On the Mus-cular Anatomy of the Posterior Limb in Aves.

by

M. Watson.

1867

22 Dissections sent in along with the Thesis —

Gentlemen.

The subject of the present Thesis was recommended to my notice by the late, lamented Prof Goodsir. That something remained to be done in this branch of Comparative Anatomy is I think sufficiently proved by his recommendation of the subject as one suitable for a Graduation Thesis. Whether I have done it as it ought to be done, I leave to your consideration.

The Plan I have adopted is as follows. - Having ascertained that any description of the muscles in Birds, in the English language is extremely defective and unsatisfactory, I have taken care to write out a full and accurate description of the Muscles of the leg in the Domestic Fowl, as I believe that in that bird all the muscles are moderately developed, and that therefore it af-

fords a good standard wherewith to compare others. Having done this I proceed to compare with it the muscles of other birds (about 20 in number) which I have examined, dividing them into their Orders, and giving at the end of each a short summary of what I believe to be the Characteristics of that Order, as far as regards the muscles of the posterior limbs. In going over the Orders I have as far as possible chosen 3 typical birds of each, but sometimes have been unable to procure more than two birds of a single order or only one - the Ostrich in the Cursores. In all such cases however I have endeavoured to supplement my own observations with those of Meckel and other authors. In the description of the different birds, I have only mentioned those muscles in which there was any difference from the like muscles in the Fowl, omitting all mention of those which were similar, and thus avoiding useless repetition. At the end I have added a short account of a few experiments with regard to the action of certain muscles, performed on the living bird. ~~Finally~~ I have also as far as possible arranged the names of the different muscles according to their homologies as given by different authors, the name which ac-

accur. first, being those which I consider as being most correctly applied. Some apology is due for the want of drawings, but the time at my disposal would not permit of this.

Finally, I have to express my obligations to the late Prof. Goodsir for the use of 2 Ostrich legs, to Mr Sterling for the use of those of a flamingo and lastly to Dr Cleland for valuable assistance rendered in various ways whilst engaged in writing this Thesis.

M. Mc

Glutens maximus (Friedemann)

Glutens medius

Descriptive Anatomy of the Muscles of the Domestic Fowl

Hip-Joint

Gluteus maximus (The gluteus medius of Vicq d'Azyr Meckel, & Cuvier, - the gluteus maximus of Carus). This muscle arises from the anterior margin of the ilium, from the anterior two thirds of a curved line extending backwards and arching over the acetabulum, as well as from the surface of bone immediately below this line. It passes backwards and downwards and is inserted by a strong tendon into the posterior part of the great trochanter of the femur. A synovial bursa intervenes between the anterior part of the trochanter and the tendon.

According as the anterior or posterior fibres of this muscle contract the femur will be flexed or extended.

Gluteus medius (The gluteus minimus of Meckel & Cuvier - the Iliaque anterieur of Vicq d'Azyr This muscle arises from the lower part of the anterior margin of the ilium. It passes backwards parallel to the lower margin of the gluteus maximus and is inserted into the external

surface of the femur immediately below the great trochanter.

The action of this muscle inserted as it is below the centre of motion of the hip-joint will aid in flexing this joint by drawing the femur forwards and upwards.

Glutæus minimus (the glutæus minimus of Vicq d'Azyr. ~~the gemellus superior~~ of Meckel does not mention this muscle).

This muscle arises from the lower margin of the ilium immediately in front of the acetabulum. It passes downwards and backwards and is ending in a thin tendon is inserted directly above that of the glutæus medius.

This muscle evidently co-operates with the former in raising the femur, drawing it forwards & upwards.

Pyriformis (the Pyramidal of Vicq d'Azyr., Cuvier & Tiedemann the gemellus superior of Meckel.

This muscle arises from the posterior third of the ridge of the ilium the anterior 2/3rds of which gives origin to the glutæus maximus. It is a weak muscle of a pyramidal form which passing downwards and outwards ends in a tendon which after passing over that of the glutæus maximus is inserted

into the posterior edge of the lower part of the great trochanter.

The action of this muscle is not very apparent. It may assist in flexing the femur after other muscles have initiated this action or it may assist in fixing the hip joint during ordinary progression.

Iliacus internus (the fléchisseur profond de la cuisse of Vicq d'Azyr - the Iliacus of Meckel & [redacted] - the Psoas & Pectineus united of Tiedemann.

This muscle arises beneath the gluteus minimus from the lower margin of the ilium immediately in front of the acetabulum. It passes downwards and outwards and winding round the inner side of the upper part of the shaft of the femur in the same manner as the pectineus in Man, is inserted into that portion of the bone which corresponds to the small trochanter.

This muscle will elevate the femur and rotate the distal end of it outwards.

Obturator internus (the iliacus internus of Vicq d'Azyr & Tiedemann - the pectineus of Meckel - the Obturator internus of Cuvier

This muscle arises inside the pelvis from the greater part of the ischio-pubic bone. It runs from

Adductor longus of Tiedemann

behind forwards and the muscular fibres end in a tendon which passing through the anterior part of the obturator foramen is inserted into the upper and back part of the outside of the great trochanter above that of the obturator externus.

Flexion and not adduction as Meckel states is evidently the primary action of this muscle, inserted as it is into the great trochanter above the centre of motion of the Hip joint.

Gemellus (l'accessoire de l'iliaque interne of Bcg d'Azyr Meckel does not name it although he describes it. — the Gemellus of Cuvier

This muscular slip arises from the external border of the anterior part of the obturator foramen and is inserted along with the tendon of the obturator internus into the great trochanter.

This muscle will co-operate with the former.

Adductor ~~brevis~~ longus (le deuxieme adducteur of Bcg d'Azyr le second adducteur of Meckel & Cuvier

This muscle arises from the middle of the lower border of the ischio-pubic bone just posterior to the acetabulum. It is inserted into the lower half of the linea aspera of the femur.

Adductor magnus of Fiedemann

Adductor ~~longus~~ magnus (le premier adducteur of Vicq d'Azyr l'abducteur inferieur of Meckel - adductor of Cuvier This muscle arises in close conjunction with and above the last muscle (~~magnus~~ longus). the two being almost inseparable. It is a smaller muscle than the magnus and descends to be inserted into the lower part of the linea aspera of the femur. This muscle can be more easily separated from the last at its insertion than at its origin.

The adductors magnus and longus will act together by pulling the femur downward and inward

Obturator externus (the Quadratus femoris of Vicq d'Azyr & Cuvier. - the obturator externus and quadratus femoris united of Meckel - the obturator externus of Tiedemann).

This muscle arises almost exactly from the same space of bone on the outside of the ischio-pubic bone as the obturator internus does from the inside only its origin is rather more limited in extent. The fibres end in a strong tendon which is inserted into the outer side of the shaft of the femur close to the insertion of the Pyriformis. The muscle passes almost directly forwards.

This is a distinctly marked slip of which I can

new muscle —

description might be better

find no notice in the works of any authority.
It arises from the posterior part of the ridge of the ischio-pubic bone. It crosses obliquely down the belly of the preceding muscle and is inserted below it into the upper part of the shaft of the femur by a very short tendon which passes obliquely posterior to that of the obturator externus.
This slip I have found only in the 2 saurial birds which I have dissected.
The two last muscles will evidently pull the femur backwards and downwards and thus to a certain extent co-operate with the adductors but they will tend to abduct the leg rather than adduct it. They will also rotate the leg outwards.
Femoro-coccygeus (the Femoro-coccygeus of Nitzsch & Owen (the Pyramidal of Meckel).
This muscle arises from the femur immediately below and close to the insertion of the last muscular slip by a very delicate tendon about 1/2 an inch in length. It then passes backwards parallel to the pubis, crossing the origins of the adductors of the femur, passes upwards over the origin of the obturator externus and continuing this direction till it reaches the lower surface of the coccygeal region

also Grèdemann

also for dorsal vertebrae

Latissimus femoris of Grèdemann

where it ends in a thin flat tendon which uniting with the like tendon from the opposite side is continued backwards as a common tendon to which also certain of the depressor muscles of the tail are attached as far as the base of the last coccygeal vertebra

This muscle from its size can hardly of itself act on the hip joint. I should think it more probable that it cooperates along with certain other muscles in depressing the tail.

Knee Joint

Sartorius (Sartorius of Vicq d'Azyr, Meckel & Cuvier)
This muscle arises from the anterior and upper margin of the crest of the ilium. It passes downwards and forwards over the gluteus maximus, and after giving off a few fibres to the Ligamentum Patellæ is inserted by a strong tendon into the anterior margin of the crest of the tibia.

Rectus femoris (the gluteus maximus and tensor vaginæ femoris combined of Vicq d'Azyr, Meckel, & Cuvier. ~~but not~~
This muscle is broad and flat and arises by a broad and flat aponeurosis from that portion

of the ridge of the ilium which extends from the Crest to the acetabulum, as well as from the spines of the sacrum, and the upper portion of the is-chio-pubic bone. The fibres pass downwards and forwards, the anterior more vertically than the posterior which pass very obliquely. The anterior and posterior portions of the muscle are separated about the middle of the femur by a thin aponeurotic slip, the two bundles of fibres passing, one on each side of the Vastus and Crureus and are inserted into the fore part of the head of the tibia. The anterior fibres of the muscle unite sooner with the vastus than the posterior. The anterior portion of this muscle would seem to correspond with the tensor vaginæ femoris.

The Sartorius is an extensor of the knee joint and a flexor of the hip joint. The Rectus femoris is an extensor of the knee-joint and a flexor or extensor of the hip joint according as the anterior or posterior fibres of the muscle come into play.

Vastus externus (vastus externus of Vicq d'Azyr part of the extenseur de la jambe of Theckel

This muscle arises from the outer surface of the femur from the trochanter major to within an inch of the condyles. It joins the following muscle

Rectus Femoris of Tiedemann

Vastus internus (Vastus internus of Vicq d'Azyr - part of the extenseur de la jambe of Meckel
This muscle arises by a short tendon from the root of the great trochanter as well as from the whole of the anterior surface of the femur. It is joined also by a few fibres which arise from the middle of the inner side of the femur which may perhaps be regarded as the Crureus. This muscle is separated at its upper part from the Vastus externus by the tendons of the glutæus medius and minimus and by a slight cellular interval. The fibres ultimately unite in a strong tendon which is also joined by the Rectus and Vastus externus and is inserted into the head of the tibia. This tendon has a well marked patella developed in it.

Gracilis (le droit interne de la cuisse (pectineus)? of Vicq d'Azyr, Meckel & Tiedemann)
This muscles arises from the inner surface of the lower three fourths of the femur, its origin being situated between that of the vastus internus and the insertion of the great adductor. It passes down over the inner surface of the knee joint and is inserted by means of a short tendon into the inner portion of the anterior tibial crest.

Gracilis of Fiedemann

or indirectly

The last 5 muscles must all act directly as extensors of the knee-joint. But they will do so in different ways. For whilst the Vastus and Crureus will extend it almost directly, the posterior portion of the rectus femoris will extend and abduct the leg, whilst the Sartorius and Gracilis will act as extensors and adductors

A muscle which I consider as having no homologue in Man (The Rectus femoris of Meckel; - le muscle grêle of Vicq d'Azyr) This muscle arises from a spine of bone immediately in front of the acetabulum. It passes downwards along the inner surface of the Vastus internus and in front of the origin of the gracilis. The belly which is of an elongated pyriform shape ends in a delicate tendon which extends from the inner and superior aspect of the knee-joint to the outer and inferior aspect. thus crossing it obliquely and passing under certain of the fibres of origin of the gastrocnemius. The tendon ends by uniting itself to the upper portion of the flexor perforatus of the toes.

This muscle has always and by most authors been described from its peculiar arrangement of passing directly or indirectly over three distinct

joints as enabling the bird to perch without exerting muscular effort. I hope I may be able to show the fallacy of this notion in another portion of the paper.

Biceps (le biceps of Meckel & Cuvier - le fléchisseur péronéal of Meckel)

This muscle lies at its origin immediately below the posterior portion of the Rectus femoris. It arises from the ridge of the ischio-pubic bone and passes downwards and forwards crossing in its course the obturator externus and Cruro-coccygeus. It ends near the head of the fibula in a tendon which after passing through a fibrous pulley is inserted into a tubercle on the outer edge of the fibula about an inch below its head. This pulley has 3 attachments - the first, the highest arising from the front of the lower end of the femur - the second, the middle from the tendon of origin of the outer head of the gastrocnemius - the third, the lowest from the inner edge of the head of the fibula.

This muscle is evidently a flexor of the knee joint. Its manner of passage through the pulley is peculiar and the purpose of it is not at all

evident. It may possibly assist the bird in perching without loss of muscular effort, as the pull upon the tendon will not require to be kept up to such an extent after passing through a pulley as it would did the muscle act directly.
Semi-membranosus (demi-membraneux of Cuvier d'Azyr, and Cuvier - Quatrième Flechisseur Tiedemann.
This muscle arises from the pelvis in a line with and directly behind the smaller adductor. It passes downwards and forwards and ends in a thin tendon which is inserted into the inner surface of the tibia 1/2 an inch below the crest after cropping the internal lateral ligament of the knee joint. Its tendon gives off a slip which goes to strengthen the fascia covering the inner part of the gastrocnemius and from which certain of the fibres of that muscle take origin.
This muscle is evidently a flexor of the knee-joint.
Semi-tendinosus (the demi-nerveux (semi tendineux) of Cuvier d'Azyr & Cuvier - the Flechisseur tibial of Meckel
This muscle situated between the biceps and semi-membranosus arises from the posterior edge of the ischium where it is closely connected with the posterior margin of the Rectus femoris

It passes forwards and downwards over the posterior portion of the Pubio-coccygeus and is joined close to its lower end by a strong broad fleshy slip which arises from the lower ½ of the posterior edge of the femur between the vastus externus and the insertion of the great adductor muscles. These two heads are united through the medium of a tendinous intersection which, passing downwards, unites opposite the junction of the upper and middle thirds of the tibia with the tendon of origin of the middle head of the gastrocnemius.

This muscle will flex the knee-joint and extend the ankle-joint.

Ankle-Joint.

