Plate I.

Fig. 1.

Fig. 2.

An Essay on

THE ANATOMY OF THE GIBBON

(Hylobates agilis)

With Notes on Comparative Anatomy.

In three Volumes.

An Essay On

THE ANATOMY OF THE GIBBON

(Hylobates agilis)

WITH NOTES ON COMPARATIVE ANATOMY.

Presented as:-

A THESIS for the DEGREE of

DOCTOR OF MEDICINE.

and

A competing ESSAY for

THE GOODSIR MEMORIAL FELLOWSHIP.

By,

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PLATE. 1.

FIGURE.1.

The hand of the gibbon.

FIGURE.2.

The foot of the gibbon.

See pocket in cover

PREFACE.

The kindness of Professor Cunningham has enabled me to carry out the dissection of a Gibbon in his possession during the past Winter Session. The dissection was carried out in the Anatomical Department of Edinburgh University.

I have, at the risk of seeming tedious, described the details of the muscles fully under the headings origin, insertion, nerve supply, structure, and relations.

My reason for doing this is the lack of evidence, positive or negative, on certain points of interest in this dissection, which I looked for in the works of others.

Under the heading of comparatvie anatomy the observations of other writers on the anatomy of the anthropoid apes have been fully referred to: as far as possible only those points in the lower animals have been noted which seemed to throw light on the anatomy of the apes and man. Many of the points which have arisen during the investigation I have sought to elucidate by observations made in the Museum of the University and in the Natural History Department of the Museum of Science and Art in Chambers Street, and by dissections

made on some of the lower animals, such as the cat, mole, and fish.

Although fully sensible of the futility of propounding theories on comparative anatomy from the results of a short investigation, I have ventured to express opinions on certain views which this dissection seemed to deal with directly.

As far as possible the points have been illustrated, the drawings are, with the exception of three, the results of my own work.

In the muscular system the peculiar continuation of the muscular sheets of the trunk on to, and down the fore limb have been noted in connection with the habits of the animal. The musculature of the forearm and hand has been fully considered, I believe the right interpretation to have been put upon certain anomalous muscles ~~muscles~~ found in the palm of this ape, and described under the name of the musculi interossei accessorii.

The true position of the flexor brevis digitorum has been dealt with, the conclusion formed tends to confirm that originally laid down in the Challenger Reports but not that interpretation which is depicted in Quain's Anatomy.

In the lower limb, attention may be directed to the descripion and comparative anatomy of the following muscles: - the obturator internus, obturator externus, the adductor group, the flexors of the legs, tibialis anticus, flexor brevis digitorum, and musculus accessorius.

PREFACE.

In the trunk muscles special attention was directed to the dissection of the sheath of the rectus and I was able in an unmistakeable manner to demonstrate the true condition of the parts.

In the arterial supply of the limbs, the large artery running down the inner side of the tibia was the most important point noted, I have attempted to show its connection with the superficial division of the anastonotic artery. The veins of both limbs were peculiar.

With regard to the nervous system the limb plexuses were dissected, the likeness born by the brachial to the sacral plexus, is apparent in the diagrams. Throughout, the dissection has been opposed to the theory formed by Ruge as to the relationship between the muscles and nerves. Ruge holding that the muscles are to be looked upon as being the end-organs of the nerves which supply them; this view being, he considers, infallible.

The facts here shewn demonstrate that if the muscles are to be looked upon as the end-organs of any structure, and I think they are, then they must be looked upon as the end-organs of the motor cells in the anterior horn of grey matter in the spinal cord, from which their axons of supply are derived; The path by which these axons reach the muscle being immaterial. The distribution of the dorsal nerves tends to shew that the intercostal muscles are not to be regarded as being derived from from one myotome nor are the ribs and lineae transversae of the rectus abdominis to be looked upon as being strictly inter segmental structures.

PREFACE.

I have been able to corroborate Professor Hepburn's statement that in this animal the pronator quadratus muscle was supplied by the posterior interosseous nerve. This statement was followed up and the fibrils traced to the median nerve higher up the arm.

In addition the significance of the communication between the median and ulnar nerves in the forearm ~~was~~ of the apes was made out in connection with the deep supply of the muscles of the palm.

※ These two forms which according to Hartmann are so often confounded, are so confounded in the Chambers Street Museum, both names being applied to the one type, The specimen is I believe H. albimanus.

※ Those marked thus are to be seen in the Chambers Street Museum of Science and Art, Natural History department. They are but poorly set up, especially H. Leuciscus which is shewn standing in the erect attitude like a man with the knees extended, instead of the position noted by Goodsir. see opposite page 17

INTRODUCTION.

The GIBBONS form one of the four families of the Anthropoid apes, the other three families being the Gorillas, the chimpanzees, and the Orangs. The Gibbons are found about the South-East of Asia and the Malay Archipelago. Of the gibboons there are many different species, many of which are but imperfectly known, The following may be mentioned:-

※ Hylobates syndactylus or Siamang, the largest known form.

H. Lar, usually known as the Lar.※

H. Albimanus, the white handed gibbon often confounded with the last species.※

※ H.Leuciscus, or the grey gibbon.

※ H. Hoolock also known as hulock, yulock, or yolock.

H. Rafflesii, or the Unko.

H. Entelloides, or the dun-coloured gibbon.

H. Pileatus, or the tufted gibbon.

H. Funereus, or the dark gibbon.

H. Leucogenys: H. Concolor: H. Muelleri: H. Choromandus;

※ and lastly H. Agilis or the Wauwau or as Marten[2] calls it the Uwa-uwa, of which this is a specimen.

Of all the anthropoids the gibbons most resemble man in the shape of their teeth and in the fact that they are capable in a marked degree of assuming the upright and erect attitude. Hartmann[1] says of them:-

Hylobates Hainanus ?

[1] Hartmann Anthropoid Apes. p. 254.

[2] Marten quoted by Hartmann. p. 253.

"Some species,such as the lar,the white-handed,and the slender gibbon,display special dexterity and endurance in maintaining this position. They press the flat soles of the feet upon the ground,turn out their knees and toes,hold their bodies fairly erect,draw their shoulders together,and place their half bent arms by their sides,with the slender hands hanging slackly down." Their walking better in the upright position than the other anthropoids may be perhaps accounted for by the fact that in the gibbon the patella surface of the femur is carried upwards and outwards on the front of the bone as in man;no other anthropoid presents this feature. The gibbon is the only one of the anthropoids that possesses callosities on the ischium;they are devoid of hair and small in size,In H.agilis they were round and measured about the size of a halfpenny.

H.agilis or the wauwau is one of the rarer species and inhabits the island of Sumatra,They appear to live in pairs rather than troops as do other species of gibbon,Their name is derived from their swiftness of motion and almost incredible agility. Hartmann[1] says "They swing two or three times to and fro,and then spring with arms outstretched so that the flat surface of the body resists the air like a parachute,and in this way they can pass through spaces of forty feet,and go on for hours without fatigue." Marten describes how in Paris a live bird was let into the cage of an H. agilis. After watching its flight for sometime the gibbon

[1] Loc. Cit. p. 254.

swung itself up on to a distant bough, which he seized with one hand and the bird with the other. Both its objects, the bird and the bough, were attained with as much certainty as if only one object had arrested its attention. (Hartmann[1])

Sufficient has now been said on the gibbons in general, and I therefore turn to consider this animal in more detail. The specimen which I had the advantage of dissecting was an adult female which had been preserved many years in spirit, but was in excellent condition of preservation. A mid section had been made (sagittal plane) and one half had been used for other investigations. Professor Hepburn of Cardiff had previously dissected the corresponding limbs of the other half of the body.

The length of the animal I am about to describe measured 41 cm. from its vertex to its ischial callosities; the body was covered by hair of a light brown colour, about one quarter to two thirds of an inch in length. The direction of the hair on the body was generally downwards and forwards (the terms used will, as far as possible, refer to the body in the erect attitude with the hand supine, as in the anatomical description of man). On the thigh the hair on the extensor aspect sloped away from the middle line of the limb downwards and backwards until the lateral lines of the limb were reached, when it began to pass upwards and backwards towards the middle line of the limb posteriorly.

1 Loc. Cit. p. 283.

On the limb below the knee the general direction of the hair was downwards both on the back and front of the limb, so that when the limb was in the position of complete flexion the hair on the flexor aspects was lying in the same direction and not in opposition on the different segments of the limb. On the upper limb the hair was not so regularly disposed, and had a general direction downwards. The hair on the gluteal region, inner side of the thigh and on the pubis, is longer than elsewhere, but the long hair on the pubic region does not extend up on to the abdomen. In the human female this is a very characteristic difference compared with the male where the hair passes up freely on to the lower part of the abdomen. The palms of the hands and soles of the feet were quite free of hair. In this animal there was no ruff as is sometimes described in these animals, nor was the hair any longer on the neck than elsewhere generally. The face is covered ~~with~~ with a more scanty clothing of hair than elsewhere; a few coarse hairs were seen round the mouth among the openings of the large follicular glands of the lips. There was no attempt at the formation of a scalp with longer hair than on the body as is sometimes depicted in books; the face was coloured dark brown— that of the male of the same species is said to be of a bluish black. The ~~hands~~ palmar aspect of the hands and soles of the feet were of a dark sepia, considerably darker than is indicated in Plate 1., the ischial

callosities were of the same deep shade;in the male the head,belly,inner sides of the arms and thighs are said to be of a darker tint than the rest of the animal,the neck and shoulders being of a lighter shade,the sides of the posteriors and thighs being of a chestnut colour or even white. None of these variations of colour were noted in this specimen.

The face of the animal as far as could be judged from the remaining half was not in a marked sense prognathous;the eyes were deeply sunk in the orbits,the supra-orbital ridge was prominent,there was no attempt at a mental protuberance in this ape;but Huxley[1] states that in the siamang (H.syndactylus) he found something approaching a chin.This he says "is the only ape which has any thing like a mental ~~protuberance~~ prominence." In this animal the chin was quite rounded off, and the line of the jaw swept up from the lower margin in a continuous curve. The ear was rounded with the margin folded and in-curved,a very small Darwinian tubercle only being present, and quite unlike the ear in some of the lower apes, where the margin is not infolded and the Darwinian tubercle forms a point. The tubercle is present in the human ear as a slight thickening in the in-turned edge in many cases, but in some it is a prominent feature of the auricle. I saw about a year ago the most remarkable pair of ears I have ever seen in the human subject;the person was a male of about 30 years of age, and his ears had very ill developed

[1] "Structure and Classification of the Mammalia" Medical Times & Gazette Vol.I & Vol.II. 1864. p.618

lobules;the anterior margin and the posterior margin low down were in-folded slightly,the tubercle was well marked and prominent and not in the least in-folded.This gave to the ears a triangular appearance, which was the more noticable as they stuck out from the head at a prominent angle;the effect was not prepossessing. The lobule of the ear was entirely wanting in this ape. The anthropoids are the only animals which possess ears that sometimes show a tendency to the formation of a lobule, which is however not a constant feature by any means, even in the auricle of man. Wiedersheim[1] quotes the statistics of Otto Ammon of Carlsruhe,who examined 4171 ears of recruits in the military district of Mosbach with the following results:- The free lobe was wanting in 36%,it was present in 64%. The Darwinian point was not found in 74%,and was present in 26%, being of large size in 9%.
On account of the fact that the ape had been lying on its side while stored it was impossible to say whether the ears had projected prominently from the side of the head or not.

There were no laryngeal pouches found, and Hartmann[2] states that the only ape of this species to possess these is the siamang (H.syndactylus).

The skull was rather small and rounded, and presented none of the coarse ridges which are seen on the vertex of the adult gorilla;the forehead was sloping and did

1. Wiedersheim. "Structure of Man". p. 153.
2. Loc. Cit. p. 45.

and did not rise to any great height above the prominent supra orbital ridges. The surface was smooth; the temporal ridges were situated at a much greater height than is found in man, and extended in a marked manner on to the frontal bone. The superior occipital line was well marked in its outer part for the attachment of the sternal portion of the sterno-mastoid muscle. The mastoid process was absent; it was absent in the skulls of several other gibbons that I examined both in the Museum of Edinburgh University and in the Chamber's Street Museum.

The teeth were complete, except for the central incisor of the lower jaw, which had been removed by the mesial division of the animal. They were all in good condition and presented the formula Incisors 2; canines 1; premolars 2; molars 3, — the formula being the same for both jaws. Of these teeth the upper canines are far the largest and strongest, and must form powerful weapons of offence and defence; the ~~th~~ teeth were not removed so that the fangs were not examined. The first premolar resembled the canine tooth in being more prolonged down on the outer side, the second premolar (of the upper jaw) is larger slightly than the preceeding tooth, more resembling the corresponding tooth in man. The molars present much sharper cusps than are seen in man; in the upper jaw they decrease in size slightly from before backwards. In the lower jaw the canines are much less powerful than in the upper . The premolars are of a more equal size,

the first being if any thing slightly larger than the second. The molars also are of more equal, size but present the same sharpness of the cusps;in both jaws they seem to have four cusps.

The canines are chisel-shaped and smooth on the outer surface.

In all the Old World or Catarrhine apes,if we exclude the Lemurs,we find that the dentition presents the same formula as in man,whereas the New World or Platyrrhine apes vary in their formular,usually having an extra premolar or molar and sometimes both.

There was a well marked os centrale in the carpus lying between the trapezoid,os magnum,scaphoid and semilunar.(the carpus of the opposite side was examined for this bone). Primrose[1.] mentions having found this bone in the wrist of the orang lying in much the same position,'hat it is always found in the orang has long been established, but still it is not recognised widely as being present in some of the gibbons. It was Rosenberg[2.]'s work, following that of Gegenbaur on the limb skeleton,which first brought man into line with the lower animals in this respect. He showed that the os centrale is always present in the carpus of man during foetal life,but it remained for Lebouc[2.]q and von Bardeleben[2.] to show that it fused with the scaphoid and did not merely disappear by absorbtion as Rosenberg was of opinion. The bone fuses with the scaphoid giving

1. Primrose "The Anatomy of the Orang Outang" p. 41.
2. Quoted by Wiedersheim. Loc. Cit. p. 80

Fig 1.

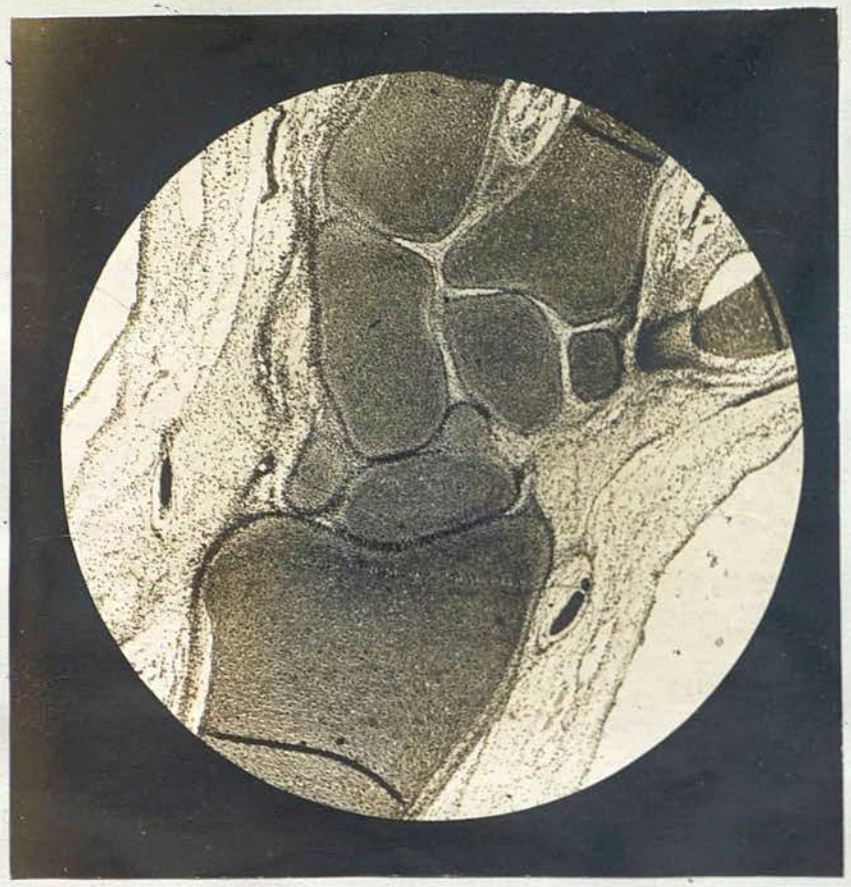
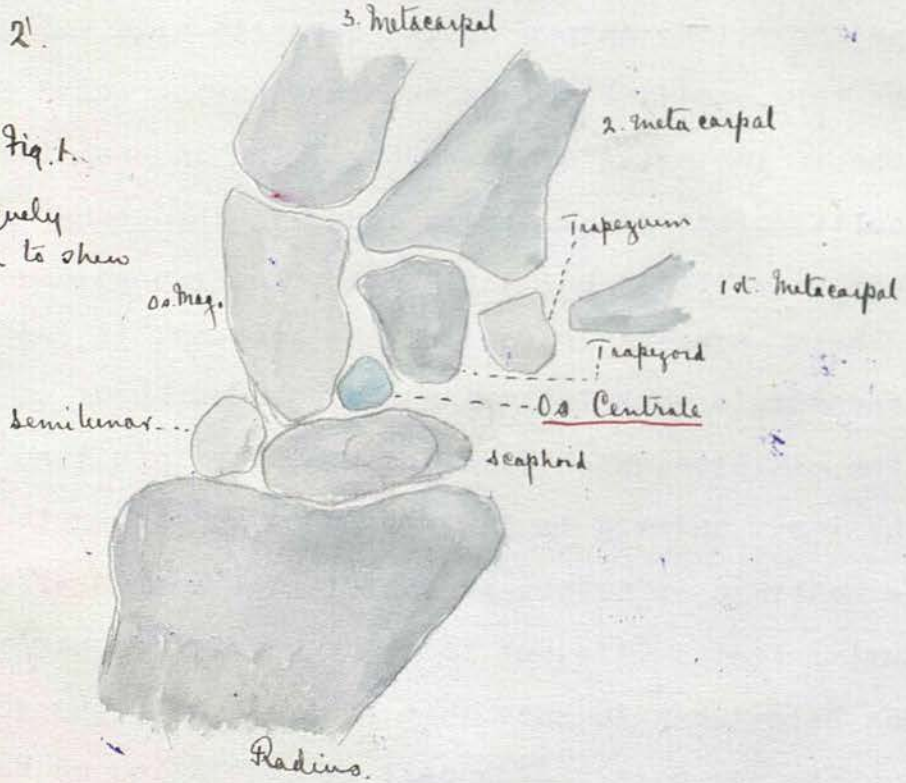


Fig. 2.



Explanation of Fig. 1.

Carpus Cut obliquely about the 8-9th week to shew Os. Centrale in man.

to that bone its square appearance in man;sometimes it forms a prominence, and Wiedersheim (to whom I owe the above references) states that: "This prominence is present also in the chimpanzee,the gorilla,and Hylobates;"

There was no prominence needless to say in the scaphoid of this ape,rather the bone gave the appearance of having a waist;it was hollowed in fact where it articulated with the os centrale. In a set of sections cut,through a foetus of about the 8th.or 9th. week or perhaps a little older,showing the carpus by Dr. Shepherd, I had an opportunity of seeing a very good example of this os centrale in its cartilaginous state lying in close relation to the ~~carpus~~ scaphoid;the serial sections showed that it lay at the posterior part of the wrist. The occurrence of this bone in the carpus has,by some,been thought to be in favour of the idea that a heptadactyle type of hand preceeded the now pentadactyle type.

The occurrence of another bone which is possessed by this ape is also thought to point in the same direction. This is the sesamoid bone found in the tendon of the extensor ossis metacarpi pollicis,and which is situated so as to articulate with the front of the scaphoid and upper part of the ridge of the trapexium. This bone occurs with great frequency in the orang, though often of small size.Hepburn[1] found it present in the orang, gibbon and chimpanzee. This structure is looked on, by those in favour of the heptadactyle type,as the

1. Hepburn. M.S.S. of Thesis in University Library. Edinburgh. Vol. III.

remains of a prepollex. Thilenius[1] found the "praetrapezium" in four case in 113 hands. He also described 13 supernumerary bone like the os centrale in the carpus of the foetus (human) from the second to the fourth month, their cartilaginous appearance differing in no way from the appearance presented by the normal eight bones of the carpus, and uniting later with the carpal and metacarpal bones in their vicinity. Born[2] in examining the tarsus of amphibians figures a supernumerary digit added on to the tibial side of the limb of Rana esculenta, consisting of three segments united by joints and attached to the same carpal elements as the first metatarsal. Baur,[3] in an investigation carried on in the reptilian carpus, comes to the conclusian that the prepollex element is the true radiale of the carpus which has been crowded out, ~~the~~ its place in the carpus having been usurped by the radiale centrale, and thus contraverts the supernumerary digit theory. Baur also contends that the results of Palaeontological investigation are in favour of the view that terrestial Vertebrata never ~~never~~ possessed more than five digits.

On the other hand von Bardeleben[4] is strongly of opinion that the heptadactyle theory is the right one, and points to two skeletons of South African rodents (Pedetes capensis) in which there was a prepollex possessing a nail and a postminimus in which there were two segments. The same writer draws attention to the fossil of Theriodesmus phylarchus, an animal which was apparently

1. G. Thilenius. Anatomischer Anzeiger IX. 1894. p. 665.
2. G. Born. Morphologisches Jahrbuch Vol. I. 1876 p. 346
3. G. Baur. Anatomischer Anzeiger. 1892. p. 206.
4. K. Bardeleben. Anatomischer Anzeiger 1890. p. 435

a reptile with mamalian characteristics,and was found in the Mesozoic beds of South Africa. There are the elements here of a praepollex situated between the scaphoid, centrale,and trapezium. Fick[1] in discussing this the oldest known animal draws attention to the fact that even here the all that is seen is a 'rudiment';he thinks therefore that it is very unlikely that the original vertebrates really possessed a true praepollex. In the ordinary frog where there is the well marked praehallux which is familiar to all Students of medicine it is still in a cartilaginous condition, and so is unlikely to be preserved well in a fossilised condition. The solution of this question must be left in the hands of the palaeontologist of the future,but it is very difficult to form an opinion,at this date,which differs from that ordinarily accepted,and much stronger arguments will have to be brought forward than have hitherto been produced if the heptadactyle theory is to suceed in replacing the pentadactyle type as the type from which all others in the higher animals have sprung.

1. Fick. Archiv. fur. Anat. und Phys. Anat. Abth. 1895. p. 27.

INTRODUCTION.

Perhaps the most striking external feature of the gibbon is the enormous length of the upper extremities. This fact arrests the attention at once, for the fore arm and hand of this animal measured 5 cm. more than the length of its whole trunk from vertex to callosities.

The following were some of the measurements taken to ilustrate the lengths of the various bones etc:

Length from the vertex to the ischial tuberosity 41 cm.

Do. from the tip of the acromian process to the external condyle 25 cm.

Do. from the external condyle to the tip of the middle digit 46 cm.

Do. of upper extremity (last two figs. added) 71 cm.

Do. from tip of trochanter to the knee 21 cm.

Do. from the knee to the end of the middle toe the foot being brought into line with the leg 32 cm.

Do. for the whole limb (last two added together) 53 cm.

Do. of humerus 25 cm.

Do. of radius 29 cm.

Do. of ulna 29.5 cm.

Do. of femur 20.8 cm.

Do. of tibia 18.8 cm.

Do. of fibula 17.3 cm

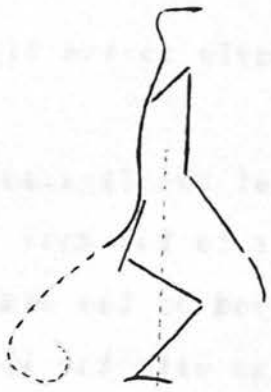
Do. of 3rd. metacarpal 5.7 cm.

Do. of the first phalanx of the same digit 4.5 cm.

Do. of 3rd. metatarsal 4.5 cm.

Do. of the first phalanx of the same digit 3 cm.

Fig. 3



"Outline diagram of an Ape in its so called erect position" (after Goodsir)
page 284. Anatomic. Memoirs. Vol. I.

INTRODUCTION.

From these figures it will be seen that it is in the upper limb that this ape differs so markedly from man. Quain gives the average human humerus as being 13 inches in length in the male and 12 in the female. As this ape was a female it is with this sex that we must compare it to in man, and here we find the humerus of the gibbon is to that of the human female as 29 is to 30.4 (12 inches equal 30.4 cm.). Now in man the numerus is nearly equal to one fifth of the stature of the individual, so that a person with a humerus of 12 inches would stand a little over 5 ft., say 5 ft.3 ins. Calculating the height of the gibbon, supposing it was capable of extending its knee and standing upright to its full height, a thing it is quite incapable of doing, we should get 41 cm. for its trunk, 20.8 for its femur, and 18.8 for its tibia; these added together would give us 80.6 cm. The amount gained by the fact that the acetabulum is at a higher level than the ischial tuberosity is more than enough to compensate for the loss in not accounting for the os calcis and astragalus. So that the height of the ape will not exceed 31¾ inches, or 2 ft. 7¾ ins. Judging the stature of the ape from its humerus, according to the rules formulated for the human subject, the height of the ape should be 125 cm. (25 multiplied by 5), this means a stature of 4 ft. 1½ ins. at least. The great difference in proportion of the two humeri is thus rendered apparent, even when the calculation is made with every thing unfavourable to the ape.

INTRODUCTION.

The anti-brachial or humero-radial index is calculated by multiplying the length of the radius by a hundred, and dividing by the length of the humerus. Therefore here the length of the radius (29) multiplied by 100 and divided by the length of the humerus (25) equals an index of 116. This may be compared with the table given in Quain for the different races and the anthropoids.

The brachio-radial index for the	Eskimo is	71
Do.	European is	74
Do.	Australian is	77
Do.	Negro is	79
Do.	Andamanese is	81
Do.	Gorilla is	80
Do.	Chimpanzee is	90
Do.	Orang is	100

None of the above figures rise to the same height as those of the gibbon, so if we have seen that the humerus is prolonged out of all proportion to its body length we see by this table that the radius is greatly elongated as compared with the humerus.

The human foetus and infant it is noted has a higher index than the adult ; this means that the foetus and developing child are less differentiated from the anthropoids than is the adult human being.

HAND AND FOOT.

The hand of this animal is very remarkable for its great length as compared with its width; measured from the wrist joint to the end of the middle digit it was 15½ c.m. long while its width at the widest part, just below the root of the little finger, did not exceed 3¼ c.m. This great length is due to development of both metacarpals and phalanges, and of these the proximal phalanges are the ones which seem to have developed most.

The thumb is short proportionately to the rest of the hand, reaching only to just below the level of the metacarpo-phalangeal articulation of the 2nd. digit, and not as far as the free edge of the web between the index and the middle digits. In man the thumb reaches to about the level of the first inter phalangeal articulation, while the inter phalangeal articulation of the thumb is at the level of the metacarpo phalangeal articulation of the 2nd. digit. The web of the thumb is very small, not reaching to half way down the 1st. metacarpal, giving the appearance almost as if the hand and thumb sprang separately from the region of the wrist. The thenar and hypothenar eminences are very small and ill-developed; the latter can hardly be said to exist. The webs of the fingers are much more extensive than in man, reaching nearly half way down the proximal phalanges, and by this means the palm appears longer and the fingers shorter than is really the case. This extensive webbing also prevents the fingers being separated to any marked degree. The fingers are placed parallel to one another, and bend into the palm ~~at ri~~ without any

× numbers refer to fig. next page. Fig 4.

HAND AND FOOT.

inclination to-wards the thumb;the middle finger is the longest.

The colour of the skin on the palm is very dark(darker than shown in the plate). Owing to the sodden condition from long immersion in spirit the superficial horny layer of the skin was inclined to come off in flakes.

The chief creases seen on the palm were as follows.

(A) x. Opposite the radio-carpal articulation there is a transverse groove due to the flexion which takes place here;from the mid point of this groove another groove

(B) runs downwards and outwards to become the deep cleft which intervenes between the pollex and the palm;this is due to the opposability of the thumb. An oblique line is

(C) also seen passing from this region downwards and inwards to about half way down the palm.The cause of this line is not so evident as the muscles of the hypothenar eminence are very rudimentary.A certain amount of shrinkage must also be allowed for due to the storage in spirit for many years,but still a line similar to this one will be noted later in the foot. Crossing

(1) x this last line is the first or highest transverse line of the palm situated about 1½ c.m. in front of the wrist line,this is the least marked of the three trans-

(2) -verse palmar lines. The second transverse palmar line is somewhat curved with the concavity upwards, the lowest part being about 3 c.m. below the wrist line.

