest form of modeling, as only one view of the subject has to be considered, as in drawing. There are various kinds of relief, from low to high relief, in which the work stands out from its background like a figure on the round, and this last is the best for study either from head or figure, as the highest possible relief, the nearest approach to the round, is the most true and direct study. Low relief is an art in itself requiring special study, and should only be attempted after a considerable amount of experience.

The best way of commencing a relief is to draw in roughly on the clay background, with a modeling-tool, the outline of a head, observing the size and proportions, then fill in with clay. The outline establishes the size and gives a boundary. Proceed with the modelling, keeping in mind the rules already given. For the study of the figure, relief is useful as offering the easiest and quickest method. It is the method in use in schools all over the world. The figure should first be outlined (as above) of a size to fit the board, observing the proportions very closely. Measuring by head lengths is the best way of getting the proportions.

It is not possible to write much that would be of use, about the study of the figure. Practical experience directed by personal instruction is the only reliable guide, and the student will find for himself, when he has proceeded thus far, that such instruction is necessary to enable him to go farther.

More can be learned in six months of practical teaching, that is, of being shown what to do and how to do it, than in six years of theoretical teaching. As a medium of instruction, one stroke of a sculptor's hand is worth more than a hundred of his pen.

J. S. HARTLEY.


JeBC

HOW TO TAKE COLD.

A Good Authority Tells Several Ways in the Hopes of Teaching How to Avoid Colds.

A writer in the Deposit Courier has the following in regard to taking cold which is sensible and especially timely at this season of the year:

"There are several things that will help to take a nice little cold which may be numbered as follows:

"First. Avoid the outdoor air. Sleep in a warm room and keep your windows closed at night.

"Second. When you go out on a cold day, bundle up the neck well, so that when you go into a cool room you may be able to throw off your wraps and get a cool draft in the neck.

"Third. Wear tight clothing so that you cannot breathe very deeply, and so that you cannot exercise very vigorously, because deep breathing and vigorous outdoor exercise are the enemies of nice little colds and hoarseness.

"Fourth. Keep your digestive apparatus in as bad a condition as possible. Few people seem to understand the close relation between the condition of the stomach and of the lungs. One who has a first rate digestion is not half as likely to take cold as one whose whole digestive tract is out of order, so if you want a fashionable little cold be careful to bother the throat and lungs as much as you can with a miserable digestion.

"This may be best brought about by living on sweets and sours, on spices, preserves and candy, and by always keeping something to nibble at between meals, especially candy and sweetmeats. The candy habit has largely taken the place of the liquor habit, and it helps to upset the lower regions about as much. So if you want colds keep up the candy and sweetmeat habit. Keep nibbling at something sweet all day to the ruin of the healthy appetite.

"These are some of the things to be noted if you want to have a dozen or so of nice little colds and at least one attack of grip during the coming winter."

with a picked team, captained by Conrad Diehl, Jr. He has a quantity of good timber to pick his fire men from and they ought to give the "real thing" quite a rub. The games will commence promptly at 8 o'clock.

—Hon. B. F. Tracy, of New York, was a Goshen visitor on Sunday.

—Excitement ran high at the club alleys on Saturday afternoon when John Wallace, one of the "old vets" of the organization, rolled up a score of 206, placin him on the roll of "bowling kings." If it had not been for a bad split in the last frame Mr. Wallace would ave made the scores of some of the other "bowling kings" look sick.

—Miss Frances Laudy, of Newark, and sister, Florence, of New Paltz, spent Saturday and Sunday at the home of their parents, Mr. and Mrs. M. Laudy.

SPECIAL TERM AT NEWBURGH.

Case of Elston Vs. Rutan Adjourned to Nov. 5th—Wheeler Vs. City of Middletown.

At a special term of the Supreme Court at Newburgh Saturday, Judge W. D. Dickey presiding, the case of Chas. E. Elston of this city vs. Brice P. Rutan, of Westtown, was brought up. This is a suit to foreclose a mortgage on the Elston homestead at Westtown. The defendant's claim that the mortgagee, the father of Mr. Elston, was mentally incompetent at the time the papers were signed. The defense was concluded and the case will be argued before Judge Dickey at Brooklyn November 5th, at a special term of the Supreme Court.

J. C. R. Taylor appeared for Mr. Elston and Thos. Watts for Mr. Rutan. There have been 65 witnesses for the defense.

The case of Louisa Wheeler vs. the city of Middletown to procure an injunction restraining the Water Board from emptying refuse from the filter plant into the pond on her premises near 81½ station was also taken up. Nine witnesses were examined on part of the plaintiff and the case will come up again at Newburgh, Nov. 1st, before Judge Dickey.