Gastrocnemius (Les jumeaux of Hicq. d'Azyr - the gastrocnemius of Meckel & Cuvier)

This muscle arises by 3 heads. The outer arises by a short strong tendon from the lower part of the line leading from the linea aspera to the outer condyle of the femur. The fibres unite to form a thick fleshy belly. The inner or anterior head arises from the anterior surface

of the ligamentum patellæ, by a few fibres from the patella itself, and from the anterior tibial crest internal to the spine of that bone also from the anterior surface of the tibia, - these fibres being inseparably connected with those of the soleus, as well as from the fascia covering its surface, which is an offset from the tendon of the semi-membranosus. From these origins the fibres pass downwards and backwards, and end in a tendon which unites with that of the outer head immediately above the ankle-joint. The middle head arises from the back of the internal condyle of the femur being closely connected with the inferior margin of that portion of the semi-tendinosus which arises from the back of the femur. It is then joined by the tendinous intersection of the semi-tendinosus, after which it unites with the inner or anterior head. The common tendon of insertion of the 3 heads passes down gliding over the fibro-cartilage of the back of the ankle-joint and is inserted directly into the upper end of the tarso-

meta-tarsal

bone, but indirectly it is continued down along the whole length of this bone being inserted into the internal and external ridges of its posterior surface. It is gradually lost as a thin fascia on the sole of the foot along with the groove on the posterior surface of the tarso-metatarsal bone it thus forms a complete channel for the transmission of the flexor tendons of the toes.
This muscle is evidently an extensor of the Ankle-joint.

Plantaris (the Plantaris of Vieq d'Azyr, Meckel & Cuvier

This is a small muscle which arises from about an inch of the upper end of the tibia on its inner side immediately posterior to the insertion of the internal lateral ligament of the knee-joint It passes down to the inner side of the flexor muscles of the toes and is inserted into the fibro-cartilage covering the back of the ankle-joint This muscle is evidently adapted to act upon the fibro-cartilage and to pull it upwards when the ankle-joint is extended. Indirectly it will act as an extensor of the ankle-joint through the medium of the fibro-cartilage which is connected

with the upper end of the tarso-metatarsal bone.
Tibialis anticus (the Tibialis anticus of Meg. d'Azyr and Meckel.
two heads
This muscle has a remarkable origin by a tendon from the anterior aspect of the outer condyle of the femur, thus arising from the inside of the knee-joint. Muscular fibres also arise from the tibia immediately below the anterior crest from its inner part: some fibres also arise from the deep surface of the fascia which covers the extensor muscle of the toes and which is attached along the inner edge of the tibia. From these sources the fibres pass down and end in a tendon close to the ankle joint, which passing below a strong fibrous band which is attached to the tibia immediately above its condyles. The tendon then passes in front of the joint and is inserted into the bottom of the groove on the front of the tarso-metatarsal bone about 1/2 an inch from its upper end.
This muscle is a flexor of the ankle-joint. The tendon of origin from the femur is an arrangement for enabling the bird to perch as it is evident that when the knee is flexed the

Fibrialis posticus – Friedmann

muscle will be pulled upwards and so act as a flexor of the ankle-joint and thus assist in maintaining the bird in the ~~flexing~~ perching position without muscular effort. Peroneus superior (Eng. p.) Muscle

Soleus (L'accessoire des fléchisseurs des doigts of Vicq d'Azyr le moyen péronnier of Cuvier. This muscle which covers the anterior surface of the tibialis anticus arises from the tibia immediately below the anterior tibial crest, where it is inseparably united with the fibres of the anterior head of the gastrocnemius arising from the same portion of bone. Its more extensive origin however is from the superficial aspect of the fascia, the deeper surface of which gives origin to the tibialis anticus and this origin is connected through the medium of the fascia to the whole length of the inner edge of the tibia except about an inch below. Its outer margin lies against the outer head of the gastrocnemius whilst its inner is connected with the inner head of the same muscle. The belly of the muscle terminates in a flat tendon which divides into 2 portions, one of which, the broader, goes to be inserted into the outer part of the fibro-cartilage covering the back of the

ankle-joint, whilst the other passes along a groove on the outer ankle and ends by joining the tendon of the flexor perforatus which goes to the middle toe.

This muscle will extend the ankle joint by means of that part of the tendon which is inserted into the fibro-cartilage. I shall refer to the action of that portion which goes to join the flexor of the toes farther on.

Peroneus (Peroneus brevis of Cuvier - the Peroneus of Vicq d'Azyr & Meckel.

This muscle arises from the shaft of the fibula except from its upper end for about an inch as well as from the adjacent margin of the tibia. It ends in a tendon which passes round the outer ankle immediately beneath the narrow tendon of the soleus and is inserted into the outer side of the base of the tarso-metatarsal bone.

The action of this muscle is not very apparent but it would seem to assist in extending the ankle-joint.

Popliteus (the Popliteus of Cuvier & Vicq d'Azyr)

This is a small muscle which arises by tendon from the head of the fibula and passing downwards and inwards is inserted into the back of the head of the tibia. This muscle will draw the bones of the leg together

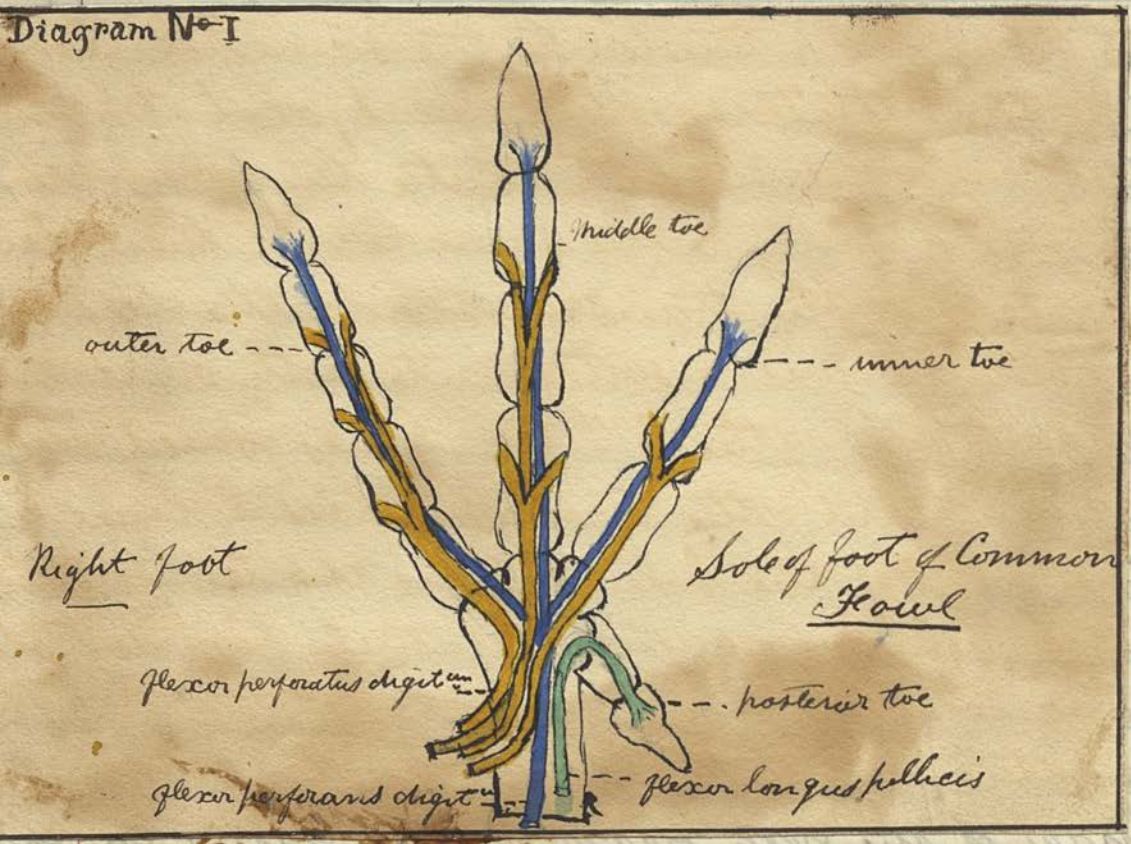
Flexors of the toes

Flexor perforatus (Flexor perforatus of Bicqd'Azyr Meckel & Cuvier

This muscle arises partly by tendon, partly by muscular fibres from the lower end of the femur at its posterior part immediately above and between the condyles. It also takes origin from the outer side of the external condyle of the femur as well as from the upper half of the shaft of the fibula It is also joined by a muscular slip from the deep flexor which joins that portion of the muscle which, after becoming tendinous goes more especially to the outer toe. After being joined by the tendon of the Rectus femoris (Meckel) the portion of the muscle which arises from the back of the femur may by careful dissection be found to split about the middle of the tibia into 3 distinct slips which ending in tendons have the following distribution. The anterior or deeper tendon passes to be inserted into the middle of the upper end of the fibro-cartilage covering the back of the ankle-joint. The outer tendon passing down over the back of the ankle joint in a distinct groove of the fibro-cartilage runs along

the back of the tarso-metatarsal bone to be inserted into the outer toe as follows.- At the base of the toe the tendon gives off from its outer edge a small slip which is inserted into the outer side of the base of the 2nd phalanx just at the spot where this slip is given off the tendon splits into two pieces between which the tendon of the flexor profundus passes. The outer of these two passes on to be inserted into the base of the 3rd phalanx at its outer side The inner passes on to the inner side of the tendon of the deep flexor but passes under it opposite the 3rd phalanx it bifurcates and is inserted into the outer and inner sides of the base of the 4th phalanx. At the spot where the tendon passes over the metatarso-phalangeal joint it enlarges into a triangular shaped fibro-cartilage. The outer surface of this is grooved for the passage of the deep flexor tendon of this toe whilst the inner surface is adjacent to the tendon of the flexor longus to the middle toe. From the inner angle of this triangular expansion a fibrous slip passes backwards to be connected with a fibro-cartilage between the first pha-

Diagram No I


middle toe
outer toe
inner toe
Right foot
Sole of foot of Common Fowl
flexor perforatus digit
posterior toe
flexor perforans digit
flexor longus pollicis

lanx and the tarso-metatarsal bone. This band serves to confine the deep flexor tendon to its place.

The tendon to the middle toe passes down in the same way as the last; as it passes over the ankle-joint it is grooved posteriorly for the passage of the deep flexor tendon to the same toe. Close above the metatarso-phalangeal joint it is connected by a fibrous slip to the tendon of the deep flexor going to the same toe. It then bifurcates for the transmission of the deep flexor tendon and is inserted into both edges of the first phalanx of the 3rd toe. It is joined about the upper third of the tarso-metatarsal bone by the tendon of the Soleus. There is a tendinous band which occupies relatively to this toe the same relations as the tendons of the flexor perforatus do to the other toes. This band arises from the inner tubercle on the posterior surface of the head of the tarso-metatarsal bone and passes down to be attached to a fibro-cartilage covering the back of the metatarso-phalangeal joint.

There is a second tendon to the middle toe

which springing chiefly from that portion of the belly of the muscle which arises from the external condyle of the femur and from the fibula, passes over the metatarso-phalangeal joint and perforating the tendon to this toe already described is inserted by two slips into the base of the 3rd phalanx of this toe, the tendon of the deep flexor passing onwards between these slips.

The tendon to the inner toe, arising chiefly from that portion of the muscle which takes origin from the external condyle of the femur passes over the fibro-cartilage of the ankle-joint and runs to be inserted into the base of the 2nd phalanx of the inner toe, previously splitting for the passage onwards of the deep flexor tendon.

This muscle flexes the toes.

2. Flexor digitorum perforans (the flexor perforans digitorum of Vicq d'Azyr, Meckel & Cuvier)

This muscle arises from the head of the fibula, from the upper half of the shaft of that bone and from the upper two thirds of the back of the shaft of the tibia. The fibres end in a

tendon which passes through a distinct groove in the fibro-cartilage on the back of the ankle joint and terminates by splitting into 3 portions, one for each of the second, third, and fourth toes which after perforating the tendons of the flexor perforates are inserted into the terminal phalanges of the corresponding toes.

This muscle evidently flexes the toes

Flexor longus pollicis. (included in flexor perforatus by Huxley)

This muscle arises from the back of the fever, immediately above the condyles, close to, and to the outer side of the origin of the flexor perforates. The tendon passes through a distinct synovial capsule in the fibro-cartilage of the ankle joint and is inserted into the terminal phalanx of the first toe. At the lower end of the tarso-metatarsal bone it is intimately connected with the tendon of the flexor perforans by a short transverse fibrous band. So close is this connection, that it is impossible for either muscle to act without acting on all the toes.

This muscle flexes the posterior toe and by means of the connection assists in flexing the other toes.

4 4 Interosseous muscle (described but not named by Meckel) A small muscle which may be analogous to an interosseous arises from the ridge situated along the outer and back part of the tarso-metatarsal bone. It is a very thin and delicate muscle, and extends nearly the whole length of the bone and is inserted into the outer side of the base of the first phalanx of the outer toe.

tion This muscle abducts the outer toe.

5 5. Interosseous muscle (described but not named by Meck
This muscle arises from the lower part of the outer side of the tarso-metatarsal bone and is inserted into the outer side of the base of the first phalanx of the 2nd toe.

tion This muscle flexes the toe and adducts it.

6. 6. Interosseous muscle (~~not described~~).
This muscle arises from the inner side of the upper end of the tarso-metatarsal bone immediately below its head. It is a short triangular muscle and ends in a tendon which passes to be inserted into a fibro-cartilage situated between the bases of the 1st and 2nd toes.

Flexor hallucis of Tiedemann

→ M. Extensor hallucis (Tedenin

A

B.

Extensors.

1. Extensor communis digitorum (the long common extensor of the toes of Meckel)

This muscle arises from the anterior surface of the tibia for nearly its whole length and partly from the fascia which gives origin to certain of the fibres of the Tibialis Anticus. It ends in a tendon which, passing under an osseous bridge at the lower end of the tibia divides into three tendons opposite the meta-tarso-phalangeal articulation, which then run onward to be inserted into the terminal phalanges of the three anterior toes.

This muscle extends the toes.

2. There are 4 small muscles on the front of the tarso-metatarsal bone which lie obliquely across the bone very much as the extensors of the thumb and index finger do in man.

The innermost of these is inserted into the first phalanx of the thumb.

This muscle extends the hind toe.

The second is inserted into the inner side of the base of the first phalanx of the second toe

This muscle extends the second toe and abducts it

C C The third is inserted into the base of the first phalanx of the third toe.

Action This muscle extends the third toe

D D The fourth which passes vertically downward has an origin from nearly the whole length of the inner ridge on the front of the tarso-metatarsal bone. After passing beneath an osseous bridge at the lower end of this bone it is inserted into the inner side of the base of the first phalanx of the 4th toe at its under aspect.

Action This muscle flexes the 4th toe and adducts it toward the middle line of the foot.

These short muscles are not described by Meckel although with the exception of muscle No 6 of the flexors. these are all described by Vicq d'Azyr.