(3) The third or lowest transverse palmar crease is the best marked of the three,situated about 4 c.m. from the wrist crease,being also curved with the concavity

These numbers refer to the photo. D.F.

fig 4. Hand of Gibbon.

Owing to the hook like position the tips of the fingers are out of focus.

directed upwards;this is just above the level of the metacarpo-phalangeal articulation. These three lines are due to the flexion caused by the long tendons of the fingers, for it should have been noted that the natural position of the hand of the animal was that of a hook formed by the palm and fingers, it being impossible, without using condiderable force, to extend the fingers completely when the wrist was not in a position of flexion, The cause of the curve will be touched on again.

Running down the centre of the palm to the root of the middle digit was a well marked longitudinal grease; to the outer side of this was a less marked crease passing to the cleft between the index and the middle digits, These together with the cleft separating the pollex from the palm were caused by the adductors of the thumb, the contrahentes and the palmar iterossei which during flexion cause the digits to converge towards the central digit, This is probably also the cause of the curve on the two lower transverse creases of the palm, owing to the convergence of the metacarpals.

See Plate I in Cover.

(4) At the roots of the fingers and level of the webs there were deep creases, transverse in the case of the middle digits and sloped in the case of the others, so that the concavity presented by continued line was as before, curved owing again to the cause given above. The fingers are long and slender, with remarkably flat palmar surfaces; they all to a greater or less extent show a crease running up the centre on the palmar

surface. This is best marked on the middle digit. There are two lines opposite the first interphalangeal joint with about 1c.m. between them. This is what gives the appearance of there being four elements and three joints in the long finger as seen in the plate, No.1. The lines opposite the second interphalangeal articulations are marked by many lines, except in the case of the little finger, where one well marked line takes the place of the many faint ones of the other fingers. The thumb has a series of oblique lines on the ~~hypo~~thenar eminence with marked lines opposite the joints, two being opposite the last. The terminal phalanges of the fingers and thumb are patulous and projecting, the ~~nail~~ free part of the nail being some distance from the back of the phalanx. This was more marked in the case of the thumb.

The nails were absent except that of the little toe, but the nail bed showed the character of the attached part of the nail; how far the nial projected was unknown.

The nail on the thumb was shorter, broader and less arched and therefore more human than on the other digits, which became longer, narrower, more arched and claw-like as one passed inwards to the little finger.

Wiedersheim notes that the same change is present in man as one passes from the thumb to the little finger.

The nail fold was well marked in all, as was also the lunule. There were fine lines seen running longitudinally on the nail bed parallel to one another as in man.

Fig. 5 Skin from the palmar surface of the digits of the hand. to show the Characters of the fine lines.

HAND AND FOOT.

The fine lines on the hand of the animal are much coarser and stronger than those on the hands of man. This is shown by the fact that they pass uninterruptedly across the creases in the palm. When one remembers that it is by the friction of these lines that the hand is able to take such a firm hold on objects, it is not to be wondered at that in the hand of an animal which is used as an organ of grasp simply the lines should be better marked than in the hand of man where the hand is not used always to take a firm grasp of objects, but is used as an organ which carries out many and varied highly specialised movements.

The arrangement of these fine lines is as follows; there is a whorl on the thenar and hypothenar eminences, better marked on the latter; in the palm, which is very flat, the lines pass parallel to each other longitudinally down the palm, going as stated uninterruptedly through the palmar creases, a thing they do not do in man.

On the fingers they are peculiar, for they present the appearance of mountain marking (the way mountains are depicted in maps) the lines converging on the crease which has already been described as running down the centre of each finger. This is better seen on the first and middle phalanges where the weight of the body rests when the hand is in its ordinary hook-like position and the animal swinging from a bough. The mountain marking was also best marked on the middle and

Fig. 6

Man.

Fig. 7

Ape.

Outline diagrams of the skeleton of the hand of Man as Compared with that of an ape. The dotted lines indicate the direction of the movements at the Metacapo-Phalangeal joints. (after. Goodsir)[1].

1. Anatomical Memoirs. of John Goodsir. Vol. 1. p. 239. Edited by Turner
2. Journal of Anat. & Phys. 1893.

4th digit, not being so distinct on the first phalanges of the little and index fingers, where the lines have a tendency to pass down the digits and converge on the middle digit, where presumably the stress of weight will be greatest. In the human hand there is still a tendency for the fine lines of the index and little fingers to converge towards the middle finger. Mechanically there is an advantage in the lines not being placed transversely, for there is less tendency to slip in lines placed in a slanting manner than in lines placed transversely to the force which in this case is the weight of the ape's body. For this reason the wheels of steam traction engines are provided with lines on their ~~wheels~~ surface which are sloped in the same manner as these lines on the fingers.

Professor Goodsir[1] pointed out many years ago that the hand of man was the only perfect hand, that the hand of an ape was fitted to grasp a cylinder such as the branch of a tree, but was unable to grasp a sphere in the same way as the hand of man. Hepburn[2] has compared the hands of the four anthropoids with that of man, and shewed how the development in the latter of the muscles of the thumb and little finger has modified the lines. In man the increased amount of opposition, and the increased development of the muscles which produce that movement, has caused the lines to become more obliquely set. In the gibbon the fingers are capable

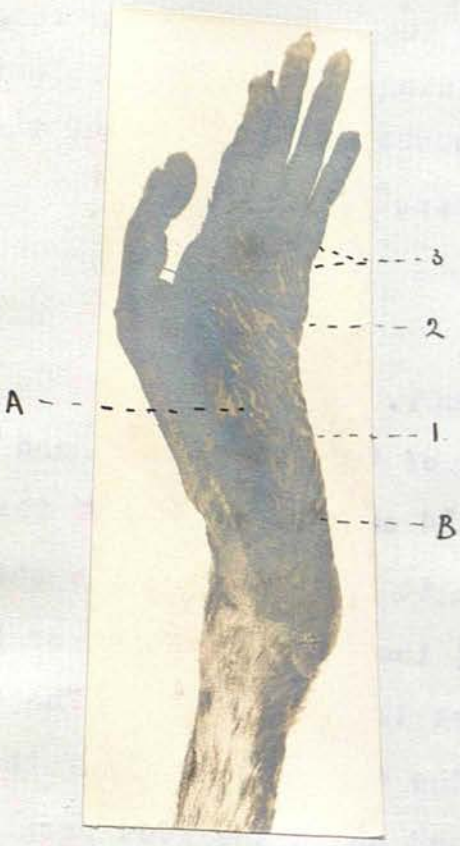
of flexion into the palm parallel to one another, and also of a certain amount of convergence towards the central digit, thus causing the transverse and longitutinal creases respectively. The diagrams opposite illustrate the difference of the movements in the hand of the ape as compared with that of man.

THE FOOT.

The foot, from the point of the heel to the end of the middle toe, measures 14 cm. in length, Of this length two thirds belong to the sole and one third to the toes. The width of the sole exclusive of the hallux, at its widest part is only 2.6 cm. The hallux reaches to the level of the second phalanx of the second toe; it is not bound up in the foot parallel to the other toes, as is the case in man, but is free from just beyond the mid point of the sole, being marked off before this point by a deep crease. The hallux is a much more powerful digit than is the thumb. The toes all have a tendency to point outwards, being set at an angle to the long axis of the sole; in flexion they bend inwards towards the hallux . The web reaches nearly half way down the first phalanx and prevents any marked separation of the four outer digits.

(A) CREASES.- On looking at the sole of the foot it is seen to be divided into two unequal parts by a longitudinal crease which starts on the inner side of the heel and passes forwards to the cleft between the great toe,

Fig. 8 Foot of Gibbon.



Oblique lines are lettered
Transverse lines are numbered.

1. Loc. Cit. Journ. of Anat + Phys. 1893.

the one half carrying the great toe the other the four outer toes.

(B) A crease starts with the last one and runs obliquely forwards and outwards in front of the heel (see plate 1.) It is situated about 3 cm. in front of the point of the heel. A better marked crease is situated about 5 cm. in front of the point of the heel, This passes almost transversely across the foot and even on to the halluk.

(1.)

A still deeper crease passes transversely across the foot at a distance of 7 cm. from the point of the heel. This crease is the best marked of all the transverse creases mentioned so far, and corresponds to the meta-tarso-phalangeal articulation, the flexion of the digits causing the crease. It corresponds to the place where the two lines of the foot meet at an angle, the one running in the long axis of the sole and the other in the long axis of the middle toe. At the root of the four outer digits there is a double crease caused also by the flexion of these digits. Hepburn[1] notes another line which he figures in the sole of the foot of the gibbon, This runs longitudinally down the centre of the sole towards the middle digit. This line he ascribes to the action of the adductores (contrahentes) muscles, It was not present in this ape, and it is extremely interesting to note afterwards that the adductores muscle were not found either, except in the case of the great toe. The creases and lines on the toes correspond to those found on the fingers, but were not so well marked.

(2.)

(3)

The fine lines on the sole, exclusive of the part bearing the hallux, started from the mid point of the heel and passed in wide curves to the margins of the foot. Those on the outer side passed forwards and outwards, those in the centre passed forwards with a slight inclination inwards, while those on the inner side passed forwards and inwards to the cleft between the hallux and the rest of the foot. This same arrangement repeated itself on a smaller scale starting from the mid point of the 'thenar eminence' of the great toe.

The same remarks that were made upon the nails of the fingers apply to the toes, The terminal phalanges of the digits of the foot were if anything more bulbous than those of the hand.

The above description will show that there is much less in common in the feet of the ape and man than there is in the hand of the ape and that of man. The ape's foot resembles a hand, and some think that it resembles a hand more than it does a foot. As we shall see later the middle digit of the ape's foot and hand are the same, namely the third, while in man the middle digit of the ~~hand~~ foot is the second. The apparent difference between the two extremities in man is due merely to specialisation, The hand, to use Goodsir's words, is used "as an instrument for acting on matter, in terms of his human faculty of thinking in space" while the foot is simply used as an organ of support and progression, enclosed in a boot which precludes its use for any other purpose, in the

Fig. 9.

Man.

Fig. 10

Ape.

Outline diagrams of the foot of an Man and an Ape.
The dotted line shows the direction of movement.
at the Metatars-phalangeal Joints — in Man. outwards
in the Ape inwards

From. Goodsir's Memoirs

European at all events. In the natives of India where custom does not confine the foot to a boot, the foot has preserved to some extent its prehensible power.

In the ape it is a more useful instrument as a hand than is the extremity of its upper limb, being far more capable of grasping a sphere than the hand is, grasping and progression in arboreal animals being to some degree synonymous. The reason why the digits can not be spread out in the ape is due very largely to the fact that the digits are webbed so far down; both in the fingers and toes the web reaches to the middle of the first phalanx,—the thumb and great toe are less webbed and are very efficient digits in the ape. In man where the great toe is webbed and bound to the rest of the foot it is useless for independent action, except in the case of the natives cited above. Goodsir's diagrams shew the difference of the opposition found in the foot of the ape to the flexion found in the foot of man. In the ape the digits flex towards the hallux, and may, as in this case, be set at an angle the better so to do, while in man the digits flex away from the hallux.

In dealing with the muscles of the back the main part of the erector spinae will not be touched on, only the three superficial layers being dealt with here, the muscles of the head and neck being described elsewhere. These layers are arranged in the same manner as those in man, the first consisting of the two muscles trapezius and latissimus dorsi; the second layer, of the rhomboius and levator anguli scapulae; the third layer, of the two serrati postici, inferior and superior.

THE FIRST LAYER OF MUSCLES OF THE BACK.

THE TRAPEZIUS.

ORIGIN.- Owing to the mid section of the specimen the origin could not with certainty be made out, but apparently the muscle did not reach up to the occiput. As far as could be ascertained it arose from (1) the lower two-thirds of the ligamentum nuchae, (2) the spines of the 7th. cervical vertebra and the spines and supra spinous ligaments of the upper 7 dorsal vertebrae, (3) from the fascia covering the muscle.

INSERTION.- Into the upper and posterior surfaces of the outer third of the clavicle, inner margin and upper surface of the acromion process, and the upper edge of the spine of the scapula in its outer two-thirds.

There was no tubercle at the base of the spine for the insertion of the lower fibres as in man.

NERVE SUPPLY.- From the spinal accessory and the 3rd. & 4th. cervical which spread out under the muscle forming the suttrapezial plexus.

STRUCTURE.- The muscle is covered by a very dense

fascia which serves to bind the coarse fibres together. There is a notable tendency for the fascia and at the outer end of the clavicle, even for the muscular fibres to past over the bone into the muscles which lie on the opposite side viz. the deltoid and pectoralis major.

RELATIONS.- Superficially the muscle is subcutaneous and is pierced by the cutaneous branches of the posterior primary divisions of the spinal nerves. Deeply there are the splenii, omo-hyoid, levator anguli scapulae, omo-cervicalis, rhomboids and the posterior part of the origin of the deltoid, the spinal accessory nerve and the 3rd. & 4th. cervical.

THE ~~TRAPEZIUS~~ MUSCLE. LATISSIMUS DORSI.

ORIGIN.- Owing again to the mid section the origin from the spinal column was rather uncertain.

(1) From the 7th. and perhaps from the 6th. dorsal to the 12th. dorsal spine with the supra spinous ligaments, (2) by means of the posterior layer of the lumbar aponeurosis, from the spines of all the lumbar and the upper sacral vertebrae and the posterior half of the iliac crest, (3) from the 6th. to the 12th. ribs by digitations which, in the case of the lower ones, interdigitate with those of the external oblique, but in the case of the upper ones the fibres of the two muscles are practically continuous, (4) from the fascia over the intercostal muscles. There is no slip from the back of the lower angle of the scapula.

REGION OF THE BACK.

INSERTION.- By means of a short tendon into the inner lip and bottom of the bicipital groove in conjunction with the dorso-brachialis;a slip from the tendon goes to the teres major. There is an indirect insertion through the dorso-epitrochlearis muscle into the inner head of the biceps and so into the forearm.

STRUCTURE.- The upper fibres pass almost straight to their insertion with a slight inclination upwards, the anterior fibres pass upwards and backwards, while the intermediate ones show all degrees of obliquity. As the muscle passes to its insertion it becomes twisted on itself in such a way that the fibres which arise highest behind are inserted lowest, while those in front are the highest at the insertion, the posterior surface of the muscle behind becoming the anterior at the axilla, the teres major muscle being lodged in the groove thus formed. The tendon splits, the larger part going in front of the teres major, the smaller behind, ~~they join together and~~ The tendons of the two muscles join together and from the front of the fused tendon the dorso-epitrochlearis muscle arises.

RELATIONS.- The muscle is subcutaneous except at its insertion; the lateral cutaneous branches of the intercostal nerves pass back over its anterior border; behind, the muscle is not overlapped by the trapezius.

Deeply there are the inferior angle of the scapula with the muscles attached, deltoid and teres major, the serratus magnus, lower intercostals and ribs with the vertebral aponeurosis. The muscle is pierced by the cutaneous nerves posteriorly.

NERVE SUPPLY.- This is double as in man, being chiefly supplied by the long subscapular which enters the muscle near its insertion and sends branches over the deep surface; it is supplied to a lesser extent by the middle subscapular nerve.

THE RHOMBOIDS.

These are not differentiated into two muscles as in man, but form one continuous sheet.

ORIGIN.- From the lower part of the ligamentum nuchae the spines and supra spinous ligaments of the 7th. cervical and upper 3 or 4 dorsal vertebrae.

INSERTION.- Into the vertebral border of the scapula in its lower three-fourths.

NERVE SUPPLY.- By the nerve to the rhomboids which runs down the anterior surface of the muscle.

STRUCTURE.- The muscle is composed of parallel bundles of fibres which run downwards and outwards to their insertion.

RELATIONS.- The muscle is covered by the trapezius, except at the angle of auscultation, where the lower border of the muscle is seen, Anteriorly there are the vertebral aponeurosis, serratus posticus superior, the nerve to the rhomboids and the posterior scapular vessels.

THE LEVATOR ANGULI SCAPULAE.

ORIGIN.- The transverse processes of the upper three cervical vertebrae by three tendinous digitations.

INSERTION.- Into the superior angle and upper part of the vertebral border of the scapula.

STRUCTURE.- The muscle arises by its pointed digitations from which the fibres arise, These remain separate till near their insertion, f the three parts the upper is the smallest, the middle the largest and the lowest is intermediate in size. At the insertion the fibres blend very markedly with those of the upper part of the serratus magnus.

NERVE SUPPLY.- The upper digitation from the loop between the third and fourth cervical nerves; the two lower divisions are supplied by the fourth by a large nerve, Both nerves enter the muscle on its superficial surface under the omo cervicalis muscle.

RELATIONS.- Superficially the muscle is in relation to the trapezius, splenius capitis, omo ~~hyoid~~- cervicalis, spinal accessory nerve and its connections with the 3rd cervical, the ascending cervical artery and a large vein going to join the transverse cervical vein and coming from the splenius. Deeper than the muscle lies the splenius colli, deep muscles of the neck, vertebral aponeurosis, serratus posticus superior and the posterior scapular artery with the nerve to the rhomboids. The muscle is twisted on itself in such a way that the surfaces which at its origin are anterior and posterior are at the insertion outer and inner.

THE SERRATUS POSTICUS SUPERIOR.

ORIGIN.- From the lower part of the ligamentum nuchae and the spines of the 7th.Cervical and upper 2 or 3 dorsal vertebrae;the mid section of the body had rendered the exact origin uncertain.

INSERTION.- Into the outer surfaces of the upper 4 ribs and the upper border of the 5th. and into the fascia over the intercostal muscles.

NERVE SUPPLY.- This was not found entering the muscle, but branches of the 2nd. & 3rd.intercostal nerves were found passing backwards at the posterior part of the intercostal spaces,which were believed to be the branches of supply.

STRUCTURE.- The muscle is flat,thick and fleshy above, but tailing away below where it could not be separated from the vertebral aponeurosis. That part which went to the upper two ribs was fleshy.

RELATIONS.- The muscle lies on the posterior part of the chest wall;situated deeper than the muscle are the erector spinae muscles,ribs and intercostals,while superficial to the muscle are the serratus magnus, rhomboids and the posterior scapular vessels and nerve.

THE SERRATUS POSTICUS INFERIOR.

ORIGIN.- From the spines of the 9th.or 10th. Dorsal to the 2nd.or 3rd. Lumbar by means of the posterior layer of the lumbar aponeurosis and the vertebral aponeurosis.

INSERTION.- Into the outer surfaces and lower borders of the 9th. to the 12th. ribs inclusive, and into the fascia over the intercostal muscles.

NERVE SUPPLY.- Not found, lower intercostals ?.

STRUCTURE.- The muscle is fleshy near its insertion into the ribs, but its origin is all tendinous fibres which pass from the spines upwards and outwards to the fleshy portion which is placed obliquely, the lower part being the furthest out.

RELATIONS.- The muscle lies under cover of the latissimus dorsi, superficial to the erector spinae, ribs and intercostals. The 12th. intercostal and the last dorsal nerve are seen passing from under cover of the lowest part of the muscle when the external oblique is reflected.

1. Loc. Cit., Vol. 3. p 2.
2. Loc. Cit. p. 75.
3. Loc. Cit.
4. Loc. Cit., p. 89.
5. Loc. Cit., p. 20
6. Loc. Cit. Vol. 6.

THE TRAPEZIUS, (Comp. Anat.)

The origin of this muscle was partially destroyed, so it was difficult to be quite sure of its exact extent; it did not seem to reach the occiput, but may have done so,— it certainly did not pass below the 7th. Dorsal spine.

In other anthropoids Hepburn[1] notes it larger and the occipital part more extensive in the gorilla and orang. Duvernoy[2] on the other hand found the upper part attenuated and the muscle not passing down below the 9th. Dorsal spine in the gorilla, Cratiolet and Alix[3] found it more extensive in Troglodytes; Aubryi and Testut[4] did the same in Troglodytes niger. Primrose,[5] while noting that in his orang the muscle was distributed like that in man, points to the shortness of the upper fibres in that animal, together with those of the levator anguli scapulae, as the cause of the short neck in that animal.

The tendency seen in this animal for the fibres to as it were overflow the clavicle and acromion into the deltoid muscle must be looked on here as a modification acquired by the creature's habits. The continuation of these two muscles is seen normally in those animals without a clavicle, such as the horse, and according to Meckel[6] in the beaver in spite of the fact that there is here a clavicle.

THE LATISSIMUS DORSI, (Comp. Anat.)

Here the muscle had no attachment, except through the the lumbar aponeurosis, to the iliac crest, but is carried forwards to get origin from the ribs up to the 6th. showing a marked tendency for these lower fibres to be

continued into those of the external oblique muscle. In this way when the animal hangs by the arm the entrance to the axilla is almost lost, as the latissimus and pectoralis major are only separated by a narrow slit, and both are more or less continued up from the external oblique .

It is not out of place here to draw attention to certain facts in regard to the musculature of the upper limb which will have to be constantly referred to with the various muscles. The great fact that strikes one looking at the muscles which connect the upper limb with the body is their want of differentiation as it at first sight appears, but, on examining more closely and more especially when the animal is suspended by the hand, the want of differentiation disappears, or rather gives place to the idea of a musculature that is of a highly specialised nature, and which has been modified to suit the animal for special functions. The muscles appear to run into each other in an extraordinary way; we have seen that the external oblique is continued into the latissimus dorsi and the pectoralis major, how the trapezius tends to over run the clavicle and outer end of the acromion into the deltoid, but when the various muscles come to be considered individually it will be seen that the latissimus dorsi is continued into the large inner or short head of the biceps by the dorso-epitrochlearis, and that the biceps is directly continued into the flexor pronator mass on the front of the forearm; that the pectoralis major is blended with the deltoid and the short head of the biceps, and so on down to the forearm

again; that the deltoid is to a ~~less~~ large extent continued into the short head of the biceps and to a less extent into the triceps and brachialis anticus; that about a third of the brachialis anticus passes directly into the supinator longus muscle. From this it will be understood how the ripple of muscular motion can pass uninterruptedly from the level of the umbilicus ~~to the~~ to the muscles that move the hand. Such an arrangement of continuous muscular fibre without the intermediation of tendon must be caused by the need of the animal for a very high degree of muscular co-ordination; this the animal possesses to a marvellous extent. The closure of the axillary opening by the approximation of the pectoralis major and latissimus dorsi gives the appearance of the limb being surrounded by the primitive muscular sleeve, but it is chiefly due to the forward emigration of the origin of the latissimus dorsi so as to take a better grip of the body, not only by attaching itself to more ribs but through the mediation of the external oblique to the pelvic girdle, it is by this specialised musculature that the animal is enabled to perform those wonderful watch-spring-like movements which have rightly gained for the animal the title of 'Agilis'.

The gorilla exhibits a development in its latissimus dorsi which is probably caused by the great weight of the animal, for Bischoff reports that the muscle took origin not only from the crest of the ilium in its whole length but from the region of Poupart's ligament even.

1. Loc. Cit., Vol. 3. p. 4
2. Loc. Cit., p. 21.
3. Loc. Cit. p. 19.
4. Loc. Cit. p. 76
5. Loc. Cit.
6. Milne-Edwards. Mycologie des Sipunculus. 1868.

THE RHOMBOIDS,(Comp.Anat.)

There was nothing much to note of interest in these; they were fused into one,a condition found in many of the lower animals,There was no occipital origin as noted in the orang by Hepburn[1] and Primrose[2]. ~~and in the gorilla~~ by and the former noted that in the gorilla the origin went as low as the 6th.dorsal vertebra, showing that the muscles in man are the remains of a very much more extensive sheet in some of the lower animals.

THE LEVATOR ANGULI SCAPULAE,(Comp.Anat.)

This muscle which arose from the three upper cervical vertebrae is much more extensive in some of the other apes. In the orang Primrose[2] found it attached to the upper 3 C.Vert.,Fick[3] to the upper 7 C.Vert.,while Hepburn found it from the upper 3 C.Vert.with aslip from the mastoid process,This last slip was found in the gorilla by Duvernoy,[4] and in the chimpanzee by Gratiolet and Alix.[5] When the serratus magnus comes to be considered it will be seen that that muscle encroaches on the lower ~~in~~ cervical transverse or costal processes, so that it becomes evident that the levator anguli and the serratus magnus are merely portions segmented off from the one originally continuous sheet of fibres, as in the Siphneus where the sheet is attached to the transverse processes of all the cervical vertebrae and to the first 10 ribs(Milne-Edwards).[6]

THE SERRATUS POSTICUS SUPERIOR AND INFERIOR,(Comp.Anat.)

Both these muscles were larger than in man,and showed by the tendinous structure of the vertebral aponeurosis an indication of their belonging to one continuous sheet.

THE MUSCLES OF THE PECTORAL REGION.

These muscles include the pectoralis major and minor, the subclavius and for convenience the serratus magnus muscle. The first three of these muscles are arranged in three layers one behind the other; they are well developed, the pectoralis major and the subclavius being considerably more so than in man.

THE PECTORALIS MAJOR.

ORIGIN.-(1) From the front of the manubrium sterni and the sides and front of the gladiolus, (2) from the anterior and partly from the lower surface of the inner three-quarters of the clavicle and the front of the sterne-clavicular articulation, (3) from the cartilages of the upper six ribs, (4) from the aponeurosis of the external oblique which stretches up on the front of the retus abdominis. Some of the fibres of the external oblique are continuous with those of the pectoralis major.

INSERTION.- (1) Into the outer lip of the bicipital groove, being here blended with the short tendon of the biceps and anterior border of the deltoid, into both of which muscles it is inserted, (2) into the capsule of the shoulder joint by a slip which is reflected up and helps to bridge over the bicipital groove which is here very deep.

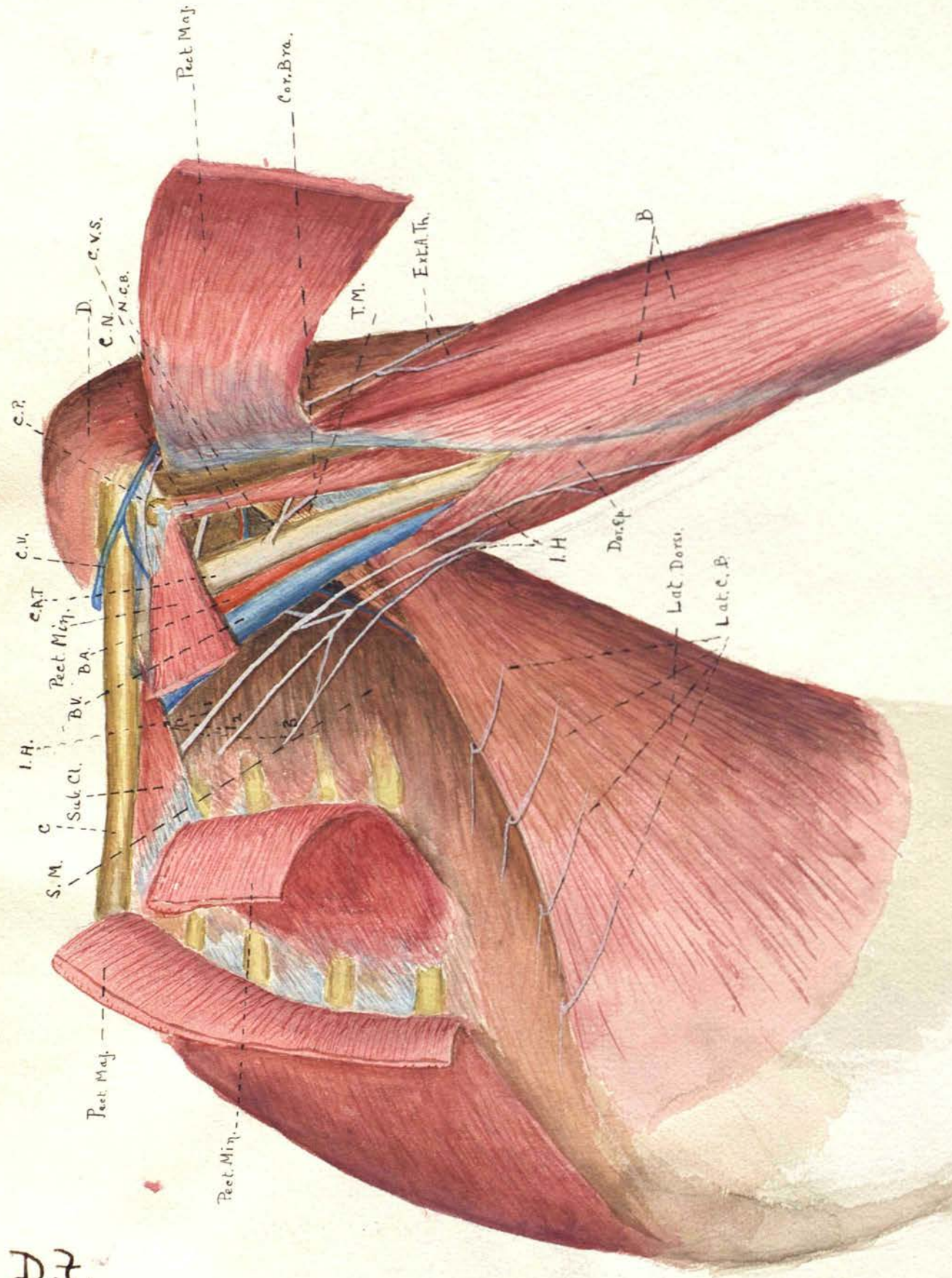
NERVE SUPPLY.- From both the external anterior thoracic nerves and the internal, the latter supplying it after having pierced and supplied the minor.

