On the Muscular Anatomy of the Posterior limb in Aves.

by M. Watson.

1867
Gentlemen.

The subject of the present Thesis was recommended to my notice by the late lamented Prof. Godwin. That something remained to be done in this branch of Comparative Anatomy I think sufficiently proved by his recommendation of the subject as one 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-
finds a good standard with which 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 kinds of a single order or only one—the Ostrich in the Cerei. In all such cases however I have endeavored to supplement my own observations with those of Brockel and other authors. In the description of the different limbs, I have only mentioned those muscles in which there was any difference from the like muscles in the Pigeon, omitting all mention 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 morphological groups as given by different authors, the names which oc-
occurs. First, being those which I consider as being not 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 Mr. Goodwin for the use of 26thich legs, to Mr. Stirling for the use of those of a flaxen and fastly to Dr. Crichton for valuable assistance rendered in various ways whilst engaged in writing this Thesis.

M. De
Anteus magnus (Andersen)
Descriptive Anatomy of the
Muscles of the Domestic Fowl.

**Hip-Joint**

Gluteus maximus (The gluteus medius of Péron d'Argy,
Meckel, & Cuvier - the gluteus maximus of Carnes)

This muscle arises from the anterior margin of
the ilium, from the anterior two thirds of a curn-
ed line extending backwards and arching over
the acetabulum, as well as from the surface of bone
immediately below this line. It passes back-
wards and downwards and is inserted by a
strong tendon into the posterior part of the great
trochanter of the femur. A synovial lura in-
tervenes between the anterior part of the trochan-
ter 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 *Piaque antérieure* of Péron d'Argy)

This muscle arises from the lower part of the
anterior margin of the ilium. It passes back-
wards parallel to the lower margin of the
gluteus maximus and is inserted into the ex-
ternal
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 joint will aid in flexing this joint by drawing the femur forwards and upwards.

*Gluteus minimus* (the *gluteus minimus* of *Bieg d'Arès*, *Gemelli superior* of *Fiechel* 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 inserted in a thin tendon is inserted directly above that of the *gluteus medius*.

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

*Piriformis* (the *Pyramidal* of Bieg d'Arès, *Cumier* & *Federmann* the *gemelli superior* of *Fiechel*).

This muscle arises from the posterior third of the arc of the ilium, the anterior 2/3rd of which gives rise to the *gluteus 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 *gluteus maximus* is inserted.
into the posterior edge of the lower part of the great trochanters.

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 flexing the hip joint during ordinary progression.

**Pliacus internus** (the fléchisseur profond de la cuisse of Biefg. d'Agry - the Pliacus of Meckel & Co - the Psoas & Pectineus united of Fiedemann).

This muscle arises beneath the gluticus 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.

**Gluturator internus** (the iliacus internus of Biefg. d'Agry - Fiedemann - the Pectineus of Meckel - the Gluturator internus of Cuvier).

This muscle arises inside the pelvis from the greater or part of the ischio-jubic bone. It runs from
behind forwards and the muscular fibres end in a tendon which passing through the anterolateral part of the obtained foramen is inserted into the upper and back part of the outside of the great trochanter above that of the obturator externus.

Flesion and not adduction as Michel states is evidently the 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 Bing, d'after Michel does not name it although he describes it. — The Gemellus of Cuvier

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

This muscle will co-operate with the former Adductor longus (le deuxième adducteur of Legally, the second adducteur of Michel & 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 (le premier adducteur of Ricq, d'Azyr
l'abducteur inférieur of Meckel - adducteur of Cuvier.
This muscle arises in close conjunction with and
above the last muscle (obst. 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 togethe
by pulling the femur downward and inward.
Obturato externus (the Quadratus femoris of
Ricq, d'Azyr & Cuvier -- the obturator externus
and quadratus femoris united of Meckel -- the ob-
turato externus of Kiedemann).
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 Piriformis. The muscle passes
almost directly forwards.
There 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 ischial-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 slightly posterior to that of the obturator externus. This slip I have found only in the 2 patrinal 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 outward. Pirou-coecygus (the Cruzo-coecygus of Piret d’Arsis, the Pyramidal of Michel).

This muscle arises from the femur immediately below and close to the insertion of the last muscular slip by a very delicate tendon about ½ 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 still reaches the lower surface of the coccygeal region.
also Siedemann
also for facade
construction
Siedemann
Latinisms from Siedemann
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 by 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 D'Azuyr, Meckel & Cuvier)

This muscle arises from the anterior and upper margin of the crest of the ilium. It passes downwards and forwards over the glutaeus maximus, and after giving off a few fibres to the Legamemona Patellas is inserted by a strong tendon into the anterior margin of the crest of the tibia.

**Rectus femoris** (the glutaeus maximus and tensor vaqueina femoris combined of D'Azuyr, 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 ischial-pubic bone. The fibres pass downwards and forwards, the anterior more vertically than the posterior which passes 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 vasti and grüen and are inserted into the 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 vajens femoris.

The vastus is an extensor of the knee joint and a flexor of the hip joint. The Vastus 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. 

The vastus externus (vastus externus of Liez, d'Urgy) is part of the extenseur de la jambe of Thérel. This muscle arises from the outer surface of the femur from the trochanters major to within one and a half of the condyles. It joins the following muscle
Rector, Henricus of Friedemann
Quaestus internus (Quaestus internus of Lieq d'Ayyr - part of the extenseur de la jambe of Fuechel)

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 Quadriceps. This muscle is separated at its upper part from the Quaestus externus by the tendons of the glutaeus 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 Quaestus 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 (rectus) of Lieq d'Ayyr, Fuechel & Lichtenmann)

This muscle arises from the inner surface of the lower three fourths of the femur, its origin being situated between that of the Quaestus 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.
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 Buteo and Cruscul will extend it almost directly, the posterior portion of the rectus femoris will extend and adduct the leg, whilst the vastus and gracilis will act as extensors and adductors. A muscle which I consider as having no homologue in Man (the Rectus femoris of Michel, — le muscle fémoral de Miró de l'App)

This muscle arises from a part of the bone immediately in part of the acetabulum. It passes downwards along the inner surface of the vastus intermus and in part of the origin of the quadratus. The belly which is of an elongated pyramidal 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 toe.

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 the paper.