It is worthy of note, that, including this muscle there are exactly the same number of interosseous muscles as in Man viz: 3 plantar and 4 dorsal which tends to prove that Vicq d'Azyr was correct in naming these muscles - Interossei.

Muscles of Wood Grouse (Tetrao urogallus)

In the muscles of the hip joint there is not observable any very great or material difference from the same muscles in the Common Fowl.

The Glutæus maximus is slightly larger whilst the other two glutei are rather smaller. The Pyriformis is however considerably smaller than the same muscle in the Fowl as is also the Obturator internus because of the larger space taken up in this bird by the depressors of the tail. The adductor magnus in this bird has an insertion equally extensive with that of the longus which as will be seen by a reference to the description of the muscles of the Common Fowl is not the case in that bird. With regard to the three muscles last mentioned as also to others this bird shows in the general arrangement of its muscles an approach to what we shall observe to be the arrangement of the same muscles in the next order we examine viz: the Perching birds (Insessores). And this is consistent with what we know of the habits of this bird for its favourite haunts are the branches of the Pine trees where it at least spends as much of its life as it does on the ground.

There exists in the brood grouse a well marked and strong accessory slip to the Obturator externus, which I have never found to be present in any other bird except the Common fowl.
The Cruro-coccygeus in this bird consists of two bellies anterior, and posterior, which are separated by an intermediate tendon beneath the origin of the biceps and its femoral origin is situated lower down than in the Fowl thus giving greater power to the muscle as a depressor of the tail than in ~~the Fowl~~ that bird because in the former the muscle will pull more directly than in the latter.

Knee-joint.

The posterior part of the Rectus femoris is much stronger in the brood grouse, as it receives fibres on the intermediate tendon down as far as the head of the tibia in which respect it resembles the same muscle in some other birds which we shall afterward refer to. The two parts are stronger than the like muscles in the fowl while the Rectus femoris of Meckel is smaller and feebler and there is a distinct bundle of fibres coming from the lower end of the femur (crureus). In

all these particulars the Muscles of the Wood grouse show a step intermediate between those of the terrestrial rasores such as the common fowl and the truly Perching birds. The Biceps in this bird has an additional origin from the posterior edge of the aponeurosis which gives origin to the Rectus femoris muscle; whilst the other two hamstring muscles (semi-membranosus & tendinosus) are weaker than the corresponding muscles in the fowl

Ankle-joint

The only respect in which the muscles of the Ankle-joint of the wood grouse differ from those of the common fowl is in as much as the flexor muscles of the toes intervene between the Soleus and the outer head of the gastrocnemius thus showing the larger proportional size of the flexors of the toes in the former bird than in the latter.

Flexors of the Toes.

Flexor perforatus is as has just been stated a larger muscle than in the fowl, and it receives no muscular slip of communication from the deep flexor neither does it give off a tendon to the fibro-cartilage of the back of the ankle-joint as it does in that bird

The Flexor perforans is a smaller muscle than the Fowl whilst the Flexor longus pollicis is more closely united with the inter-condyloid origin of the flexor perforatus than it is in that bird thus again showing a tendency to the same arrangement as we find in the Insessores where the flexor longus pollicis and flexor perforatus are inseparably united. The slip of communication between the tendon of the flexor perforans and that of the flexor longus pollicis does not exist in this bird so that it would seem that in this bird these two muscles can act independently and separately which is impossible in the Fowl.

As regards the interossei - there is no remarkable difference from the corresponding muscles in the hen except that they are weaker in the bird we are describing at present; whilst the muscle (No 5 flexors) of the common fowl is absent and No 6 is inserted into a fibro-cartilage covering the lower aspect of the meta-tarso-phalangeal joint of the middle toe. There is also in the goose a Flexor brevis pollicis which arises from the inner edge of the tarso-metatarsal bone. It

tendon passes along with that of the flexor longus pollicis and is inserted into the base of the first phalanx of the thumb. This muscle does not exist in the common fowl.
The extensors of the toes do not differ from the same muscles in the Common fowl.

I have looked over the muscles of the Pheasant (Phasianus Colchicus) in a cursory manner but could detect no differences of any value, in them as compared with the Common fowl, or which it would be worth while noting down.

Characteristics of the Rasores

It will be observed by a comparison with the Orders which I am about to describe, that the Rasores are characterised by the generally moderate development of all the muscles as compared with the same in birds of other orders in which some are comparatively increased in size whilst others are diminished, or even alto-gether wanting. So far as my observations go, there is not a single muscle absent in the posterior extremities of the Rasorial Birds which

kind which is found in those of any other kind except one, which is altogether peculiar to the Ostrich, and which will be described along with the muscles of that bird.
More especially I would say that the Rasores are characterised by the large size and complete number (seven 4 in front 3 behind) of the interossei muscles which, so far as I know are not developed to the same extent in the birds of any other order. and by the existence of an accessory slip to obturator externus

Order II Insessores

I have examined four birds in this Order, — the Magpie (Pica caudata) the Thrush (Turdus musicus) the blackbird (turdus merula) and the Starling (sturnus vulgaris). The blackbird so closely resembles the thrush in regard to its muscles that a reference to the one bird will serve for both.
In the muscles acting directly on the hip joint the following peculiarities are worthy of notice. The glutæus maximus in the thrush and magpie is proportionally a weaker extensor than in the Rasorial birds owing to the shortness of the great trochanter, and the consequent insertion of the muscle nearer the centre of motion of the joint.

This muscle however in the Starling has a similar arrangement to the same muscle in the common fowl. It is worthy of note that the two birds first mentioned progress by leaping during which action both feet are removed from the ground simultaneously whilst the Starling progresses in the same mode as the Rasorial birds - that is by alternate strides.

The Pyriformis is absent in all three birds, and I was unable to find any trace of the Iliacus internus in the thrush although it was present in both the others.

The Obturator internus is weaker in all the Insessores than in the Rasores, because of the space which it occupies in birds of the latter order, being encroached upon by the large depressor muscles of the tail which are not necessary to the same extent, to the Rasorial birds; which are not dependant so much on their powers of flight but on their powers of walking and using their legs for their daily subsistence, and thus we find that in one set of birds, the muscles of the tail, and in another those of the leg, are well developed according as the one or other series of muscles are most essential to the welfare of the individual.

The Adductor longus has an arrangement in these birds now under consideration not differing materially from the same muscle in the common fowl, with this exception, that in the magpie and thrush the muscle is proportionally longer, its insertion occupying the whole length of the linea aspera of the femur, and not confined to its lower half, as it is in the Starling and Rasorial birds. This observation is the more remarkable when taken in connection with what has previously been stated with regard to the different modes of progression in these birds
The Adductor magnus has relatively to the longus in all the birds of this order a different arrangement from the same muscle in the common fowl; as it arises directly behind and not above the longus and passing down posterior to that muscle, is inserted into the back part of the inner condyle of the femur, in this respect closely resembling the tendinous portion of the adductor magnus in Man.
The Obturator externus had an arrangement in these birds of the present Order closely resembling the same muscle in the common fowl

but in two of them, the thrush and magpie, its size, relatively to that of the obturator externus was larger than in the fowl whilst in the Starling it was the same in this respect as in the former birds.

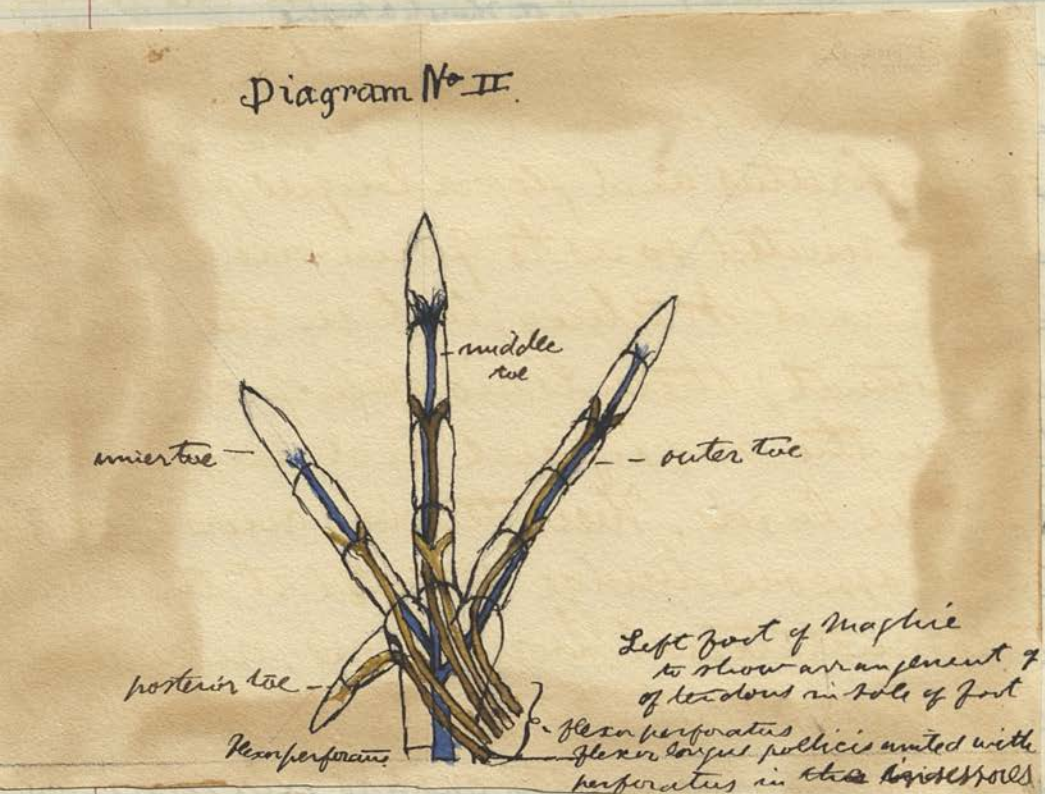
The accessory slip to the Obturator externus is absent in all of these birds.

The Cruro-coccygeus muscle, in the thrush & magpie, was similar as regards its relations to the same muscle in the common fowl but it was larger, and more powerful; but in the Starling this muscle is not attached to the femur, at all, but takes origin from the posterior extremity of the ischium.

The Rectus Femoris of Meckel is altogether absent in ~~the four birds~~ these birds now under examination; an interesting fact when we remember that all these birds are habitual perchers, and yet we have been taught to regard this muscle as that, by means of which birds are enabled to perch without loss of muscular effort.

The Semi-membranosus in consequence of the change in the relative positions of the adductors arises above the magnus instead of behind it, whilst at its insertion the muscle passes altogether

Diagram No II.



Left foot of Magpie to show arrangement of tendons in sole of foot

below the internal lateral ligament of the knee joint instead of crossing it as it does in the Rasorial birds. This arrangement obtains in all the birds of this order which I have examined.

Ankle-joint

The Plantaris ~~was~~ is absent in the Starling but present in all the others, and neither the Tibialis anticus nor the Soleus had any fascial origin in either of the birds of this order

The flexor perforatus and flexor longus pollicis are inseparably united so as to form one muscle in the Magpie and Starling, but in the thrush they are distinct; there is no slip of communication between the superficial and deep flexors in any of these birds. Their tendons moreover pass beneath an osseous bridge situated at the head of the tarso-metatarsal bone bone, an arrangement which does not obtain in the Rasorial birds. That portion of the flexor perforatus which, after ending in a tendon goes to the middle toe, is in these birds particularly distinct from the rest of the muscle, and constitutes the "flexor perforant et perforé" of Meckel. The arrangement of the tendons in the sole of the foot differs from

diagram II. Opposite page.

that of the Raptores, but so slightly that I do
think it worth while describing them.
In none of the insessorial birds which I ha
examined was there any trace of the Interos
seous muscles.
The tendon of the Extensor communis digitor
in the magpie perforates an osseous tuberc
situated on the anterior aspect of the head
the tarso-metatarsal bone, besides passi
beneath the osseous bridge at the lower en
of the tibia. What the precise purpose of t
arrangement is, is not very apparent.
There is no ~~flexor~~ extensor of the ~~hind~~ poster
toe in any of the insessorial birds now und
examination, but in place of it there is a pecu
arrangement which seems to be peculiar to
Order, which has never so far as I am aw
been noticed and which I will now descr
The posterior toe is articulated to a small bon
which is connected by ligament to the low
end of the tarso-metatarsal bone. There is a
distinct trochlea on the lower end of this
for the articulation of the posterior toe. The te
of the flexor perforates to this toe hooks rou

the outside of this little bone, between it and the innermost facet on the lower end of the tarso-metatarsal bone which articulates with the second or innermost toe, so as to pass from the back to the front of the posterior toe, and thus when the muscle contracts oppose it to the other or anterior toes. This tendon does not however play directly round the trochlea of the small bone with which the posterior toe articulates, but is separated from it by a Cartilaginous pulley which is accurately adapted to the curves of the lower end of the small bone. This cartilaginous pulley is attached by its upper end to about the middle (in length) of the small bone with which the posterior toe articulates, and by its lower end it is attached to the plantar aspect of the base of the first phalanx of the posterior toe. From the middle of this cartilaginous pulley a small slip is given off to be attached to each side of the trochlear surface of the small bone. The lower or plantar surface of the cartilaginous pulley is grooved for the passage of the flexor tendon to the posterior toe. The action of this arrangement seems to be the

following. - The Cartilaginous pulley is elastic and is curved round the trochlea. When the toe is extended the cartilaginous pulley is stretched to the full; but when the toe is flexed by the action of the flexor muscle, the cartilaginous pulley is necessarily compressed, and being retained in situ by the lateral bands described above, it is thrown into two folds, one in front, the other behind these bands. When the flexor muscle ceases to contract the elastic pulley being [illegible] having nothing to oppose it comes into action, and immediately extends the posterior toe somewhat in the manner of a compressed spiral spring. This extensor arrangement would dislocate the toe altogether, were it not for the lateral ligaments of the joint which compel the elastic pulley to describe the curve formed by the lower end of the trochlea of the latter bone and so keeps the base of the first phalanx of the posterior toe always in opposition with the lower end of the bone with which this toe is articulated.

Characteristics of Insessores.

These may be summed up shortly as. —

1. Absence of the Pyriformis muscle.
2. Origin of the Adductor magnus behind that of the Adductor longus, and its insertion into the inner condyle of the femur.
3. Absence of the Accessory slip to the Obturator externus.
4. Large size of the Cruro-coccygeus.
5. Absence of the Rectus femoris of Meckel
6. Insertion of Semi-membranosus below the internal lateral ligament of the knee-joint
7. Want of fascial origin of the Tibialis Anticus & Soleus.
8. Entire absence of Interossei muscles.
9. Existence of the peculiar extensor arrangement of the posterior toe, before described.
10. Absence of the slip of communication between Flexor perforatus and Flexor perforans.
11. Absence of slip from Flexor perforatus to fibro-cartilage of back of ankle-joint.