STRUCTURE.- The muscle is composed of thick bundles of

fibres which arise fleshy from their origin,except where the muscle is attached to the costal cartilages where short tendinous fibres are seen on its under aspect. The muscle can be divided,though not without some artificial aid,into three parts. An abdominal part which arises from the aponeurosis and fibres of the external oblique and the 5-6th. costal cartilages, This passes up under cover of,~~the~~ and becomes lost on the deep surface of the sterno-costal part. Tie sterno-costal part is very incompletely divided from the next or sterno-clavicular part,but a slight indication of division does exist,This is the largest part of the muscle,the fibres of which pass outwards and downwards to the arm where they become largely continued into those of the short head of the biceps. The third or sterno-clavicular part is thick,the inner fibres passing outwards and downwards slightly superficial to the last, the outer fibres passing nearly vertically downwards, both largely continuous with those of the deltoid.

RELATIONS.- Anteriorly the muscle is subcutaneous, The platysma does not arise below the clavicle, The mammary gland was very ill developed or had wasted,it was not certain which. Under cover of the muscle lie the pectoralis minor,subclavius,serratus magnus and intercostals,the coracoid process and the coraco-brachialis muscle and the third part of the axillary vessels and nerve trunk. At the lower border of the muscle there is seen the pectoralis minor appearing below the muscle. Between the muscle and the deltoid,lying in the groove,

Plate. II


Pect Maj.
Cor.Bra.
C.V.S.
N.C.B.
D.
C.N.
C.P.
T.M.
Ext.A.Th.
B
C.V.
C.A.T
Pect Min.
B.A.
B.V.
I.H.
Sub. Cl.
C
S.M.
I.H
Dor.Sp
Lat. Dors.
Lat.C.B
Pect Maj.
Pect.Min.

D.T.

EXPLANATION OF PLATE. II

The Plate shews the Axillary Region.

Pect.Min..... The Pectoralis minor.

Pect.Maj..... The pectoralis major.

S.M..... The serratus magnus.

C..... The clavile.

Sub.Cl..... The subclavius.

I.H...1,2,3.....The intercosto-humeral nerves.

B.V..... The axillary vein.

B.A..... The axillary artery.

C.A.T..... The common axillary nerve trunk.

C.V..... The cephalic vein.

C.P..... The coracoid process, just above lies the cutaneous branch of the external thoracic nerve.

D..... The deltoid.

C.N..... The circumflex nerve.

C.V.S..... The circumflex vessels.

N.C.B..... The nerve to the coraco-brachialis.

Cor.Bra..... The coraco-brachialis.

T.M..... The teres major.

Ext.A.Th..... The cutaneous twig of the external anterior thoracic nerve.

B..... The biceps.

Dor.Ep..... The dorso-epitrochlearis.

Lat.Dorsi..... The latissimus dorsi.

Lat.C.B..... The lateral cutaneous branches of the intercostal nerves.

Note that the attachment of the pectoralis major to the clavicle is not shewn.

are a branch of the thoracic axis artery,the cephalic vein and a cutaneous branch of the external thoracic nerve.

THE PECTORALIS MINOR.

ORIGIN.- (1) By fleshy fibres from the upper borders and anterior surfaces of the 2-3-4th.ribs and by a thin tendon from the corresponding place on the 5th. rib, (2)from the fascia covering the intercostal muscles in the 2-3-4th. spaces.

INSERTION.- Directly into the coracoid process and slightly into the tendon of origin of the coraco-brachialis muscle,while indirectly it is attached to the tip of the clavicle and acromion by the coraco acromial ligament,many of the fibres of which are the direct continuation of the tendon of this muscle. It should be noted that the acromion process overrides the thin outer end of the clavicle completely.In addition to this which is the main insertion there is a curious little slip of tendon which leaves the fleshy upper border of the muscle to be inserted into the front of the junction of the inner three fourths with the outer fourth of the clavicle.

NERVE SUPPLY.- By the internal anterior thoracic nerve which enters the deep aspect of the muscle nearer its lower than its upper border and after supplying it leaves the anterior surface to enter the major.

STRUCTURE.- The muscle is triangular in shape with a serrated base situated on the chest wall, the apex being at the coracoid process;the fassiculi of the

muscle are of a fine character.

RELATIONS.- In front is the pectoralis major, and below the lower border of that muscle a small part is subcutaneous. The deep surface of the muscle is in relation to the anterior thoracic nerves, the lateral cutaneous branches of the first three dorsal nerves, then external to them; appearing from under cover of the subclavius muscle are the ~~brae~~ axillary artery, vein and nerve and some of their branches.

THE SUBCLAVIUS MUSCLE.

ORIGIN.- (1) From about 1½ cm. of the anterior surface of the first rib, (2) from the front of the anterior extremity of the bony part of the second rib, and from its upper border for 2cm. slightly from the upper border of the 3rd. Rib. (3) from the fascia over the first 2nd. intercostal spaces.

INSERTION.- Into the inferior surface of the outer third of the clavicle.

NERVE SUPPLY:- From the nerve to the subclavius which comes from the front of the fifth cervical in common with fibres for the phrenic nerve. (see plate XIII. Vol 3. p 30)

STRUCTURE.- The muscle is flat and tendinous at its origin, but becomes fleshy and round towards its insertion into the under surface of the clavicle.

RELATIONS.- Superfially from above downwards there are the following structures in front of the muscle; the plavicle, pectoralis major strong band of fibrous tissue corresponding to the costo coracoid ligament in man, and then the pectoralis minor. It is also in relation to

some branches of the axillary artery,the cutaneous branch of the external anterior thoracic nerve and the communicating branch from the cephalic vein.

Between this muscle and the chest wall covered here by the serratus magnus are the lateral cutaneous branch of the first intercostal nerve,the axilary sheath containing from within outwards the vein,the artery,and the nerve. Lastly behind these structures there is the nerve of Bell supplying the serratus magnus.

THE SERRATUS MAGNUS MUSCLE.

ORIGIN.- (1) From the upper 11 ribs by digitations, (2) the fascia covering the external intercostals in the corresponding spaces.

INSERTION.- Into the vertebral border of the scapulae, its upper part being blended with the levator anguli scapulae.

NERVE SUPPLY.- From the external respiratory or the nerve of Bell.

STRUCTURE.- The muscle arises by digitations from the ribs along a curved line,which starting below and behind passes upwards and forwards to the 6th.or 7th.rib when a change of direction takes place and the line now passes upwards and backwards. From the second rib a very large digitation arises from a large area on the outer surface of the rib. The muscle is not arranged in one sheet, but is cleft into an upper and a lower fleshy part. The cleft is triangular with the base at the insertion. It is filled up by a layer of dense fascia which is continued from the upper to the lower portion.

The upper portion comes from the first rib and the back part of the second;it forms a thick strap-like muscle and is inserted into the front of the superior angle of the scapula, being blended with the levator anguli scapulae,and even receives a twig from the posterior scapular nerve. The lower portion is formed by the front part of the digitation from the second rib and the digitations from the ribs below the second;these form a muscle which is thin above but becomes thicker as one passes down.It is inserted into the ventral part of the inferior angle of the scapula and into the lower part of the vertebral border.

RELATIONS.- The lower part of the origin of the muscle lies under cover of the latissimus dorsi,which cuts the muscle off from the external oblique.In front of the latissimus dorsi the muscle is slightly continuous with the fibres of the external oblique. Above the muscle lies under cover of the two pectorals and the subclavius muscles,from which it is separated by the structures in the axilla.

THE COMPARATIVE ANATOMY OF THIS GROUP OF MUSCLES.

THE PECTORALIS MAJOR.(Comp.Anat.)

In this ape the muscle was very imperfectly divided up into its four primitve portionsviz:- the clavicular, the sternal,the costo-chondral,and the abdominal portions. In fact the upper three of these were fused, here was a separation of the lower part, which we may take to represent the abdominal portion, Although it was

Not shewn in Plate. II p. 42.

1. Loc. Cit., 1. p. 15. and 2. p. 298.
2. Loc. Cit. p. 26.
3. Loc. Cit. Vol. 3. p. 6
4. Loc. Cit.
5. Loc. Cit. p. 161.
6. Loc. Cit.

partially attached to the ribs as well as to the abdominal aponeurosis, its direction indicated that it was passing upwards and outwards to the great ~~tree~~ tuberosity, which is the old insertion of this portion, and well seen in Primrose's plates of the orang, but it was completely fused with the deep surface of the parts above it. The clavicular portion was partially separated and extended right out to the deltoid.* The sternal and costo chondral portions of the muscle were quite fused.

According to Bischoff[4] the lower apes never have a clavicular portion, while the gorilla, chimpanzee, and ~~orang~~ gibbon possess one. It would appear that the orang is the only anthropoid that the clavicular portion is not constantly met with, Primrose[2], Hepburn[3], Chapman[5], and Owen[6] did not find the muscle attached to the clavicle, while Fick[1] was able to find the clavicular portion in both his orangs and Bischoff found it in one. It would seem as if the clavicular portion had been an extension outwards of the sternal portion of the muscle, and later a segmentation off with the development of a cellular interval. In this ape there was no cellular interval although the extension was so great as to cause the fusion of the outer part with the deltoid. It is this portion which is left if possible ~~after~~ when the breast and muscle are taken away, in the human subject, for cancer of the breast; it is then able to hypertrophy to such an extent that very few movements of the arm are impeded.

1. Loc. Cit., Vol. 3. p. 7.
2. Loc. Cit. Vol. 1. p. 456.
3. Broca. Bull. Soc. d'Anthropologie 1869 Vol. IV. p. 316
4. Loc. Cit. 1. p. 16.
5. Loc. Cit.
6. Loc. Cit. p. 8.
7. Loc. Cit. 1. p. 209
8. Loc. Cit.
9. Loc. Cit. p 28.

MYOLOGY, UPPER LIMB.

PECTORALIS MAJOR. (Comp. Anat.)

This muscle has considerable interest attaching to it on account of the various ligaments which arise and are attached to the coracoid process into which it gains insertion, so that it is well to examine the condition of the muscle in the other apes and lower animals. The description given here coincides entirely with the description given by Hepburn[1]. It is evidently a mere slip on his part inserting it into the combined tendons of the coraco-brachialis and short head of biceps, as he describes the short head of the biceps subsequently as arising from the humerus. Hepburn states that the insertion of the muscle in the gorilla was into the tip of the coracoid process, in the orang near the base. In the chimpanzee the tendon passes above the process, and is continued outwards to be inserted into the capsule of the shoulder joint and the tendon of the supra-spinatus. The same observations have been made by other observers in the chimpanzee, Huxley[2], Broca[3], Fick[4], Vrolik[5], Testut[6], Bischoff[7], and Gratiolet and Alix[8]. The two last observers in Troglodytes Aubryi found a very complicated insertion into both tuberosities and into the back of the coracoid brac process by a reflected tendon. In the orang Bischoff found it resembling that of man and passing to the coracoid. Primrose[9] however found in the same species that it was inserted into the clavicle and acromion by fibres which were produced onwards from the main insertion into the coracoid. From a consideration of these

1. Loc. Cit. p. 56 et seq.
2. Loc. Cit., p. 28.

different insertions and their constant occurrence in the lower apes,Anatomists have been led to the belief that the gleno-humeral ligament is really only the degenerated end of this muscle. This view is however denied by Bland Sutton[1] who formulates the theory that the gleno-humeral ligament is really associated with the subclavius,and points out that the gleno-humeral ligament is inside the joint and that the pectoralis minor tendon when inserted into the humerus is always outside that structure. He moreover points out,I think conclusively, that the gleno-humeral ligament is part of the tendon of the levator humeri,which is the homologue of the subclavius muscle in birds. Sutton then states that he thinks the coraco-humeral ligament of the shoulder joint is the transformed tendon of the pectoralis minor,but here Primrose[1] joins issue with him. Primrose noting the various insertions met with in the apes,and the special insertion in his orang into the tip of the coracoid and over that into the clavicle and the acromion process,is induced to believe that the trapezoid portion of the coraco-clavicular ligament and the ~~acro~~ coraco-acromial ligament may be derivatives of this tendon,and he holds that Sutton is not warranted in coming to the conclusion he does.

As far as this dissection goes it furnishes evidence in favour of the opinion of Primrose as to the connection of the tendon with the coraco-acromial ligament. Although there was no slip to the clavicle,beyond the coracoid process,different to the slip to the acromion

1. Loc. Cit. p. 29.
2 Loc. Cit. Vol. 3 p. 9.
3. Loc. Cit Vol. 3. p. 13.
4 Loc. Cit.
5. Trans. Roy. Irish. Acad. 1871.
6. Loc. Cit.

Middle + Hunting Dan papers

I think that this one slip could quite represent the double arrangement found in the orang by Primrose, for the end of the acromion overlaps the outer end of the clavicle to such an extent that the ligament is attached to both bones.

SUBCLAVIUS. (Comp. Anat.)

This was comparatively a much larger muscle than is the case in man, for it arose from the upper three ribs passing down under cover of the pectoralis minor muscle. It is stated that this muscle is poorly developed in all the anthropoids (Primrose[1]). Hepburn[2]'s account does not seem to tally with this, for in his orang the muscle arose from the first and second ribs and in the gibbon from the second and third. Huxley however found the muscle only a mere ligament in the gorilla. In any case the muscle can not be of any very great importance.

THE SERRATUS MAGNUS. (Comp. Anat.)

This muscle was of interest because of the increased number of digitations by which it arose, by its division into two, and by its fusing with the leveator anguli scapulae. The increased number of ribs from which the muscle arises is found in many of the apes thus: Hepburn[3] found the muscle arising from 10 in the ~~pan~~zee, orang, 11 in the gibbon and chimpanzee, from all 13 ribs in the gorilla. Primrose[1] found it arising from 11 in the orang, Fick[4] from 12. In the gorilla Macalister[5] found the muscle arising from 10, and Bischoff[6] from 11 in the same species. So that in all the apes though

1. Loc. Cit. Vol. 3. p. 13.
2. Loc. Cit. Vol. II. pt. 2.
3. Loc. Cit. p. 181.
4. Wood. Proc. Roy. Soc. Vol. XV. p. 231.

the exact number seems to vary there is always a greater extent of origin than in man.

The division of the muscle into two portions, an upper and a lower, is apparently an uncommon thing to find in the anthropoids, Testut, Hepburn[1], Primrose, and Gratiolet and Alix mention nothing about it in their dissections. It is true that the second of these observers notes that the insertion in the gibbon was destroyed before there was an opportunity of examining it, this being the explanation of its not being reported in the gibbon. In the other apes however the muscle seems to always be inserted into the whole vertebral border as in man.

In man, however, it happens not unfrequently, that the muscle may be divided into three portions (Quain)[2] and sometimes the middle portion is defective.

This division of the muscle into two portions is the usual condition in some of the Cheiroptera, Maisonneuve[3], in the bat (Vespertilio murinus), found the muscle in such a complete state of division that he described it as two, "Le grand dentelé superieur et le grand dentele inferieur."

Wood[4] once noticed in a human subject, in whom the muscle did not arise beyond the 7th. rib, that on the right side there were two fleshy bands complete and distinct from the muscle which arose from the 9th. & 10th. ribs and were inserted into the lower angle of the scapula, with the lower fibres of the serratus; on the left side the same kind of supernumerary fibres were seen arising from the 8th. rib. These segmented portions he thinks

are the homologue of the depressor scapulae of Birds. Birds,according to the same author,have a muscle separate and distinct from the the serratus magnus lying posterior to it,arising from the lower end of the scapula and inserted into the outer surfaces of the ribs;this is greatly developed in the birds of prey the heron,and the penguin. In this ape only the lower fibres of the lower half could act in depressing the bone,the rest would powerfully rotate the scapula and draw it forward. Having a muscle arranged to control the upper and lower ends of the scapula,and produce powerful rotation round a pivot which would correspond to the attachment of the rhomboids,might be of service to the animal in swinging with its arms above its head. I find no explanation for the fact that in this ape and in man there should be a more powerful attachment developed in the case of the second rib than with any other.

Lastly the fusion with the levator anguli scapulae is to be explained by the fact that in many animals the two muscles form a continuous sheet of fibres; the serratus magnus arises from the thoracic ribs,while the levator anguli scapulae arises from the costal ribs or their remains.This is seen in the cat,horse, rat and many other of the common animals.

The muscles of the shoulder joint comprise the following muscles, the deltoid, supra spinatus, infra spinatus, teres major, teres minor and subscapularis.

THE DELTOID MUSCLE.

ORIGIN.- From (1) the front and under surface of the outer fourth of the clavicle, (2) the tip and outer border of the acromion process, (3) the lower border of the spine of the scapula in its whole length, (4) by means of a thick aponeurosis from the vertebral border of the bone below the spine and from the inferior angle, the infra spinatus taking origin from the deep surface and the teres major from the superficial surface of the same aponeurosis .

INSERTION.- Into the outer surface of the shaft of the humerus in its upper part, the insertion extending for a distance of 10 c.m. being broader above than below and occupying the bone on the outer side of the bicipital groove in common with the short head of the biceps and the pectoralis major. Below and in front it is inserted into the septum between it and the brachialis anticus, below and behind into that between it and the triceps.

NERVE SUPPLY.- By the circumflex which passing round the back of the humerus supplies the muscle on its deep surface, some of the twigs piercing the muscle and becoming cutaneous over it(see circumflex nerve page).

STRUCTURE.- The muscle is not so coarsely fassiculated

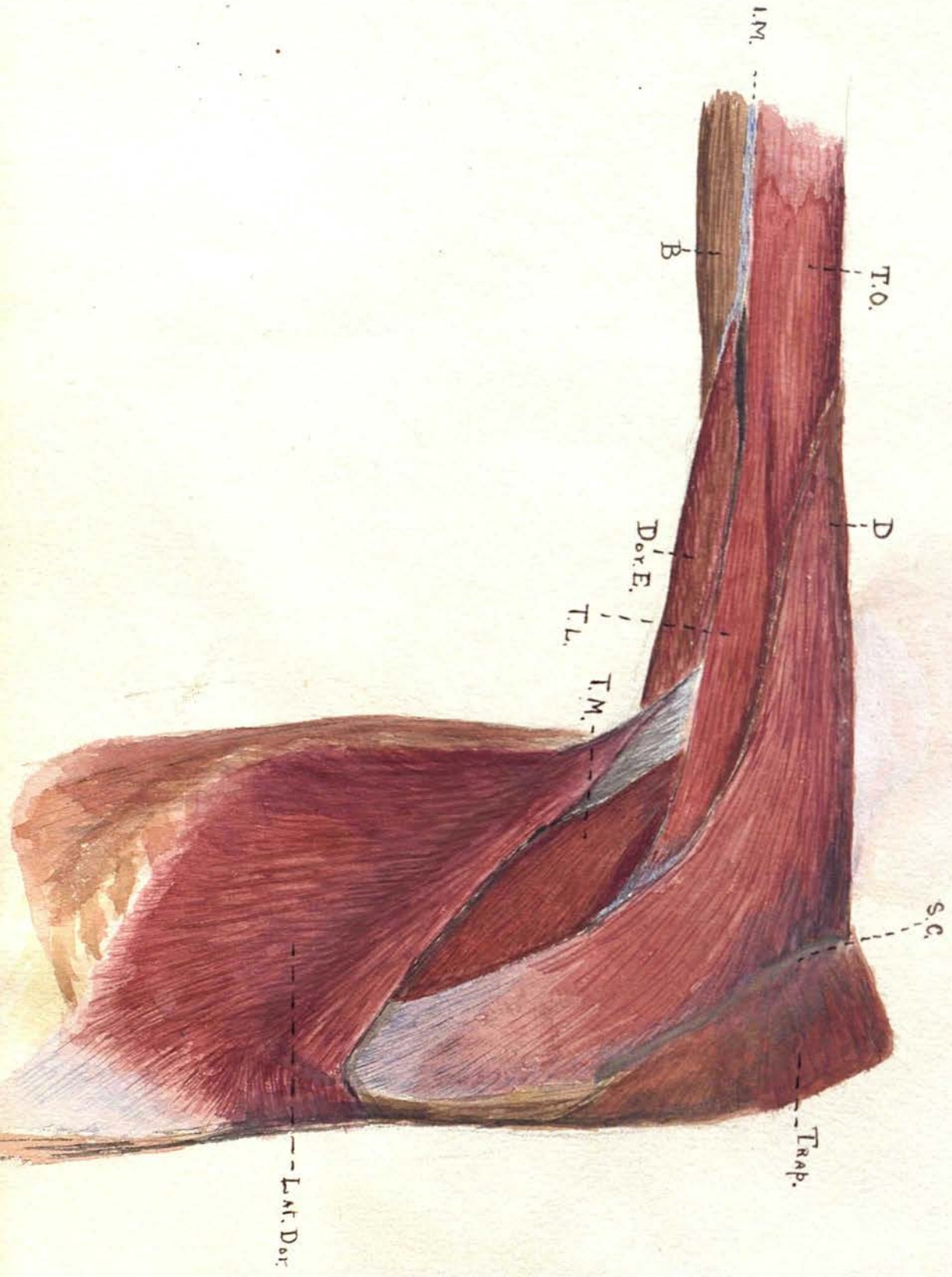
as in man. From the region of the clavicle, acromion and outer third of the spine of the scapula an aponeurotic tendon is spread out over the surface of the muscle, triangular in shape like the muscle itself. This gives rise to many of the fibres which pass to short strong tendons on the under surface by which the muscle is inserted. The anterior part of the muscle is folded on itself in such a way that the outer surface of the muscle forms the anterior border, and becomes fused to a large extent with the sterno-clavicular portion of the pectoralis major and the short head of the biceps.

RELATIONS.- Superficially the muscle is subcutaneous, the circumflex, supra acromial and anterior external thoracic nerves supplying the skin over it. Near the inferior angle of the scapula the origin is overlapped by the latissimus dorsi and the teres major muscles. Under cover of the muscle there are the slip of the pectoralis major up to the capsule of the shoulder joint, insertion of the pectoracis minor, the teres minor, the circumflex nerve and branches, long and middle heads of the triceps and the infra-spinatus. In the sulcus between it and the pectoralis major lie the cephalic vein, a branch of the thoracic axis artery and a branch of the external anterior thoracic nerve.

See plate III p 54.

THE COMPARATIVE ANATOMY will be considered when all the group of muscles of this region have been dealt with.

Plate III



D. 7.

EXPLANATION OF PLATE. III

This plate shews the back of the shoulder and upper arm.

Trap..... The trapezius.

Lat.Dor..... The latissimus dorsi.

T.M..... The ~~deltoid~~ teres major.

T.L..... The long head of triceps.

Dor.E..... The dorso-epitrochlearis.

B..... The biceps, inner head.

I.M..... The internal intermuscular septum and the tendon of the dorso-epitrochlearis.

T.O..... The outer head of the triceps.

D..... The deltoid, note appneurotic extension down to the inferior angle of the scapula.

S.C..... The spine of the scapula.

THE INFRA-SPINATUS.

ORIGIN.- From (1) the infra-spinous fossa and lower surface of the spine of the scapula, (2) the deep surface of the aponeurosis of the deltoid and the intermuscular septa between it and the teres major, minor and long head of the triceps.

INSERTION.- Into the back of the middle of the great tuberosity of the humerus above the teres minor and incorporated with the capsule of the joint, a bursa interveneing between the muscle and the bone previous to insertion.

NERVE SUPPLY.- From the supra scapular nerve.

STRUCTURE.- The muscle is characterised by a singular lack of tendons either of insertion or origin, the fibres passing outwards to their insertion.

RELATIONS.- The muscle is completely overlapped by the deltoid, inferiorly to it lie the origins of the long head of the triceps, teres minor and teres major, which also overlaps it slightly near the inferior angle of the scapula.

THE SUPRA-SPINATUS.

ORIGIN.- From (1) the supra spinous fossa and upper surface of the spine of the scapula, (2) the fascia over the muscle to a slight extent.

INSERTION.- Into the upper part of the back of the great tuberosity of the humerus and into the capsule of the shoulder joint.

NERVE SUPPLY.- From the supra scapular nerve from the back of the junction of the 4th.& 5th.cervical nerves, it enters the deep surface of the muscle at the supra-scapular notch.

STRUCTURE.- Like the last muscle there is very little or no tendon in its composition.

RELATIONS.- The muscle lies competely concealed under the trapezius ;it is in relation with the upper and back part of the capsule of the joint. The supra scapular vessels and nerve pass down between it and the bone.

THE TERES MAJOR MUSCLE.

ORIGIN.- From (1) the back of the aponeurosis of the deltoid near the inferior angle of the scapula, (2)from a flat area on the dorsum of the inferior angle and the axillary border of the bone in its inner ¾, (3)the septa between it and the longhead of the triceps, serratus magnus and the subscapularis muscles.

INSERTION.- In common with the insertion of the latissimus dorsi it finds attachment to the inner lip and bottom of the bicipital groove. Some of the upper fibres of the coraco-brachialis are also inserted with it;some of the fibres are attached to the slip of the tendon of the latissimus dorsi which is sent in behind the muscle.

NERVE SUPPLY.- By the middle subscapular which enters the muscle about half way down the axillary border after giving off a branch to the latissimus dorsi.

MYOLOGY, UPPER LIMB.

STRUCTURE.- The muscle is twisted on itself in such a way that the lowest fibres which arise at the inferior angle of the scapula are the highest at the insertion; the posterior surface at the origin becomes the anterior at the insertion.

RELATIONS.- The muscle lies in the groove formed by the twisting of the latissimus dorsi, that muscle being in front of its insertion and behind the lower part of its orign. The long head of the triceps is behind the insertion and behind the upper part of the origin, which it completely separates fromthe teres minor. At the insertion the tendon lies some way behind the important axillary structures, artery, vein and nerve.

THE TERES MINOR MUSCLE.

ORIGIN.- From (1) the outer half of the axillary border of the scapula and the back of the bone adjoining (2) the septa between it and the infra-spinatus and long head of the triceps.

INSERTION.- Into the lower part of the great tuberosity of the humerus and into the capsule of the joint.

NERVE SUPPLY.- BY a branch from the circumflex which enters the deep surface of the muscle after having given off a twig to the joint.

STRUCTURE.- The muscle is triangular, becoming broader as it passes out towards its insertion; it is devoid of tendinous structure.

RELATIONS.- The deltoid completely hides the muscle from view posteriorly; the infra-spinatus lies above,

NERVE SUPPLY.- Also from a nerve which leaves the common ~~brachial~~ axillary trunk just about the level of the scapula and enters the upper part of the muscle.

and the long head of the triceps takes origin in front and below, completely separating the muscle from the teres major muscle. The lower part of the capsule of the joint lies in front of the insertion of the muscle; the small articular nerve already mentioned runs up between the muscle and the joint.

THE SUBSCAPULARIS MUSCLE.

ORIGIN.- From the venter of the scapula, except the parts occupied by the insertion of the serratus magnus and the parts about the neck of the bone, (2) from tendinous intersections from the venter of the bone, (3) from the intermuscular septum between it and the teres major.

INSERTION.- Into the small tuberosity of the humerus, the bone below for 1½ c.m. and into the capsule of the joint.

NERVE SUPPLY.- From the short subscapular nerve which enters the thoracic surface of the subscapularis opposite the neck of the bone.

STRUCTURE.- The muscle is divided up by the tendinous ribbing from by which it gets additional attachment to the venter of the bone; the muscle becomes much thicker as it passes out towards its insertion.

RELATIONS.- The thoracic surface of the muscle is in contact with the serratus magnus behind, but the two muscles separate anteriorly and the structures in the axilla separate them, the cleft between them being filled with fat, the outer surface of the muscle being in con-

1. Loc. Cit., Vol. 3. p. 10.
2. Loc. Cit., p. 337.
4 Loc. Cit.,
3 Loc. Cit., p. 81.
5. Loc. Cit.
6 Loc. Cit., 341.

-tact with the scapula, the shulder joint and the small tuberosity of the humerus.

THE COMPARATIVE ANATOMY OF THIS GROUP.

THE DELTOID(Comp.Anat.)