Biceps (les biceps d'Argyi d'Cuvier - le Lecteur péronéal of Mäckel)

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 rising 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
It may possibly assist the limb in
reaching without loss of muscular effort, as the
force 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** (Semi-membraneux of Ricq
 et Argy, and Currier - Quatrième Pliisseur Tribulianus)

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 crossing 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 cer-
tain of the fibers of that muscle take origin.

This muscle evidently a flexor of the knee-joint.

**Semi-tendinosus** (the demi-nerveux (semitendinos)
 of Ricq d'Argy & Currier - the Pliisseur tribulianus)

This muscle situated between the liceps and
semi-membranosus arises from the posterior
edge of the ischium where it is closely connect-
ed with the posterior margin of the Rectus femor
It passes forwards and downwards over the posterior portion of the ilio-coccygeus and is joined close to its lower end by a strong broad fleshy slip which arises from the lower 1/2 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 interosseous which, passing downwards, unite opposite the junction of the upper and middle thirds of the shaft 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 Ricq d'Alzay - the gastrocnemius of Meckel & Curries)*

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 patellae, by a few fibres from the patella itself, and from the anterior tibial crest internal to the shin 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 rises 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 the joint 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 downward gliding over the joint cartilage of the back of the ankle-joint and is inserted directly into the upper end of the tarsometatarsal.
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 tarsometatarsal bone at this forms a complete channel for the transmission of the flexor tendons of the toes. This muscle is evidently an extensor of the ankle-joint.

Plautari (the Plautari of Niez d'Algy or Maciel and Currier.

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. "Fibularis anticus" (the "Fibularis anticus" of Piez, d'Alger and Meckel).

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 muscles of the toes and which is attached along the inner edge of the tibia. From these sources the fibres pass downward 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 crosses 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
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.

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 muscle is connected through the muscle 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 perforates which goes
to the middle toe.

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

Perovent (Perovent brevis of Cuvier - the Perovent
of Vieq, d'Algr & Meechel.)

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
g of the tibio-calcaneus and is inserted into the outer side of
the base of the tarsometatarsal 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 & Vieq, d'Algr)

This is a small muscle which arises by tendon from
the head of the fibula and passing downwards and
medially is inserted into the back of the head of the tibia.

This muscle will draw the bones of the leg together.
Flexor of the toes

Flexor perforatus (flexor perforatus of Gregory)

Michel & Courrier

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 (Michel) 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 2 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 base of the tarso-metatarsal line 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 ten-
don of the deep flexor but passes under it op-
posite the 3rd phalanx to bifurcate and is in-
serted into the outer and inner sides of the base
of the 4th phalanx. At the spot where the ten-
don passes over the metatarsophalangeal joint
it enlarges into a triangular shaped fibro-car-
tilage. The outer surface of this is grooved for the
passage of the deep flexor tendon of this toe while
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. 1

Right foot

Sole of foot of Common Fowl

flexor perforatus digiti

flexor perforans digiti

flexor longus hallucis

outer toe

inner toe

middle toe

posterior toe
lax 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 metatarsophalangeal joint it is connected by a fibrous slip to the tendon of the deep flexor going to the same toe. It then diverges 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 flexors. There is a tendinous band which occupies relatively to this toe the same relations as the tendons of the flexor perforates 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 fibrocartilage covering the head of the metatarsophalangeal joint.

There is a second tendon to the middle toe.
which springing chiefly from that portion of the body of the muscle which arises from the external condyle of the femur and from the fibula, passes over the metatarsophalangeal joint and perforating the tendons to this toe already described is inserted by two slips into the base of the 2nd phalanx of this toe, the tendon of the deep flexor passing onwards between these slips.

The tendon to the lesser toe, arising chiefly from that portion of the muscle which takes origin from the external condyle of the femur.

This muscle flexes the toes.

*Flexor digitorum brevis* (the flexor brevis digitum of Vicq d'AZYRE, Mackel & CERVEN)

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 perforatus are inserted into the ter-
minal phalanges of the corresponding toes.

This muscle evidently flexes the toes

[Underlined: Flexor longus pollicis (included in flexor perforatus.)]

This muscle arises from the back of the flexor im-
mediately above the condyles, close to and to
the outer side of the origin of the flexor perforatus.

The tendon passes through a distinct synovial
capsule in the fibro-cartilage of the ankle
joint and is inserted into the terminal phalan-
gue of the first toe. At the lower end of the
tarsometatarsal bone it is intimately con-
ected with the tendon of the flexor perfora-
tus 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.
Interosseous muscle (described but not named by Buckel)

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 phalange of the outer toe.

This muscle abducts the outer toe.

Interosseous muscle (described but not named by Buckel)

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 phalange of the 2nd toe.

This muscle flexes the toe and adducts it.

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.
Extensores.

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

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 fibers of the Tibialis Anterior. It ends in a tendon which, passing under an osseous bridge at the lower end of the tibia, divides into three tendons opposite the metatarsophalangeal articulation, which run onward to be inserted into the terminal phalanges of the three anterior toes.

This muscle extends the toes.

There are 4 small muscles on the front of the tarsometatarsal bone which lie obliquely across the bone very much as the extensors of the thumb and index fingers do in man.

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

This muscle extends the little 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.
The third is inserted into the base of the first phalange of the third toe.

This muscle extends the third toe.

The fourth, which passes vertically downward, has an origin from nearly the whole length of the inner ridge on the front of the tarsometa-tarsal 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 phalange of the 4th toe at its under aspect.

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

These short muscles are not described by Micheal, although with the exception of muscle 13 to 6 of the flexors, these are all described by Niey d'Appy.

It is worthy of note that, including this muscle, there are exactly the same number of interosseous muscles as for Man viz: 3 plantar and 4 dorsal which tends to prove that Niey d'Appy was correct in naming these muscles: Inteossus.
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 Gluteus maximus is slightly larger whilst the other two glutei are rather smaller. The Papilloris is however considerably smaller than the same muscle in the Fowl as is also the Pectoralis 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 rectus 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 (Passerines). 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 hood grous a well marked and strong accessory slip to the adductor externus which I have never found to be present in any other bird except the Common Fowl. The crus-cocygeus 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 because in the former the muscle will pull more directly than in the latter.

Three-joint muscle.