Order III Scansores.

In this Order I have dissected two birds, the Psittacus torquatus, and the Psittacus erithacus. In both of these birds the glutens maximus had a more extensive origin than the same muscle in the common fowl, so much so that in the Psittacus erithacus, the whole length of the curved line of the ilium gives attachment to this muscle, in this respect differing from the same line in the Rasorial birds, in which the posterior part of the line gives origin to the Pyriformis. In the Psittacus torquatus the glutens maximus leaves only about 1/8th of an inch for the origin of the Pyriformis from this line, which muscle is consequently much reduced in this bird. In the former bird this muscle is inserted into the posterior portion of the outer aspect of the great trochanter, whilst in the latter it is inserted into the anterior portion of it.

In both of these birds both the smaller glutei muscles are fused together, so as to constitute one continuous muscular belly, which occupies the whole of the superior margin of

the ilium, from the anterior margin, backwards to the acetabulum. The insertion of the common tendon corresponds in position to that of the gluteus medius in the generality of birds. The Pyriformis is absent alto-gether in the "erythacus", whilst in the "torquatus" it is reduced to a minimum consistent with its presence. This is due to the increased size of the gluteus maximus as mentioned above. It might be imagined by a superficial observer, that in the latter bird the Pyriformis was only the posterior portion of the gluteus maximus: but that it is a distinct muscle, is proved by the fact that it has a tendon distinct from that of the gluteus maximus which passes at right angles to the latter tendon and is inserted below it. It does not however glide over the tendon of the gluteus maximus as this last is inserted into the fore part of the great trochanter, not into the posterior part as in the Raptorial birds whilst that of the Pyriformis is inserted at the usual spot.
The Obturator internus had the usual limited origin in these birds, consequent on the large size of the depressor muscles of the tail.

The adductors longus, and magnus are inseparably united in both of these birds now under examination, the lower fibres of the muscle (which probably corresponds to the adductor magnus) being inserted into the back of the inner condyle and uniting with the tendon of origin of the ~~inner~~ middle head of the gastrocnemius, in this respect differing from the same muscle in the Raptorial birds. The purpose of the lower fibres uniting with the ~~inner~~ middle head of the gastrocnemius is not very evident, but there can be little doubt that it is connected in some way with the peculiar habits of the Scansorial birds in climbing as the muscle will not only act directly on the hip joint, but also indirectly on the knee and ankle through the medium of the gastrocnemius.

Meckel states that in the Parrots the Cruro-coccygeus is more than usually strong. In the two which I have examined this certainly does not hold good.

The accessory slip to the Obturator externus is absent in these birds

Knee-joint.

The Sartorius takes origin in both the birds we are at present examining, from the spine of the last dorsal vertebra as well as from the usual portion of the crest of the ilium, and is inserted directly into the front of the anterior tibial crest, thus giving the muscle a greater power of rotation over the knee-joint, which in these birds admits of very extensive movement, than in the Rasorial birds in which it is inserted into the inner side of the anterior tibial crest.

The Rectus femoris in these birds is remarkable for its narrowness and does not much exceed in breadth the Sartorius. It arises only from the curved line of the ilium and not at all from the ischio-pubic bone, and consequently leaves the origin of the Biceps altogether uncovered, thus differing from the same muscle in the generality of birds. Its insertion is as usual.

Those fibres of the extensor of the leg which I regard as the Crureus are not all differentiated from the rest of the muscular mass in the Parrots.

The Gracilis does not differ in its origin from the

same muscle in the common fowl, but its insertion is situated much more anteriorly on the tibia than in that bird; and this arrangement is so well marked in the Psittacus torquatus that it passes to be inserted as far forwards as the inner side of the anterior tibial spine. Taken in connection with the arrangement of the Sartorius in these birds, it is evident that a free rotation of the knee-joint is necessary for their mode of life as the gracilis will in this respect aid the Sartorius.

The Rectus femoris of Meckel in the Psittacus erithacus is a very slender and feeble muscle while in the "torquatus" it is absent.

The Biceps in the Parrots differs only from the same muscle in the Raptores in as much as it is not concealed by the Rectus femoris, and that it has an additional origin from the posterior edge of the aponeurosis which gives origin to the latter muscle. In the "erithacus" the semi-membranosus is connected by a bundle of muscular fibres with the semi-tendinosus, so that it would appear that the one cannot act without the other, an arrange-

which does not obtain in the "torquatus".

Ankle-joint.

The Gastrocnemius in the Scansores is remarkable for its very broad and thin tendon of insertion, which embraces all the other muscles of the back of the leg laterally as well as posteriorly, the muscular heads of origin, 3 in number as in other birds, being small. The origin of the anterior head from the tibia is also more extensive than in the generality of birds a fact which did not escape the notice of Meckel. In other respects it does not differ materially from the same muscle in other birds. The Plantaris as Meckel has observed is absent in the Parrots but according to him in the Woodpeckers it is present and well developed. This latter observation I have had no opportunity of verifying.

In the Scansores the Tibialis anticus does not differ from the same muscle in the Common fowl except at its insertion which is placed altogether on the inner aspect of the tarso-metatarsal bone instead of being inserted on the front of it. This arrangement as Meckel observes will enable the muscle to direct the sole of the foot towards

the opposite side of the body" an arrangement extremely favourable to the action of climbing. The tibialis is remarkable in the parrots for its extremely feeble development, its relations also being altogether different from what they are in the generality of birds. It arises solely from the lower 3/4ths of the outer edge of the fibula, posterior to the origin of the Peroneus, and has only one tendon instead of two as in the common fowl, which is inserted into the fibro-cartilage covering the back of the ankle-joint. It therefore sends no tendon to join the flexor perforatus of the toes. Such is its arrangement in the Psittacus torquatus and in the "Psittacus" it is even smaller and arises only from the lower end of the tibia and is very closely connected with the ~~flexor~~ muscular belly of the flexors of the toes. The Peroneus to a certain extent compensates for the small size of the last muscle, for in the order we are considering it is of very large size arising from the whole length of the fibula, except a small piece below, and in the "Psittacus" arising

as high as the ligamentum patellae. It ends in a strong tendon which is inserted into a well marked projection on the outer side of the head of the ~~fibula~~ tarso-metatarsal bone. This muscle will evidently act in such a manner as to oppose ~~the~~ ~~action~~ of the Tibialis anticus as it will direct the sole of the foot outwards. This action is also taken notice of by Meckel. This muscle is also one of the chief muscles which comes into play when a parrot feeds himself by holding the morsel to his mouth, an action which is very important to these birds in their native state when their food consists largely of hard fruits which must be decorticated before they can be digested, and this can only be performed by these birds by holding the fruit in their foot whilst they peel it with their bill.

Flexors of Toes

The Flexor perforatus in the Psittacus erithacus differs from the same muscle in the common fowl, in as much as it gives off two tendons to the inner toe instead of one as in the Fowl and most other birds. This additional tendon

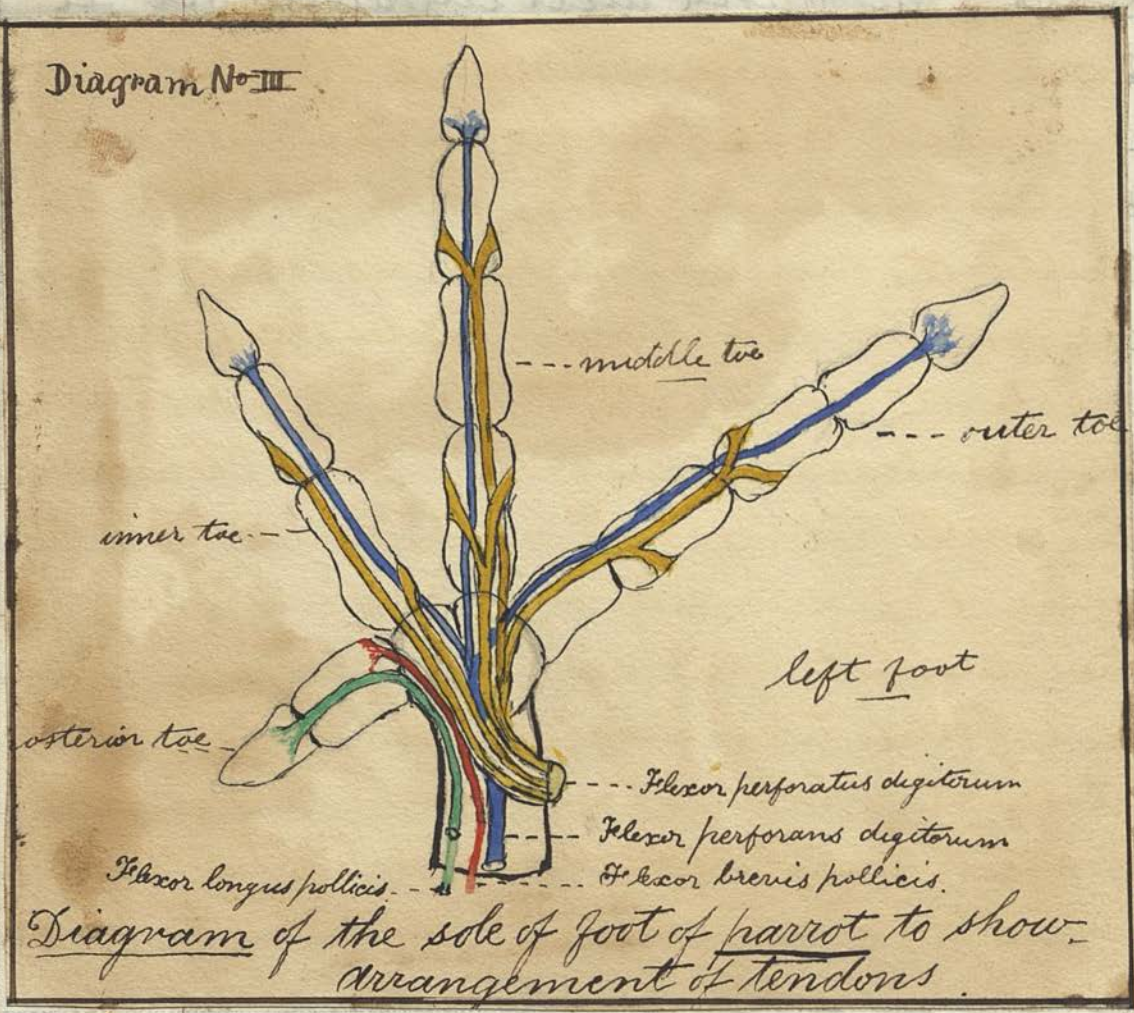


Diagram of the sole of foot of parrot to show arrangement of tendons.

arises from that portion of the muscle which arises from the fibula, and is inserted into the outer side of the base of the first phalanx of the inner toe. The difference between these tendons in the birds referred to will be seen by comparing diagrams 1 & 3. In the Psittacus torquatus however this additional tendon is wanting. In the Parrots generally the main difference as regards the disposition of the flexor tendons compared with the generality of birds, consists in the peculiar manner in which they oppose the outer toe as well as the posterior, to the inner and middle toes. This arises from the obliquity of the outer facet on the lower end of the tarso-metatarsal bone and the angle at which it is placed to the neighbouring facets. The tendons to the outer toe, thus twist round between the middle and outer facets of the tarso-metatarsal bone, and gliding over the latter, pass to be inserted as shown in diagram 3. The passage round the facet thus alters the direction of the pull of the muscle and

causes it to oppose the outer toe, both to the inner, as well as the anterior toes.
The flexor perforans does not differ essentially from the same muscle in the Rasorial birds except in as much as its tendon along with that of the flexor longus pollicis passes through an osseous foramen, situated at the posterior aspect of the upper end of the tarso-metatarsal bone. Meckel states that this arrangement is found in all the Parots. The same intimate connection exists in the Scansores, between the tendons of the flexor longus pollicis, and the flexor perforans digitorum, so that the one muscle cannot act without pulling upon the tendon of the other as in the generality of birds. But the flexor longus pollicis is a distinctly differentiated muscle in these birds and is not fused with the flexor perforates as in the Insessores.
A second proper flexor of the posterior toe exists in the Parots. It probably corresponds to that muscle, which in the Common fowl, is inserted into the intro-cartilage

situated between the inner and posterior toes. At least it arises from the same point of bone as the muscle just mentioned, but it is inserted into the base of the first phalanx of the posterior toe, instead of into the fibro-cartilage above mentioned.
A muscle (No 4 of domestic fowl) also exists in the parrots and has the same origin and insertion as in that bird, but the muscle No 4 of that bird is wanting in both the scansorial birds which I have examined.
The origin of the Extensor communis digitorum is rather more limited in the Parrots than in the Rasorial birds as it arises only from the upper half of the tibia. Its tendon ultimately divides into 4 - one for each of the toes including the posterior toe, so that there is no need for that peculiar extensor arrangement in connection with that toe which we have described under the Insessores.
There is only one anterior interosseous muscle in the Parrots which corresponds to the Muscle C. of the Common fowl. It is a strong fleshy bundle composed of short fibres

which arise only from the lower end of the front of the tarso-meta-tarsal bone and are inserted as in the Common fowl into the base of the first phalanx of the middle toe. Its action is the same as in the Fowl.

Characteristics of Scansores

These may be summed up shortly as follows.

1. Comparatively large size of the Glutæus maximus
2. Glutæus medius and minimus combined so as to form a single muscle.
3. Small size of Pyriformis
4. Adductors magnus, and longus combined so as to form one muscle, the lower fibres of which end on the middle head of origin of gastrocnemius
5. Additional origin of Sartorius from spine of last dorsal vertebra and its insertion into the front (not the side) of the head of tibia.
6. Narrowness of Rectus femoris.
7. Insertion of gracilis muscle farther forward on the tibia than in other birds
8. Broad membranous tendon of gastrocnemius.
9. Absence of Plantaris.
10. Insertion to inner side instead of front of the

tarso metatarsal bone of Tibialis anticus

11. Very small size of Soleus, and the absence of its tendon which joins the flexor perforatus.

12. Very large size of Peroneus.

13. Arrangement of flexor tendons so as to oppose the outer toe to the inner and anterior. (flexor profundus digitorum)

14. Passage of tendons of flexor longus pollicis through an osseous foramen at head of tarso metatarsal bone (4 & 6 of four)

15. Existence of only 3 (2 of four) interosseous muscles - 2 posterior and 1 anterior.

16. Division of Extensor tendon into 4. (including one to the posterior toe.

Order IV Raptores.