Here the three parts of the muscle are fused together as they are in man, the clavicular, acromial and spinous portions all being present, the clavicular part fused with the pectoralis major at their insertions, a point also noted by Hepburn[1] in the chimpanzee. The posterior part of the muscle is specially well developed in this animal, as in nearly all apes, reaching down to the inferior angle of the scapular along the vertebral border, as noted in by Testut[2] in the orang and chimpanzee, and Gratiolet and Alix[4] in Troglodytes Aubryi, but Hepburn only mentions it arising from the fascia over the infra spinous fossa; it arose by tendon from the lower part in this animal. In the cat all three parts of the muscle are separate. The muscle passed further down the arm in this (gibbon) animal, and the transference of some of the fibres into the triceps and brachialis anticus have been noted in dealing with the muscle, The same continuation of fibres was noted by Humphry[5] in the chimpanzee and by Duvernoy[3] in the gorilla; in both these cases the fibres were only prolonged into the brachialis anticus, Testut[6] has seen the same thing in man. Both its extended origin and insertion give greater power to the muscle when used so as to act on the trunk, the arm being the fixed point, as is the case in many of the movements of

1. Loc. Cit. Vol. 3. p. 10.
2. ~~Loc~~. Sabatier. Comparison des Ceintures et des Membres. 1880. p. 220.
3. Loc. Cit., p. 350.
4. Loc. Cit. Vol. VI. p. 278.
5. Trans. Roy. Irish Acad. 1871.

this animal.

THE INFRA-SPINATUS, (Comp. Anat.)

There was nothing unusual to be noted about this muscle as it resembled the human muscle very closely This similarity is seen throughout the anthropoid series; in all it is smaller than the supra-spinatus, except in the chimpanzee, where Hepburn[1] notes that the obliquity of the bone causes it to be smaller. In the lower animals it is often impossible to separate it from the teres minor, as in Ornithoryncus and echidna (Sabatier)[2], in some of the Cercopithecidae (Testut)[3], and as I have seen in the cat. The muscle is of very large dimensions in the bats and in the mole, where Meckel[4] says that it is the largest muscle in the body. In examining a mole last Summer I noted the large size of this muscle, which is evidently associated with the digging powers of the animal, and is more important than the latissimus dorsi.

THE SUPRA-SPINATUS, (Comp. Anat.)

Like the last there was nothing special to note about this muscle, Hepburn[1] noted that in the chimpanzee a part of the tendon of the pectoralis minor was inserted into the tendon of the muscle. In human anatomy Macalister[5] reported the lack of variation in the muscle, saying that it was "singularly invariable".

THE TERES MAJOR, (Comp. Anat.)

Owing to the fact that the deltoid came down to the back of the inferior angle of the scapula this muscle arose partly from the posterior surface of the deltoid aponeurosis.

1. Blandin Nouveaux Elements d'anatomie Vol. 1. p. 460.
2. Loc. Cit. Vol. 3. p. 11.
3. Loc. Cit. Vol. 3 p. 12.
4 Loc. Cit. p. 29.

MYOLOGY, ~~LOWE~~ UPPER LIMB.

Of all the anthropoids this is the animal that has the largest teres major, probably for the same reason as was given for the large attachment of the deltoid and triceps, to enable the muscles to act on the body with greater advantage when the arm is fixed. Its insertion is closely blended with that of the latissimus dorsi and the upper part of the coraco-brachialis.

Owing to the fact that the muscle has occasionally been observed to send a process to the deep fascia of the upper arm Blandin[1] formulated the theory that the muscle was the homologue of the tensor fasciae femoris in the lower limb, This is not accepted by many anatomists, the deltoid being held to represent the tensor fasciae and the gluteus maximus.

THE TERES MINOR, (Comp.Anat.)

This muscle was completely hidden from view by the large deltoid, being separated from the major by the long head of the triceps; the outer head of the triceps reached up to the muscle, Hepburn[2] found it present in all the four great anthropoids.

THE SUBSCAPULARIS, (Comp.Anat.)

This resembled the muscle found in man, Hepburn[3] noted nothing peculiar, neither did Primrose[4]; Fick described a slip of origin from the teres major in the orang.

The muscles of the upper arm are the coraco-brachialis, the biceps, the dorso-epitrochlearis, the brachialis, and the triceps.

THE CORACO-BRACHIALIS.

This muscle is well developed, and situated on the upper and inner aspect of the upper arm, reaching nearly half way down.

ORIGIN.-From the tip of the coracoid process by tendon, and slightly from the sides of that process by muscular fibres, from the tendon of the pectoralis minor which is inserted into the tendon, and from the coraco-acromial ligament (pectoralis minor).

INSERTION.-Into the shaft of the humerus in its upper and inner part for a distance of 6 c.m. The insertion corresponds to the inner lip of the bicipital groove, being here fused with the combined tendons of the latissimus dorsi and teres major; the lower part of the insertion lies between the inner head of the triceps and the deltoid.

NERVE SUPPLY.-This leaves the front of the axillary trunk just below the circumflex. The nerve then passes downwards and outwards to the muscle, dividing into two before entering the muscle. This nerve is not the external circumflex, as it contains no cutaneous fibres.

STRUCTURE.-A tendon passes from the tip of the coracoid process, and from either side of this a few

fleshy fibres arise from the bone, the majority proceed from the sides of the tendon, tendon of insertion is seen on the inner and posterior aspect below the tendon of the latissimus dorsi by means of which the lower fibres are attached to the bone. The only indication found in the arrangement of this muscle of its being divided into three parts, was that the nerve divided into two before entering the muscle; if this was taken to indicate division then the portions increased in size from above downwards, the lowest being considerably larger than the other two put together.

RELATIONS.-Superficially, there are the pectoralis major, below this the subcutaneous tissues, and below this again the short head of the biceps crosses it from without inwards, lying in front of the insertion of the muscle; the nerve supply to the outer head of the biceps is also superficial to the lower part. Behind it lie the subscapularis, the circumflex nerve and vessels, its own nerve, the combined tendons of the latissimus dorsi and teres major muscles, below these the long head of the triceps. To the inner side lie the structures in the axillary sheath. To the outer side the deltoid and the two heads of the biceps, the inner of which crosses and lies in front of the lower part.

COMPARATIVE ANATOMY.-The morphology of this muscle

Fig. 11.

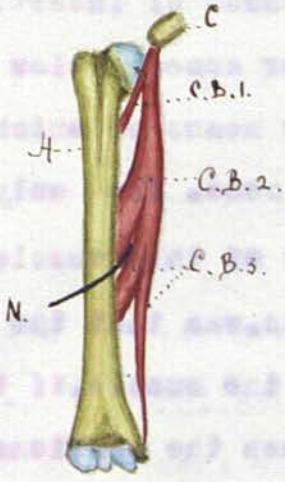


Fig. 12

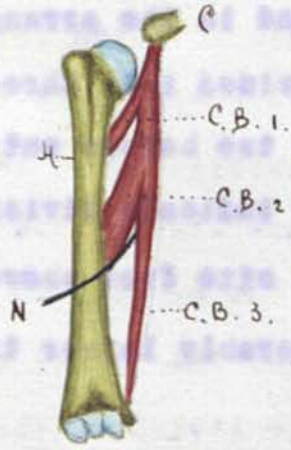
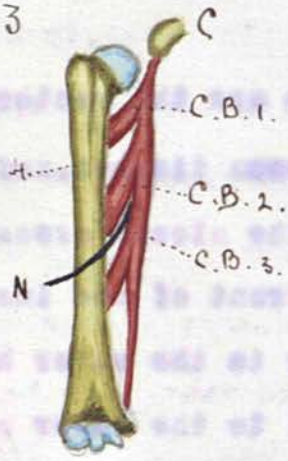


Fig. 13



H... Humerus.
C.... Coracoid.
N. ... Ext. Cutaneus Nerve.
C.B.1. ... Coraco-brachialis Brevis.
C.B.2. .. Coraco-brachialis Medius.
C.B.3 --- Coraco-brachialis Longus.

After Sutton.

Shewing Chief Variations of the Muscle found in Man.

1. J. Wood., On Muscular Variations, and their Relation to Comparative Anatomy. Journ. Anat. & Phys. Vol. 1. 1867. p. 45.
2. Sutton. Ligaments, their Nature & Morphology. p. 15.
3. Quoted by Sutton.
4. Loc. Cit. Vol. 3. p. 14.
5. Proces. Royal. Soc. Lond. ~~Vols~~ 1866-7. Vols ~~XV & XVI~~
6. Loc. Cit. p. 30.

was first worked out by Wood,[1] who pointed out that the muscle was really composed of three parts, a coraco-brachialis longus, medius, and brevis. Bland Sutton[2] compares this arrangement with that of the three adductors in the thigh. Wood stated that the C.-B.-brevis was inserted into the shaft of the humerus above the tendon of the latissimus dorsi, the C.-B.-medius was inserted about the middle, and the C.-B.-longus was inserted low down on the inner side of the shaft of the humerus in the region of the supra-condylar ridge. The muscle is absent according to Parsons,[3] in the African polecat (Ictonyx), in one of the insectivora (Gymnura), and the Vizcacha (Lagostomus). Hepburn[4] found it absent from the right side of his gorilla. Wood[5] found only the brevis present in the dog, cat, bat, and mole. Hepburn describes the medius and longus in the Chimpanzee and Orang, the longus and brevis both rudimentary on one side of the gorilla, absent on the other, an undivided muscle in the gibbon. Wrolick found the medius and longus in his chimpanzee, Primrose[6] the brevis and medius in his orang. Both Hepburn and Primrose, though describing two different parts of the muscle, say that the nerve passes between the two parts described, so that it is just possible that the two parts described by Primrose as brevis and medius were after all really medius and longus.

*

The long head of the biceps really arose from the upper margin of the glenoid fossa and glenoid ligament as in man, but until the joint was opened this was not seen. The great depth of the bicipital groove in this animal gave the appearance of the tendon arising from a pit. The ligament was very dense almost cartilaginous, the canal is completed by bone in some animals, see under comparative anatomy.

In man the muscle is represented by the medius, in the variations that occur the longus is more frequently than the brevis; the 'internal brachial ligament' of Struthers is partly a remnant of this muscle, being left by the recession of the C.-B.+ longus, and partly a remnant of the dorso-epitrochlearis.

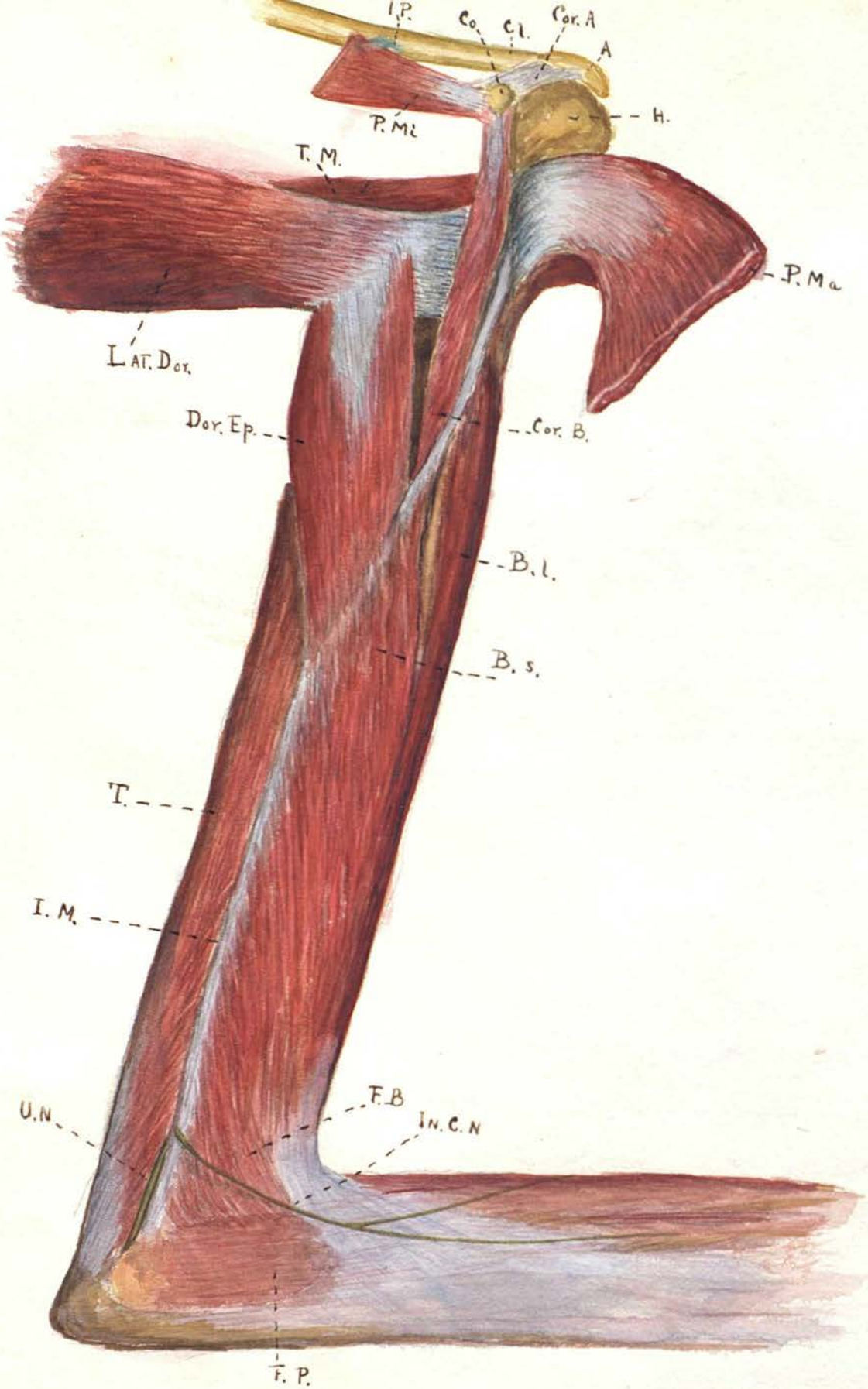
THE BICEPS FLEXOR CUBITI.

This muscle is well developed, and reaches from the region of the shoulder joint to that of the elbow.

ORIGIN.- This is very different from that of man; it might be described as arising by three heads, the third from the inner aspect of the shaft of the humerus, but this head I have included with the short head as they are closely associated.

The Long Head arises from a pit, between and below the two tuberosities of the humerus, in which the upper end of the bicipital groove ends.*

The Short Head arises from (1) the ~~junction of the~~ ligament joining the two tuberosities above this pit and from the fibrous fibrous tissue which forms a sheath for the upper part of the long tendon, (2) from an extensive septum which intervenes between it and the insertion of the dorso-epitrochlearis muscle, many of the fibres being continuous, (3) from the front of the intermuscular septum on the inner side of the arm in its whole length, and from the inner side of the humerus in its lower half down to the front of the internal condyle.


I.P.
Co.
Cl.
Cor. A
A
H.
P. M.
T. M.
P. M a
Lat. Dor.
Dor. Ep.
Cor. B.
B. l.
B. s.
T.
I. M.
F.B
U.N.
In. C. N
F. P.

D. 7.

Plate IV

EXPLANATION OF PLATE. IV

Shewing the inner side of the upper arm.

P.Mi..... The pectoralis minor.

I.P..... Insertion of pectoralis minor into the shaft of the clavicle.

Co..... The coracoid process.

Cl..... The clavicle.

Cor.A..... The coraco-acromial ligament.

A..... The acromion process.

H..... The head of the humerus.

P.Ma..... The pectoralis major.

Cor.B..... The coraco-brachialis.

B.L..... The long head of biceps.

B.S..... The short head of biceps.

F.B..... Fibres of biceps passing to the flexor pronator mass on the front of the forearm.

In.C.N..... Internal cutaneous nerve.

F.P..... The flexor pronator mass of muscles.

U.N..... The ulnar nerve.

I.M..... The internal intermuscular septum and the tendon of the dorso-epitrochlearis.

T..... The triceps.

Dor.Ep..... The dorso-epitrochlearis muscle.

Lat.Dor..... The latissimus dorsi.

T.M..... The teres major.

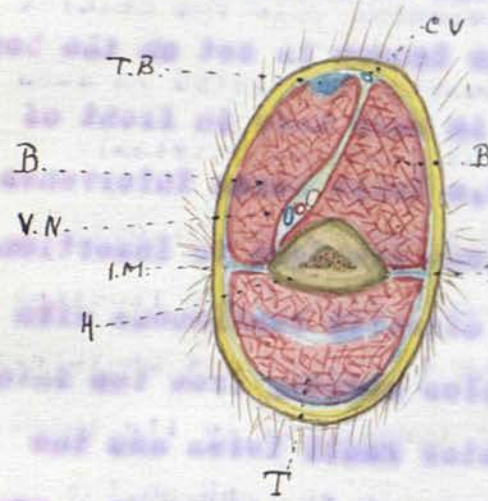
INSERTION.- This is double, the muscle dividing into a part which is inserted by tendon and a part which is fleshy and continuous with the common flexor pronator mass on the front of the forearm. The smaller and tendinous portion, which is round as it dips into the anticubital fossa, passes forwards in front of the tendon of the brachialis anticus to spread out into a thin tendon 3 c.m. wide, which is inserted into the back of the tuberosity of the radius passing up to the outer side of the tendon of the brachialis anticus. The tendon is set on the bone obliquely, as the lower part is much more in front of the bone than the upper part; a large bursa intervenes between the tendon and the bone previous to insertion.

The larger fleshy part is directly continuous with the flexor pronator mass of muscles arising from the internal condyle, especially the pronator radii teres and the flexor carpi radialis; over the muscles it sends a weak insertion into the fascia of the forearm.

NERVE SUPPLY.- From the common brachial trunk near its commencement, by a large branch which runs downwards in front of the brachial vessels to supply the muscle at different levels, some of the twigs becoming cutaneous by piercing the fibres on the inner side of the arm.

STRUCTURE.- The muscle is divided into two parts by the long head, not joining the short head till 5 c.m. from the web of the elbow. The outer head arises by a long tendon which only gives rise to its mass of fibres after a course of 5 or 6 c.m. as a tendon; its fusiform

Fig. 14.



Cross Section of the upper Arm of the Gibbon, in its lower Third. to shew the relations of the biceps & brachialis Anticus to each other & to the Vessels & Nerves.

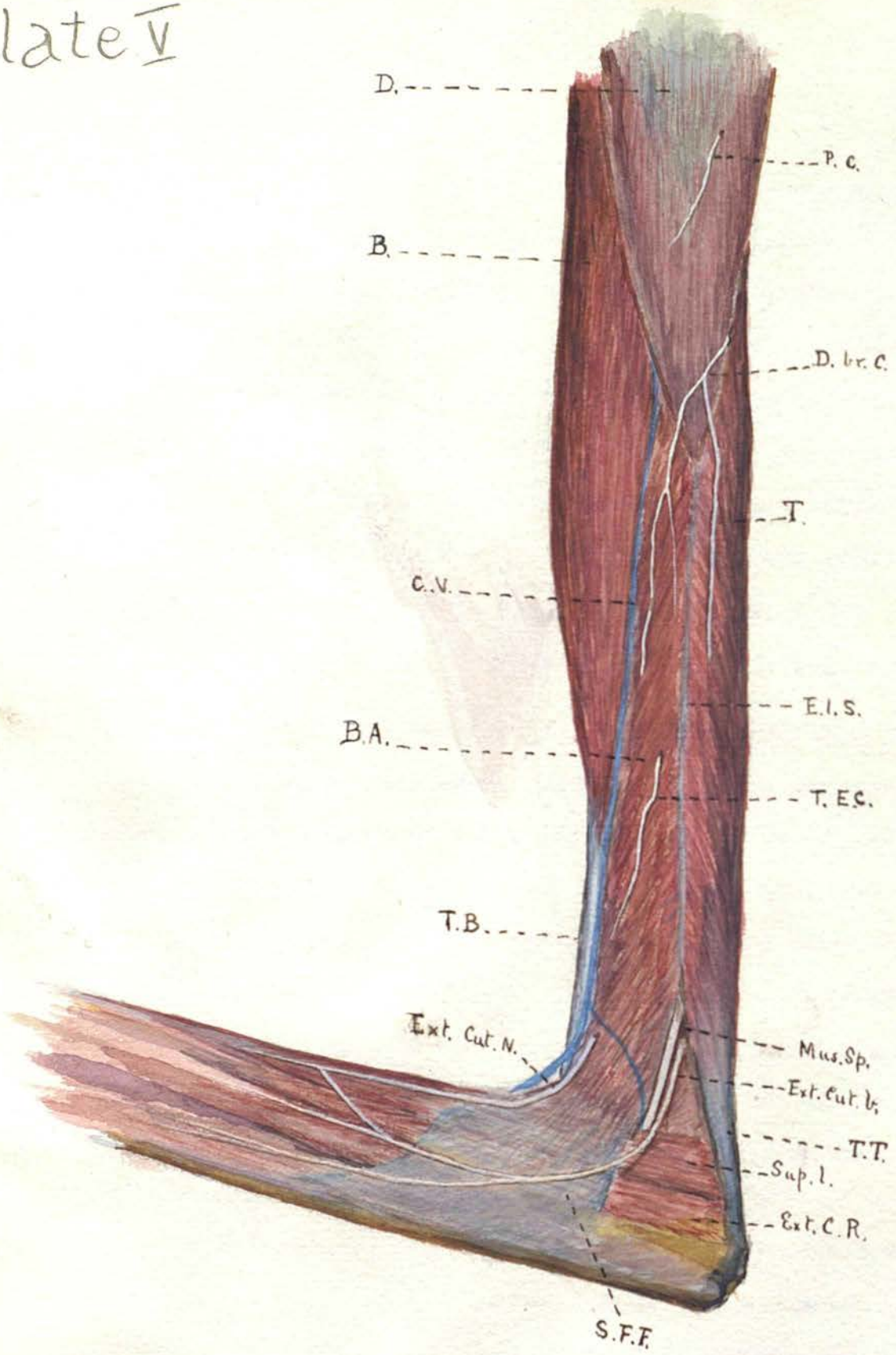
C.V. .... Cephalic Vein
T.B. .... Tendon of biceps
V.N. .... Vessels & Nerves.
H. .... Humerus
T. .... Triceps
B.A. .... Brachialis Anticus
I.M. .... Internal Intermuscular Septum
E.M. .... External " "

belly runs down in front and to the outer side of the rest of the muscle; about half of it goes into the tendon and half into the muscles of the forearm.

The short head has fibres which in the upper part run straight down the arm, while in the lower part, where the fibres are mostly those arising from the humeral shaft and internal intermuscular septum, the fibres run downwards and forwards into the muscles of the forearm. The whole muscle is twisted in such a way that the surfaces are internal and external.

RELATIONS.- The long head passes straight down from its origin behind the short head, which receives the insertion of many of the fibres of the pectoralis major into it here; the long tendon has to its inner side the coraco-brachialis muscle and behind the structures inserted into the groove; lower down the short head crosses inwards in front of the tendon, and lies to its inner side for the rest of the way. The short head crosses inwards, not only over the long head, but in front of the coraco-brachialis and the brachial vessels and nerves, so coming into relation with the dorso-epitrochlearis muscle. The whole muscle lies more on the inside of the arm than does the muscle in man, so that in the lower part it is lying side by side with the brachialis muscle, the vessels and nerves being between them. The ulnar and internal cutaneous nerves pierce the muscle low down, and are seen above

Plate V


D.
P. C.
B.
D. br. C.
T.
C. V.
E. I. S.
B. A.
T. E. C.
T. B.
Ext. Cut. N.
Mus. Sp.
Ext. Cut. br.
T. T.
Sup. l.
Ext. C. R.
S. F. F.

D. T.

EXPLANATION OF PLATE. V

This plate shews the appearance of the outer side of the arm.

D..... The deltoid.

B..... The biceps, outer head.

C.V..... The cephalic vein.

B.A..... The brachialis anticus.

T.B..... The tendon of the biceps.

Ext.Cut.N....The external cutaneous nerve.

S.F.F.....The semilunar fold of fascia from the brachialis anticus on the outer side of arm.

Ext.C.R..... The extensores carpi radilis longior et brevior.

Sup.L..... The supinator longus.

T.T..... The tendon of the triceps.

Ext.Cut.b... The external cutaneous branch of the musculo-spiral nerve.

Mus.Sp..... The musculo-spiral nerve.

T.E.C..... Twig from the external cutaneous nerve piercing the brachialis anticus.

E.I.S..... The external intermuscular septum.

T..... The triceps.

D.br.C..... The descending branch of the circumflex which takes the place of the upper external cutaneous branch of the musculo-spiral nerve.

P.C..... A perforating twig from the circumflex nerve piercing the deltoid muscle.

the internal condyle accompanied by the inferior profunda artery and vein.

THE BRACHIALIS ANTICUS.

ORIGIN.- From (1) the whole of the front of the lower half of the humerus, (2) from the front of the upper ¾ of the external intermuscular septum, (3) from the front of the septum between it and the front of the lower part of the insertion of the deltoid, the insertion of which it does not embrace.

INSERTION.- From the front and outer part of the muscle a strong semilunar fold of fascia goes to the fascia on the upper part of the forearm much better marked than that from the biceps. Fully a third of the fibres of the muscle are directly continuous with those of the pect- ~~oralis major~~ supinator longus, the rest of the muscle becomes clothed with tendinous fibres and are inserted into the front of the coronoid process of the ulna, passing to the inner side of the biceps tendon ~~and~~ after crossing behind it ; it ~~then~~ does not reach so far down the bone as the biceps tendon, not extending more than 4 c.m. below the joint.

NERVE SUPPLY.- A large branch is given off the common brachial trunk just about the level of the trunk's division into ulnar and median nerves. This branch after dividing into two halves, both halves of which enter the muscle, the lower division being the largest, contains the cutaneous branches of the external cutaneous nerve in man, emerges at the anterior border of the muscle, and is

distributed as the external cutaneous nerve supplying the skin on the outer side of the forearm. In addition to this supply 4 small nerves leave the common brachial trunk at different levels and supply the muscle.

STRUCTURE.- The fibres arise from their origin fleshily, and have a general direction downwards and forwards;a tendon appears just above the elbow on the ~~outer~~ inner or bicipital side which passing behind the bicipital tendon reaches the ulna.

RELATIONS.- The muscle lies in front of the lower part of the deltoid and the outer part of the triceps,To the outer side the muscle is subcutaneous; between it and the lower part of the external intermuscular septum the musculo-spiral nerve and its external cutaneous branch (only one in this animal) are seen above the condyle. To the inner side lie the biceps separated by the brachial vessels and nerves with the branches of each;the cephalic vein runs up in the groove between the two muscles, and the external cutaneous nerve emerges from the front of the muscle above the supinator longus.

COMPARATIVE ANATOMY.- will be dealt with later.

(See page 79)

THE TRICEPS EXTENSOR CUBITI.

This muscle occupies practically the whole of the posterior division of the upper arm.

ORIGIN.- By three heads along,a short and a middle. The Long Head arises from the outer half of the axillary

border of the scapula and from just below the glenoid cavity.

The Middle or Outer Head arises from the back of the shaft of the humerus above the musculo-spiral groove as high as the teres major under which it extends, from the back of the intermuscular septum which separated it from the deltoid above and the brachialis anticus below.

The Short or Inner Head arises from the back of the shaft of the humerus below and to the inner side of the musculo-spiral groove, and from the back of the internal intermuscular sptuc which separates it from the biceps.

INSERTION.- Into the olecranon process and the fascia on the back of the forearm.

NERVE SUPPLY.- The Long head gets its nerve supply from two nerves, one of which leaves the back of the common axillary trunk and winds back around the lower border of the tendon of the latissimus dorsi to supply the upper part; the other leaves the musculo-spiral soon after its commencement and passes down the musculo-spiral groove, leaving the lower part of the canal to supply the lower part of the long head. The other two heads derive their nerves from the musculo-spiral at various levels in the canal; of those to the short head two long filaments can be traced down to the elbow through the substance of the muscle.

STRUCTURE. On the outer side of the long head there appears a tendon before that head joins the middle. This is continued on into a large superficial tendon which covers the muscle posteriorly, the fibres being inserted into the deep surface of the tendon. There is only a very slight amount of fibrous tissue over the musculo-spiral groove, the roof being formed by muscular tissue.

RELATIONS.- The long and outer heads are both in the upper part of the arm under cover of the deltoid , the outer being under cover of the insertion of the teres minor to a slight extent and the long between the teres major and mior at its orign. In front and to the inner side of the long head is the dorso-epitrochlearis muscle, a portion of the tendon of the latissimus dorsi passing between them. The musculo-spiral nerve lies between it and the bone and then between it and the brachialis anticus just above the external condyle, being accompanied by the superior profunda artery and the external cutaneous branch of the nerve. The ulnar nerve holds a similar position above the internal con--dyle between the muscle and the lower part of the biceps, as it passes down to the back of the internal condyle.