The posterior part of the Rectus femoris is stronger in the hood grousse as it receives fibres of 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 heads are stronger than the like muscles in the fowl while the Rectus femoris of Meckel is smaller and junctus and there is a distinct bundle of fibres coming from the lower end of the femur (current).
all these particulars the muscles of the Wood grouse show a step intermediate between those of the terrestrial raptors such as the common fowl and the truly ruffling birds. The Rectus in this bird has an additional origin from the posterior edge of the aponeurosis which gives origin to the Nectus peron ios muscle whilst the other two hamstring muscles (semi-membranous & 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 so far as the flexor muscles of the toes intervene between the tibiae and the outer head of the gastrocnemius thus showing the larger proportional size of the flexor of the toes in the former kind than in the latter Flesas of the Toes.

Flesas perforatus is as has just been stated a larger muscle than in the fowl, and it receives no slip muscular slip of communication from the deep flexor neither does it give off a tendon to the femo-calcaneal if the back of the ankle joint as it does in that kind.
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 kind. Thus again showing a tendency to the same arrangement as is found in the Интерок, 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 kind so that it would seem that in this kind 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 kind we are describing at present whilst the muscle (No 5 in Hen) of the common Fowl is absent and No 6 is inserted into a fibro-cartilage covering the lower aspect of the meta-tarsophalangeal joint of the middle toe. There is also in the Fowl a Flexor lumbricus pollicis which arises from the inner edge of the tarsometatarsal 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 Raptors

It will be observed by a comparison with the Orders which I am about to describe, that the Raptors 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 altogether wanting. As far as my observations go, there is not a single muscle absent in the posterior extremities of the Raptorial Birds which
and which is found in those of any other bird 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 Passeres are characterised by the large size and complete number (seven) of the interosseus 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 Passeres**

I have examined four birds in this Order—the Magpie (Pica caudata) the Thrush (Turdus musica) 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 Gluteus maximus in the Thrush and Magpie is proportionally a weaker extensor than in the Passerine 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 Stalwing 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 Stalwing progresses in the same mode as the Rotorial birds — that is by alternate strides.

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

The Obturator internus is weaker in all the Passers than in the Rotorial, because of the space which it occupies in both of the latter birds, being encroached upon by the large depessor muscles of the tail which are not necessary to the same extent to the Rotorial birds, which are not dependent 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 most 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 larger, 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 Stalking and Passerine 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 internus was larger than in the fowl whilst in the Starling it was the same in this respect as in the fowl itself.

The accessory slip to the obturator externus is absent in all of these birds, in the thrush and magpie. The crura-coccygeus muscle 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 Michel is altogether absent in the four 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 m. magnus instead of behind it, whilst at its insertion the muscle passes altogether
Diagram No. II.

- Outer toe
- Middle toe
- Medial toe

Left foot of Mastic to show arrangement of tendons in sole of foot.

Perna pernurus - flexor digitorum pedis united with peronaeus in this specimen.
below the internal lateral ligament of the knee joint instead of crossing it as it does in the Radial lids. This arrangement obtains in all the lids after order which I have examined.

Ankle-joint

The Plantaris is absent in the Standing but present in all the others, and neither the Tibialis anticus nor the Dorsus had any fascial origin in either of the lids after order.

The Flexor perforatus and Flexor longus pollicis are inseparably united so as to form one muscle in the Medial and Standing, but in the Thrush they are distinct; there is no slip of communication between the superficial and deep flexors in any of these lids. Their tendons moreover pass beneath an osseous bridge situated at the head of the tarsometatarsal bone bone, an arrangement which does not obtain in the Radial lids. That portion of the Flexor perforatus which, after ending in a tendon goes to the middle toe, is in these lids particularly distinct from the rest. It muscle and constitutes the “flexor perforant et perforase” of Marchel. The arrangement of the tendons in the sole of the foot differs from

Hajamur II. Ephesancy.
that of the Rabbits, but so lightly that I don't think it worth while describing them.

In none of the intersosseal bands which I have examined was there any trace of the interosseous muscle.

The tendon of the Extensor communis digitorum in the majority perforates an osseous tubercle situated on the anterior aspect of the head of the tarseo-metatarctal bone, besides passing beneath the osseous bridge at the lower end of the tibia. What the precise purpose of this arrangement is, is not very apparent.

There is no Flexor extensor of the hind foot toe in any of the intersosseal bands now under examination, but in place of it there is a peculiar arrangement which seems to be peculiar to this order, which has never so far as I am aware been noticed and which I well now describe.

The posterior toe is articulated to a small bone which is connected by ligament to the lower end of the tarseo-metatarctal bone. There is a distinct trochlea on the lower end of this bone for the articulation of the posterior toe. The tendon of the Flexor perforates to this toe hooks round
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 clamped 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 then 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 little toe 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 Insectors.

These may be summed up mostly 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 Iliotrochanter externus.
4. Large size of the Crucio-coccygeus.
5. Absence of the Rectus femoris of Kocher.
6. Insertion of semi-membranosus below the external lateral ligament of the knee-joint.
8. Entire absence of Interosssei 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 fibrocartilage of each phalangeal 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 glutaeus 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 Passerine birds, in which the posterior part of the line gives origin to the Pyriformis. In the Psittacus torquatus the glutaeus maximus leaves only about 1/8 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 glutaei muscles are fused together so as to constitute one continuous muscular belly, which occupies the whole of the inferior margin of
the ilium, from the anterior margin, back wards to the acetabulum. The insertion of the common tendon corresponds in position to that of the glutaeus maximus in the generality of birds. The Pyriformis is absent altogether in the "erythro"; whilst in the "torquatus" it is reduced to a minimum consistent with its presence. This is due to the increased size of the glutaeus 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 glutaeus maximus, but that it is a distinct muscle, is proved by the fact that it has a tendon distinct from that of the glutaeus 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 glutaeus maximus as this last is inserted into the front part of the great trochanter, not into the posterior part as in the Passorial birds whilst that of the Pyri- 

formis is inserted at the usual spot.

The Adductor 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, more under examination, the lower fibres of the muscle (which probably corresponds to the adductors magnus) being inserted into the back of the inner condyle and uniting with the tendon of origin of the same head of the gastrocnemius, in this perfect differing from the same muscle in the terrestrial birds. The purpose of the lower fibres uniting with the inner 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 Scapularis Study in climbing, as the muscle will not only act directly on the tarsal joint, but also indirectly on the knee and ankle through the median of the gastrocnemius.