I have examined 4 birds in this order, the Sparrow Hawk (Accipiter nisus), the Ring tailed Harrier (Circus cyaneus), the long eared Owl (Asio otus), and a young eagle( ). In all these birds the the Glutæus maximus was of moderate size and had the same general arrangement as in the Passores: but in the Harrier and Sparrow Hawk it was inserted into the anterior portion of the outer side of the great trochanter, whilst in the Owl it agreed with the same muscle in the Common fowl, in as much as it was inserted into the posterior portion of the same aspect of the great trochanter, thus occasioning a difference between the diurnal and nocturnal birds of prey, in the relation which this tendon bears to that of the Pyriformis. In all three birds the two smaller glutei muscles are united together and end in a common tendon, the insertion of which corresponds to that of the glutæus medius in those birds in which those two muscles are distinct. The Pyriformis is present in all, but in the Owl alone does its tendon glide over that of the glutæus maximus, whilst in the other two it passes altogether behind that tendon, because

of the different points of insertion of it on the different birds. It is very closely connected to the glutæus maximus. In all three birds the ~~glutæus~~ Iliacus ~~maximus~~ was absent. This observation contradicts that of Meckel who states that it is present in the diurnal birds of prey. The Obturator internus is a strong muscle in the Harrier and Sparrow-Hawk but weak in the owl, having the same arrangement as in the common fowl. The gemellus is present in the Harrier and Owl but absent in the Sparrow-Hawk. The Adductors in these birds now under examination differ from those of the common fowl in as much as the Adductor magnus is equal in size ~~to that of the~~ and in one of them, the Harrier, exceeds that of the Adductor longus, an arrangement which I am not aware occurs in the birds of any other order. The lower fibres of the Adductor longus end on the internal condyle of the femur, whilst the lowest end on the middle head of origin of the gastrocnemius in these birds, in which respect also ~~they~~ it differs from the same muscle in the fowl. The Obturator externus is proportionally a stronger muscle in both the Hawks, than in the

common fowl but in the Owl it is proportionally a much weaker muscle. It has however in all of them the same general arrangement, but in consequence of the peculiar bend downwards of the posterior portion of the Pelvis in the Raptorial birds but more especially in the diurnal birds of prey, the action of this muscle will be much more powerful as an extensor of the hip-joint than in the generality of birds. It will thus be an almost direct antagonist to the two smaller gluteii muscles, these last flexing the femur and rotating it inwards, whilst the external obturator will extend and rotate it outwards. The accessory slip to the obturator externus is wanting in all the birds of this order. The Crureo-coccygeus muscle is very powerful in the hawks but weak in the Owl, and in all it arises from the middle of the femur (lower than in the fowl) and thus has greater power (as it acts more directly) on the tail an organ which is so essential to the accurate movements of the birds of prey

Knee-joint.

The Sartorius in the Owl arises from the superior

margin of the ilium, and consequently does not cross the glutæus maximus as it does in the Rasores and the Diurnal birds of prey. The Rectus femoris in the Raptores is a narrow muscle arising almost solely from the ridge of the ilium from the anterior margin of that bone, backwards to the acetabulum, although a very few fibres take origin from the ischio-pubic bone. It thus leaves the Biceps altogether exposed at its origin in which respect it differs from the same muscle in the Rasorial birds. The Rectus femoris of Buteo is a very delicate muscle in the two hawks; in the Owl it is altogether absent. The Biceps in all the birds under consideration has an additional origin from the posterior margin of the aponeurosis which gives origin to the Rectus femoris, and it lies altogether posterior and therefore uncovered by that muscle. The Semimembranosus is a rounded muscle and gives off no prolongation to the fascia covering the leg in any of these birds; and what is very remarkable the Semi-tendinosus is absent in the whole of them (the eagle included). This muscle is not altogether wanting in any other order of birds so far as I know.

Ankle-joint

The Gastrocnemius in the birds of prey is remarkable for its feebleness generally, but especially of its inner or anterior head, which arises from but a very limited portion of the head of the tibia. This head however receives in the Owl an additional slip from the inner side of the internal condyle of the femur. This head almost immediately unites with the middle, and the two together end on a tendon, which unites with that of the outer head, only when they have reached the head of the tarso-metatarsal bone. As Meckel has justly observed the tendons from the different heads unite much sooner in the nocturnal than in the diurnal birds of Prey. The flexors of the toes which are extremely large in the Raptorial birds, project so as to intervene between the outer head on the one side and the anterior and middle united on the other. The arrangement of the muscle as regards its insertion does not differ from that of the common fowl except that the prolongation downwards is proportionally much thinner than in that bird. Its tendon is broad and membranous in the noc-

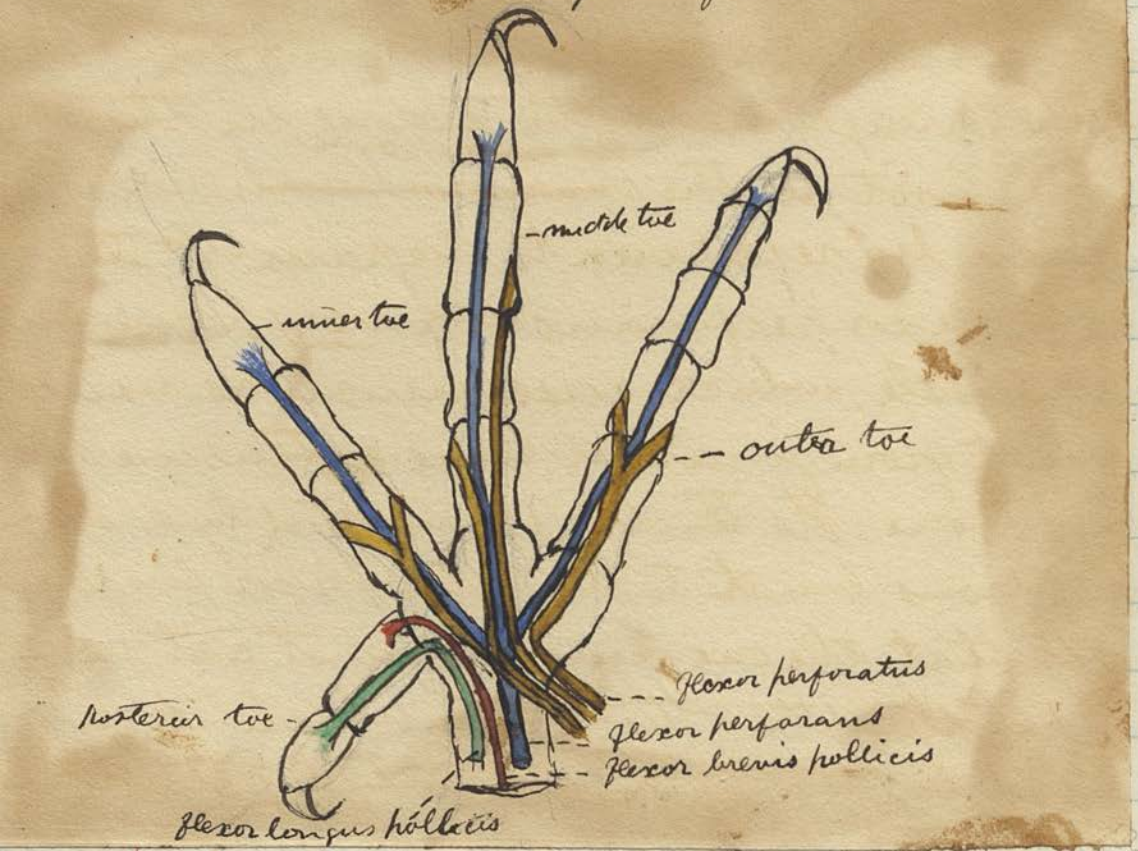
turnal birds of prey.
The Soleus in both the hawks which I have examined, is an exceedingly small, and feeble muscle. It arises in both from about the upper 1/4th. of the outer side of the fibula, its origin being almost concealed by the large tibialis anticus in front and the flexors of the toes behind so that its relations to other muscles are altogether different from what they are in the Rasorial and indeed in the generality of birds. In the long-eared owl the muscle is entirely absent. The insertion of the muscle in the Sparrow hawk is as in the generality of birds, that is, by two tendons which have the usual arrangement. The Plantaris as Meckel has observed is absent in all the Raptorial birds. The Tibialis anticus is proportionally much larger in this order of birds, than in any other order with which I am acquainted. It arises by two heads as in the common fowl, but its inner head takes origin from the whole length of the tibia, and this after being joined by the outer head, forms a very powerful muscle which completely covers the Extensor of the toes

as well as the Peroneus, and is embraced on each side by the flexor muscles of the toes. This arrangement obtains in all the birds of this order which I have examined. The insertion of the muscle is as usual into the front of the tarso-metatarsal bone.

Flexors of toes.

The flexor perforatus in the Raptores differs from that in other birds in as much as it is smaller than the flexor perforans. It arises in the Marrow hawk by only one head of origin from the back of the outer condyle of the femur, but in the Harrier and Owl it arises by 2 heads as in the generality of birds. In the hawks this muscle is joined by the tendons of the Rectus femoris & Brachial and of the Solens, but in the Owl as we have already stated both these muscles are absent. The flexor perforatus in the birds under consideration gives off no slip to the tibio-cartilage of the ankle-joint, neither does it receive any slip of communication from the deep flexor as it does in the Domestic Fowl. It gives off only one tendon to the possible toe

Diagram No IV. Shows right foot of long eared owl and arrangement of tendons in sole of foot.



In the Hawk, and in the Owl although it gives off two tendons to that toe, yet in reality they have the same arrangement as if there were only one; telling that the 2nd tendon to this toe does not perforate the first tendon as it does in the majority of birds. The arrangement of the tendons in the sole of the foot in the ~~Hawk~~ long eared Owl will be seen by referring to diagram No IV.

The flexor perforans is a very powerful muscle, which arises much as usual, but from a rather more extensive surface of bone. Its tendon is connected by a strong fibrous band to that of the flexor longus pollicis so that the one muscle cannot act independently of the other, after which it divides into 5 parts at the lower end of the tarso-metatarsal bone, and is inserted into the terminal phalanges of the 3 anterior toes.

The flexor longus pollicis is also a remarkably powerful muscle in the Raptores. Except as regards size it does not differ from the same muscle in the common fowl.

The large size of the two muscles last

mentioned is beautifully adapted to the habits of the present order of birds. The generality of these kill the living prey on which they feed, by thrusting their claws into the animals vitals; and accordingly we find those muscles which act upon the terminal phalanges which carry the Claws are more strongly developed, than the other muscles of the toes. The band of connection between these two muscles also ensures a simultaneous action of the two muscles, so that the anterior and posterior toes are to a certainty opposed to each other at the same moment and thus the escape of living prey is effectually prevented.

All the posterior interosseous muscles exist in the owl and have the same arrangement as in the Rasorial birds; but in the hawk muscle No 4 of domestic fowl is absent. The anterior interosseous muscles are also all present in the owl but in the hawk muscle ~~No~~ C of common fowl is absent: and in both birds the innermost of these (the proper extensor of the posterior toe) arises by 2 heads

of origin, between which the tendon of the Tibialis anticus is inserted.
The tendon of the Extensor communis digitorum in the owl passes beneath an osseous bridge situated at the upper end of the tarso-metatarsal bone, instead of at the lower end of the tibia as in the Sparrow-hawk and the generality of birds.

The Characteristics of the Raptores may be stated shortly as follows. -

1. Union of two smaller glutei muscles to form one.
2. Absence of Pyriformis internus.
3. Equality in size of Adductor magnus with adductor longus.
4. Absence of accessory slip to obturator externus.
5. Small size of Rectus femoris.
6. Absence of semi-tendinosus.
7. Small size of adductor femoris especially the anterior head
8. very small size or even absence of Soleus.
9. Absence of Plantaris.
10. Very large size of Tibialis anticus.
11. Very large size of Flexor perforans and Flexor longus pollicis, has combined with Flexor perforatus
12. Flexor perforatus gives off only two tendons to middle toe the other does not separate to any degree

Order V. Grallatores.

I have examined 3 birds in this order - the Heron (Ardea cinerea), the Flamingo (Phoenicopterus ruber) and the Curlew (Numenius arquata).

In all these birds the gluteus maximus is remarkable for its large size, especially in the Flamingo, in which bird the insertion of this muscle is particularly strong, corresponding in breadth to the whole length of the great trochanter. The gluteus, medius and minimus form a single muscle in the Flamingo occupying the whole inferior margin of the ilium in front of the acetabulum; but in the other birds of this order, the two muscles are separable at their origins but are inserted by a common tendon, which corresponds in position to that of the gluteus medius in other birds. It is worthy of notice, that in these 3 birds the place of origin of the gluteus medius is carried farther backwards than in the common fowl, so that it arises from the superior, and not from the anterior margin of the ilium as in that bird. The tendon of the Pyriformis does not glide over that of the gluteus maximus in any of these birds, because of the insertion of the last named muscle into the fore part of the great

trochanter. The Iliacus is absent in the Curlew but present in both the others, although it is reduced in these to a very small muscle, whose origin does not exceed 1/4th of the place of origin of the Gluteus minimus, whereas, it will be remembered that in the Raptorial birds, the origin of the Iliacus is co-extensive with that of the Gluteus minimus. The Adductor muscles vary as to their arrangement in the different birds of this order, for in two of them (the Flamingo, and Curlew), the two muscles are united so as to form a single one, which takes origin from that part of the pubis which generally gives rise to the Adductor longus, and is inserted into the lower two thirds of the linea aspera of the femur, as well as into the back of the internal condyle; but in the heron the two muscles are distinct, and easily separable, the adductor longus being inserted into the back of the internal condyle, whilst the adductor magnus is inserted into the lower half of the linea aspera of the femur. In the heron the lower fibres of the adductor longus end on the posterior aspect of the head of the tibia, whilst in the Curlew the lower fibres of the single adductor end on the

middle head of origin of the gastro-cnemius, so that the adductors in these birds will act on the knee as well as on the hip joint.
The Obturator externus in all these birds has the same general arrangement as in the Common Fowl, but proportionally it is considerably weaker than in that bird, more especially in the Flamingo in which it is a particularly weak muscle, and in which it arises higher up on the Pelvis than usual. In none of the birds under consideration was there any accessory slip to this muscle.
The Caudo-coccygeus muscle is absent in the Flamingo, but in the others it has the usual arrangement. Meckel states that in the Heron this muscle arises from the Ischium, but in the individual which I examined this certainly was not the case.

Knee-joint.