THE DORSO-EPITROCHLEARIS MUSCLE

The dorso-epitrochlearis or latissimo condyloideus is well marked.

ORIGIN.-From the front of the fused tendons of the latissimus dorsi and the teres major muscles. (See Plate IV p66)

INSERTION.-(1)Into the septum between it and the short head of the biceps;(2) into the fascia of the upper arm especially over the triceps;(3) by a long slender tendon whcih passes down to the internal condyle,more or less incorporated with the internal intermuscular septum all the way.

NERVE SUPPLY.-From the back of the axillary trunk a nerve passes to the muscle behind the vessels,which in company with some small vessels,enters the deep surface of the muscle.

STRUCTURE.-The muscle arises by a short tendon, then flattens out into a broad belly which is twisted somewhat on itself. The anterior and upper border is short, and after a course of 3 c m.is inserted into the septum between it and the short head of the biceps. The posterior and lower border is fleshy for twice that length, and is continued into the tendon and the fascia;the muscle is threfore very oblique the tendon being 11 c.m.long.

RELATIONS.-The anterior and inner surface is subcuteous and in contact with the intercosto-humeral nerves.

1. Loc. Cit. p. 21.
2. Loc. Cit Vol. 3. p. 3.
3. Loc. Cit. Vol. 3. p. 17.
4. Loc. Cit.

The posterior and outer surface is in contact with the tendons from which it arises, the long head of the triceps, the axillary vessels and nerve trunk, these becoming the brachial structures at the lower border of the latissimus dorsi tendon and separate it from the insertion of the coraco-brachialis. The tendon of the muscle runs down between the triceps and the biceps, the ulnar nerve passing backwards beneath, and then running down behind it.

COMPARATIVE ANATOMY.- This muscle is widely found throughout the animal series, and is especially regular in its occurrence in apes. All writers mention it not only in the anthropoids but in the lower apes as well. Primrose[2] and Hepburn[3] both mention the slip described here which passes from the latissimus dorsi in behind the teres major (see latissimus dorsi), but this does not seem to have any thing to do with the dorso-epitrochlearis. Its insertion seems to vary a great deal, Hepburn[3] states that "In no case did it reach the internal condyle, and its insertion was into the internal intermuscular septum between the coraco-brachialis and internal condyle". But other writers have found it extending down to the internal condyle—Duvernoy[4] in the gorilla and Primrose[2] in the orang; it seems to depend on how much is looked on as internal intermuscular septum and how much is tendon of this muscle and of the coraco-brachialis as to the exact insertion. In

1. Loc. Cit. p. 5.
2. Loc. Cit. p. 119.
3. Quoted by Testut
4. By Professor Robinson, now of Birmingham.
5. Loc. Cit. Vol. 3. p. 15.
6. Loc. Cit. 1. p. 210.
7. Loc. Cit Vol. 1 p. 648.

other animals where it is more developed the muscle seems to possess a variety of insertions. Cunningham[4] found in the Phascogale that the muscle was inserted into the inner head of the triceps and tip of the olecranon process;the Cuscus had much the same origin; while the Thylacine shewed the muscle joining the triceps.

In the Civet (Devis[3]) the muscle was inserted into the fascia of the forearm,the same thing being seen in the Lemuridae,In the Seal Testut states that it descends further still and reaches down to the palmar fascia so that it becomes "a strong retracter of the whole arm." The same author found that in the Bear the muscle was very large, being inserted into the olecranon process and the fascia covering the muscles which arise from the internal condyle of the humerus. The muscle is sometimes met with in man,I was shewn one this time last year in the dissecting room at King's College[4] London,where the muscle passed to the internal inter muscular septum of the arm.

THE BICEPS.(Comp.Anat.)

The gibbon is the exception amomg the higher apes in regard to the origin of the biceps;in the other apes the muscle appears to be arranged as in man,but in this animal both heads shew differences. The short head has left the origin from the coracoid process and become attached elsewhere. Hepburn[5] described the origin from the short head as being similar to the method found here;Bischoff[6] noted it from the lesser tuberosity, Huxley[7] from the tendon of the pectoralis minor.

Fig. 15

Humerus of Gibbon

Transverse ligament

Short tendon of biceps

Entrance to Bicipital Canal in which lies the long head not shewn

Fig. 16.

Humerus of Musk Deer. shewing bicipital foramen Arrow going thro' it.

after Brodie.

1. Loc. Cit. p. 6.
2. On the flexor muscles of the Vertebrate limbs. Journ. Anat. & Phys. 1869 p. 286
3. Loc. Cit. Vol. II. p. 158.
4. Murie & Mivart. On the Myeticebus. Proc. Zoolog. Soc. 1865. p. 244.
5. Loc. Cit. p. 273.

The first of these three anatomists notes that there is a considerable amount of blending of the muscles in the region of the elbow; this will be referred to presently. The long head of the muscle arises as in man from the upper part of the glenoid fossa being continuous with the glenoid ligament, but it passes out of the joint under the ligament from which the short head arises, lying so deeply between the two tuberosities that it appears to arise from a pit between them, unless the ligament is severed, when the true nature of the attachment is seen. The depth of this groove in the gibbon is of some interest, as we find that in Moschus moschiferous, the musk deer, the ligament is actually replaced by a bridge of bone (Sutton)[1] and in Talpa europaea, the common mole, the long tendon plays in an osseous tunnel (Austin Freeman). In the gibbon with its arm constantly above its head, as in hanging and swinging, the need of a strong ligament to keep the tendon in its place can be readily understood; the reason is not so obvious in the other two animals.

The biceps muscle seems to be made up of two originally distinct muscles, a coraco-radial and a gleno-radial muscle, and in some animals only one of these two is to be found. The coraco-radial is present in the pig, Echidna, ostrich and frog (Macalister)[2]. The gleno-radial is present in the a great number of different families, beaver racoon, dog, seal and cat, in the Marten (Meckel)[3], Stenops (Macalister), Nycticebus (Mivart and Murie)[4], and Ursus americanus (Testut)[5]. Many other

1 Loc. Cit. p. 270.
2 Loc. Cit.

variations of this muscle are found in the animal kingdom which can not be touched on here,such as the different insertions into the ulna and radius. In man occasionally a third head is seen in man coming from the upper part of the humerus,There was an example of this in the New School of Medicine,Royal College of Surgeons,Edinburgh, last Winter session,where the additional head of origin came from the front of the lesser tuberosity. Testut thinks that this is a portion of the long head which has become detached and joined the humerus external to the joint. The large ~~inserti~~ origin from the inner side of the shaft of the humerus and the internal intermuscular septum found in this animal can hardly have that explanation;it is probably developed in accordance with the needs of the animal on account of its peculiar arboreal habits.

The semilunar fascia was not well marked in this animal; really there was a better marked fold in connection with the brachialis anticus than with the biceps;it was absent altogether in the orang dissected by Fick.[2] Here however this was not to be wondered at, for a great part of the muscle was directly inserted into the muscles of the forearm,there being no need therefore for an attachment to them through the mediation of the fascia.

The fibres from the muscle found their way largely into the pronator radii teres,and here we have an example of what small importance to the lower animals is the action of pronation and supination,for all the advantage of supination which the muscle possessed by its attachment to the radius was nullified by its continuation into the pronator muscle.

1. Loc. Cit., Vol. 3. p. 16.
2. Loc. Cit., p. 31.
3. Loc. Cit., p. 87.
4. Loc. Cit. Vol. XV. p. 234.

BRACHIALIS ANTICUS.(Comp.Anat.)

The gibbon seems to differ from the other anthropoids in the fact that the brachialis anticus does not embrace ~~the head of~~ the deltoid insertion, but is altogether in front of it. In this my dissection bears out the account given by Hepburn,[1] who found that in all the other three apes he dissected that the muscle was as in found in man; he also noted the insertion into the supinator longus. Primrose[2] reported that, in the orang, a slip from the outer part of the muscle passed to the supinator longus in front of the musculo spiral nerve, Holleston and Duvernoy[3] having noted the same condition in the chimpanzee and gorilla respectively. As this is the case in the higher apes it is no surprise to find that Wood[4] and others have reported the same condition in man. There was a well marked fold of fascia on to that of the forearm from the muscle.

THE TRICEPS.(Comp.Anat.)

This muscle differs little from that found in man; the long head has a more extensive attachment to the axillary border of the scapula. This is found in all the anthropoids, and would naturally give the muscle greater power to act on the body of the animal when the arm was a fixed point, as is so often the case in arboreal animals. In some the dorso-epitrochlearis muscle has been found inserted either wholly or partially into this muscle. Primrose[2] found that in his orang the musculo-spiral nerve was separated from the bone by the inner head of the muscle.

MYOLOGY, UPPER LIMB.

THE MUSCLES ON THE BACK OF THE FOREARM.

The muscles on the back of the forearm are the extensor and supinator group, They are more easily differentiated at their origin than the muscles on the front of the arm, and can be divided up into two groups, superficial and deep. Those in the superficial group are the supinator longus(brachio-radialis), the extensor carpi radialis longior and brevior, extensor(communis digitorum) sublimis digitorum, extensor minimi and the extensor carpi ulnaris. The extensor minimi digiti and the sublimis digitorum are only incompletely separated from each other, but will be considered as two muscles for ease of description. The muscles of the deep group are the three extensors of the thumb, the extensor(indicis) profundus digitorum and the supinator brevis.

The anconeus, or rather its remains, will be considered at the end of the superficial group of muscles.

THE SUPINATOR LONGUS MUSCLE(Brachio-radialis).

ORIGIN.- From(1) the upper half of the external supra condyloid ridge, (2) the front of the lower part of the external intermuscular septum, (3) the outer side of the brachialis anticus muscle, many of the fibres of that muscle being directly continued into this muscle, (4) the fascia over the muscle below the semilunar fascia on the outer side of the upper part of the forearm which is quite free from it, The muscle at its origin is quite free from the next muscle to be considered.

INSERTION.- Into the front of the outer side ~~of the~~ of the shaft of the radius 12 c.m. from its lower end, having an attachment of about 3 c.m. long.

NERVE SUPPLY.- From the musculo-spiral nerve by a branch which enters the deep surface of the upper part of the muscle.

STRUCTURE.- The fleshy fibres converge rather suddenly on a tendon which appears at the junction of the middle and lower thirds of the muscle, although it is seen fully 6 c.m. higher up on the inner surface.

RELATIONS.- Superficially lie the semilunar fold of fascia given off by the brachialis muscle to the fascia of the forearm, the external cutaneous branch of the musculo-spiral nerve, the external cutaneous nerve and the cephalic vein. Deeply lie the brachialis anticus, insertion of the pronator radii teres, the musculo-spiral nerve and its division into the posterior interosseous and the radial; the latter runs down under cover of the muscle and turns back round the outer side of the forearm under the tendon of the muscle. The muscular belly forms one of the boundaries of the anticubital fossa.

THE EXTENSOR CARPI RADIALIS LONGIOR.

ORIGIN.- From (1) the lower half of the external intermuscular septum, (2) the lower half of the external supra condyloid ridge, (3) the septum between it and the extensor carpi radialis brevior.

INSERTION.- Into the base of the 2nd. metaparpal on its outer side with a slip given to the back of the 1st.

NERVE SUPPLY.- From the musculo-spiral by a twig which passes down under cover of the supinator longus.

STRUCTURE.- The muscle consists of a belly of only 6 c.m. in length with a tendon which measures fully 25 c.m. becoming narrower as it descends the arm.

RELATIONS.- The muscle lies between the last muscle and the next to be described; its tendon is crossed by the radial nerve as it passes down the arm, Reaching the posterior annular ligament it passes through a compartment by itself after being crossed by the two short extensors of the thumb, At its insertion it is crossed by the remainingextensor of the 1st.digit. Deeper than the belly lie the brachialis anticus, musculo-spiral nerve and its two branches of termination.

THE EXTENSOR CARPI RADIALIS BREVIOR.

ORIGIN.- From (1) the common origin from the external condyle of the humerus, (2) the septa between it and adjacent muscles and the fscia covering the muscle.

INSERTION.- Into the adjacent sides of the 2nd. & 3rd. metaparpals for a distance of 1½ c.m. and into the posterior carpo-metacarpal ligaments of these bones.

NERVE SUPPLY.- By a branch of the posterior inter-osseous nerve which runs between it and the supinator brevis muscle and enters on the deep surface.

MYOLOGY, UPPER LIMB.

STRUCTURE.- Although the disproportion in length between the belly and the tendon is not so extreme in this as in the last case, still the belly is very short compared with the tendon, no fibres passing further than 12 c.m. below the external condyle. The tendon measured from here is 20 c.m. long and in reality it starts some 5 c.m. higher up on the anterior border of the muscle, and as the tendon of origin extends down on the posterior surface for 7 c.m. the muscle fibres which pass from one to the other form a very small part of the whole structure. The tendon is larger than that of the last muscle and broadens out considerably at its insertion.

RELATIONS.- The muscle above lies between the longior and the extensor sublimis digitorum on the supinator brevis, and below this on the extensor ossis metacarpi pollicis, which in company with the extensor brevis pollicis crosses the tendon lower down. The extensor longus pollicis crosses the tendon just before its insertion.

THE EXTENSOR SUBLIMIS DIGITORUM (Communis).

ORIGIN.- From (1) the common extensor origin, (2) the posterior border of the ulna in its upper two-thirds, (3) the fascia covering it and the and the septa between it and adjacent muscles.

INSERTION.- By means of the dorsal expansion into the middle and terminal phalanges of the 2nd., 3rd. and

4th. digits, with a small slip to the tendon of the extensor minimi digiti.

NERVE SUPPLY.- From the posterior interosseous on the back of the forearm.

STRUCTURE.- The tendon begins on the superficial aspect of the muscle about the middle of the arm, the fibres being inserted into it as low down as 6 c.m. from the wrist on the deep and inner aspects of the tendon. On the dorsum of the hand the tendon spreads out in an aponeurotic manner, the tendons to the three digits being connected together as if by an aponeurotic web, the tendons only becoming free at the roots of the fingers, while from the inner side the web is connected with the tendon to the little finger. Each tendon as it passes on to the back of the first phalanx spreads out into a dorsal expansion into which are inserted the lumbricals and some of the interossei muscles. The tendon then spread into three, the centre one being inserted into the base of the middle phalanx, while the two lateral portions, into which the lumbricals and interossei can be traced, are, after joining together and subsequently splitting, inserted into the sides of the base of the terminal phalanx on its dorsum.

RELATIONS.- The muscle lies between the muscle last described and the extensor minimi digiti, superficial to the supinator brevis, the extensors of the thumb and the extensor profundus digitorum (indicis), the posterior

nerve and its branches lying under cover of the muscle. On the dorsum of the hand the broad tendon lies on the broad tendon of the deep extensor. As the tendon passes under the posterior annular ligament of the wrist it is accompanied by the deep flexor, the extensor longus pollicis and the posterior interosseous nerve. The tendon of the latter muscle only has a special compartment in the lower part of the ligament which branches off this larger compartment in an outward ~~manner~~ direction.

THE EXTENSOR MINIMI DIGITI.

ORIGIN.- This is the same as the inner part of the last muscle, the main portion coming from the posterior border of the ulna in its middle two-fourths and the fascia covering it, the upper end being lost in the origin of the last muscle from which it is only imperfectly separated.

INSERTION.- Into the middle and terminal phalanges of the little finger by a dorsal expansion in the usual way, which need not be described again(see page 84).

NERVE SUPPLY.- From the same branch of the posterior interosseous which supplies the last muscle entering the upper part which is common to both.

STRUCTURE.- The thin slender belly, only separable in the lower part from the extensor sublimis digitorum, gives place to a tendon about 12 c.m. from the wrist, passes through a special compartment of the posterior annular ligament, becomes flatter and broader as it approaches the little finger where it receives a slip from the

extensor sublimis digitorum.

RELATIONS.- The muscle is really the most internal part of the extensor sublimis digitorum;it lies dorsal to the inner part and to the inner side of the tendons.

THE EXTENSOR CARPI ULNARIS.

ORIGIN.- From (1) the back of the common origin, (2)the posterior border of the ulna in its upper third, (3) the fascia covering it and the septa between it and neighbouring muscles.

INSERTION.- Into the outer and back aspects of the shaft of the 5th. metacarpal bone about 1 c.m. beyond its base.

NERVE SUPPLY - From the posterior interosseous by a twig which pierces the supinator brevis and remains of the anconeus.

STRUCTURE.- The muscle is clothed with the strong fascia of the upper part of the forearm,The belly which forms only one third of the length of the ~~tendon~~ whole muscle tapers to a tendon which is thin and oval.

RELATIONS.- The muscle is bound to the upper part of the shaft of the ulna,and lies over the remains of the anconeus muscle and the supinator brevis,The tendon passes through the innermost or 6th. compartment of the posterior annularligament.

THE ANCONEUS.

This,as a muscle,is absent,but stretching from the back of the external condyle of the humerus to the

junction of the upper and middle thirds of the ulna is a strong shining band of tendinous fibres about 6 or 7 m m. broad on the average in the thick part, but spreading out down a forearm as a thin layer of ~~muscle~~ fascia over the muscles. Posteriorly and above, the structure is sharply defined and the fibres of the supinator brevis can be seen running at right angles to the direction of fibres which are the remains of the anconeus.

THE DEEP LAYER OF MUSCLES ON THE BACK OF THE FOREARM.

In the case of the muscles of the thumb the same nomenclature is used as in man, although the action or insertion is in some cases essentially different.

THE EXTENSOR OSSIS METACARPI POLLICIS.

ORIGIN.- From (1) the back of the upper half of the shaft of the radius, (2) the back of the interosseous membrane and the septa between it and neighbouring muscles.

INSERTION.- Into the front of the outer side of the base of the first metacarpal bone by means of a sesamoid bone, into the fascia and muscles (short) of the thumb, into the anterior annular ligament, and indirectly by the ligaments of the sesamoid bone, which articulates with the ridge on the trapezius, (tubercle of scaphoid) into the trapezius and some of the anterior carpal ligaments.

NERVE SUPPLY.- From the posterior interosseous nerve which enters the upper part of the muscle while still under cover of the supinator brevis muscle.

STRUCTURE.- The fleshy belly forms about one half of the whole muscle, the tendon the other half.

RELATIONS.- At the upper part of its origin the muscle lies under cover of the ~~extensor~~ supinator brevis then under the extensor sublimis digitorum, and below this under the extensor carpi radialis brevior; then with the extensor brevis pollicis tendon it passes between these two last muscles and crosses the two radial extensors to gain the 1st. or outermost compartment of the posterior annular ligament, where it lies on the outer side of the styloid process of the radius. At the insertion the tendon is quite close to the place where the flexor carpi radialis plunges into the short muscles of the thumb and disappears from view.

THE EXTENSOR BREVIS POLLICIS.

ORIGIN.- From (1) slightly from the middle two-fourths of the back of the inner part of the shaft of the radius, (2) the corresponding portion of the interosseous membrane, (3) the septum between it and the last muscle.

INSERTION.- Into the outer side of the base of the first metacarpal rather on its dorsal aspect.

NERVE SUPPLY.- From the posterior interosseous nerve.

STRUCTURE.- The muscle is thin and narrow and slightly bipenniform with a narrow flat tendon.

RELATIONS.- Lying rather under cover and to the inner side of the last muscle the two tendons accompany each

other-that of the brevis lying to the inner side, Passing through the same compartment in the posterior annular ligament, they separate at their insertions.

THE EXTENSOR LONGUS POLLICIS.

ORIGIN.- From(1) the outer part of the middle third of the shaft of the ulna,(2) a corresponding portion of the interosseous membrane.

INSERTION.- By means of a dorsal expansion into the bases of the two phalanges of the pollex.

NERVE SUPPLY.- By a twig, from the posterior interosseous nerve, which enters it on its deep surface.

STRUCTURE.- The muscle is slender. The tendon is long in comparison to the length of the belly, and appears first on the outer part of the muscle, becoming very rounded and thin as it passes under the posterior annular ligament-at first in the same compartment as the extensors of the digits, and then in the lower part entering a separate compartment passing more outwards. It next crosses the extensores carpi radialis tendons, and shortly before it reaches the metacarpo-phalangeal joint of the thumb it spreads out and divides into three, being inserted in the usual way of a dorsal extensor expansion.

RELATIONS.- The muscle is in series but higher up than the extensor profundus digitorum, to be described next, and is under cover of the extensor sublimis to the outer side of the extensor profundus. The tendon

crosses, in addition to the structures already mentioned, the posterior interosseous nerve.

THE EXTENSOR PROFUNDUS DIGITORUM (Indicis).

This is in series with the last muscle.

ORIGIN - From (1) the lower half of the outer part of the posterior surface of the ulna, (2) a corresponding portion of the back of the posterior interosseous membrane.

INSERTION.- Into the dorsum of the proximal phalanges of the 2nd., 3rd. and 4th. digits near their bases.

NERVE SUPPLY.- By twigs from the posterior interosseous nerve which enter its deep surface.

STRUCTURE.- The tendon begins to appear almost at the upper and and runs down the outer side of the muscle. On the dorsum of the hand the tendon spreads out under that of the sublimis and in a very similar manner, the three tendons being webbed together till near the roots of the fingers in the same way.

RELATIONS.- The muscle throughout its whole length lies under cover of the extensor sublimis, passing through the same compartment at the back of the wrist; the extensor longus pollicis lies to its outer side in the arm and at the wrist.

THE SUPINATOR RADII BREVIS.

ORIGIN.- From (1) the back of the external condyle, (2) the external lateral and orbicular ligaments, (3) the posterior border of the ulna in its upper third

and the outer part of the shaft of the same bone below the lesser sigmoid notch,(4) to a slight extent from the tendinous remains of the anconeus muscle.

INSERTION.- Into the front and outer side of the shaft of the radius, limited in front and behind by the oblique lines.

NERVE SUPPLY.- By several twigs from the posterior interosseous nerve, which leave that nerve some before and some while the parent trunk pierces the muscle.

STRUCTURE.- The superficial part of the muscle is tendinous posteriorly, the deeper surface of this tendon giving origin to many of the fibres; the rest of the muscle is fleshy.

RELATIONS.- The muscle lies under cover of the other muscles which arise from the outer condyle and laps round the back, outer and anterior aspects of the radius and elbow joint. Deeper than the muscle behind is the upper end of the extensor ossis metacarpi pollicis. The posterior interosseous nerve pierces the muscle in front and to the outer side of the radius, and behind the nerve lies between the muscle and the extensor ossis meta-carpi pollicis, till it appears at the lower border of the muscle.

1. Loc. Cit., p. 87.
2. Loc. Cit., Vol. 3. p. 25.
3. Loc. Cit.
4. Loc. Cit., Vol. I. p. 648.
5. Loc. Cit. p 37.
6. Loc. Cit. Vol. V. pp. 360 - 367. Vol. VI p. 305.
7. Alix. Sur la détermination du long. Supinateur des Oiseaux
Bull. Soc. Philomathique de Paris 1874. p. 1.

MYOLOGY, UPPER LIMB.

THE COMPARATIVE ANATOMY OF THE MUSCLES ON THE BACK OF THE FOREARM.

SUPINATOR LONGUS, (Comp. Anat.)

The chief points of difference between this muscle and that of man are the direct continuation into it of many of the fibres of the brachialis anticus and the high insertion 12 c.m. above the wrist. Duvernoy[1] noted this ~~insertion~~ blending of the muscle with the brachialis in the case of a gorilla, Hepburn[2] in the gibbon. The latter author together with Bischoff[3] and Huxley[4] noted the high insertion in the gibbon. The high insertion may be due to the great length of the forearm, for as the muscle does not act on the wrist joint there is no advantage, mechanical or otherwise, of prolonging the insertion down the bone more than a certain length, for what it gains in leverage it loses in quickness.

In some other anthropoids the muscle has a much more extensive origin, Hepburn[2] found it in the chimpanzee arising as high as the insertion of the deltoid. Primrose[5] found it as high as the middle of the shaft of the humerus in his orang. In lower animals it is still more extensive in origin, arising from nearly the whole length of the humerus in the Otter (Meckel)[6]. The same condition of affairs was present in a cat that I examined. Alix[7] found that the muscle was attached to the whole length of the bone, including the head in some of the Birds.

Extensor carpi radialis Longior and Brevior, (Comp. Anat.)

The disparity in length between the belly of the muscle and the tendon was the most remarkable thing noticed,

[1] Loc Cit. p. 14.

the tendon being about four times as long as the belly in both cases. In many animals these two muscles are fused together,a single belly giving rise to two tendons.

This was the case with the Phascogale and one Thylacine examined by Cunningham;this he states to be the general rule in all the Marsupials.

THE EXTENSORS,(Comp.Anat.)

The extensors of the fingers,the thumb being left out of the question,are three in number,the sublimis which corresponds to the communis,the profundus which corresponds to the indicis and lastly the extensor minimi digiti which is the same in both man & ape.

In the gibbon these three form the extensor mechanism, being distributed as follows.-The sublimis passes to the 2nd.3rd.& 4th.digits giving a slip to the tendon of the little finger.This muscle forms the dorsal expansion on these fingers,being inserted into the middle and terminal phalanges. The extensor profundus passes to the same three digits, but does not give a slip to the special tendon to the little finger,gaining attachment to the proximal phalanges. The extensor minimi digiti passes to form a dorsal expansion on the little finger,being inserted into the terminal and middle phalanges after receiving a slip from the sublimis tendon.

With regard to the sublimis,there is nothing much to be said;it corresponds to that of man very closely in all anthropoids,giving off no slip to the little finger except in the case of the gibbon. This muscle is very regular throughout the series of mammals, though

1. Journ. of Anat. & Phys. Vol. XVI
2. Loc. Cit. Vol. 3. p. 28.
3. Loc. Cit. p. 37.

Young found an exception in the Koala[1], for in this animal the muscle sent a slip to each digit. But it is chiefly with the indicis and the minimi digiti that we have to deal. As there is an indication that there are two sets of extensor tendons to the fingers in man and the anthropoids, we would naturally suppose that in the animals still lower in the scale we should find the arrangement more perfect. This we do, and as there are typically two long flexors to the fingers, so are there typically two long extensors, and a tendon from each passes to the individual digits, (the thumb as before mentioned is excluded). Where this arrangement is present we find that the superficial ~~tendon~~ muscle is the one which sends the superficial tendon, while the deep tendon is provided for by the indicis and the minimi digiti between them, the distribution of the one being inversely proportionate to that of the other, that is to say if the indicis supplies two fingers then the minimi digiti will supply two fingers also, and if the indicis supplies three then the minimi digiti only supplies one. Thus Hepburn[2] and Primrose[3] found in the orang that the indicis supplied the index and middle digits while the minimi digiti supplied the little and ring, The first author noted that in his gibbon, as here, the indicis supplied the index, middle and annularis while the minimi digiti supplied the little only. In the orang however the superficial tendon fails to the little finger, in the gibbon and in man the remnant of the superficial tendon is seen in the slip given off by that tendon to the minimi digiti.

1. Loc. Cit. p. 15.
* See page. Exteriores Longus Pollicis. Comp. Anat.
2. Loc. Cit.,
3. Loc. Cit., Vol. 3. p. 17.
4. Loc. Cit.,

MYOLOGY, UPPER LIMB.

In the Marsupialia Cunningham[1] described the minimi digiti going to the little and ring fingers in the Phascogale, Cuscus and Thylacine, but makes no mention of the indicis. Macalister[2] found this muscle passing to the three inner digits in the Tasmanian devil, Bennet's Kangaroo and in the Great Kangaroo. As far as I know, although the indicis and minimi digiti supply the deep tendons in this manner, they do not form the radial and ulnar halves respectively of one muscle, nor do they appear to arise in the same layer of muscles. In man the minimi digiti is a superficial muscle, while the indicis belongs to the deep group. In the gibbon they are separated the one from the other by a portion of the flexor sublimis which takes origin from the ulna low down.

EXTENSOR CARPI ULNARIS, (Comp. Anat.)

This differed in no respect from that found in man, and the same similarity is preserved throughout the anthropoid series.

THE ANCONEUS, (Comp. Anat.)

This muscle was absent, only being represented by a band of tendon. This is evidently an exception in the apes, for Hepburn[3] found it present in all the four he dissected, but he noted that it was weak and ill-defined at the upper part in the orang and gibbon. Primrose[4] stated it to be well developed in his orang with connections similar to those in man.

1. Loc. Cit. Vol. 3. p. 31.
2. Loc. Cit., 1. p. 213.

EXTENSOR OSSIS METACARPI POLLICIS, (comp. anat.)