Michel states that in the Parrots, the Crucero-coygus is none than usually strong. In the two which I have examined, this certainly does not hold good. The accessory slip to the Altutate external is absent in these birds.
Three-joint.
The biceps femoris in these birds is remarkable for its narrowness and does not much exceed in breadth the biceps. It arises only from the curved line of the ilium and not at all from the ischio-fibular bone, and consequently leaves the origin of the biceps almost entirely uncovered, thus differing from the same muscle in the penguin and birds. Its insertion is as usual. Those fibers of the extensor of the leg which I regard as the Oseus 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 than
on the tibia than in that bird, and this ar-
rangeent is so well marked in the Psittacu-
torquatus that it passes to be inserted as far
 forwards as the inner side of the anterior tibial
malleol. Taken in connection with the arrange-
ment of the vastorius in these birds, it is evi-
dent that a free rotation of the knee-joint is
necessary for their mode of life as the gracilis
will in this respect aid the vastorius.

The Rectus femoris of the Psittacu-
seritracus is a very slender and feeble muscle which
in the ‘torquatus’ it is absent.

The Biceps in the Parrots differs only from the
same muscle in the Passerines 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 superficialis which gives origin to
the latter muscle. In the ‘eritracus’ 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 "touquetae".

Ankle-joint.

The gastrocnemius in the Scapnere is remark-
able for its very broad and thin tendon of in-
sertion, which embraces all the other muscles of
the back of the leg, laterally as well as posteriorly,
the muscular heads of origine, 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 Parno, but accord-
ing to him in the woodpeckers it is present
and well developed. This latter observation I have
had no opportunity of verifying.

In the Scapnere the Fibialis anticus does not
differ from the same muscle in the Common fowl
except at its insertion which is placed altogether
at the inner aspect of the tarsometatarsal bone
instead of being inserted to the front of it. This
arrangement as Meckel observes will enable
the muscle to direct the sole of the foot toward
the opposite side of the body—an arrangement extremely favourable to the action of climbing. The tocsis 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 3/4 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 one tendon to join the flexor perforatus of the toes, such as its arrow bent in the Pittacus, trigonatus, and in the Tritracus. It is much smaller and arises only from the lower end of the tibia and is very closely connected with the fibro-muscular jelly 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 Tritracus arising
as high as the hyomandibulum cartilage. It ends in a strong tendon which is inserted into a well marked projection on the outer side of the head of the 3rd tarsometatarsal bone. This muscle will evidently act in such a manner as to oppose that of the tibialis anterior, as it will direct the sole of the foot outward. This action is also taken notice of by Brehm. This muscle is also one of the chief muscles which come 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 fruit 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 peck it with their bill.

**Flexors of Toes**

The flexor peroneus 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 No. III

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 differential between these tendons in the hinds referred to will be seen by comparing diagrams 1 and 3. In the Ptilactes terquatum however this additional tendon is wanting. In the Passerina 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 tarsometatarsal bone and the angle at which it is placed to the neighbouring facets. The tendons to the outer toe, they twist round between the middle and outer facets of the tarsometatarsal 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 bell of the muscle and
causes it to oppose the outer toe, its tip to the dimer, as well as the anterior toe.

The flexor perforans does not differ essentially from the same muscle in the Dorsal lids 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. Necker states that this arrangement is found in all the Primates.

The same intimate connection exists in the Scansores between the tendons of the flexor longus pollicis and the flexor perforans digitomin so that the one muscle cannot act without pulling upon the tendon of the other as in the generality of limbs. But the flexor longus pollicis is a distinctly differentiated muscle in these limbs and is not fused with the flexor perforans as in the Primates.

A second proper flexor of the posterior toe exists in the Primates. It probably corresponds to that muscle which in the Common fowl, is inserted into the tarso 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 pha-
loane of the posterior toe, instead of into the proximal cartilage above mentioned.
A muscle (No 4 of domestic fowl) also exists in the parrots and has the same origin and in-
sertion as in that bird, but the muscle No 4 of that bird is wanting in both the psittacine
birds which I have examined.
The origin of the extensor communis digitorum
is rather more limited in the Parrots than
in the Psittacine birds as it arises only from
the upper half of the tibial. Its tendon ul-
timately divides into 4, one for each of the toes
including the posterior toe so that there is
no need for that peculiar extensor arrange-
ment in connection with that toe which
we have described under the Ibis.
There is only one internus interosseous muscle
in the Parrots, which corresponds to the
Muscle C of the Common Fowl. It is a
strong flexor bundle composed of short fibres
which arise only from the lower end of the front of the tarsus-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 gluteus maximus, gluteus medius, and summius combined so as to form a single muscle.
2. small size of popliteus.
3. adductor magnus, and longus combined so as to form one muscle, the lower fibers of which end on the middle head of origin of gastrocnemius.
4. Additional origin of tibialis from thine of last dorsal ventricle and its insertion into the front (not the side) of the head of tibia.
5. Narrowness of tibialis posterior.
6. insertion of gracilis much farther forward on the tibia than in other birds.
8. Absence of plantaris.
9. Insertion to inner side instead of front of the
11. Tarsometatarsal bone of Tibialis anticus
Very small size of Golius, and the absence of its tendon which joins the flexor perforatus
Very large size of Peroneus

12. Arrangement of flexor tendons so as to oppose the outer toe to the inner and anterior

13. Passage of tendons of flexor longus pollicis through an osseous foramen at head of tarsometatarsal bone (Fig. 104 (1))

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

16. Division of Extensor tendons into 4 (excluding one to the posterior toe)
Order 1st Raptore.

I have examined 4 birds in this order, the Harrow Hawk (Accipiter nisus), the Ring-tailed Harrier (Circus cyaneus), the long eared Owl (Asio otus), and a young eagle.