The Sartorius in the Heron takes an additional origin from the spine of the last dorsal vertebra, and is a weak muscle; but in the Flamingo & Curlew it is a strong and broad muscle and wants the additional fibres of origin. The insertion of this muscle in the Flamingo is peculiar, as it ends by three distinct slips, one of which unites with the

intermediate aponeurosis of the Rectus femoris, the second unites with the ligamentum patellæ, while the third which corresponds to the ordinary insertion of the muscle, consists of a narrow tendinous band which is inserted into the inner side of the anterior tibial crest. In the birds now under consideration the Rectus femoris presents nothing worthy of notice, except in the Flamingo in which bird it is proportionally a much narrower muscle than in the Common Fowl, arising as it does only from the posterior part of the ridge of the ilium and ischio-pubic bone, so that it leaves a large portion of the glutæus maximus uncovered. In the Heron also this muscle is rather narrower than usual.

The Vastus externus in the Curlew has an additional origin from the middle of the femur, which origin arises as far back as the linea aspera, and forms quite a distinct muscular slip.

The Heron differs from the other birds we are considering in as much as it wants the small muscle known as the Rectus femoris of Meckel entirely, whilst it is present in both the others although in them it is extremely feeble.

The Biceps in all the Grallatores which I have

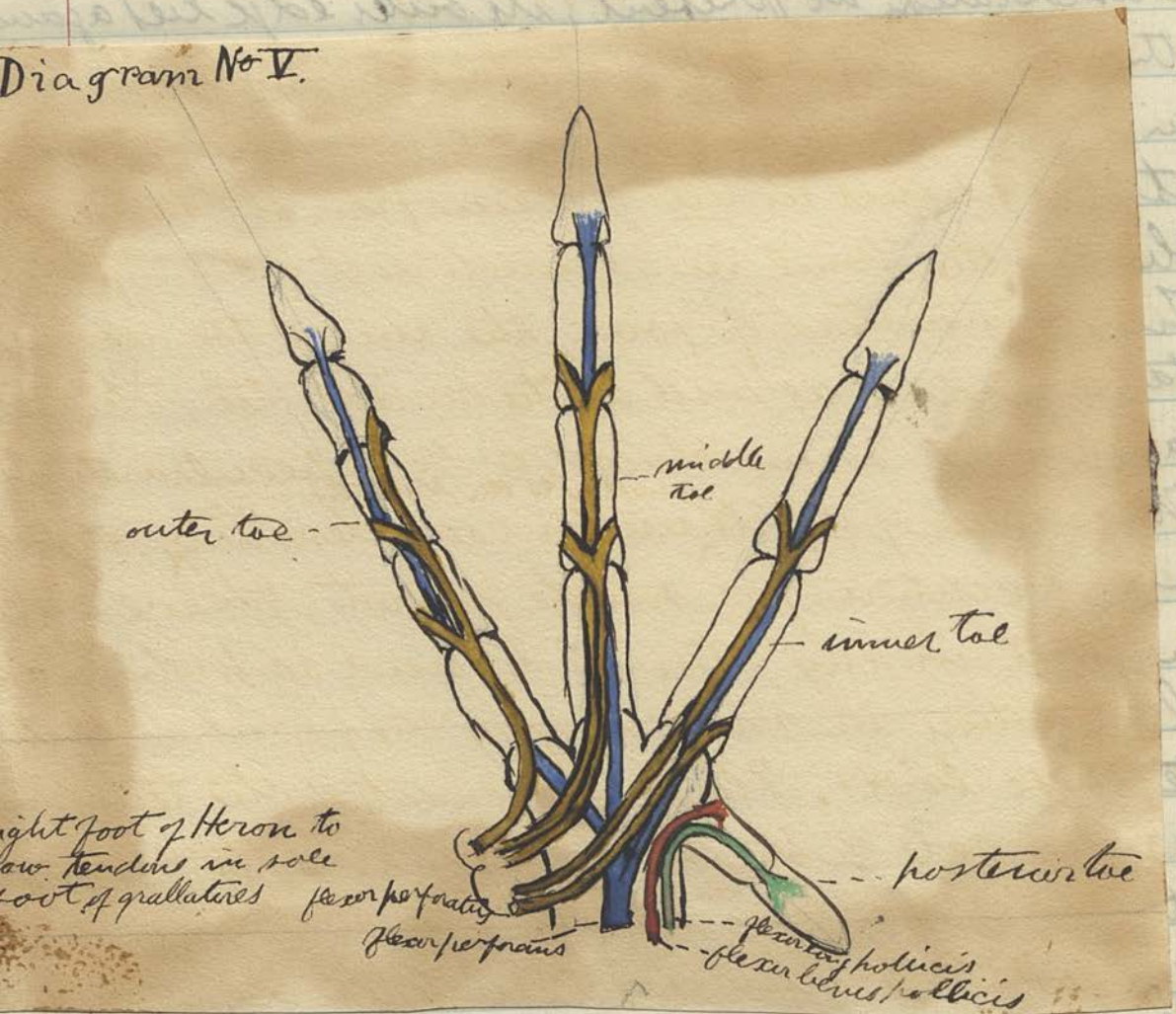
examined is a very large and powerful muscle - especially so in the Flamingo; and in all of them it has an additional origin from the posterior margin of the aponeurosis which gives origin to the Rectus femoris. By reason of the narrowness of this last muscle in these birds the Biceps is not at all covered by it at its origin. The Semi-membranosus in all is a weak muscle and its insertion is placed lower down on the tibia than in the Raptorial birds. The Semi-tendinosus in the Curlew presents a remarkable exception to the general arrangement of this muscle, in as much as it wants entirely its second head of origin, which arises from the back of the lower end of the femur. The muscle as usual however unites through the medium of a tendinous intersection with the middle head of origin of the Gastrocnemius, and a thin additional tendon is given off from its lower end, which, passing forwards is inserted along with that of the Semi-membranosus. This bird therefore offers an exception to the statement of Meckel that both heads of this muscle exist in the Grallatorial birds. In the other birds of this order, this muscle offers nothing remarkable except that it is rather weaker than usual.

Ankle-Joint

The Gastro-cnemius in the Grallatorial birds is remarkable chiefly for the large size of the anterior head of origin as compared with the others, a fact noticed also by Meckel, and for the length of its tendon of insertion. This length of tendon is common however to all the muscles which cover the tibia and gives rise to one of the distinguishing characteristics of the waders. In the Flamingo the outer head arises in a different manner from that of any other bird of which I know viz: from the outer ~~side~~ portion of the ligamentum patellae which in this bird is very broad, and covers the outer side as well as the anterior aspect of the knee joint, instead of from the back of the outer condyle, as in the generality of birds; and the common tendon of insertion in this bird is particularly strong and cord like. In the Curlew and heron the muscle does not present any peculiarity worthy of note except those mentioned above. The Plantaris is absent in the Flamingo although present in both the others in which it presents the usual arrangement. The Soleus in all the birds under examination

is very thin, and its relations are somewhat different from what they are in the Common Fowl, as in that bird the muscle lies between the heads of the gastrocnemius, whereas in the bird under consideration at present, its outer edge lies against the flexors of the toes, which intervene between it and the outer head of the gastrocnemius. Otherwise it is similar to the same muscle in the Fowl.
The Gallatorial birds have the insertion of the Tibialis anticus placed nearer the head of the tarso-metatarsal bone than the generality of birds a fact which did not escape the notice of Meckel.
The Flamingo exhibits in a more marked manner what is common to all birds viz: that the outer head of origin of the Tibialis anticus from the External condyle is round at its origin, but becomes flattened as it passes down. Muscular fibres arise from the anterior aspect of this tendon, leaving the posterior smooth to glide over the condyle during flexion and extension of the knee joint.
The Peroneus is absent in the Flamingo although present in both the others, and in the heron its tendon of insertion is confined by a distinct annular ligament to the outer side of the lower

Diagram No V.



ight foot of Heron to
ow tendons in sole
oot of grallatores

end of the tibia. This muscle Meckel denies to the herons, a statement which our observations do not confirm. He also states that it is absent in the storks.

Flexors of the Toes.

The flexor perforatus of the toes in the Grallatorial birds has the same origin as in common fowl; but it differs in all of them from the same muscle in the Fowl, in as much as it gives off five tendons instead of four, the inner toe receiving two tendons as well as the middle toe. This arrangement seems almost to be a peculiarity to this Order of birds as well as to the Natatory under consideration, as with the exception of a single parrot, I have never seen it in any other bird: and is probably an adaptation in some way to the peculiar habits of these birds. The arrangement of the tendons in the sole of the foot, which is the same in all, will be seen by referring to diagram No V and will be more easily understood than by means of any detailed description.

The flexor perforans in the Curlew besides the usual origin from the back of the tibia and fibula has a slight origin from the back

of the lower end of the femur. In the other birds it has the usual arrangement.
The flexor longus pollicis is absent in the Flamingo on account of the extremely rudimentary condition of the posterior toe; and in the Curlew it may also be said to be absent as a distinct muscle, although a delicate slip of tendon is given off from that of the flexor perforatus which goes to the inner toe, and this tendon occupies the usual position of that of the long flexor of the thumb. In the Heron however it is a distinct muscle and presents the usual arrangement. A fibrous slip connects this tendon with that of the flexor perforans in the Heron. Arising partly from the tendon of the flexor longus pollicis and partly from that of the flexor perforans in the Heron is a very small fleshy slip which seems to represent a lumbrical muscle. It passes to be inserted into a fibro-cartilage covering the back of the metatarso-phalangeal articulation. This is the only bird with which I am acquainted in which there is any trace of a lumbrical muscle and I can find no mention of it in any of the authorities to whom I have referred.

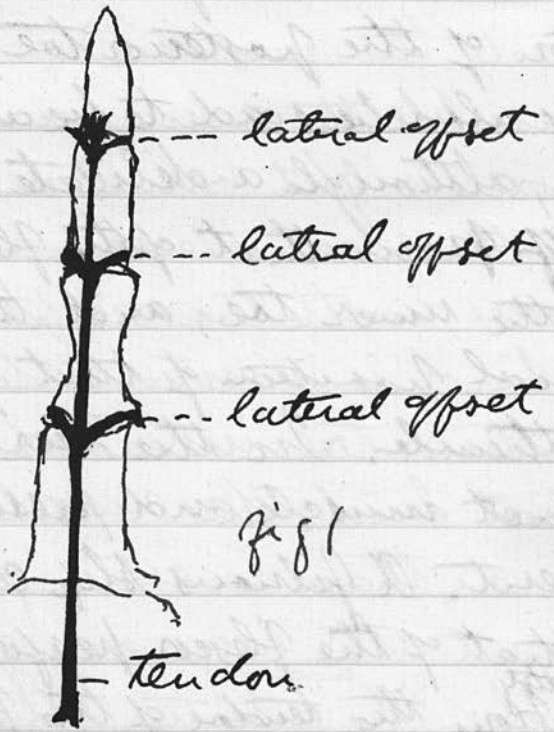


fig 1

plan of extension of toes.

The Posterior interosseous muscles are all present in the birds we are considering, as are also the anterior except in the Curlew, in which there is only a single anterior interosseous which corresponds to the muscle D of the Common fowl. They resemble the same muscles in the fowl with some slight variations not worthy of mention as to their exact places of origin on the tarso-metatarsal bone, with the exception that Muscle No 6 of that bird is inserted into the first phalanx of the posterior toe instead of into a fibro-cartilage as in that bird. This muscle is much larger in the Heron than in either of the others probably on account of the large size of the posterior toe in this bird. The mode of insertion of the extensor communis digitorum is particularly distinct in the flamingo and is as follows. As each of the tendons passes over a phalangeal articulation, it sends off a lateral band to each side of the joint to be inserted into each side of the base of the distal phalanx whilst the central portion passes on to divide into 3 at the next articulation where the different parts have the same arrangement and so on to the last phalanx. (Fig 1.)

The arrangement of the facets on the lower end of the tarso-metatarsal bone in birds is such that at the same time that the Extensor communis extends the toes it also abducts them from the middle line so as to prepare the foot for being planted on the ground without any additional muscular action

The Grallatores may be characterised shortly thus.-

1. Large size of Gluteus maximus.
2. Origin of Gluteus medius from superior and not anterior margin of the ilium
3. Small size or absence of Iliacus internus
4. Want of accessory slip to Obturator externus.
5. Additional origin of Biceps from posterior margin of aponeurosis of origin of Rectus femoris.
6. Large size of anterior head of Gastrocnemius.
7. Absence generally though not always, of Peroneus.
8. Presence of 2 tendons from Flexor perforatus to the inner toe
9. Extreme length of tendons of those muscles which cover the tibia and fibula.

Note

Although the Flamingo is generally classed with the natatorial birds, the muscles of its legs are altogether those of a Grallator

Order VI Natatores

In this Order I have examined 3 birds - the Black-headed gull (Larus ridibundus), - the Black Scoter (Oidemia nigra), and the Black Swan of Australia (Cygnus atratus).

In the web-footed birds as stated by Meckel the gluteus maximus "arrives at its greatest development" In the gull however it is not larger than the same muscle in the common fowl. In the swan the two smaller gluteal muscles are combined so as to form but one muscle, in the Scoter these two muscles are separate at their origins but end on a single tendon, and in the gull they have the same arrangement as in the domestic fowl. In all these birds however the gluteus medius arises rather from the superior than from the anterior margin of the ilium. Meckel affirms that this muscle is wanting in the grebes and several other palmipedes The Pyriformis is strong in the swan, feeble in the Scoter, and moderate in the gull. Its tendon does not however glide over that of the gluteus maximus as in the common fowl. Meckel remarks that in the grebes this muscle is also absent. The Iliacus in two of the birds we are at present con-

sidering viz: the Swan and Gull is wanting, whilst in the Scoter it is reduced to the smallest size consistent with its presence. According to Meckel this muscle is present in the goose as well as in the Guillemot, but absent in the Cormorant. The Obturator internus is rather weak, and is more elongated and narrower in the birds we are considering than in the Raptorial birds. This is due to the elongated form of the Pelvis in these birds. The Arrangement of the Adductors in the truly swimming birds as the Swan and Scoter is peculiar. In these both of the muscles mentioned are of a triangular shape, arising by a very broad linear origin from the lower margin of the Ischio-pubic bone, that of the adductor magnus being above and extending for some distance behind that of the Adductor longus. The Adductor longus narrowing as it passes down is inserted by means of a thin tendon into the back of the inner Condyle of the femur, and into the line leading from it to the linea aspera. In the Swan from this tendon of insertion certain of the fibres of origin of the middle head of the gastrocnemius take rise. The Adductor magnus is larger than the "longus"

in the Swan, but smaller in the Scoter. In both birds it narrows as it nears the femur and is inserted by a narrow tendon into the linea aspera about the middle of the femur, and consequently considerably higher up than in the Raptorial birds, the origin of the Crureo-coccygeus being united with it. The high insertion of this muscle on the femur is probably an arrangement whereby greater speed may be obtained in the act of extending the femur, as in the stroke backwards of the leg in swimming, although at the expense of power, and to this last may be due the large size of both adductors in these birds. In the Gull the adductors do not differ from the same muscles in the fowl. In all the birds we are considering the Obturator externus is comparatively a weak muscle, and in the Swan and Scoter its origin is chiefly from a tough membrane which fills up a large vacuity in the pelvis of these birds. Its relations also are slightly different from what they are in general, as the Adductor longus, and Crureo-coccygeus run parallel with its lower margin and the latter does not cross it as usual. The Crureo-

Coccygeus as mentioned above arises in common with the tendon of insertion of the Adductor magnus.