This muscle has been modified considerably as regards its insertion, for instead of passing to the base of the 1st. metacarpal it is inserted into the sesamoid bone which articulates with the scaphoid and trapezium and goes through it to these bones and to the front of the base of the metacarpal and anterior annular ligament. This description coincides with that given by Hepburn[1] in the same animal under the name of the abductor longus pollicis. Although Hepburn finds the same insertion as here, he calls the muscle an abductor, but I found that the only action which was produced by pulling on the muscle was flexion of the thumb forwards and inwards, and as long as the tendon was kept in the deep groove in the posterior annular ligament on the outer side of the radius, this was all. But on the other hand, if the tendon was allowed to escape from the groove by cutting the ligament, then abduction could be obtained. There is a great variation in the reports of different authors in regard to the insertion of this muscle in the anthropoids; for Bischoff[2] found that in the gorilla, gibbon, chimpanzee, cercopithecus and macacus it had two tendons, one passing to the trapezium and the other to the first phalanx of the thumb, while the same author says that in the orang, cynocephalus pithecia and hapale the muscle was inserted as in man. Hepburn[1] reported that in the gorilla it was as in man, but in the chimpanzee the tendon passed to the sesamoid bone and the trapezium, in the orang to the

1. Loc. Cit. 1.
2. Loc. Cit. p. 39.
3. Brooks. H. St. John. On the Short Muscles of the Pollex & Hallux of the Anthropoid Apes, with special reference to the. opponens Hallucis. Journ. Anat. & Phys. Vol. XXII. 1887. p. 78.
4. Zuckerkandle. Verhandlungen der Anatomischen Gesellschaft. Göttingen 1893. p. 193.
5. Loc. Cit. p. 565.
6. Loc. Cit. p. 32. Vol. 3.
7. Loc. Cit.
8. Loc. Cit. 1 & 2.
9. Loc. Cit.
10. Loc. Cit., p. 285.

sesamoid bone and to the base of the first metacarpal. Fick[1] describes the sesamoid bone, and states that on the one side of his orang the tendon went to the trapezium and the metacarpal while on the other it went to the scaphoid in addition. Primrose[2] found the sesamoid bone in his orang and the tendon went to the trapezium with a slip to the fascia from which the short muscles of the thumb took origin. Brooks[3] states that the sesamoid bone is constant in all anthropoids; Zuckerkandl[4] has reported the sesamoid in man. Testut[5] has seen all these variations which occur in the apes reproduced in the muscle in man.

EXTENSOR BREVIS POLLICIS, (Comp.Anat.)

In this muscle we find a marked departure to the condition found in man, for the tendon instead of being inserted into the base of the first phalanx is attached to the proximal end of the shaft of the metacarpal bone. Hepburn[6] found the same condition in the gibbon, orang and chimpanzee. In the gorilla it was inserted into the base of the metacarpal and also into the base of the first phalanx. The same author states that the muscle, in the gorilla and the chimpanzee, was closely associated with the last muscle. This muscle is said to be absent in most of the apes for Langer[7], Fick[1], Bischoff[8], Huxley[9] and Chapman[10] failed to find it in the orang, although Primrose[2] describes it in the same way as Hepburn. Bischoff states that it is absent in all apes with the exception of the gorilla. It is most probable therefore that the muscle is really not absent, but is merely present incorporated with the extensor ossis metacarpi pollicis, this being the real reason of the double insertion

1. Loc. Cit., Vol. 3. p. 33.
2. Loc. Cit., p. 16.
*. See. Extensor indicis. Comp. anat.

described in so many cases. One is all the more inclined to this belief when it is remembered that the the homologue of these two musclesin the lower limb is the single muscle, the ~~brachialis~~ fibialis. anticus. It is this fusion of the two muscles in the lower limb that gives rise to the double insertion of this muscle, i.e. into the base of the first metatarsal and the internal cuneiform bone.

EXTENSOR LONGUS POLLICIS, (Comp. Anat.)

This has to differ from the muscle as found in man, as it has to replace the brevis as well as supply the terminal phalanx. Hepburn[1] found that in the gibbon, chimpanzee and orang where the short tendon failed to reach the phalanx the long tendon supplied the deficiency, while in the gorilla, where the short tendon was inserted as in man the long tendon sent no slip to the first phalanx, but it sent one to the index finger. This last arrangement is significant as we find that in the lower animals the longus pollicis is inclined to replace the indicis to a certain extent.

Cunninham[2] found this to be the arrangement in the Thylacine and Phascogale, where the muscle had an extensive and high origin from the ulna and supplied tendons to the three radial digits, the two inner digits being supplied by the extensor minimi digiti muscle. This is the reason evidently why there is no mention of the extensor indicis.*

From this we must suppose that the two muscles belong to the same sheet, the longus pollicis being always placed at a higher level than the indicis. (see extensors of the fingers)

FOREARM.

THE FASCIA AND MUSCLES OF THE FOREARM.

THE DEEP FASCIA of the forearm is very strong and dense, especially on the upper part, as the biceps is partially inserted into the inner and the brachialis into the outer side of the fascia of that part. The deep surface is closely adherent to, and gives origin to, many of the fibres of the muscles both on the back and front of this segment of the limb. In the region of the wrist joint the fascia is specially thickened to form the two annular ligaments, anterior and posterior, which hold in place the various tendons of the muscles which act on the wrist or beyond it.

The anterior annular ligament is a strong dense band of fascia which stretches across the front of the wrist, attached to the pisiform and the hook of the unciform on the inner side and to the scaphoid and the prepollex or sesamoid bone in the tendon of the extensor ossis metacarpi pollicis on the outer side. The upper border being continuous with the fascia of the forearm, the lower with the insertion of the palmaris longus (palmar fascia), some of the short muscles of the thumb and little finger take part of their origin from the front of the lower border. In front of the ligament the following structures pass from within outwards, ulna artery, ulna nerve, palmaris longus tendon which is inserted just below and the palmar cutaneous branch of the median which is larger than in man. Behind the ligament there is one

common compartment for the flexor tendons of the fingers and thumb, the synovial membrane of which communicates with that of the thecal sheaths of the fingers in every case; the median nerve passes through the same compartment. The flexor carpi radialis pierces the outer part of the ligament.

The POSTERIOR ANNULAR LIGAMENT is situated in the same position as in man, and has the same number of compartments, but the tendons which pass through them are arranged in a different manner. The 1st. or outermost compartment has the two tendons of the extensor ossis metacarpi pollicis and brevis pollicis, the 2nd. has only the extensor carpi radialis longior tendon, the 3rd. has only the tendon of the extensor carpi radialis brevior, the 4th. is a large compartmant with the tendons of the extensor sublimis (communis) and extensor profundus (indicis) digitorum with the extensor longus pollicis, and posterior interosseous nerve. The tendon of the extensor longus pollicis does enter a special compartment, but only in quite the lowest part of the ligament, the 5th. is for the tendon of the extensor minimi digiti, while the 6th. or innermost is for the extensor carpi ulnaris tendon.

The superficial veins and nerves are between the skin and the deep fascia.

THE MUSCLES ON THE FRONT OF THE FOREARM.

The length of the limbs has been touched on in the introduction, but of all the segments of the limbs which have developed in length in this animal, none have developed to such an extraordinary length as the forearm and hand.

In this section the description of the muscles of the hand will also be included. The muscles which lie on the front of the forearm are the flexor pronator group, and are mostly attached to the internal condyle of the humerus. They are divided into a superficial group of 5 which include the pronator radii teres, flexor carpi radialis, palmaris longus, flexor sublimis digitorum and the flexor carpi ulnaris muscles. These form a more or less undifferentiated mass on the upper part of the forearm, and spring from the common origin: the deeper group only include two muscles, the flexor profundus digitorum and the pronator quadratus, the flexor longus pollicis of man being here only a part of the deep flexor of the digits.

THE SUPERFICIAL GROUP.

THE PRONATOR RADII TERES.

ORIGIN.- From (1) the common flexor pronator origin from the internal condyle, (2) the bone for a short distance above, (3) the intermuscular septum between it and the flexor carpi radialis, (4) many of the fibres of the biceps muscle are continued into this muscle.

INSERTION.- Into the front and outer side of the shaft of the radius below the supinator brevis for a distance of 6 c.m.

NERVE SUPPLY.- From the median nerve.

STRUCTURE.- The origin is fleshy, the insertion tendinous, the belly can not be separated from the common muscular mass.

RELATIONS.- The muscle passes obliquely across the upper part of the arm to the outer side of the flexor carpi radialis, forming one of the boundaries of the anticubital fossa and crossing the structures which it contains.

THE FLEXOR CARPI RADIALIS.

ORIGIN.- From (1) the common flexor mass into which many of the fibres of the biceps are continued, (2) the front of the middle third of the shaft of the radius below the insertion of the last muscle, (3) the fascia covering it and the intermuscular septa between it and adjoining muscles.

INSERTION.- Into the bases of the 2nd. and 3rd. metacarpals on their radial aspects.

NERVE SUPPLY.- From the median nerve in the upper part of the forearm.

STRUCTURE.- The muscle is closely associated with the last. The tendon begins to appear on the front of the muscle about half way down the forearm, but it receives fibres from its radial head until a short distance above the wrist.

RELATIONS.- Below the insertion of the pronator radii teres this tendon is the outermost, that of the palmaris longus being next, At the wrist the tendon disappears from view by piercing the anterior annular ligament and origins of the short muscles of the thumb.

THE PALMARIS LONGUS.

ORIGIN.- From (1) the common origin, (2) the fascia covering it and the septa on either side.

INSERTION.- The tendon spreads out to form the palmar fascia which is attached to the roots of the fingers.

NERVE SUPPLY.- From the median nerve.

STRUCTURE.- The muscle became separated from the flexor mass about the level of the junction of the upper and middle thirds of the forearm, The belly was short and the tendon long, the latter passed in front of the anterior annular ligament, to the lower part of which it was attached as it spread out; a process went to the ball of the thumb, the rest was the palmar fascia which was not so well marked as in man, There was a superficial transverse ligament across the roots of the fingers.

RELATIONS.- The muscle lies superficial to the other flexor muscles, between the flexor carpi radialis and the flexor sublimis; the median nerve lies behind it at the wrist and slightly to its inner side.

ORIGIN.- in addition- From the anterior aspect of the shaft of the ulna to within 10 c.m. of the wrist, from the anterior surface of the shaft of the radius to with in 5 c.m. of the wrist.

THE FLEXOR SUBLIMIS DIGITORUM.

ORIGIN.- From (1) the common origin, (2) the fascia covering it and the intermuscular sapta on either side.

INSERTION.- Into the sides and bases of the middle phalanges of the four inner digits.

NERVE SUPPLY.- Several branches from the median enter the upper part on its deep surface; a branch from the ulnar nerve passes to the ulnar head especially to that of the little finger.

STRUCTURE.- The muscle is best described as double, having a radial and an ulnar half, each giving rise to two tendons which go to the digits on the corresponding side (the thumb being left out of the question) so that the radial half gives rise to the tendons of the index and long, the ulnar half to these of the ring and little fingers. In addition the tendons of the long and ring are situated in front of those of the other two, both at the wrist and in the arm, and these two anterior tendons are the first to become separated, which they do at a much higher level relatively than in man so as almost to have the appearance of four muscles.

RELATIONS.- The muscle is blended above with the other muscles of the group and with the deep flexor to some extent, superficial to which it lies as it passes down the limb. The palmaris longus lies over the centre of the muscle for the upper part. The flexor carpi ulnaris and radialis are superficial to the adjacent

parts of the muscle respectively, In the hand the tendons are situated in front of the deep tendons under the digital nerves and the superficial palmar arch, and the palmar fascia. Bearing this same relation to the deep tendons they enter the digital sheaths, which are strong only opposite the the middle of the phalanges, but there they are extremely strong. Here opposite the first phalanx the tendon splits and divides into two, the deep tendon perforating and now lying superficial to the sublimis tendon. The two parts of the sublimis now are twisted on themselves, so that the anterior surface now looks outwards and inwards as it winds round the deep tendon, and at last lying behind it that surface looks backwards. Behind the deep tendon in this position the ~~present inne~~ adjacent sides of the tendons send processes which decussate and so join the two halves of the tendon, which, as it approaches the middle phalanx, divides again, the two halves forming a groove for the profundus tendon to lie in, and are inserted into the margins of the phalanges.

THE FLEXOR CARPI ULNARIS.

ORIGIN.- From (1) the back of the internal condyle and common origin from the humerus, (2) the inner border of the olecranon process and inner and posterior borders of the bone in its upper half, (3) the fascia covering it and the septum between it and the last muscle.

INSERTION.- Into the pisiform bone and through its ligaments into the base of the ~~pi~~ 5th. metacarpal and

hook of the unciform.

NERVE SUPPLY.- From the ulna nerve by a branch which enters just below the condyle.

STRUCTURE.- The muscle is thin, slender and long, the tendon appearing about 18 c.m. above the wrist joint, but fleshy fibres are inserted into it as far as the wrist, some being inserted into the pisiform bone itself, these fibres arising from a strong fascia which binds it down to the posterior border of the ulna.

RELATIONS.- Lying on the inner side of the forearm lapped round the ulna to the inner side of the flexors of the fingers, the ulnar nerve enters the forearm between its humeral and olecranon heads, is separated from it in the arm by the ulna attachment of the flexor sublimis, but lies to its outer side at the wrist joint.

THE DEEP GROUP OF MUSCLES ON THE FRONT OF THE FOREARM.

These are only two in number, the flexor profundus digitorum and the pronator quadratus.

THE FLEXOR PROFUNDUS DIGITORUM.

ORIGIN.- From (1) the common origin, this is due to the fact that it is fused with the common muscular mass to some extent, (2) the inner side of the coronoid process and front of the shaft of the ulna to within 11 c.m. of the wrist, (3) the front of the shaft of the radius behind and internal to the pronator radii teres

and the flexor carpi radialis and flexor sublimis to which it is partially blended, (4) the anterior interosseous membrane.

INSERTION.- Into the bases of the terminal phalanges of all 5 digits.

NERVE SUPPLY.- From the median by branches which enter the upper part of the muscle, and by a large branch which runs down between the bellies, which will eventually give rise to the tendons for the 1st. & 2nd. digits, supplying both. From the ulna by twigs which enter the humeral portion, the coronoid portion (already having had a twig of the median traced to it) and the ulnar portion of the muscle.

STRUCTURE.- The muscle is divided into two parts at its origin by the fact that the ulna vessels run between the humeral and radial portion on the one hand and the coronoid and ulnar portions on the other, Each of these parts gives rise to tendons, two from the inner and three from the outer. Although these two halves are separated above, they are blended together about the middle of the forearm, The tendon of the inner part begins about 8 c.m. below the point of the elbow, but only becomes separated from the radial part about 6 c.m. from the wrist to be bound to them firmly again as they pass under the anterior annular ligament, When this tendon reaches the palm it breaks up into two for the ~~four~~ inner two digits. The part which gives rise to the outer three digits arises chiefly from the back of the

internal condyle by a rounded belly which passes down to join the radial portion, the fibres of which join the tendon which has already appeared on the humeral portion. The different tendons begin to separate high up the forearm, but there are fleshy fibres inserted into them as far as the wrist, the bony origin ceasing about 5 c.m. from the wrist. While the tendons are separate the fleshy belly remains common to all. At the lower part of the anterior annular ligament the tendon for the thumb turns outwards under a loop of fibrous tissue, which binds it down to the lower part of the trapezium, and passes to its insertion into the terminal phalanx of the thumb.

From the other tendons which are here bound together the lumbricals arise.

RELATIONS.- Between the two ~~heads~~ parts of the muscle in the upper third of the forearm the ulna artery passes inwards with a branch of the median nerve, The ulnar nerve passes a little outwards to lie between the two parts, and there the artery and nerve come first in contact, while the branch of the median joins the ulna nerve, the ulnar portion of the muscle lies rather posterior to the other half at first, then they come to lie side by side ~~over~~ deeper than the superficial group of muscles, The humero-radial head has the branches of the median in front of it. At the wrist the tendon lies behind those of the sublimis and between those of the two flexores carpi with the median nerve in front of it. The relations in the palm and fingers

have been noted in dealing with the sublimis tendons.

THE LUMBRICALS.

These little muscles are four in number.

ORGIN.- From the adjacent sides of the tendons which they lie between, In the case of the first the origin is from the side of the tendon to the index finger. In addittion they all arise from the dorsum of the tendons.

INSERTION.- Into the dorsal extensor expansion of the four inner digits.

NERVE SUPPLY.- The first or outer is supplied by the nerve to the outer side of the index finger from the median, the second was supplied from the nerve to the cleft between the index and the long fingers from the median, The third from the nerve from the median and ulnar to the cleft between the 3rd. & 4th. digits; the fibres were thought to come from both, The fourth was supplied by the superficial division of the ulnar to the inner cleft.

STRUCTURE.- They are small bipennaniform muscles except the outer one, They have relatively long tendons which can be traced up as far in the dorsal expansion as the first interphalangeal joint, being chiefly inserted into the lateral part, and therefore having more action on the terminal phalanx than on the middle one.

MYOLOGY, UPPER LIMB.

THE PRONATOR RADII QUADRATUS.

ORIGIN.- From the front of the lower ¼ of the shaft of the ulna.

INSERTION.- Into rather less than the lower ¼ of the front of the shaft of the radius, and also into the inner portion of the bone just above the wrist joint.

NERVE SUPPLY.- From the posterior interosseous nerve which sends a branch to enter the posterior surface of the muscle low down. On tracing this nerve up it is found to be a mere posterior interosseous collateral, as it is composed of fibres which originally came from the median nerve higher up in the forearm, and which piercing the interosseous membrane joined themselves to this nerve.

STRUCTURE.- The muscle fibres pass downwards and outwards to the radius, the opposite way to the fibres of the interosseous membrane, The front of the muscle is covered with strong fascia with tendinous markings on the surface. The lower part of the muscle is the thickest.

RELATIONS.- The muscle lies across between the ends of the two bones, deeper than the flexor tendons, The posterior interosseous artery pierces the lower part of the muscle and joins the radial half of the anterior carpal arch, being seen at the lower border of the muscle in front.

1 Loc. Cit. Vol. 3. p. 18.
2 Macalister. On the arrangement of the Pronator Muscles in the limbs of Vertebrate animals. Journ. Anat + Phys. 1869. p. 335. Ibid. 1867. Vol. II p. 8.
3 Loc. Cit
4 Loc. Cit., p 434
5. Humphrey. Observations in Myology. p. 174.
6 Loc. Cit., p. 32.
7. Loc. Cit., p. 178
8 Loc. Cit., p. 162.
9 Loc. Cit., p. 502. Trans. Roy. Irish Acad. 1871. Ser. 2. Vol.

MYOLOGY, UPPER LIMB.

MYOLOGY COMPARATIVE ANATOMY OF THE MUSCLES ON THE FRONT OF THE FOREARM.

PRONATOR RADII TERES. (Comp. Anat.)

This muscle was poorly developed and only presented one head of origin, that from the humerus. The insertion was rather into the front as well as the outer side of the bone. The muscle only has one head in most animals below man, but in the chimpanzee the muscle was found to have two heads by Hepburn[1], Macalister[2], Champneys[3], Testut[4], and Humphry[5]. Both heads were found in the orang by Hepburn[1], Primrose[6], Langer[7] and Chapman[8]. In the gorilla both heads were found by Macalister[9], but not by Bischoff or Duvernoy. In the gibbon Bischoff and hepburn only found one head. Testut did not find the deep head in his orang. According to Macalister[2] the deep head is also absent in the Ruminants, Pachyderms, Cetacea and the Rodents, and in the dog, lion, cat, and bear in the Carnivora, in the monkeys in Cercopithecus, Cebus capucinus and Macacus nemestrinus.

Langer[7] notes that in his orang the insertion of the muscle was high just below the upper third of the bone. This fact led him to state that it was only the distal portion of the radius that was elongated as compared with the bone in man. On this subject Primrose[6] writes, "Langer's orang was young, but in the adult animal dissected by Fick he found the position of the insertion of the pronator ~~silim~~ similar to that occurring in man; he therefore concludes that either the high insertion is characteristic of the young orang, thus differing

1. Macalister Journ. Anat + Phys. Vol. III. 1869. p. 340.

from the old animal,or that Langer's case was abnormal —my specimen would go to prove the truth of the former hypothesis." I do not agree with Langer's theory, for it requires that a muscle should be inserted into the same place in the bone throughout the animal series,A mere glance into comparative anatomy is sufficient to convince any one that such is not the case; the gluteus maximus,biceps either in the upper or lower limb are good examples. In spite of the support given by Primrose's orang I believe the second of Fick's hypotheses,for, if the high insertion was found in the young and the low in the old animal, then one of two things must have taken place,either the muscle must migrate as the animal becomes older-a phenomena which is I believe unknown,or the bone must grow from the upper epiphysis, in which case the bicipital tuberosity would also be found migrated down with the muscle. A muscle may grow in size as the animal becomes older, as is seen in the temporal muscles of the gorilla,but this is an extension and not a migration,the old origin being still maintained.

In dealing with the muscle that is usually accepted as the homologue of this muscle in the lower limb, namely the popliteus,it is noted that Macalister considers that the true homologue of this muscle is the inner head of the biceps,but to me at all events his able paper is not quite convincing. The same author, viewing the appearance of a deep head to the muscle in the higher apes and man, looks on this head as "the germ of a superior transverse muscle,the upper

1. W. Leche. — Mammalia. In Bronn's Klassen und Ordnungen des Thierreichs Bd. VI. Abth. V, 1, 1898.
2. Loc., Cit., p. 22.
3. Loc., Cit., p. 32.
4. Loc. Cit., Vol. 3. p. 18.
5. Loc. Cit., p. 438.
6. Loc. Cit., Vol. 6. p. 315.
7. Alix. Soc. Philom. de Paris. 1877 p. 199.
8. Loc. Cit

equivalent and coordinate of the pronator quadratus below. In the same way as the popliteus muscle will be seen to occupy the whole length of the interosseous space in the lower limb in certain animals, so does the pronator quadratus, in the upper limb, reach up to and join the pronator radii teres in the Parameles, some species of Halmaturus (Leche)[1]. It is supposed therefore that the central portion has degenerated and left the deep head above and the pronator quadratus below. As soon as the deep head appears there is only a small pronator quadratus. This is very analagous to the retreat up the leg beat by the popliteus muscle

THE FLEXOR CARPI RADIALIS.(Comp.Anat.)

This muscle was peculiar in having besides the ordinary origin an additional one from the front and outer side of the radius in common with the flexor sublimis. Fick[2], Primrose[3] and Hepburn[4] all describe this extra head of origin in the orang, The last author noted the same in the gorilla and the gibbon as well but not in the chimpanzee, In each case the muscle passed to the 2nd.& 3rd.metacarpals. Primrose[3] only found the muscle inserted into the 2nd. metacarpal. The insertion of the muscle in the lower animals shows a tendency to pass to other insertions than that found in man, for in Ursus americanus it passes to the scaphoid(Testut)[5], in the Opossum to the trapezium and the 2nd.metacarpal(Meckel)[6], in the Echidna to the scaphoid, trapezium, 2nd. and 3rd.metacarpals (Alix)[7] a sesamoid bone being developed in its tendon, in the cat to the 2nd. and 3rd.(Strauss-Durcheim)[8], in

1. Young. Journal of Anat. + Phys. Vol. 16. p. 230
2. Loc. Cit., p. 17.
3. Loc. Cit., Vol. 3 p. 19.
4 Quoted by Testut.
5. Quoted by Testut.
6 "Lectures in Human Myology", Brit. Med. Journ., 1872. p. 58.
"Observations in Myology" 1871.
7. Loc. Cit., p. 443.
8. Loc. Cit., p. 33.
9. Loc. Cit., p. 104.
10 Loc. Cit., p. 23.
11 Loc. Cit., Vol. 6. p. 316.
12. Journ. Anat. Phys. Nov. 1869.
13. Anat. Compatee des. Animeaux. domestiques, p. 289.

the Koala to the third metacarpal(Young)[1], Cunningham[2] found that in the Cuscus the muscle passed to the 2nd. & 3rd. metacarpals, in the Thylacine into the trapezium and base of the 1st. metacarpal, in the Phascogale into the trapezium. From this list, which could be prolonged, it will be seen that the muscle is very varied in its insertions.

THE PALMARIS LONGUS.(Comp.Anat.)

Few muscles in the body have been the seat of wider controversity than has the palmaris longus muscle. It is a muscle that is constant apparently in the higher apes with the exception of the gorilla. In the chimpanzee it was met with by Hepburn[3], Rolleston[4], Champneys[5], Humphry[6] and Testut[7]. In the orang by Hepburn[3] Hepburn, Primrose[8], Duvernoy[9] and Fick[10], the latter in two animals. In the gorilla the muscle was not found by either by Hepburn[3] or Duvernoy[9]. In man the muscle is often absent. Before entering on the various theories about this muscle we may with advantage glance through the animal kingdom and see in what animals the muscle occurs, its distribution and its absence. It is absent then in the ~~lower~~ animals below the mammalia, and is only found as a separate muscle in the higher animals of that class, being absent in the Monotremes, Plantigrades, Ruminants and Pacchydermes. In the Hyena and Bear(Meckel)[11] and the Pangolin(Humphry)[12] the muscle is fused to the superficial flexor. In the dog it is separated from the deep flexor(Chauveau)[13]. In the Anteater it is not quite separated from the flexor carpi ulnaris(Humphry).

1. Loc. Cit. Journal. Anat + Phys. 1880, p. 171.
2 Loc. Cit. Ibid. May. 1868. p. 303.
3. Loc. Cit. p. 18.
4. Maisonneuve. "Osteology et Myologie du Vespertilio murinus" Paris 1878.

In the Civet Young[1] found two tendons for this muscle both of which ended in the palmar region. In the Seal the muscle was noticedby Humphry[2] to arise from the olecranone- where it was to a certain extent continuous with the fibres of the triceps, It was inserted in the hand as the palmar fascia, giving three slips to the three middle digits; these fused with the tendons of these digits.

Cunningham[3] found in some of the Marsupials what as we shall see later is a very interesting arrangement, and one which seems to throw light on the morphology of this muscle, The arrangement in the three animals examined was as follows. In the Thylacine, "It springs from the superficial aspect of the great flexor muscle of the digits, and ends in a powerful tendon which penetrates into the midst of the palmar pad. Here it breaks up into four strong slips which go to join the flexor sheathes of the four inner digits. In the Phascogale the palmaris longus is arranged upon a similar plan, but in the palm it spreads out into a distinct palmar fascia. In Cuscus there are three small muscular slips representing the palmaris longus, viz., (1) a very delicate fasciculus which springs directly from the internal condyle of the humerus: (2) a larger slip which arises in common with the great flexor of the digits: (3) and a deeper portion which issues from the superficial aspect of the flexor of the fingers. They all proceed to join the palmar fascia."

In some of the Bats as Vespertilio murinus, Maisonneuve[4] found the following arrangement: "C'est un petit muscle

très tenu qui s'insère à la partie la plus saillante de l'épitrochlée,immédiatement en avant du fléchisseur commun auquel il est accolé,tout le long de l'avant-bras. Cette insertion se fait par un tendon,long d'un centimètre environ,auquel fait suite un corps charnu fusiforme extrêment grêle,long également d'un centimètre,et qui se continue par un tendon fin comme un cheveu. Ce tendon abandonne celui du fléchisseur commun au point où celui-ci est recouvert par la première arcade fibreuse du poignet et passe au-dessus d'elle; puis il se divise,en s'épanouissant à la paume de la main:il forme alors une lame fibreuse superficielle,à forme triangulaire,de laquelle partent deux expansions tendineuses assez fortes,l'une destinée au pouce, l'autre au petit doigt. Celle du pouce se subdivise en deux tendons secondaires qui se terminent a la partie inférieure du premier métacarpien,l'un en dehors l'autre en dedans:celui du petit doigt s'épanouit en une mince lame aponévrotique,ou plutôt en plusieurs petits filets tendineux qui divergent légèrement entre eux et vont se distribuer à la membrane de l'aile,tant en dehors qu'en dedans du petit doigt. En outre de la face profonde de l'épanouissement du petit palmaire partent de minces lamelles qui se portent aux trois doigts médiaux et aux espaces interdigitaux."

In the elephant the muscle is large and well nourished, becoming tendinous at the level of the carpus only, and inserted into the aponeurosis,and sesamoid bone of the little digit,and blended with the extensors on the radial

1. Loc. Cit. Jour. Anat. and Phy. 1868 p. 270.
2. Max-Grapow, "Die Anatomie und Physiologische Bedeutung der. Palmaraponeurose" Archiv. f. Anat. und Entwickelungsgeschichte 1887. p. 145.
3. Loc. Cit. p. 16-17.
4. Playfair McMurrich. American Journ. of Anat. Vol. II. p. 195

side of the limb (Miall and Greenwood)[1].