In all these birds the glutaeus maximus was of moderate size and had the same general arrangement as in the Nastes, but in the Harrier and Harrow Hawk it was inserted into the anterior portion of the outer side of the great trochanter whilst in the Owl it passed 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 Pygiformis. In all three birds the two smaller glutaeus muscles are united together and end in a common tendon, the insertion of which corresponds to that of the glutaeus medius in those birds in which those two muscles are distinct. The Pygiformis is present in all, but in the Owl alone does its tendon glide over that of the glutaeus maximus whilst in the other two it passes altogether behind that tendon because
of the different points of insertion of its in the different birds. It is very closely connected to the glutaeus maximus. In all these birds the glutaeus iliacus was absent. This observation contradicts that of Pechel who states that it is present in the diurnal birds of prey. The Obturator exterius is a strong muscle in the Harrier and Harrow-Hawks 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 Harrow-Hawks. The Adductors in these birds now under examination differ from those of the common fowl inasmuch 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 inner 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 those birds, in which respect also 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 Raptoresial 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 glutæi muscles, these last flexing the femur and rotating it inwards whilst the external obturator will extend and rotate it outwards. The accessory hip to the obturator externus is wanting in all the birds of this order. The Cruro-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 three-joint.

The tail in the owl arises from the superior...
margin of the ilium, and consequently does not cross the gluteus maximus as it does in the reptiles and the diurnal birds of prey. The Rectus femoris in the reptiles is a narrow muscle arising almost solely from the ridge of the ilium from the anterior margin of that bone, backward to the ischio-pubic line, although a very few fibres take origin from the ischio-pubic bone. It then leaves the femur altogether exposed at its origin in which respect it differs from the same muscle in the avian birds. The Rectus femoris of birds is a very delicate muscle in the two branches, in the bird it is altogether absent. The Biceps in all the birds under consideration has an additional origin from the posterior margin of the femoralis which gives origin to the Rectus femoris, and it lies altogether posterior and therefore uncovered by that muscle. The Semi-membranosus 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.
Amphle-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 tarsometatarsal bone. As Nuckel has justly observed the tendons from the different heads unite much sooner in the nocturnal than in the diurnal kinds of prey. The flexors of the toes which are extremely large in the Raptorial kinds, project so as to interlire 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 foot except that the prolongation downwards is proportionally much thinner than in that kind. Its tendon is broad and membranous in the use-
Tarsal birds of prey.
The tarsus in both the hawks which I have examined, is an exceedingly small, and feeble muscle. It arises in both from about the upper 1/4 of the outer side of the tibia, 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 Raptorial and indeed in the generality of birds. In the long-eared owl the muscle is entirely absent. The insertion of the muscle in the Marsh hawk is as in the generality of birds, that is, by two tendons which have the usual arrangement. The Plantaris as Reidel 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 poulp, 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 hind legs 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 Ratitae differs from that in other birds in as much as it is smaller than the flexor perforatus. It arises in the Marrow hawks by only one head of origin from the back of the outer condyle of the femur, but in the Parrots and Eul. 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 of Medial and the Soleus, but in the Eul. as we have already stated both these muscles are absent. The flexor perforatus in the birds under consideration gives off no slip to the piston cartilage of the ankle joint, neither does it receive any slip of communication from the deep flexors as it does in the Domestic Fowl. It gives off various slips to the adductile.
Diagram No. IV. Shows right foot of long eared owl and arrangement of tendons in sole foot.
In the raven, 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, seeing 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 stork, which 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 Raptorial. 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 animal's vitals; and accordingly we find these muscles which act upon the terminal phalanges which carry the Claws are more strongly developed than the other muscles of the toes. The hinder 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  to each other at the same moment and thus the escape of living prey is effectively prevented.

All the posterior interosseous muscles exist in the owl and have the same arrangement as in the Raptorial 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 ~beak~ muscle No. 4 of common fowl is absent, and in both birds the unemployment of (the pro- per extensor of the anterior toe) arises by 2 heads.
of origin, between which the tendon of the \textit{fibularis anticus} is inserted.
The tendon of the \textit{extensor communis digitorum} in the owls passes beneath an ossous bridge situated at the upper end of the tarso-
metatarsal bone, instead of at the lower end of the tibia as in the sharrow-hawk
and the generality of birds.

The Characteristics of the Raptures may be stated thus:

1. Union of two smaller glutæi muscles to form one.
2. Absence of \textit{iliacus internus}.
3. Equality in size of Adductor magnus with adductor longus.
4. Absence of accessory slip to obliterate externus.
5. Small size of \textit{rectus femoris}.
6. Absence of \textit{biceps tendoninosus}.
7. Small size of abductor muscles especially the anterol.
8. Small size or even absence of \textit{soleus}.
9. Absence of \textit{plantaris}.
10. Very large size of \textit{fibularis anticus}.
11. Very large size of \textit{flexor perforans} and \textit{flexor longus}.
12. Adductor has only one head with 
13. \textit{flexor perforatus} gives off only one tendons to middle toes
Order V. Gryllatones.

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

In all these birds the glutaeus 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 glutaeus, 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 glutaeus medius in other birds. It is worthy of notice, that in these 3 birds the place of origin of the glutaeus medius is carried farther backwards than in the common fowl, so that it arises from the inferior, and not from the anterior margin of the ilium as in that bird. The tendon of the Pyriformis does not slide over that of the glutaeus 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 1/4 of the place of origin of the gluteus minimus, whereas it will be remembered that in the Rapacial 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 lined apex 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 lined aspera of the femur. In the heron the lower fibres of the adductor magnus 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 gastrocnemius, so that the adductors in these birds will act on the knee as well as on the hip joint.
The Gluteus 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-cocygeus muscle is absent in the Flamingo, but in the others it has the usual arrangement. Néchel states that in the Heron this muscle arises from the Ischiium, but in the individual which I examined this certainly was not the case.

Knee-joint.
The Articulum in the Heron takes an additional origin from the spine of the last dorsal vertebra, and is a weak muscle; but in the Flamingo and Curlew it is a strong 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 Ractus femoris, the second unite with the ligamentum patellae, 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 consider-
ation the Ractus 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 ischial
pubic bone, so that it leaves a large portion of
the ischiatic maximus uncovered. In the Heron also
this muscle is rather narrower than usual.

The Ractus externus in the Curlew has an additi-
onal 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 con-
sidering in as much as it wants the small muscle
known as the Ractus femoris of the cheek entirely,
whilst it is present in both the others although
in them it is extremely feeble.