Knee-joint

The Sartorius in the Scoter arises only from the Spinous process of the last dorsal vertebra, and not at all from the crest of the ilium; and in this bird the intermediate aponeurosis of the Rectus femoris is placed much higher than usual. The Rectus femoris of Meckel is particularly large both in the Swan and Scoter, especially so in the latter in which its origin is 1/2 an inch in breadth. It is proportionally larger than in any bird I have examined. It is a flattened muscle in both these birds and presents the usual arrangement. Meckel states that this muscle is absent in the Cormorant, Crested Grebe, and guillemot, but present in the Wild duck, and Goose. The Biceps is particularly strong in the birds now under examination. It is not concealed by the Rectus femoris and the femoral pulley thro which its tendon passes to be inserted lower on the fibula than usual is longer than ordinary. In the Swan and Scoter the Semi-membranosus is very feeble and arises from the ischio-pubic bone so as to separate the origins of the adductor muscles. It is

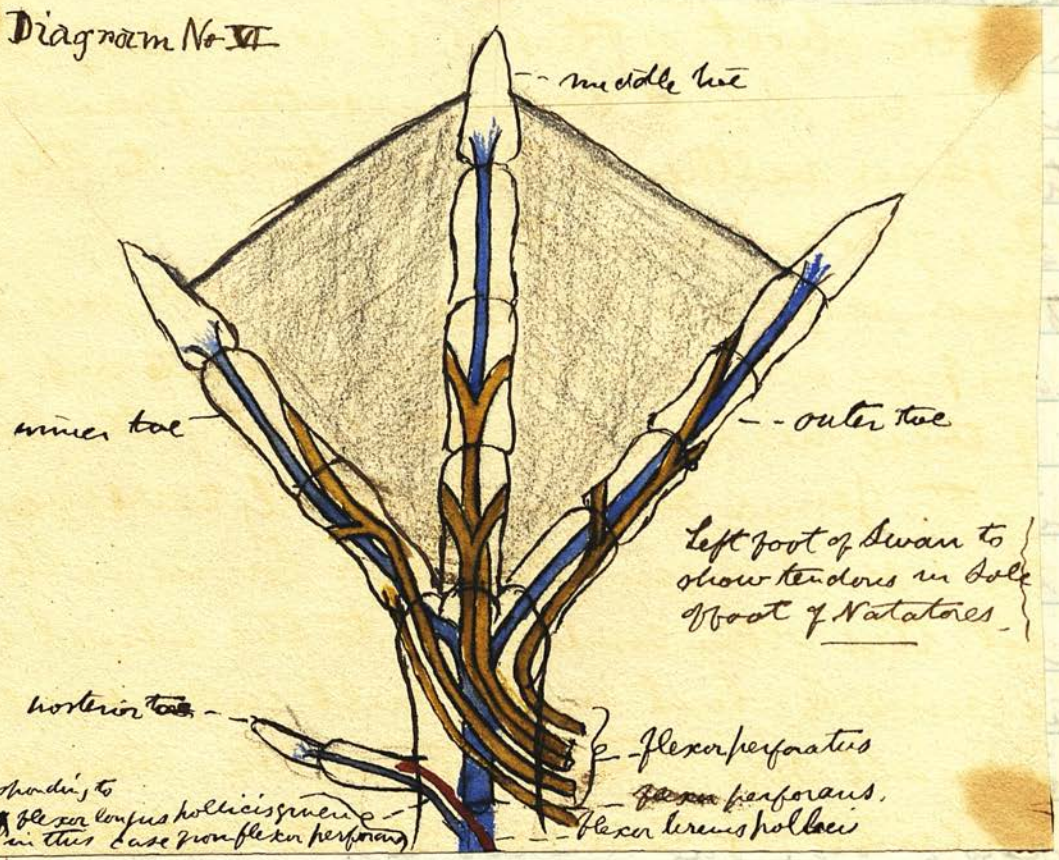
joined close to the tibia, by the semi-tendinosus and both together are inserted into the inner side of the head of that bone. In the Gull however this semi-membranosus does not differ from the same muscle in the Common fowl. The semi-tendinosus is a particularly strong muscle in the true swimming birds such as the Swan and Scoter, and arises directly behind the biceps from the ischio-pubic bone as well as from the 2 or 3 first coccygeal vertebrae. It inserts the short head from the back of the femur altogether, and its tendon unites with that of the semi-membranosus as mentioned above, and is inserted along with it. ~~His peculiarity with~~ In the Gull this muscle excludes the usual arrangement with this exception, that its tendinous intersection blends with the anterior instead of with the middle head of origin of the gastrocnemius.

Ankle-joint.

The origin of the middle head of the gastrocnemius in the Swan and Scoter is slightly different from what it is in the common fowl, as it arises by two pieces, upper and lower; the upper corresponds to the usual origin from the back of

the internal condyle of the femur, whilst the lower which constitutes an additional origin arises from the inner side of the head of the tibia close to the insertion of the internal lateral ligament of the knee-joint. The muscle otherwise has the usual arrangement. The Plantaris exists in all the birds of this order which I have examined. The Relations of the Soleus are different in all these birds from what they are in the domestic fowl, as its outer side rests against the flexors of the toes, which in these birds intervene between it and the outer head of the Gastrocnemius. The two heads of origin of the Tibialis anticus are more distinct than usual in these birds, and it does not arise from fascia at all as in the Common fowl. Meckel states that in the Grebe this muscle has 3 heads of origin - an additional one arising from the Patella. Flexors of toes. The Flexor perforatus is a very large fleshy muscle in all the birds under examination, its origin from the fibula being more extensive than usual. In these birds as in the Grallatores two tendons are given off from the muscle to the inner toe as well as to the middle, the arrangement of which will be seen

Diagram No XI



Left foot of Swan to show tendons in Sole Foot of Natatores

corresponding to tendon B in this case from flexor perforans

flexor longus pollicis pedis

by referring to diagram VI. It is remarkable that in these two orders of birds alone viz: the waders, and Swimmers should be possessed of two tendons to the inner toe, whilst the other orders should only have one tendon to this toe. What the object of this is, it is not easy to say. There is no slip of communication from the deep flexor neither is there any tendon to the fibro cartilage of the ankle-joint.

The flexor perforans has two heads of origins, the tendons from which ultimately unite into one. One of these heads is from the back of the lower end of the femur, and undoubtedly corresponds to the usual origin of the flexor longus pollicis, whilst the other corresponds to the usual origin of the muscle, but in the gull in consequence of the small size of the posterior toe, there is no tendon given off to it and yet this additional head of origin of the flexor perforans exists in that bird. In both these others, however the common tendon divides into 4 which pass to be inserted into the terminal phalanges of the toes, the posterior toe included.

The interossei muscles, anterior and posterior are

all present and tolerably well marked in the Swan and have the same arrangement as in the Common Fowl with the exception that the muscle No 6 of that kind is inserted into the first phalanx of the posterior toe and not into fibro-cartilage as in that kind. In the Black Scoter, the posterior interosseous muscle No 6 of Fowl is absent, but all the anterior are present and present the usual arrangement. In the Gull all the posterior interossei are absent, whilst the anterior corresponding to those marked B & D of the Common Fowl presented the usual arrangement. The others were wanting. The Common extensor of the toes presented nothing worthy of note in any of these birds.

Characteristics of true Natators as Swan, Scoter, &c &c are as follows

1. Very large size of Gluteus maximus.
2. Elongated and narrow form of Obturator internus
3. Large size and peculiar arrangement of Adductors.
4. Origin of Crureo-coccygeus from pelvis in common with insertion of Ext. Adductor
5. Extreme length of fibrous pulley thro which tendon of Biceps plays
6. Large size of Semi-tendinosus, and want of its short head
7. Additional origin of middle head of gastrocnemius from bd. of tibia
8. Existence of 2 tendons to inner toe from flexor perforatus
9. Union of flexor pollicis longus with flexor perforans.

Order VII. Cursores.

In this order I have only had the opportunity of examining one bird viz the two toed Ostrich. (Struthio Camelus). The Muscular Anatomy of this bird has been so fully described by Macalister of Dublin that it is unnecessary that I should enter fully into it which I would certainly have done as I have a full description of the muscles of that bird as displayed in the individual I examined had this not been done before. As it is, I shall merely point out any difference that may occur between the description of that gentleman and my own, and compare the anatomy of that bird with that of the common fowl merely to carry out the plan I have all along pursued in this paper.

The Glutæus maximus is a small muscle as compared with that of the common fowl, indeed as Huxley observes this muscle is at its minimum in the Ostrich. The two smaller glutei muscles are also feeble as compared with the common fowl but occupy the same relative positions as in that bird. The Glutæus minimus however arises higher than in the bird just named as instead of arising from the inferior margin of the ilium it arises from

about the middle of that bone and is inserted by a tendon common to this muscle and the Gluteus medius. It constitutes the Ilio-capsular of Macalister. The Pyriformis which is not described as a separate muscle by Macalister who seems to consider it as part of the gluteus maximus is so very closely connected to the posterior margin of that muscle that the two cannot be separated. There is however a distinct tendon belonging to the deeper plane of the posterior fibres of the great gluteal muscle which passing downwards glides over the ~~of the~~ proper tendon of that muscle and is inserted below it. Its relations therefore being the same as in the Fowl justify us in regarding it as in reality a distinct muscle. The Iliacus is proportionally a much stronger muscle than in the Domestic Fowl. It arises rather higher up than in that bird. The Obturator internus muscle is also stronger than usual. The arrangement of the muscle and its accompanying fleshy slip does not differ from that of the fowl.

A peculiar muscle however exists in the ostrich which I have found in no other bird. It arises from the outer surface of a tough membrane

which fills up a large vacuity between the ramus of the ischium and the posterior portion of the femur. It passes downwards and forwards, crossing the tendon of the Obturator internus obliquely and is inserted into the femur a short distance below that tendon. Meckel describes what I take to be the same muscle as being inserted into the lower end of the femur but this certainly was not the case in the Specimen I examined. The Adductor longus ~~vagus~~ differs from the same muscle in the fowl in as much as it is a much narrower and thinner muscle, and is inserted merely into the back of the internal condyle and into the intercondyloid space of the femur. The Adductor magnus is absent in the Ostrich as in other birds that muscle described above corresponds to it, and this does not seem improbable as the relations of the origins of these two muscles exactly correspond to those in other birds. Its insertion however is at the upper end of the shaft of the femur instead of at the lower end as it is in all other birds.

The Muscle corresponding to the Obturator externus of other birds also exists in the Ostrich but as an extremely feeble muscle. It arises partly from the Ramus of the ischium and partly from the upper

portion of the tough fibrous membrane before mentioned. Its insertion is however altogether different from what it is in any other bird as it passes to be inserted into the back part of the small trochanter instead of into the outside of the great trochanter. Its action in this bird will therefore be entirely different from what it generally is as it will rotate the femur inwards instead of outwards and will thus aid instead of opposing the action of the two smaller gluteus muscles. Its origin as will be seen from the description is also much higher on the pelvis than in other birds. There is no accessory slip to this muscle as in the fowl. Meckel says that this muscle is absent or else fused with the obturator internus in the Ostrich but in this he is certainly wrong.

Knee-joint.

The Rectus femoris in this bird is at its maximum. It forms a very thick fleshy mass which has its usual origin but in addition takes origin from the first two or three movable coccygeal vertebrae. Its tendon of insertion instead of being chiefly fixed to the tibia as in the common fowl, has only a small portion disposed in this manner whilst

by far the larger portion of it passes downwards over the knee-joint and unites itself with the anterior and lateral heads of the gastrocnemius As Meckel puts it this muscle is as broad as it is long in the Ostrich

The Sartorius in addition to its usual origin takes its rise from the spines of the last two dorsal vertebra It is a thin, thick muscle and its insertion differs somewhat from that of the domestic fowl in as much as its tendon divides into two portions one of which is united with that part of the tendon of the Rectus cruris is inserted directly into the tibia whilst the other unites with the tendon of the gracilis. A considerable space intervenes between this muscle and the Rectus femoris so as to leave a large part of the fleshy masses exposed.

The Rectus externus takes some fibres of origin from the tendon of the Psoas minor in which respect it differs from the ordinary birds

The Gracilis in the Ostrich presents the peculiarity of having two heads of origin, the one arising from the ilium immediately below the acetabulum, the other occupies the usual place on the femur. Its insertion

of the muscle does not differ from that of other birds. So far as I am aware the Ostrich is the only bird in which this muscle presents the peculiar arrangement described. In no other bird does it arise from the Pelvis.

The Rectus femoris of Meckel has a particularly short pyriform muscular belly which ends in a strong tendon which has the usual relations and mode of termination. The mere fact of this muscle being so well developed in the Ostrich ought to have convinced those Anatomists who consider that this muscle is chiefly a perching apparatus of the absurdity of that theory. This will be referred to again.

The Biceps is a particularly strong muscle in this bird. It presents the usual arrangement with this exception that the fibrous pulley through which its tendon passes is not attached in the usual way to the femur but is formed altogether by a splitting of the tendinous outer head of origin of the gastrocnemius. Macalister states that in the female which he dissected a slip connected this muscle to the

back of the femur, although it was absent in the female. It was absent in the one I examined. The semi-membranosus is a weak muscle in this bird. It arises mostly from the fibrous membrane previously referred to, as well as from the posterior iliac spine. Its insertion is as usual. The semi-tendinosus arises also from the iliac spine as well as from the ischium. It presents the same arrangement as in the common fowl with the exception, that its tendon of insertion does not unite with the middle head of the gastro-cnemius but is inserted along another that of the semi-membranosus into the inner side of the head of the tibia. Meckel mentions the crure-coccygeus as occurring in the ostrich but I could find no trace of this muscle in the bird I examined but this might be due to the imperfect state of the muscles of the tail.