From these accounts it will be seen that the muscle varies in many different ways. Grapow[2] states that the connection between the muscle and the palmar fascia was first drawn attention to by Dupuytren in 1832, This has been again ~~laid~~ emphasised by Bland Sutton and others. Bland Sutton[3] thinks that the fascia is merely a retrograded part of what is a distinct muscle, and points to the Cape anteater (Orycteropus capensis) where the muscle is large and sends slips to help flex all the digits, as proof of this theory. Grapow holds that the main part of the palmar fascia is derived from the lower part of the anterior annular ligament, and that only the superficial longitudinal portions are the result of the palmaris longus muscle. Playfair McMurrich[4], in a really excellent paper on the phylogeny of the forarm muscles, shews that the muscles is with the superficial flexor merely a segmentation off the flexor mass which is represented still in man as the deep flexor. The muscle is never really absent in man, he thinks, but merely undifferentiated. The view of this segmentation from the flexor mass of both the superficial flexor and the palmaris longus are certainly favoured by the quotations given above especially that from Cunningham's work on the marsupials. The insertion also in the various animals is in favour of this view, for the varying attachments are explained by McMurrich by saying that the muscle is not the same throughout the range of animals in which it occurs, but that different parts segment off from the

deep flexor mass. That this can occur is seen in the Cuscus (see above) and in the Orycteropus, where these animals have more than one belly to the muscle.

The muscle could not, McMurrich thinks, be accounted for as regards its sporadic appearance among animals closely related to those which do not possess the muscle, as is seen in the anthropoids, the gorilla being without the muscle, if it did not have a representative throughout the mammalian series, and this representative is furnished by the deep flexor, which he points out was not originally inserted into the individual digits but into a common tendon.

In view of this explanation it becomes apparent that the palmar fascia which is derived from the tendon of the muscle is merely a degeneration of the distal part of the muscle, but that this is a secondary part of the history of the muscle, which shews a rise and fall of the power of the muscle as one passes up to the higher animals.

FLEXOR SUBLIMIS DIGITORUM. (Comp. Anat.)

This muscle differed from that in man by having an additional head of origin from the anterior surface of the radius to within 5 cm. of the wrist. In dealing with the structure of the muscle it was stated that it was divided into two parts, an outer to the 2nd. & 3rd. digits and an inner to the 4th. and 5th. and that the tendons for the 3rd. & 4th. were placed in front of the other two, the division being so high up the limb ~~that~~ as to give rise to the appearance almost of four muscles being present. This arrangement

1 Loc. Cit., Vol. 3. p. 19.
2. Loc. Cit., p. 33.
3. Anat. des. Gorilla. München. 1879.
4 Loc. Cit., p. 185.
5. Loc. Cit., p. 105.
6. Trans. Royal. Irish Acad. 1871.
7. Loc. Cit., p. 195.
8. Loc. Cit., Vol. 6 p. 312.
9. Journ. Anat + Phys. 1869. p 41.
10 Young, (Civet) Journ. Anat + Phys. 1880. p. 171
(Koala). Ibid. 1882. p. 229.

agrees with what Hepburn[1] found in the gibbon, but this comparativiy simple arrangement is not found in the case of the orang and gorilla, where according to Hepburn[1], Primrose[2] and Bischoff[3] the tendons for the index and little fingers arise from the ulnar side of the muscle, while those to the middle and ring arise from the radial portion of the muscle, the tendon for the index having to pass outwards behind the others. Pick in the orang found the muscle disposed as has been described here. The nerve supply in this animal to the ulnar segment came from the ulnar nerve, see nerves.

In some of the apes the radial segment is absent, as in Cynocephalus anubis (Champneys)[4], Cynocephalus maimon, Maccacus cynomolgus, and the Hapale (Bischoff), Duvernoy[5] noticed it in the orang, and Macalister[6] in the chimpanzee.

The muscle is really according to McMurrich[7] nothing more than an offshoot from the great flexor mass which is seen in the lower animals, and which will be mentioned with the profundus.

THE FLEXOR CARPI ULNARIS.(Comp.Anat.)

This muscle was arranged in exactly the same way as in man, the ulnar nerve entering the forearm between its two heads and the tendon passing to the pisiform. It seems to be the same throughout the anthropoids. In the hyena according to Meckel[8] the pisiform is the place where the tendon breaks up into processes to the ~~other~~ four outer metacarpals; in the Aï (Humphry)[9], in the Civet and Koala (Young)[10] much the same arrangement is found.

1. Loc. Cit. Vol. 3. p. 21.
2. Loc. Cit. Journal. Anat. + Phys. 1880.
3. Loc. Cit. p. 18.
4. Loc. Cit. Vol. 6. p. 332. also Vol. 5.
5. Loc. Cit. Jour. Anat. + Phys. 1869.
6. Loc. Cit. p. 200.

FLEXOR PROFUNDUS DIGITORUM.(Comp.Anat.)

This muscle includes the flexor longus pollicis of man which is here not separated off from the common mass; the muscle also still retains its humeral attachment to the internal condyle. The description given with the muscle agrees in the main with that given by Hepburn[1], but he found that the flexor tendon to the pollex was so separated as to enable him to say:"This constitutes a true flexor longus pollicis." Here the tendon was separate from the other tendons for some distance but there was a common fleshy belly which gave fibres to each of the tendons as far as the wrist. The nerve supply also was different, as the outer part of the radial portion obtained fibres from both the median and the ulnar nerves. In the animals of the mammalian series below the quadrumania we find that the flexors are not differentiated into a superfical group, but form a more or less common mass which springs from the internal condyle, and from both bones of the forearm in some cases only one tendon being supplied to each digit;in some two to the four inner and one to the outer digit. Examples of this undifferentiated condition are found in the Civet (Young)[2], the Marsupials reported on by Cunningham[3], the Ai (Humphry)[5] and the Ornothorhynchus (Meckel)[4]; many other examples could be given, but these are sufficient. According to McMurrich[6] the original plan of the flexors of the forerm was as follows:-The flexor mass gave rise to a single tendon, as in Ornothorhynchus; this tendon at the wrist gave rise to a superficial and a deep set of small tendons, no differentiation having taken place

1. Loc. Cit. p. 19.

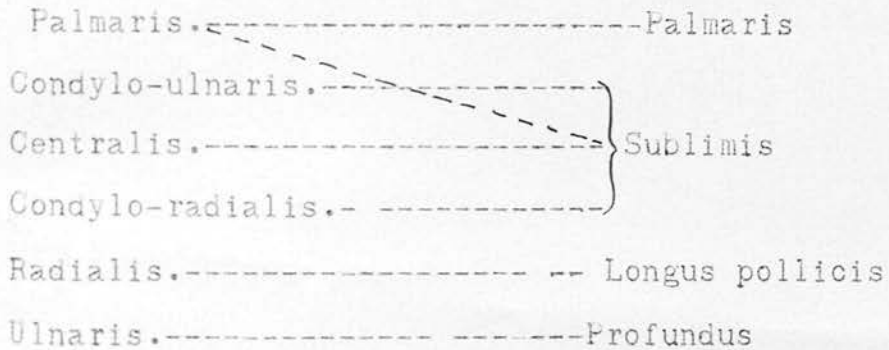
in the muscular mass. The first to segment off is the palmaris longus, which becomes attached to the sublimis tendon of the little finger as well as the palmar fascia. A portion of the condylo-ulnaris(the part attached to the condyle and the ulna) segments and becomes the belly for the outer three tendons of the sublimis.

Later on the whole of the condylo-ulnaris segments and joins the sublimis tendons;the palmaris which has already been differentiated now segments, the part which was associated with the tendon to the little finger is incorporated in the sublimis-the other half is the palmaris longus."Finally in ~~man~~ the anthropoids and in man, all the superfical or condylar portions of the original flexor communis separated to join the sublimis tendons, leaving only the ulnaris and radialis attached to the profundus tendon". We might go further and say that the ulnaris and radialis are in man additionally segmented into the profundus of human anatomy and the flexor longus pollicis. In the Phascogale and the Thylacine there is a very beautiful example of this process, for Cunningham notes that the sublimis tendons spring from the superficial surface of the strong rope like tendon of the profundus near the wrist;the tendons are minute and have no fleshy belly.

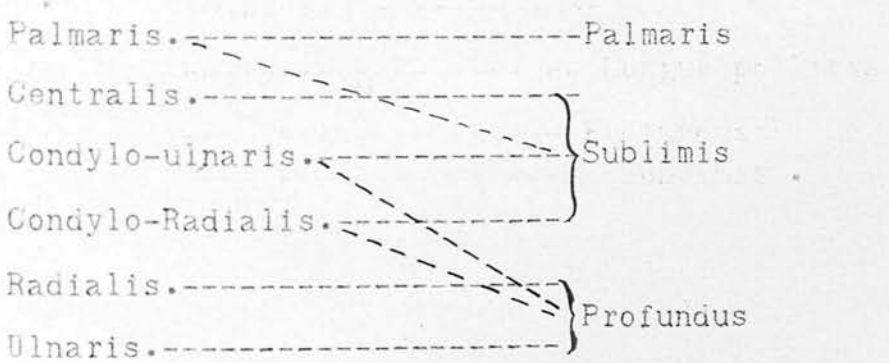
Examples of incomplete segmentation are common, and one is seen in this animal where the profundus still has a portion of the condylar head attached to it, ~~how far the extra attachment~~. This is only what one might expect from the attachment of the sublimis to the profundus

and the generally undifferentiated state of the flexor pronator mass. Occasionally there is seen in human anatomy cases where the humeral head of the profundus and even of the flexor longus pollicis is intact, I was fortunate to see both these while demonstrating anatomy last Winter. Using the same nomenclature as McMurrich I should construct the table of the muscles for the gibbon as follows.

MAN. (McMurrich)



GIBBON.



The centralis portion I am not sure about: it belongs to the sublimis in man and the orang, so it has been put in that position in the gibbon although the muscles here are not so segmented as in either of the other two cases.

1. Loc. Cit., p. 207.

The differentiation of the long flexor which is such a characteristic muscle in man as compared to the apes we may look on as largely due to the great number of fine and specialised uses the hand of man is put to as compared with that of the ape,the thumb taking a principle share of all fine movements of the hand on account of its power of opposition.

THE LUMBRICALS Were longer than in man on account of the length of the palm and phalanges;they could be traced up the sides of the dorsal expansion to the nearly as far as the first interphalangeal joint,The little muscles were quite relaxed when the fingers were extended and were only taut when the hand was in the flexed position. The origin of the second was different from that of man in that it had a slight attachment from the index tendon as well as from its own tendon of the medius. The muscles diminished in size from without inwards;the innermost was attached to the adductor (contrahens 4) of the inner digit by two fleshy slips. The origin of the muscles passed upwards so high that there was very little interval between the flexor profundus belly and the bellies of the muscles that was really free from muscular fibres..

McMurrich derives all the profundus tendons from the reptilian aponeurosis in which the volar cartilage is developed.The tendons of the sublimis which arise from the common extensor tendons are the remants of the superficial layer of the flexor brevis medius of reptiles, the lumbricals being a portion of the same muscle apparently which has retained its muscular character.

1. Bull. de la Soc. Philom. de Paris 1867 p. 192.
2. Jour Anat. + Phys. 1869. p 335
   Ibid. 1870. p. 32.
3. Loc. Cit., p. 491.
4. Loc. Cit.,

MYOLOGY,UPPER LIMB.

THE RRONATOR QUADRATUS.(Comp.Anat.)

This was found to occupy the same position and to be relatively about the same size as in man. When dealing with the comparative anatomy of the pronator teres this muscle was refered to. It is absent in some animals such as the Ornithorhynchus[4] and Echidna (Alix)[1], and occaisionally in the seal where Macalister[2] found it absent in two specimens out of three,but in other animals we have seen that it can be very large as in the dog,wolf and fox (Testut)[3]. Leche[4] says that in the dog hyena,Parameles and some species of Halmaturus the muscle reaches up to the pronator teres of which it is supposed to supply the deep head. Being very like the popliteus muscle in the lower limb,but in the former case the muscle disappears in the middle leaving the deep head of the teres above and the pronator quadratus below,and in the other case the muscle retreats up the limb leaving no portion above the ankle as a homologue of the pronator quadratus. At the very end of his paper Macalister[2] writes," The only instance in which a true pronator quadratus has been found in the hinder limb as far as I am aware,was in a fine alligator which died in the Dublin Zoological Gardens Feb.1869.a distinct transverse fasiculus of fibres crossed from tibia to fibula perfectly differentiated from all other muscles in the locality."

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SHORT MUSCLES OF THE THUMB. See plate VI p. 134

THE ABDUCTOR POLLICIS.

ORIGIN.- From the sesamoid bone(prepollex) and the ligaments which bind it to the scaphoid and trapezium, the outer side of the front of the anterior annular ligament.

INSERTION.- Into the outer side of the base of the first phalanx of the thumb at its base.

Omission- The muscle also arises from the common opponens and the superficial head of the flexor brevis pollicis by three small fleshy slips.

NERVE SUPPLY.- From the outer branch of the median.

STRUCTURE.- The muscle has a distinct belly from the other muscles of the thumb, except where the three slips joint it, the belly is relatively broad, the tendon is distinct all the way to its insertion being the outer most and posterior tendon inserted into this phalanx, with the exception of the dorsal expansion.

RELATIONS.- Lying to the outer side of the blended opponens and superficial head of the flexor brevis pollicis, it is separated from the tendon of the extensor brevis pollicis by a small part of this blended mass.

THE OPPONENS POLLICIS.

This muscle is blended with the outer head of the short flexor so that is is difficult to tell which is which.

ORIGIN.- From the tendon into the sesamoid bone, the

sesamoid bone itself, the scaphoid and trapezium, and the front of the outer part of the anterior annular ligament.

INSERTION.- Into the outer side of the 1st. metacarpal bone and prolonged up with the flexor, from which it is here quite inseparable, on to the outer side of the shaft of the 1st. phalanx.

NERVE SUPPLY.- From the outer division of the median.

STRUCTURE.- The muscle is composed of short bundles of fibres which mostly pass in an outward and downward direction.

RELATIONS.- The muscle lies to the outer side and blended with the short flexor, to the inner side of the abductor pollicis, behind which a portion passes to be inserted into the outer side of the metacarpal; this separates that muscle from the tendon of the extensor brevis pollicis, the tendon passing between this muscle and the proximal end of the bone.

THE FLEXOR BREVIS POLLICIS.

This muscle is composed of two d heads the superficial one of which is fused to a great extent with the opponens.

ORIGIN.- Superficial head. From the scaphoid trapezium and sesamoid bone by fleshy fibres fused with the last muscle, by tendons (not shown in the plate) from the front of the anterior annular ligament.

Deep head. From the part of the trapezium which projects between the 1st. & 2nd. metacarpals, from the

front of the base and the inner side of the 1st. metacarpal.

INSERTION.- into the sesamoid bone in front of the base of the 1st. metacarpo-phalangeal joint. The fleshy fibres are prolonged up over this to the side (outer) of the shaft of the 1st. phalanx, where they are inserted.

STRUCTURE.- The part that arises from the bone is fleshy, but the superficial head arises from the front of the anterior annular ligament by thin tendons not seen in the plate, these end in bellies which join the rest of the muscle. The muscle is fleshy at its insertion.

RELATIONS.- The two heads join infront of the metacarpal and lie internal to the abductor pollicis, the long flexor tendon lies ~~in~~ternally to both heads, a vessels passes up the inner side of the thumb in relation to the deep ~~carpal arch~~ head of the muscle, from the deep carpal arch. The muscle has already been described as blended with the opponens pollicis.

THE SHORT MUSCLES OF THE LITTLE FINGER. See plate VI p. 134.

These are three small and ill developed muscles, the abductor, the opponens and the flexor brevis minimi digiti. They hardly form any prominence on the palm of the hand.

THE ABDUCTOR MINIMI DIGITI.

ORIGIN.- A slip from the pisiform and anterior annular ligament, and a deeper head from the inner part of the unciform behind the flexor brevis muscle. See fig. page 146.

INSERTION.- Into the inner side of the base of the proximal phalanx of the little finger.

NERVE SUPPLY.- From the deep division of the ulnar which passes between the two heads.

STRUCTURE.- The belly formed by the two heads is very short the tendon being proportionately long and seems to be too strong for the feeble belly.

RELATIONS.- The muscle lies to the inner side of the metacarpal bone and dorsal to the flexor brevis ~~pollicis~~ minimi digiti, so that it is not seen from the front.

THE FLEXOR BREVIS MINIMI DIGITI.

ORIGIN.- From the front and inner side of the pisiform in common with the last muscle, from the hook of the unciform by a slip which lies in front of the slip from the same bone to the last muscle and from the front of the inner part of the anterior annular ligament. See fig. page 146.

INSERTION.- By short tendinous fibres into the sesamoid bone which lies in front of the metacarpo-phalangeal joint of the little finger, by fleshy fibres into the front of the base of the proximal phalanx of the little

finger and the fleshy belly is continued up along the inner side of the digit to give place to a tendon, which spreads out and is inserted into the inner margin of the same (1st.) phalanx and into the inner margin of the middle Phalanx, some fibres going to the dense pulp of the finger.

NERVE SUPPLY.- By two twigs from the deep division of the ulnar nerve which disappears between its two heads.

STRUCTURE.- The pisiform head is muscular the other is tendinous, the rest of the muscle is fleshy till it approaches its insertion where its structure has already been seen.

RELATIONS.- That of the ulnar nerve has been noted, the origin lies in front of that of the last muscle the pisiform heads being fused. The muscle lies to the inner side of the finger and of the digital sheath.

THE OPPONENS MINIMI DIGITI.

ORIGIN.- From the anterior annular ligament and the hook of the unciform.

INSERTION.- Into the inner side and front of the 5th. metacarpal in its whole length.

NERVE SUPPLY.- By a twig from the deep division of the ulnar which is given off before that nerve leaves the palm and accompanies it between the two heads of

the ~~al~~ last muscle to enter its deep and inner parts.

STRUCTURE.- The muscular fibres are largely intermixed with tendinous fibres,the muscle is blended with the small palmar interosseous muscle of this digit, the inner or fourth contrahens is also closely associated with the fibres of this muscle.

RELATIONS.- The muscle is under cover of the flexor brevis ~~digitorum~~ minimi digiti and is overlapped by the 4th.contrahens muscle,the deep division of the ulnar nerve pieroes it the muscle near its origin.

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We come now to consider the muscles found deeply in the palm of the hand they will be described as far as possible in their three layers of Contrahentes,Palmar and Dorsal interossei,or better as Cunningham described and named them the Adductores,the flexores breves and the abductores.

FIRST LAYER.

CONTRAHENTES,(Adductores)

All four of these muscles were present, the largest being that to the thumb which showed a segmentation into two an adductor transversus and an adductor obliquus.

They all took orign from the central portion of the palm in the neighbourhood of the 3rd.metacarpal bone and from a well marked tendinous fascia which occupied the hollow of the palm in front of the metacarpals and was best marked over the 3rd.& 4th.

1,a.ADDUCTOR TRANSVERSUS POLLICIS.

~~ORIGIN.- From the front of the proximal half of the 3rd.metacarpal and from the deep layer of fascia over the metacarpals.~~

~~INSERTION.-~~

ORIGIN.- From the front of the anterior carpal ligaments and the bases of the 2nd.& 3rd. metacarpals

INSERTION.- Into the inner side of the distal half of the 1st.metacarpal slightly in front of the next muscle.

NERVE SUPPLY.- The deep division of the ulnar nerve.

STRUCTURE.- The muscle isfleshy throughout its extent being widest at its base.

* It was found that the deep division of the ulnar nerve was composed partly of fibres from the ulnar and partly of fibres from the median, which ran in the ulnar. See nerves.

RELATIONS.- It lies between the next muscle and the deep head of the flexor brevis pollicis, from which it is separated by a branch of the deep carpal arch, the deep flexor tendon (longus) being in close relation to it at its insertion and first part of its course.

1,b.ADDUCTOR OBLIQUUS POLLICIS.

ORIGIN.- From the front of the proximal half of the 3rd.metacarpal and from the deep layer of fascia over the metacarpals.

INSERTION.- Into the inner side of the distal half of the 1st.metacarpal, rather behind the attachment of the last muscle and into the inner side of the base of the proximal phalanx of the 1st.digit.

NERVE SUPPLY.- From the deep division of the ulnar, the fibres of which all came from the median as noted opposite.*

STRUCTURE.- The origin is the widest and thinest portion of the muscle which becomes thicker as it passes outwards and the fibres converge. It is twisted on itself so that those fibres which arise highest up are inserted into the phalanx while those lowest down pass to the metacarpal and are posterior to the former.

RELATIONS.- The muscle lies over the palmar interossei and deep palmar arch and deep division of the ulnar, in front are the long flexor tendons and lumbricals.

2nd.CONTRAHENS.

ORIGIN.- From the front of the 3rd.metatarsal not far from its base and the fascia over the metacarpals.

INSERTION.- Into the inner side of the base of the

proximal phalanx of the index.

3rd.CONTRAHENS.

ORIGIN.- From the front of the base of the 3rd.metacarpal and the proximal end of the shaft, from the front of the 4th. in the proximal ¾ of the bone, and from the strong fascia.

INSERTION.- Into the outer side of the base of the proximal phalanx of the 4th.digit, and also into the dorsal extensor expansion.

4th.CONTRAHENS.

ORIGIN.- Slightly from the base of the 3rd., chiefly from the base of the 4th. and from the strong fascia. It also gets a slip from the small inner lumbrical.

INSERTION.- Partly into the outer side of the base of the 1st. Phalanx of the 5th.digit, into the dorsal expansion with the lumbrical and partly into the sesamoid bone on the front of the 5th.metacarpo-phalangeal articulation.

THE NERVE SUPPLY.- This has been dealt with in the case of the adductors of the thumb, in the case of the others it was found that the deep division of the ulnar supplied them all, and that these fibres came from the median nerve in the case of the 2nd.& 3rd. but it was not quite certain in the case of the 4th. but I think that this was no exception.

STRUCTURE.- The 2nd, counting the adductors of the pollex as the 1st., was the smallest, then the 4th. they all have small tendons, which in the case of the outer two are inserted into the dorsal expansion just below the lumbricals.

MYOLOGY,UPPER LIMB.

RELATIONS.- The muscles lie in front of the bones and the muscles in the interosseous spaces.

SECOND LAYER.

PALMAR INTEROSSEOUS MUSCLES.

This group will be described and in it will be included all those muscles not yet mentioned with the exception of the dorsal interossei. And of these there is one undoubted palmar interosseous arranged as seen in man, it lies on the index digit,there is one on the little finger but it is rudimentary. Then there are other muscles of which the human hand has no trace,these are muscles which run from the metacarpal bones on to the phalanges and in the case of the 1st.& 5th. digit reaching the middle of the second phalanx

Of the palmar interossei proper the one on the index is as follows.

ORIGIN.- From the front and inner aspect of the 2nd. metacarpal,very slightly from the base of the 3rd.

INSERTION.- Into the inner side of the base of the first ~~me~~ phalanx of the index and into the dorsal extensor expansion.

NERVE SUPPLY.- From the deep division of the ulnar, the fibres really coming from the median nerve.

STRUCTURE.- The muscle was strong and well developed being penniform and ending in a small tendon.

RELATIONS.- The muscle lies in front of the 2nd. dorsal interosseous muscle,behind the adductors of the thumb and index,i.e.contrahentes,1.& 2. The nerve to the muscle passing up its anterior surface.

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The muscle overlaps the metacarpal from which it arises in the Proximal half of the bone, it comes in contact with the 1st. dorsal interosseous which does the same on its side. But in the ~~upper~~ distal portion the two muscles become separated by a third muscle, which arises from this part of the bone. This intermediate muscle forms one of a series which will be refered to under the name of musculi accessorii, this being the 1st. The tendon of the 1st. palmar interosseous is inserted just above that of the adductor indicis (contrahens 2.).

The 2nd. palmar interosseous is entirely absent, there being no need for an adductor as that action is brought about by the strong adductor or contrahens of this finger.

The Palmar Interosseous of the little finger or the third of human anatomy, is a very rudimentary structure.

ORIGIN.- From a small part of the outer and front aspect of the 5th. metacarpal under cover of the adductor or contrahens to this finger.

INSERTION.- Into the outer side of the base of the proximal phalanx of this digit and partly into the ligaments of the joint.

NERVE SUPPLY.- From the deep division of the ulnar nerve, the fibres being ulnar in origin.

STRUCTURE.- The muscle had a small belly and a thin weak tendon.

RELATIONS.- The muscle was completely hidden by the adductor of the digit, so that it appeared to be absent until that muscle was pushed aside, behind it lay the

EXPLANATION OF PLATE VI (x 1½ Nat. Size.)

THE SHORT MUSCLES OF THE HAND.

F.P..... Tendon of the flexor profundus to the thumb.

Ad.P..1&2.... Aductors Transversus and Obliquus pollicis or Contrahens 1.

F.B.P..... Both heads of the flexor brevis pollicis.

Ab.P..... The Abductor pollicis.

Op.P..... The Opponens Pollicis.

Ant.A..... The Anterior annular ligament cut.

P..... . The Pisiform bone.

Ab.M.D..... The abductor minimi digiti. Two heads.

FB.M.D..... The flexor brevis minimi digiti.

Op.M.D..... The Opponens minimi digiti.

P.1& 3..... The first and third palmar interossei the latter is only just seen.

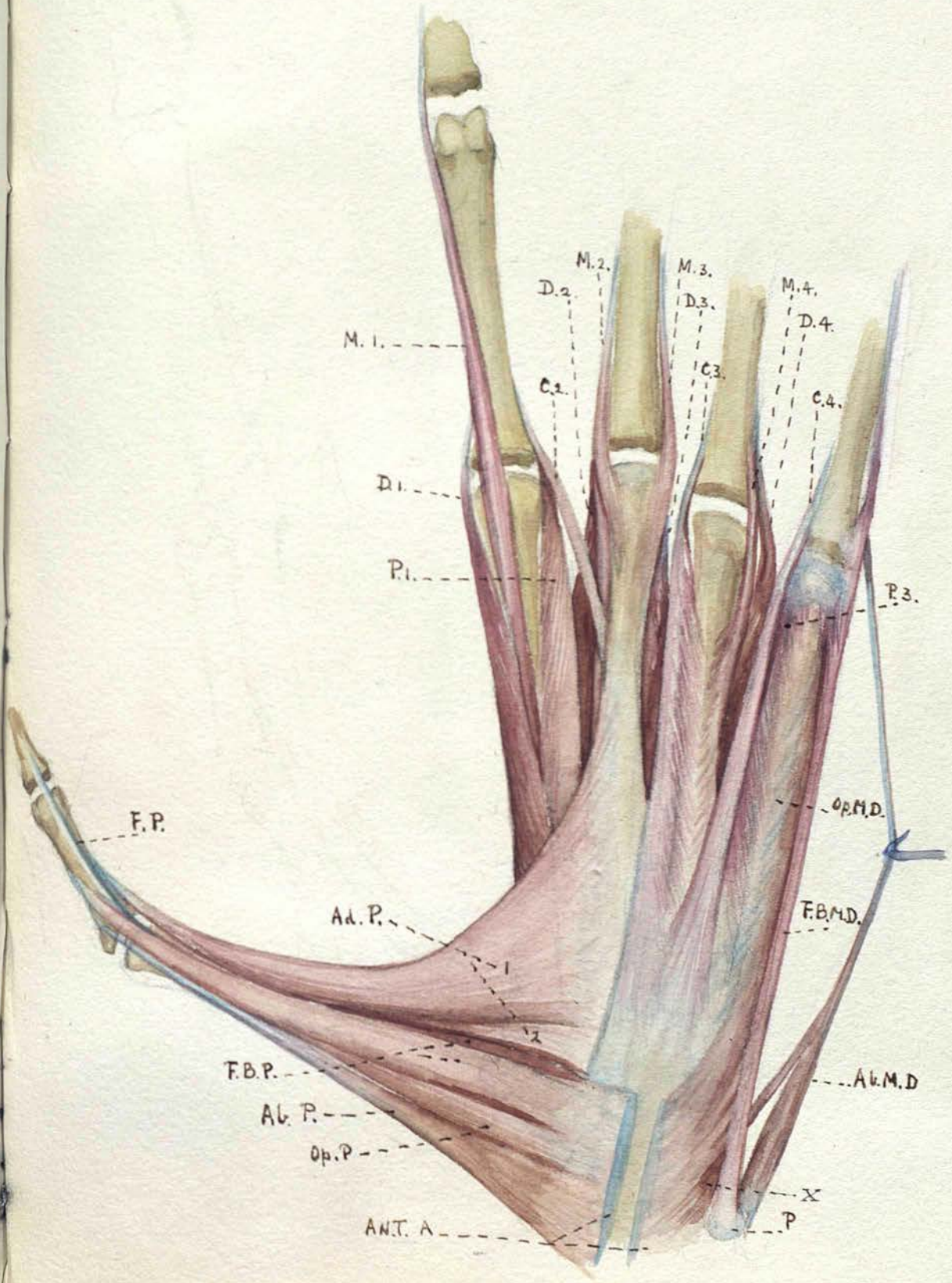
C.2,3& 4..... The second,third, and fourth contrahentes muscles. The first is labelled Ad.P.