The Biceps in all the Grallatorae which I have
examined is a very large and powerful muscle especially so in the felines, and in all other it has an additional origin from the posterior margin of the supraspinous which gives origin to the Rectus femoris. By reason of the narrowness of this vast muscle in these birds the Biceps is not at all covered by it at its origin. The semi-membranous in all is a weak muscle and its insertion is placed lower down on the tibia than in the Passorial birds. The semi-tendinosus in the Carolina 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 third additional tendon is given off from its lower end which, passing forwards is inserted along with that of the semi-membranosus. This kind therefore offers an exception to the statement of Bockel that both heads of this muscle exist in the Gallatorial birds. In the other birds of this order, this muscle offers nothing remarkable except that it is rather weaker than usual.
Achile-Joint

The gastro-caneimus in the Galliatrilus dikes is remarkable chiefly for the large size of the anteror head of origin as compared with the others, a fact noticed also by Michell, 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 leaders. In the Flamingo the outer head arises in a different manner from that of any other kind of which I know, viz. from the outer side portion of the ligamentum patellae which in this kind is very broad and covers the outer side as well as the inner aspect of the knee joint, instead of from the back of the outer condyle, as in the generality of kinds, and the common tendon of insertion in this kind is particularly strong and cord like. In the Curlew and Heron the muscle does not present any pecularity 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. No biceps 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 birds under consideration at present, its outer edge lies against the flexors of the toe, which intervene between it and the outer head of the gastrocnemius. Otherwise it is similar to the same muscle in the Fowl.

The plantar flexor bird have the insertion of the Tibialis Anticus placed near the head of the tarsometatarsal bone than the flexority finds a fact which did not escape the notice of Meckel. The Flamingo exhibits in a more marked manner what is common to all birds now, that the outer head of origin of the Tibialis Anticus from the tibial 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
Diagram No. V.

Outer toe

Middle toe

Inner toe

Posterior toe

Right foot of Heron to show tendons in sole

Foot of Gallinaceae: pectoralis, pectoralis, and peroneus.
end of the tibia. This muscle Miciel deviates to
the barred a statement which our observations
do not confirm. He also states that it is absent
in the Storks.

Flescres of the Toes.
The Flexor perforatus of the toes in the Gallatrical
bird, has the same origin as in common fowls;
but it differs in all of them from the same mus-
cle 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 ar-
rangement seems almost to be a peculiarity to
this Order of birds considerableness 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 role of the foot, which is the same in
all, will be seen by referring to diagram No. 7
and will be more easily understood than by
means of any detailed description.
The Flexor perforans in the Cereleus 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
kinds it has the usual arrangement.
The flexor longus pollicis is absent in the Flae-
ningo on account of the extremely rudimentary
condition of the posterior toe; and in the Carbo
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 perforostris which
goes to the inner toe, and this tendon occupies
the usual position of that of the long flexor
of the thumb. In the Keron however it is
a distinct muscle and presents the usual ar-
rangeeement. A fibrous slip connects this tendon
with that of the flexor perforostris in the Keron.
Arising from the tendon of the flexor longus pollici
and partly from that of the flexor perforostris is
a very small fibrous slip which seems to repre-
sent a lumbral muscle. It passes to be
inserted into a fibro-cartilaginous covering the back
of the metatarsophalangeal articulation. This
is the only kind with which I am acquainted
the which there is any trace of a lumbral
muscle and I can find no mention of it in
any of the authorities to whom I have referred
lateral offset
lateral offset
lateral offset

Fig. 1

Tendon

Plan of extension of tendons.
The posterior interosseous muscles are all present in the limbs we are considering, as are also the anterior except in the Canis, in which there is only a single anterior interosseous which corresponds to the muscle D of the Canis fossa. They resemble the same muscles in the fox, with some slight variations not worthy of mention as to their exact places of origin on the tarsus-tarsal bone, with the exception that Muscle No. 6 of that limb is inserted into the first phalanx of the posterior toe instead of into a fibro-cartilage as in that limb. This muscle is much larger in the Canis than in either of the others probably on account of the large size of the posterior toe in this limb. The insertion of the extensor communis digitorum is particularly distinct in the Canis and is as follows.—As each of the tendons passes over a phalangeal articulation, it sends off a lateral branch 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 tarsus-metatarsal bone 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 grallatones may be characterized shortly thus:—

1. Large size of Gluteus maximus.
2. Origin of Gluteus medius from inferior and not anterior margin of the ileum.
3. Small size or absence of Gluteus internus.
4. Want of accessory slip to Obturator externus.
5. Additional origin of Piriformis from posterior margin of ischial aponeurosis of origin of Rectus femoris.
6. Large size of anterior head of gastrocnemius.
7. Absence generally though not always of Peroneus brevis.
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.

Although the grallatones is generally classified with the metatarsal birds, the muscles of its legs are altogether those of a runner.
Order VI Natatulls

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

In the web-footed birds as stated by Heckel the glutaeus maximus "arrives at its greatest development" in the guil however it is not larger than the bicep muscle in the common fowl. In the swan the two smaller glutaeus 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 guil they have the same arrangement as in the domestic fowl. In all these birds however the glutaeus medius arises rather from the inferior than from the anterior winging of the ilium. Heckel affirms that this muscle is wanting in the pelicans and several other palaeopodes.

The Pygicorn is strong in the swan, feeble in the Scoter and moderate in the guil. Its tendon does not however slide over that of the glutaeus maximus as in the common fowl. Heckel remarks that in the pelicans this muscle is also absent. The iliacus in two of the bridies are at present co-
paddling bird; the swan and gull is wanting whilst in the Scoter it is reduced to the smallest size consistent with its presence. According to Nichol this muscle is present in the goose as well as in the Guillemot, but absent in the Cormorant. The Adductor internus is rather weak, and is more elongated and narrower in the birds we are considering than in the Poenicid 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 birds the muscles concerned are of a triangular shape, arising by a very broad linear origin from the lower margin of the Ischiatic pubic bone, that of the Adductor magnus being alone and extending for some distance behind that of the Adductor magnus. The Adductor magnus 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 7 insertions certain of the fibers 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
iliac crest about the middle of the femur, and
consequently considerably higher up than in the
Passorine bird, the origin of the Cruro-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 back-
wards 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 full the Adductors do not differ from the
same muscles in the Fowl. In all the
birds we are considering the Cruro-coccygeus
is comparatively a weak muscle and in the
Swan and Scoter its origin is chiefly from a
tough membrane which fills up a large cavity
in the pelvis of these birds. Its relations also are
slightly different from what they are in gen-
eral, as the Adductor longus, and Cruro-coccy-
geus run parallel with its lower margin and
the latter does not cross it as usual. The Cruso-
Coccygeus as mentioned above arises in common with the tendon of insertion of the Adductor magnus.