Ankle-joint

The gastrocnemius arises by 4 heads in the ostrich instead of by 3. as usually. The additional head arises from the outer side of the patella, and from the outer side and

anterior surface of the ligamentum patellae. The other heads have the usual places of origin. The mode of insertion of this muscle is similar to same muscle in the common fowl. This muscle is proportionally infinitely more powerful than in any other bird.

The soleus is a strong muscle. Its origin is as in the Common fowl with the addition of a muscular bundle which it receives from the tuberosity of the fibula into which the tendon of the biceps is inserted as well as from 2 inches below this of the fibula. Its relations are similar to the same muscle in the common fowl, but as there is no distinct fibro-cartilage of the ankle-joint in this bird the broad part of the tendon of this muscle passes to be inserted directly into the head of the tarso-metatarsal bone and forms the anterior layer of the sheath for the transmission of the flexor tendons the posterior layer being formed by the tendon of the gastrocnemius. The narrow portion of its tendon passes round the outer ankle and joins the superficial flexor tendon to the inner toe.

The Peroneus is absent in the Ostrich.
Meckel describes the Plantaris in the Ostrich but there was no such muscle in the bird we are describing. Indeed one cannot see what use there could be for this muscle in the Ostrich as there is no fibro-cartilage of the ankle joint for it to act upon.
The Tibialis anticus differs only with regard to its tendon of insertion from that of the fowl for in the Ostrich it splits into two at its insertion the two pieces being separated by an interosseous muscle which does not take place in the Fowl.
Flexors of toe.
The flexor perforatus in the ostrich has an additional origin by tendon from the front of the lower end of the ~~[illegible]~~ femur, this tendon receiving a slip from the deep aspect of the ligamentum patellæ. It also has a narrow fleshy slip from the outer side of the anterior tibial spine, ~~this slip does not correspond to that~~. There 2 origins are found in no other bird with which I am acquainted. The other origins of this muscle correspond very much in general arrangement to those of the common fowl

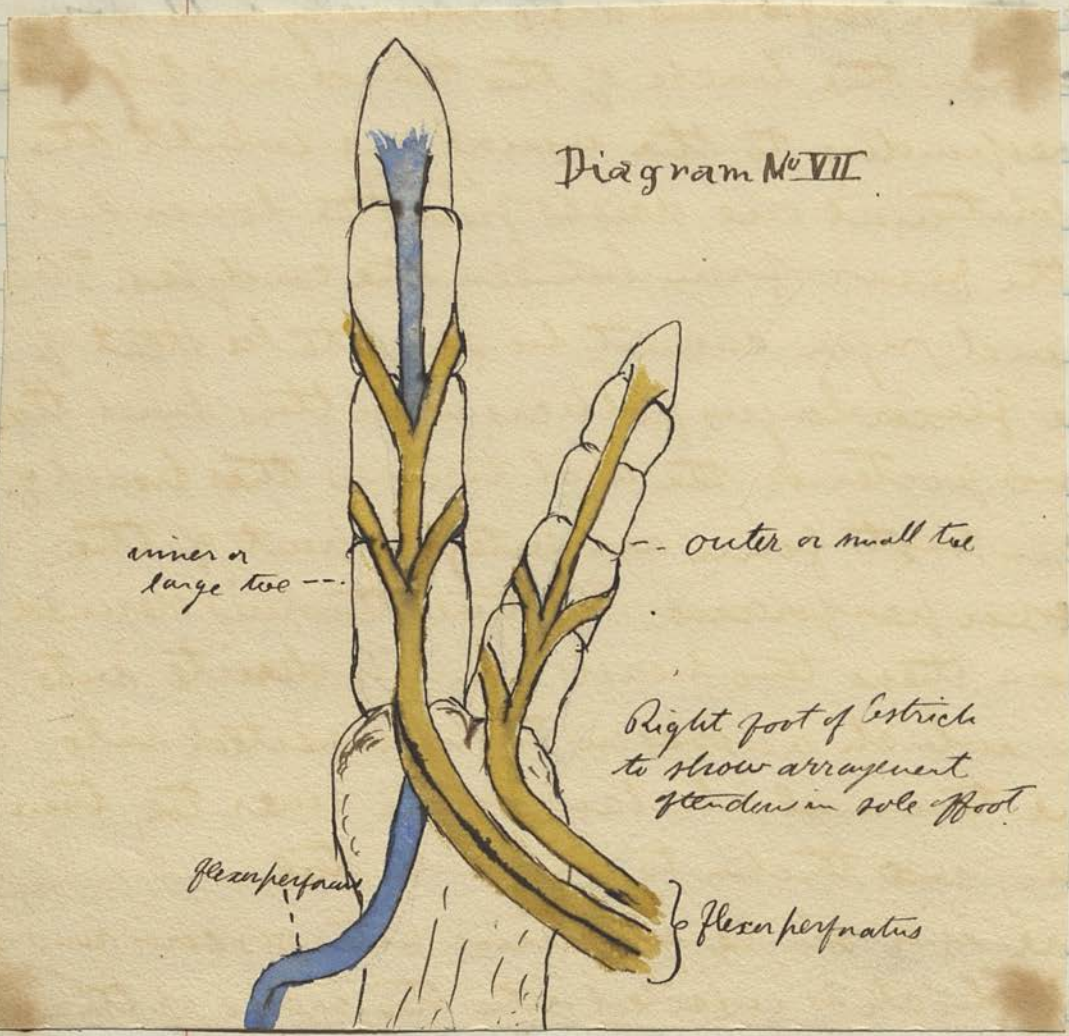


Diagram No VII
inner or large toe
outer or small toe
Right foot of Ostrich to show arrangement of tendons in sole of foot
flexor perforans
flexor perforatus

The muscle ends in 3 tendons - one to the outer toe and 2 to the inner toe. The arrangement of the tendons on the toes will be seen in diagram VII.
The flexor perforans also arises by two heads one from the back of the tibia and fibula corresponding to the usual one whilst the additional one arises from each of the lower end of the femur from between the condyles. This second origin cannot be said to be that of the flexor longus pollicis as in this kind there is no posterior toe and therefore this head of origin must form an integral part of the flexor perforans. The two tendons derived from these two heads finally coalesce into one which passes on to be inserted into the terminal phalanx of the inner toe, there being no tendon to the outer toe.
There is a single posterior interosseous muscle which is inserted into the base of the first phalanx of the outer toe. It is very thin and delicate
The tendon of the Extensor digitorum does not pass beneath an osseous bridge

at the lower end of the tibia as in the common fowl, its place being taken by an additional fibrous band which confines this tendon. The tendon finally divides into two parts - one for each toe. which are inserted into the terminal phalanges of these toes. There is only one very delicate anterior interosseous muscle which arises from the anterior portion of the capsular ligament of the ankle joint. It passes down and ends by joining the tendinous expansion of the long extensor tendon over the first phalanx of the inner toe.
I regret that the muscular anatomy of the leg of the ostrich ~~being~~ is so complicated a description that it is quite impossible though deeply interesting, to do justice to it in the present paper which has already exceeded proper bounds. I think I have however enumerated the chief differences between it and that of other birds. I now rely on what I believe to be the essential characteristics of the Ostrich as compared with other birds in this respect.
1. Insertion of obturator externus into the small trochanter

2. Very high insertion and very small size of Adductor magnus.
3. Existence of 2 heads of origin of Gracilis one arising from the Pelvis.
4. Existence of 4 heads of origin of Gastrocnemius.
5. Additional Origin of Soleus from Fibula
6. Additional origin of Flexor perforatus from the front of the lower end of femur
7. Absence of any osseous bridge through which the tendon of the Extensor communis digitorum might pass - its place being taken by an additional fibrous ligament.

Being unable to procure any account of the muscular anatomy of the Emeu or Cassowary I am unable to say how far these characteristics may hold good of the properly limited Order of Cursores.

On the Perching of Birds.

The peculiar mode of action of the muscles of the leg of the bird as far as relates to the conditions in which they are in during perching, has been the subject of remark over and over again of anatomists and Physiologists. It is well known that during the most stormy weather, birds maintain their position on the branches of trees even when asleep. The Rationale of this had been a puzzle until about the end of the eighteenth century when Borelli in his work "de motu animalium" stated it as his opinion that the real solution of the difficulty was to be found in the peculiar arrangement of that muscle which Meckel describes under the name of the Rectus femoris. This notion seems to have prevailed since then, for in Rees' Cyclopaedia (Article bird) the writer of that article agrees with Borelli as to the function of this muscle, and in the Article "Ones" by Prof R. Owen in the Cyclopaedia of Anatomy, the following passage occurs. - "The disposition of the former muscle (viz: the Rectus) is such, passing first over the convexity of the knee-joint, and afterwards over the projection of the heel, that from its connection with a flexor of the toes, these must necessarily be bent

simultaneously with every inflection of the joints of the knee and ankle. As these inflections naturally take place when the lower extremities yield to the superincumbent weight of the body, birds are thus enabled to grasp the twigs on which they rest whilst sleeping, without making any muscular exertion". Meckel in his "anatomie Comparée" also seems to have the same idea in his mind's eye, for after describing the muscle he goes on to say that he has been unable to find it in the Crested Grebe, the Guillemot, and the Cormorant, and he adds, "This remark is so much the more curious, that its action on the flexion of the toes is not necessary in these birds."

It has always seemed to me since I began to look into this matter, that too much stress had been laid on this muscle with regard to its peculiar action in the way of maintaining the bird securely on its perch without loss of muscular action. For, had this been its principal action as the Authors quoted seem to have imagined, why should there not have been merely a tendinous band (similar to what exists in the anterior limb of the horse) occupying the position of the Rectus muscle

Why was knee killed it
& seen if union had taken place?

The author since giving in his thesis performed an additional experiment on the domestic fowl, & after an interval of three or four weeks killed the bird. The divided ends of the tendon were found to be far removed from each other. W.H.

and uniting with the flexors of the toes as it does which would have served the purpose equally well with the muscle in question? And we do not find Nature applying a superfluous and complex contrivance to suit a given purpose when a much simpler method will do equally well! Determined however to put the matter beyond doubt I procured a large domestic fowl and cutting down along the inner side of the thigh, I secured the tendon of the Rectus and snipped it through with a pair of scissors. Two days afterwards I operated in like manner on the muscle of the opposite leg. After each operation there was noticed merely slight inversion of the foot, but the bird walked ran, and perched as well as ever.

Shortly after this it was suggested that the experiment was not satisfactory as the cut ends of the tendon might have again united, and thus in reality have left the bird in the same condition as it was previous to the operation. Accordingly I procured a second fowl and operated first upon the right leg, but in this operation I carefully drew the tendon of the Rectus upwards, and cut out a portion of it about

half an inch in length, and when the muscle contracted the cut ends would probably be 3/4 of an inch from each other. As before, a slight inversion of the foot was noticed but nothing more. Two days after the operation I cut out 1/2 an inch of the tendon of the left rectus muscle. Immediately after the operation the bird walked about as well as ever. In the apartment where I kept the birds, I now put up a much thinner stick than is usually allowed to such birds for the purpose of a Roost, so as to do away with all fallacies with regard to its powers of perching. The evening after the second operation, the bird was perching along with others, exactly as if it had sustained no injury and has continued to do regularly at night ever since. No deficiency is now to be observed in any of its motions, either whilst walking or running; the slight inversion of the toes having entirely disappeared. These experiments taken in connection with the distribution of the Rectus femoris in different birds seems to me perfectly to prove the falsity of the notion under review. For as mentioned in a previous part of this paper the muscle is entirely wanting in

four of our habitually perching birds viz: the Blackbird, Magpie, Thrush, and Starling; whilst it is present in many of those birds which never under any circumstances are known to perch such as the Swan, the Scoter, and the Gull &c

The only other theory as to the action of this muscle with which I am acquainted is that propounded by the Revd Sam. Haughton of Dublin in the Proceed. Royal Irish Academy. for 1865, Vol IX part I. He considers it only with reference to the Ostrich and seems to think it an arrangement whereby dislocation of the leg is prevented in this bird during the sudden and violent extension of the joints when the bird is in rapid motion. This theory however ingenious (and it certainly has the merit of ingenuity) does not seem to me to be tenable for the reason that the Rectus is quite as well if not better developed in proportion to the size of the bird in the true diving sea ducks such as the Scoter and in the true swimmers such as the Swan, as it is in the Ostrich, and in these birds no such violent extension of the leg takes place in the act of swimming as would necessitate an arrangement such as the present to prevent

dislocation even supposing that this were the function of the muscle. In the Ostrich moreover the arrangement and strength of the ligaments of the different joints is abundantly sufficient to prevent any such dislocation as Dr Haughton seems to fear would ~~happen~~ take place, were it not for the Rectus muscle. His analogy between the leg of an ostrich and a Cornish pumping engine seems to have to be as far fetched as can well be imagined and if he had taken the trouble to look into the arrangement of the muscle in different birds I should doubt if he would ever have published this theory. What the function of the Rectus muscle really is, I am unable to say but if I have disproved an erroneous theory previously prevalent with regard to this, we have made one step in the right direction.

The explanation of perching I believe to be as follows. The flexor muscles of the Hip joint first contract, By this means the distal end of the femur is removed further away from the posterior portion of the pelvis from which the Hamstring muscles take their rise. This again causes flexion of the knee joint, as these muscles, being unyielding, will

approximate the tibia and fibula to the pelvis and thus again bring into action the outer head of origin of the Tibialis anticus by rotating upwards the anterior aspect of the condyles of the femur. This rotation upwards of the anterior aspect of the outer condyle of the femur will act through the outer head of origin of the Tibialis anticus upon the tarso-metatarsal bone and thus flex the ankle-joint. The flexors of the toes being thus drawn tense will strongly flex the toes, and the tendons to the anterior toes being connected by the transverse slip formerly described with that to the posterior toe, will cause the toes to be flexed simultaneously and thus grasp any branch upon which the bird may have taken its station. This contraction of the toes will continue so long as the joints are flexed without any exertion of muscular power; and for this reason again it seems to me that the Rectus Femoris would be altogether a superfluous and indeed inefficient arrangement for this purpose.
Thinking that perhaps that tendon of the Soleus which unites with the flexor tendons of the toes, might in some way be essential to

the Perchers, I cut out 1/2 an inch of it in each leg as it passes round the outer ankle, in a living fowl, but this as in the former case did not interfere with the perching powers of the animal in any way.
In a Bantam cock I divided the fibrous pulley which retains the tendon of the biceps in position but beyond occasioning lameness it had no effect on the habits of the bird as it also perched equally well after as before the operation.
I believe that the explanation given above is quite sufficient to account for all the facts of the case.