D.1,2,3,& 4..... The dorsal interossei according to their numbers.

M.1,2,3,& 4..... The Musculi interossei accessorii according to their numbers.

The ulnar nerve is not shewn but it disappears immediately to the outer side of the pisiform bone between the two heads of the abductor minimi digiti and the flexor brevis minimi digiti, at the spot marked X.

Plate VI


M. 1.
M. 2.
M. 3.
M. 4.
D. 2.
D. 3.
D. 4.
C. 2.
C. 3.
C. 4.
D. 1.
P. 1.
P. 3.
F. P.
Ad. P.
1
2
Op. M. D.
F. B. M. D.
F. B. P.
Al. P.
Op. P.
Al. M. D
X
P
ANT. A

4th.dorsal interosseous. The muscle was also in close relation to the outer side of the opponens minimi digiti.

At this point it is as well to draw attention to the relations born to each other by the adductors or contrahentes and the palmar interossei. Cunningham has pointed out how the muscles of the palm are arranged in three layers,the first being adductors,the second flexors and the third abductors,with these latter at present I am not concerned. In the course of evolution the adductores disappear all except that of the thumb, which on account of the great use that digit is put to becomes much developed. The flexores are not needed as they are over shadowed by the stronger flexors of the forearm,they therefore migrate and take up the function of the adductores. In this hand we see a striking example of the relation each bears to the other, for,in the index finger,there is a strong palmar interosseous producing adduction,therefore there is only a very weak adductor(contrahens 2.). In the third finger there is a total absence of the palmar interosseous, adduction being brought about by the strong contrahens 3. In the case of the little finger there is a well marked adductor (contrahens 4.) so consequently there is an extremely rudimentary palmar interosseous.

In each finger then we see that the two sets of muscles bear an inverse ratio the one to the other,in the middle finger there is no need for adduction,the

central line passing down the centre of this digit, the two abductors with which it is furnished bring it back to the central position after it has been deflected.

MUSCULI INTEROSSEI ACCESSORII.

Under this name I have placed certain muscles which belong to the interosseous group of muscles,but which do not fall naturally into either the palmar or dorsal group. That they belong to the interossei,is shown by the fact that they lie posterior to the deep division of the ulnar nerve. These muscles all arise from the shafts of the metacarpal bones and are inserted into the phalanges,usually into the proximal phalanx,but in the case of the first into the middle phalanx and the pulp of the middle segment of the finger.

MUSC.INTEROS.ACCES. 1.

This is the largest of the series,being amuscle 9 c.m. in length. It is slightly thicker than is depicted in the plate. See Plate VI p 134

ORIGIN.- From the front of the lower half of the 2nd. metacarpal bone,between the dorsal and palmar interossei of this digit,being closely associated with each.

INSERTION.- Into the outer side of the middle phalanx of the index,both into its base and outer margin of the shaft,some processes of the tendon passing to the pulp of the finger.

NERVE SUPPLY.- From the deep division of the ulnar nerve,the fibres coming from the median.

STRUCTURE.- The shape of the muscle is that of a

cylinder tapered at both ends. The muscle arises fleshy from the front of the bone and is inserted by a tendon, which only begins opposite the first interphalangeal articulation.

RELATIONS.- The muscle lies on the front of the metacarpal,infront of the outer part of the metacarpo-phalangeal joint,the outer margin of the first phalanx and then lies to the outer side of the interphalangeal articulation. On either side of its origin is an interrosseous muscle. The relation to the tendon of the first lumbrical is important;this minute tendon passes between it and the first phalanx round the outer side of the bone.

MUSC.INTEROS. ACCES. 2.

This is a double muscle situated on the outer side of the middle digit,the two halves of the muscle being placed one in front of the other. The muscle is about 6 c.m. in length.

ORIGIN.- The posterior part arises from the outer side of the head and shaft of the 3rd.metacarpal in front of the dorsal interosseous through which it may have a slight attachment to the proximal half of the 2nd.metacarpal.

The anterior half arises from the front of the head and lower part of the 3rd.metacarpal on its outer aspect.

INSERTION.- The two halves are inserted together or very close together. The posterior half passes to the outer side of the base of the first phalanx of the middle digit,but chiefly into the dorsal expansion

of the middle digit. The anterior half is inserted partly with the tendon of the posterior half and partly by fleshy fibres into the dorsal expansion just in front of that tendon.

NERVE SUPPLY.- The deep division of the ulnar sends the nerve to these two bellies, the fibres coming from the median. The twig that supplies the muscle appears from under cover of the adductor layer and runs up on the front of the metacarpal, sending a twig right up the proximal phalanx of the digit; what the distribution was up there was uncertain, but it probably formed a communication with the branch of the median which supplied this digit.

STRUCTURE.- As already said the muscle was in two halves, of which the anterior half was situated lower down the metacarpal and was not so long as the posterior measuring only 4 c.m. while the posterior measured at least 6 c.m. The little muscles or each half of it was pointed, arising from the bone fleshy and being inserted chiefly by tendon.

RELATIONS.- The two bellies lay the one in front of the other, between the adductors of the pollex and index on the one hand and the 2nd. dorsal interosseous muscle on the other, to the outer side was the 1st. palmar interosseous.

MUSC. INTEROS. ACCES. 3.

This is situated on the inner side of the metacarpal of the 3rd.digit, and extends up on to the first phalanx.

ORIGIN.- From the inner and front aspect of the lower half of the 3rd.metacarpal bone, and from the fascia which gives rise to the adductor layer of muscles.

INSERTION.- Into the inner side of the dorsal expansion of this digit nearly at the first interphalangeal articulation.

NERVE SUPPLY.- By the deep division of the ulnar, the fibres coming from the median nerve.

STRUCTURE.- The muscle is small, arising from the bone fleshy and becoming thinner as it passes down till it ends in a small tendon of insertion.

RELATIONS.- The muscle lies to the outer side, and on a slightly posterior plane at its origin, to the adductor of the 4th.digit (contrahens 3). Between the muscle as described and the dorsal interosseous of the third space is a small part of the same muscle, but which has not been included in the description. This is in itself a minute muscle with belly and tendon, but only measuring 2½ c.m. in length. This portion arises from the inner side of the bone between the rest of the muscle and the 3rd.dorsal interosseous. There is a short round belly which ends in a thread like tendon, which gains insertion into the inner side of the base of the proximal phalanx of the finger. To the outer side the muscle is in contact with the corresponding muscle on the outer side of the same metacarpal bone.

MYOLOGY, UPPER LIMB.

MUSC. INTEROS. ACCESS. 4.

This muscle is situated on the inner side of the 4th. digit and extended onto the phalanx.

ORIGIN.- From the front and inner aspect of the 4th. metacarpal in its lower three quarters.

INSERTION.- Into the inner margin of the first phalanx of the fourth digit and into the dorsal expansion.

NERVE SUPPLY.- From the deep division of the ulnar, the fibres coming from the ulnar.

STRUCTURE.- The muscle is very similar to the last, but posseses no second part.

RELATIONS.- Behind the muscle is the 4th. dorsal interosseous, while to the inner side and rather to the front is the adductor of the little finger.

What the exact morphological relation these muscles bear to the other interossei is difficult to say. It was pointed out above that as the deep division of the ulnar nerve passed in front of them, they must belong to one of the two groups of interossei, palmar or dorsal.

The dorsal interossei are, we find on examination, all well represented and occupy the positions in which they are found in man. They exhibit however a tendency to wander onto the palm of the hand, especially is this well seen in the case of the 1st. interosseous.

The ~~plantar~~ palmar interossei are, on the other hand very poorly represented, a well marked muscle being furnished to the index and a rudimentary muscles is seen on the little finger. It would appear likely therefore that these

muscles, which have been described under the name of musculi interossei accessorii, are really portions of ~~these~~ this palmar layer of interossei.

Function has had a great deal to do with the shifting of the muscles down the digits, for these muscles help to maintain the hook-like positon of the hand, and this in spite of the fact that these muscles are inserted into the dorsal expansion. The dorsal extensor expansion passes so far round the phalanges of digits that there is only a small amount of extension of the first inter-phalangeal articulation brought about, the chief action of these muscles is therefore flexion of the metacarpo-phalangeal joints. The muscle on the index has a strong flexing action on the middle phalanx also.

Professor Cunningham has shewn that the type of palmar interossems muscles is a double headed muscle for each digit. These muscles will be found to correspond accurately with a such a type arrangement. In the present case the index finger shews the inner head of the typical muscle situated as the 1st. palmar interosseous. I consider that the outer head is represented by the musculus interosseous 1, which has slipped down to the lower half of the metacarpal bone. The fact that the muscle has slipped down the digit does not militate against such a theory, other muscles whose identity is unquestioned shew the same tendency. A good example is found in the case of the flexor brevis minimi digiti which is really the inner head of the same originally two headed muscle to the little finger, this has wandered down the

See Plate VII. p 144.

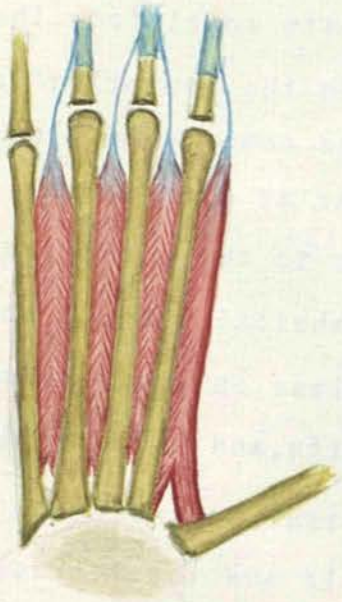
digit to the middle phalanx. In the middle digit both heads of the typical muscle are present, situated on either side of the front of the metacarpo-phalangeal articulation, and described as the musculi interossei accessorii 2 & 3. In each case the inner and outer head has become segmented into two parts, of which the anterior has passed further down than the posterior. On the fourth digit one of the heads of the type is wanting. Usually in man one of the heads of the type muscle is wanting; in human anatomy it is the inner head which is wanting the outer head being the 2nd. palmar interosseous. But in this gibbon it is the outer head which is wanting, the inner being placed on the front of the inner side of the 4th. metacarpo-phalangeal joint and described as the musculus interosseous accessorius 4. Why the outer head should be absent in the 4th. digit is not easy to explain in a satisfactory manner. For the need of flexors is evidently great, as is seen by the developement of the other digital flexors, one might suppose that the outer head had become an adducting palmar interosseous before there was any great need for flexors, and that then it's need as an adductor was not felt as there was a large adductor or contrahens supplied to that digit, so that the muscle disappeared.

This will I think explain in a satisfactory manner what the morphology of these curious muscles is. There is one point that is is well to mention, and that is that the tendon of the first lumbrical passes between the first phalanx of the index and the first musculus

accessorius. This Might be taken to indicate that these muscles really belonged to the other and dorsal group of interossei. But quite apart from the fact that there is no room for them in the posterior layer, as we shall see when those muscles come to be described, there is nothing to shew, as far as I know, that the tendon of the lumbrical should pass to the outer side of this muscle.

In man the only lumbrical tendons which come into relation with the palmar interossei tendons are those to the 4th. & 5th. digits, and here the lumbricals are inserted into the dorsal expansion in front of the interossei muscles. If now the interossei muscles begin to dvelope and become large there is no reason why they should not pass down to the outer side of the tendon of the lumbrical instead of on the inner side.

fig. 17.



The dorsal interossei; seen from behind.

MYOLOGY, UPPER LIMB.

DORSAL INTEROSSEI.

These muscles all abduct from a line which passes through the centre of the middle digit as in the hand of man. They are four in number and are arranged as follows.

No.1. (ABDUCTOR INDICIS).

ORIGIN.- (1) From the base of the metacarpal of the thumb on its inner side, (2) from the whole length of the outer side of the metacarpal of the index, being rather more on its anterior than its posterior surface.

INSERTION.- Into the outer side of the base of the first phalanx of the index and slightly into the dorsal extensor expansion.

NERVE SUPPLY.- From the deep division of the ulnar, the fibres coming from the median.

STRUCTURE.- The muscle is penniform and is inserted by means of a tendon.

RELATIONS.- The muscle lies on the outer side of its digit, the proximal end being covered in front by the adductor of the thumb. On the front of the metacarpal it comes into relation with the 1st. palmar interosseous being separated from it further down by the 1st. musculus interosseous accessorius.

THE 2nd., 3rd. & 4th.

These are all bipenniform muscles.

ORIGIN.- From the sidesof the two metacarpals between which they lie, receiving more fibres from the metacarpal of the digit into which they are inserted.

INSERTION.- Nos.2 & 3 are inserted into either side

of the base of the proximal phalanx of the middle digit, and into the dorsal expansion. No.4 is inserted into the inner side of the base of the proximal phalanx of the 4th.digit and into the dorsal ~~ep~~ expansion.

NERVE SUPPLY.- From the deep division of the ulnar, the fibres in the case of Nos.2 & 3 coming from the median and in the case of the 4th.from the ulnar.

STRUCTURE.- They are all bipenniform muscles with small tendons.

RELATIONS.- The muscles lie dorsal to all the other structures in the interosseous spaces,but can be seen from the front.

[1] Loc. Cit., Vol. 3, p. 38.

MUSCLES OF THE HAND. (Comp. Anat.)

Some of the points in reference to these muscles have been dealt with when the muscles themselves were considered and little remains to be said.

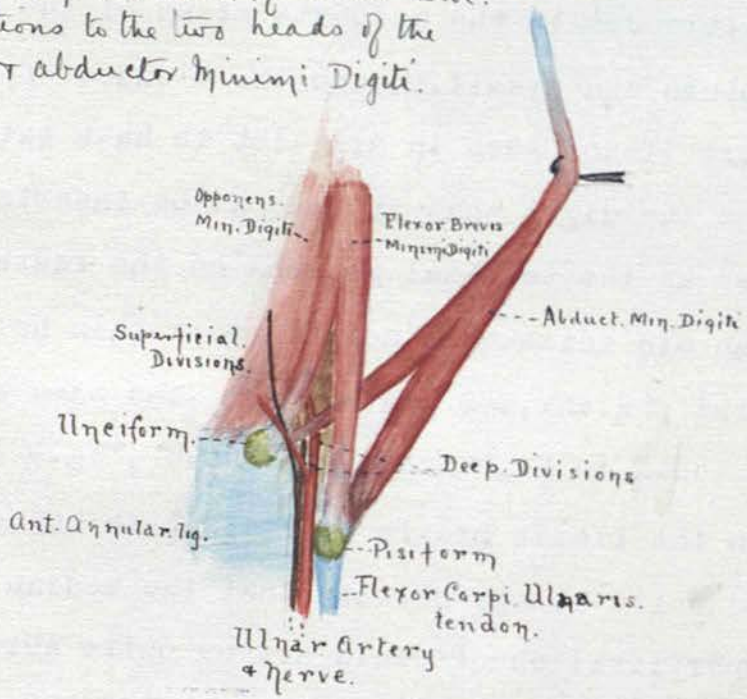
THE SHORT MUSCLES OF THE THUMB.

These as a whole were well developed but showed a ~~whole but showed~~ a marked want of differentiation. It is this want of differentiation that has caused the differences in the accounts given of the muscles by Hepburn and myself, though the blended opponens and short flexor seem in his limb to have extended further down the digit than in mine, as he inserts them as far down as the terminal phalanx on the radial side, while mine did not extend down further than half way down the first phalanx, see plate , the same arrangement is shewn in Hepburns plates No. 8, Fig. 1.

In the flexor brevis pollicis both heads were present and while it was certain that the median supplied the superficial one I could not be quite sure afterwards whether the same nerve had supplied the deep one, on further examination however I came to the conclusion that whether it did or not was a matter of little importance, for if it did not then the deep head of the ulnar nerve must have done so. On separating the large branch of communication which the median gives to the ulnar in the upper part of the forearm, from the fibres of the ulnar itself, it was found that this branch of the median supplied all the radial half of the hand. Therefore the fibres to the deep head of the

Fig. 18.

To show deep Division of Ulnar nerve. and its relations to the two heads of the Flexor brevis + abductor Minimi Digiti.



muscle
must have come from the median nerve. The deep head of the muscle is closely associated with the outer and upper part of the adductor pollicis which is slightly segmented off from the rest of the adductor pollicis, in this case certainly the adductor has not supplied the muscle with a deep head.

THE SHORT MUSCLES OF THE LITTLE FINGER.

These besides shewing a lack of developement differed little from the same muscles in man.

The abductor and the flexor brevis both arose by two heads, the ulnar nerve sending its deep division between these two heads. The flexor brevis shewed the same tendency to wander down on to the phalanges as the other muscles of the same layer, the flexores breves of Cunningham, in this case reaching the middle phalanx. See. fig.

The abductor minimi digiti received a twig from the dorsal cutaneous branch of the ulnar by the digital nerve to the ~~outer~~ side of the index, this has been omitted in the description of the muscle but is mentioned in connection with the distribution of the nerve. I have endeavoured to shew that I consider there is no importance to be attached to the theory that the muscle is the end organ of a nerve, and that if they are to be considered the end organs of anything then they must be considered as the end organs of the cells in the spinal cord from which the axons which supply them are derived, irrespective of the nerve tracts that they run in, this is dealt with in the section on the nerves.

1 Cunningham Challenger Reports. Zool. Vol. V p. 50.
2 Halford. Loc. Cit.

The relations which the adductores of Cunningham[1] or the contrahentes of Halford[2] bear to the palmar interossei have been considered with those muscles, in the same way the ~~the~~ correct, as I consider, position of the muscles which were described under the name of musculi interossei accessorii have also been dealt with when those muscles were described.

It now remains to consider how far the muscles of the hand conform to the three typical layers of the mammalian manus as laid down by Cunningham. It would be perhaps as well to state what these layers are, so as to be quite clear as to what we refer, they may be said to be as follows:-

A PALMAR LAYER----------ADDUCTORES.

AN INTERMEDIATE LAYER----------FLEXORES.

A DORSAL LAYER----------ABDUCTORES.

These layers consist in the typical condition of the following muscles:-

PALMAR LAYER. This has one muscle supplied to each digit with the exception of the middle[3] one, which does not need it as all the other digits are adducted towards it. This layer is separated from the next or intermediate layer by the deep branch of the ulnar nerve.

INTERMEDIATE. This consists of a layer of double headed muscles, one double headed muscle being supplied to each digit.

DORSAL LAYER. This consists of a layer of six muscles

Plate VII

fig. I.

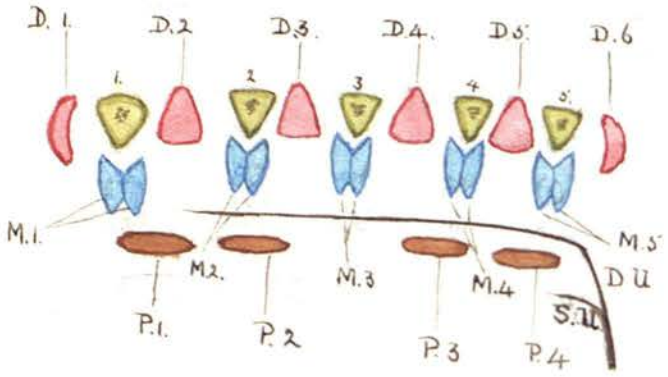


fig. II.

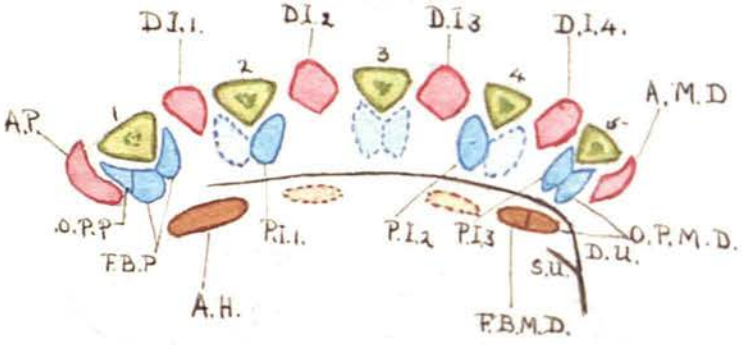
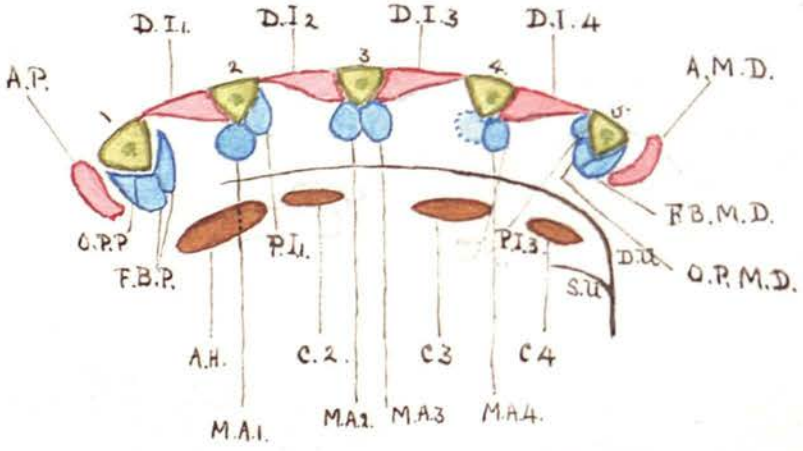


fig. III.



D. 7.

EXPLANATION OF PLATE VII

The METACARPALS in Green; the DORSAL LAYER in Red; the INTERMEDIATE LAYER in Blue; the PALMAR LAYER in Brown.

FIGURE.1. The typical arrangement, after Cunningham.

1,2,3,4,5,..... The metacarpal bones.

D.1,2,3,4,5,6,..... The dorsal layer.

M.1,2,3,4,5,..... The intermediate layer.

P.1,2,3,4,..... The palmar layer

D.U..... The deep division of the ulnar.

S.U..... The superficial Do.

FIGURE.2. The human hand according to Quain.

FIGURE.3. The hand of the gibbon. The figures are the same for each.

1,2,3,4,5..... The metacarpals.

D.U..... The deep division of the ulnar.

S.U..... The superficial Do.

D.I.1,2,3,4,..... The dorsal interossei.

A.P..... The abductor pollicis.

A.M.D..... The abductor minimi digiti.

P.I.1,2,3,..... The palmar interossei.

O.P.P..... The opponens pollicis.

O.P.M.D..... The opponens minimi digiti.

F.B.M.D..... The flexor brevis minimi digiti.

A.H.....The adductor pollicis.

M.A.1,2,3,4..... The musculi interossei accessorii.

Those muscles which are only faintly marked and dotted round are not represented. I do not beleive the correctness of Fig.2. as regards the O.P.M.D. and F.B.M.D.

four of which are placed in the four interosseous spaces the other two are placed one on the inner side of the inner metacarpal and one on the outer side of the outer metacarpal bone. See Plate VII Fig. I.

In the gibbon we find that the first layer of muscles is a complete one, an adductor or contrahens muscle being supplied to every digit with the exception of the middle one, as is the typical arrangement.
The large size of the adductor of the thumb is accounted for by the great use that digit is put to and its opposability. This muscle shews the commencing segmentation into two portions which are found in the hand of man viz. the adductor obliquus and transversus, the greater segmentation in man being again due to the still greater use to which that digit is put.
In the second layer the muscles are not only not so complete but they have also departed more from the original type. In the human description they were divided up into the palmar interossei and the musculi interossei accessorii, of which there were two of the former and four of the latter. But there are other muscles which we must include in this layer, these belong to the special muscles of the first and fifth digits being the flexor brevis muscles of both these digits. The two opponens muscles will not be disscussed at present. In arranging these muscles, so that there are two heads to each digit, we find that for the first digit the two heads of the flexor brevis constitute the whole muscle. In the second digit the

arrangement was not at first sight apparent,but I have spent a good deal of time in dealing with the question of the musculi interossei accessorii and the palmar interossei when those muscles were considered,and I believe I have relegated the former muscles to their proper place when saying,that they are the modified heads of the other wise absent flexores breves. So that returning to the second digit we find that there is a well marked palmar interosseous muscle which constitutes the inner or ulnar head of this double muscle,the outer head being represented by the first musculus accessorius This muscle though modified in position still retains its primitive function which was flexion,the inner head is an adductor its function being modified more than its position. It is needless again to point out the relative sizes of the adductores of the respective digits and the relation they bear to the sizes of the respective palmar interossei muscles as it has been fully done already with the discription of the muscles. In the third finger,being the centre of adduction,there are neither palmar interossei nor adductores supplied to this digit,but the double muscle to this finger of the second layer is well marked being situated on either side of the front of the metacarpo-phalangeal joint and described as the musculi accessorii Nos.2 & 3. On account doubtless of the need for muscles to produce flexion of the digits,owing to the habits of the animal, both these heads of the muscle have been segmented into two layers placed one in front of the other.

In the third digit there is only one head present, it has been described as the musculus accessorius 4; it represents the inner head of the muscle. Of the outer head there is no trace its adducting function which it performs in man is here performed by the contrahens of this digit.

In the fifth digit there are both heads present, a large well marked one which goes by the name of the flexor brevis digitorum which represents the inner head, and a smaller poorly developed outer head the palmar interosseous of this digit. The inner head shews the same tendency to wander away down the digit onto the [illegible] phalanges as the other muscles of this layer, in this case it reaches the middle phalanx. If the outer head is weak there is a strong adductor to take up its function.

The opponens muscles I have left till now to be considered, that of the thumb is I consider plainly a segmentation off from the flexor brevis muscle, either the inner or the outer heads, probably from the outer for it is hardly differentiated off from that head.

In the case of the little finger the opponens was poorly developed, but sufficiently so to cloth the front of the bone, it was fused with the unciform head of the flexor brevis minimi digiti and one would classify it as a segmentation of that muscle or from the other half of the flexor brevis of this finger, namely the third palmar interosseous muscle, it was to the latter of these that I referred it, but I find that Kuge has shown by sections through the developing foot that it is a seg-

1. Loc. Cit., Vol. 3. p. 55

mentation off from the flexor brevis digitorum.

It will have been noticed that I have included the flexor brevis minimi digiti in the layer of the flexores breves, and that its origin was different from that in man for it arose from the pisiform by one head and the hook of the unciform and anterior annular ligament by the other.

This dissection goes to shew that the muscle although pierced by the nerve is not altogether external to it and in this animal there is no more reason to include it in the palmar group of muscles than the abductor minimi digiti which is pierced in exactly the same way by the nerve, having the same attachments only situated dorsal to the flexor. Moreover we have seen that the palmar layer is complete, and has no more room for an additional muscle. The fact that a muscle can travel across a nerve is proved by an observation which Hepburn made in the supinator brevis of the chimpanzee: " the posterior interosseous nerve of the chimpanzee which deserves special attention because it affords some explanation of the position ~~of the position~~ of this nerve in the substance of the supinator brevis muscle. As the nerve passes from the anterior to the posterior aspect of the forearm it is never hidden altogether from view being merely covered by a very thin aponeurotic fascia on the surface of the supinator brevis and it can be readily understood how an increase in the size of the muscle and in the amount of its fibres taking origin from this investing fascia would cause a submergence of the nerve and produce the

See fig

[1] Loc. Cit. Vol. 2. Part 2. p. 276.

characteristic appearance of the nerve piercing the muscle." I think the same reasoning may justly applied in this case: here the muscle is migrating outwards, half being internal and half external to the nerve. In man of course we find the muscle wholly external to the nerve here I think the muscle has passed completely across the nerve, but it still belongs nevertheless to the intermediate group of muscles. Quain on the other hand thinks that the inner adductor (contrahens 4) does not disappear in man but that it segments into the flexor brevis minimi digiti and half of the opponens, at least that is the diagram that he has constructed and labbelled "after Cunningham" though I can find nothing in the writings of that author that warrant this assumption. I have reproduced his diagram in Plate VII fig. 2. p 148.

In the third or dorsal layer of muscles this ape presents a complete set, the four dorsal interossei, the abductor of the thumb, and the abductor of the little finger. All these muscles act as abductors from a line drawn through the middle digit. The muscles are all attached to the two bones between which they lie, but are more attached to the metacarpal of the digit on which they act, hence the unequal appearance presented in the diagram. The abductor minimi digiti presented the same relationship to the deep division of the ulnar nerve as did the flexor brevis, but no one would, I think, ever place this muscle in the

1. Ruge. Morphol. Jahrb. 1878. p. 137.

palmar group. In the diagram the outer part of these two double headed muscles is not shewn. See fig. page

Ruge[1] has shewn that all these muscles have been developed on the palm of the hand, and that is their position still in the early foetus, the metacarpal bones being pressed closely together. It is only as developement advances that the muscles become pressed into their adult position between the metacarpals which separate to accomodate them.

Does not refer to Brooks's work