Three-joint

The tarsi of the tarsus arises only from the epiphysis 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 Common, Crested, Grebe, and Guillain but present in the Wild duck and Goose. The Rectus is particularly strong in the body now render experimentation. It is not concealed by the Rectus femoris and the peroneus fibularis which its tendon passes to be inserted lower on the fibula than usual is larger than ordinary. In the Swan and Scoter the semi-membranous is very feeble and arises from the ischio-pubic bone to try to separate the rump 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 full bow over the semi-membranosus does not differ from the same muscle in the common foul. The semi-tendinosus is a particularly strong muscle in the true swimming liquids such as the swan and duck, and arises directly behind the biceps from the ischi-jugular bone as well as from the 2 or 3 first coccygeal vertebrae. It unites 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. This peculiarity end. In the full this muscle excludes the usual arrangement with this exception, that its tendinous intersection extends 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 duck is slightly different from what it is in the common foul 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
other order which I have examined. The Relations
of the Doleus 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
Suralis anterior are more distinct than usual
in these birds, and it does not arise from fascia
at all as in the Common Fowl. The chef states
that in the Frelle this muscle has 3 heads of
origin - an additional one arising from the Patella
flexens of toes. The Flexor perforatus is a very
large flabby muscle in all the birds under exami-
nation, its origin from the Filum being
more extensive than usual. In these birds as
in the Gallinaceae 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. vi

Middle line

inner toe

outer toe

Medial toes

Flexor profundus

Gastrocnemius

Flexor tibialis posterior

Gastrocnemius

Hollow bone in lower half of foot.

Left foot of swan to show tendons in development of foot of Natator. 

Medial side of foot with long elephant phalanges.

The olecranon is not seen in this case from flexor profundus.
by referring to diagram VI. It is remarkable that in these two orders of birds above mentioned, the tendons and sinewmers 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 flexor cartilage at the ankle joint.

The flexor perforans has two heads of origin, the tendons from which ultimately unite into one.

One of these heads is from the back of the lower end of the femur, and undoubtedlgy corresponds to the usual origin of the flexor corpus pollicis, whilst the other corresponds to the usual origin of the muscle, but in the full 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 Hound with the exception that the
muscle No 6 of that kind is inserted into the
first phalange of the posterior toe and not into
fused cartilage as in that kind. In the Black
Scoter, the posterior interosseous muscle No 6 of
Hound is absent, but all the anterior are present
and present the usual arrangement. In the Sharp
all the posterior interossei are absent, whilst
the anterior corresponding to those marked B & D
of the Common Hound presented the usual arrange-
ment. The others were wanting. The Common ex-
tension of the toes presented nothing specially of note
in any of these birds.

Characteristics of true Natatorae as shown are as follows:

1. Very large size of Gluteus maximus.
2. Elongated and narrow form of Colobinator internus.
3. Large size and peculiar arrangement of Adductors.
5. Extreme length of fibrous body thus which tendon of M. Peron.
6. Large size of semi-tendinosus, and want of its short head.
7. Additional origin of middle head of gastrocnemius for calcaneus.
8. Existence of 2 tendons to inner toe of claw.
9. Union of flexor pollicis longus with flexor perforans.
Order VII. Cursores.

In this order I have only had the opportunity of examining one kind viz. the two toed Cynocephalus (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 deployed 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 Gluteus maximus is a small muscle as compared with that of the common fowl, indeed as Nelson observes this muscle is at its maximum in the Cynocephalus. The two smaller glutei muscles are also peculiar as compared with the common fowl but occupy the same relative position as in that bird. The Gluteus minimus likewise 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-supraspinous. The Papiporus which is not described as a separate muscle by Macalister who seems to consider it as just the gluteus maximus is 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 planes of the posterior fibres of the great gluteal muscle which passing downward to the gluteus and often passes anterior to 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 Plicarius is apparently a more elongated muscle than in the Domestic Fowl. It arises neither higher up than in the Fowl. The elevator vertebrae 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 ostra 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 pons of the sciotic and the posterior portion of the pons. It passes downward and forwards, crossing the ten
do of the Adductor internus obliquely and is inserted into the femur a short distance below that tendon. I shall describe what I take to be this same muscle as being inserted into the lower end of the femur
but this certainly was not the case in the specimen
examined. The Adductor longus differs from
the same muscle in the femur 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 intercondylar fossa of the femur. The
Adductor magnus is absent in the ostrich, and
what muscle described above corresponds to it, and
this does not seem improbable in 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 Adductor externus
of other birds also exists in the ostrich but as an
extremely feeble muscle. It arises partly from the
biceps of the ischium and partly from the ilium.
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 forward instead of outwards and will thus aid instead of opposing the action of the two smaller glutaei 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. Reidel says that this muscle is absent or else fused with the obturator internus in the ostrich but in this he is certainly wrong.

Three joint

The Ductor femoris in this bird is at its maximum. It forms a very thick flabby 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 joined to the tibia as in the common fowl, has only a small portion inserted in this manner whilst
by far the larger portion yet passes downwards over the knee-joint and unites itself with the anterior and lateral heads of the gastrocnemius

As Buckel puts it this muscle is as broad as it is long in the ostrich.

The tectorius, in addition to its usual origin takes its rise from the sinews of the last two dorsal vertebrae.

It is a strong thick muscle after its insertion differs somewhat from that of the domestic fowl. As much as its tendon divides into two portions one of which is united with that part of the tendon of the flexor also inserted directly into the tuber ischii while the other unites with the tendon of the gracilis. A considerable space intervenes between these muscles and the tendons become so as to leave a large part of the psoas maximus exposed.

The tectorius extensor takes some fibres of origin from the tendons of the pyriformis 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 space 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. No more fact of this muscle being so well developed in the Ostrich ought to have convinced those anatomists to whom consider that this muscle is chiefly a perching apparatus of the abnormality of that theory. This will be referred to again.

The Breeds is a particularly strong muscle in this bird. It presents the usual arrangement with this exception that the fibrous cylinder through which its tendon passes is not attached in the usual way to the femur but is formed also petter by a splitting of the tendinous outer head of origin of the gastrocnemius. Macleister states that in the female which he dissected a slip connected this muscle to the
Each of the four, although it was absent in the male. 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 ischial spine as well as from the ischium.

It presents the same arrangement as in the camel, with the exception, that its tendon of insertion does not unite with the middle head of the gastrocnemius but is inserted along with that of the semi-membranosus into the more side of the head of the tibia.\[Michel mentions the cruro-cocygeus as occurring in the ostrich, but I could find no trace of this muscle in the bird I examined.\] 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 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 pedicles of origin. The mode of insertion of this muscle is similar to some muscle in the common foot. This muscle is proportionally infinitely more powerful than in any other head.

The soleus is a strong muscle. Its origin is as in the common foot with the addition of a muscular bundle which it receives from the tuberosity of the fibula into which the tendo of the biceps is inserted as well as from 0 inches below this of the fibula. Its relations and are similar to the same muscle in the common foot, but as there is no distinct fibro-cartilage of the ankle joint in this bird, the broad head of the muscle passes to be inserted directly into the head of the tarsometatarsal bone and forms the anterior layer of the sheath for the transmission of the flexor tendons. The posterior layer being formed by the tenor of the gastrocnemius. The nerve now passes out into tendo passes round the outer ankle and joins the superficial flexor tendo to the inner toe.
The Peroneus is absent in the Ostrich.\n\nHerrick describes the Plantaris in the Ostrich, but there was no such muscle in the bird we are describing. Indeed, one cannot see what use these 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 anterior muscle which does not take place in the Fowl. Flexors of toe.

The flexor perforatus in the Ostrich has an additional origin by tendons from the front of the lower end of the tibialis, hence this tendon receiving a slip from the deep aspect of the ligamentum patellae. It also has a narrow fleshy slip from the outer side of the anterior tibial nerve, this slip doubtless corresponding to that. These 2 muscles are found in no other bird with which I am acquainted.

The other muscles 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 tendons in sole of foot
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 chapter 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 the lower end of the femur from between the condyles. This second origin cannot be said to be that of the flexor digitorum but is as in this limb there is no posterior toe and therefore the head of origin must form an integral part of the flexor perforans. The two tendons derived from these two heads finally divide into one which passes on to be inserted into the terminal phalanx of the inner toe, then being not 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 encircles 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 phalange of the inner toe.

I regret that the muscular anatomy of the leg of the ostrich being so complicated a subject that it is quite impossible, though deeply interesting, to do justice to it in the present space which has already exceeded proper bounds. I think I have however enumerated the chief difference between it and that of other birds. I know only what I believe to be the essential characteristics of the Ostrich as compared with other birds in this respect.

1. Insertion of \textit{Gluteralis extensorius} into the small trochanter.
2. High insertion and very small size of Adductor magnus.
3. Existence of 2 heads of origin of Gracilis are arising from the Pelvis.
5. Additional Origin of trochanter from fibula.
6. Additional Origin of flexor perforates from the part of the lower end of femur.
7. Absence of any osseous bridge through which the tendo of the extensor communis digitium might pass — its place being taken by an additional fibrous ligament.

Being unable to procure any account of the muscular anatomy of the horse or Cassowary, I am unable to say how far these characteristics may hold good of the properly limited Order of Cassowary.
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 reasons of this had been a puzzle until about the end of the eighteenth century when Bozzelli 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 he called the "Rectus". His notion seems to have prevailed since then, for in Reed's Cyclopedia (Article Birds) the writer of that article agrees with Bozzelli as to the function of this muscle and in the article "Aves" by Prof. A. Owen in the Cyclopedia of Anatomy, the following passage occurs:—"The disposition of the former muscle (viz. the Rectus) is such as first over the concavity of the knee-joint, and afterwards over the projection of the heel, that from its connection with a flexor of the toes, there must necessarily be heat..."
Simultaneously with every flexion of the joints of the knee and ankle, as these flexions naturally take place when the lower extremities yield to the superincumbent weight of the body, limbs are thus enabled to grasp the twigs on which they rest whilst sleeping, without making any muscular exertion. Though in his "Anatome Comparata" 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 lid securely on its perch without loss of muscular action. For, had this been its principal action as the author quoted seems to have imagined, why should there not have been merely a tendinous band (similar to what exists in the anterior limb of the horse) and occupying the position of the Rectus muscle...
Why must we have killed it? I have not seen if union had taken place.

The author, averse to doing the experiment on the domestic fruit, after an interval of three or four weeks killed the bird. The ovaries and of the semen were found to be far removed from each other.
and writing with the fingers 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 continuance 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 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 nor, 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 kept the bird in the same condition as it was previous to the operation. Accordingly I procured a second fowl and operated just upon the right leg, but in this operation I carefully drew the tendon of the Rectus upward, and cut out a portion of it about
half an inch in length, and when the muscle contracted the cut ends would probably be 7/4 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 nest, 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 had continued to do regularly at night ever since. No deficiency is now to be observed in any of its actions, 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 are the Blackbird, Mistle 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 Teeter, and the Fulmar.

The only other theory as to the action of this muscle with which I am acquainted is that propounded by the Rev. D. L. Haughton of Dublin in the Proceed. Royal Irish Academy. for 1865, Volume 7.

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 originality) 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 Teeter 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 junction 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 the 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 kinds I doubt if he would ever have published this theory. What the junction of the Rectus muscle really is, I am unable to say but if I have disproved an erroneous theory previously advanced with regard to this, one must make one step in the right direction.

The explanation of flexing I believe to be as follows. The flexor muscles at the Hip joint first contract. By this means the distal end of the femur is removed farther 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 upward the anterior aspect of the condyles of the femur. This rotation upward 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 toes, metatarsal bone and thus flex the ankle joint. The flexors of the toes being thus drawn taut 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 hind 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 Achilles 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 condyle, 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 pully which retains the tendon of the laces in position but beyond occasioning laceration 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.