XIV.—*A Revised Description of the Dorsal Interosseous Muscles of the Human Hand, with Suggestions for a New Nomenclature of the Palmar Interosseous Muscles and some Observations on the Corresponding Muscles in the Anthropoid Apes.*
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The main features of the scope of this paper are indicated by its title, from which it will be seen that I do not regard the current descriptions, which appear in text-books of human anatomy, as providing an adequate conception either of the attachments or of the functions of the muscles at present named "Dorsal and Palmar Interosseous." It may seem strange, in connection with such an exact (and, according to some, exhausted) science as human anatomy, that it should be possible to doubt the accuracy of modern text-books concerning such an apparently elementary consideration as the description of a group of muscles in the human hand; but we must bear in mind, first, the ease with which a statement is handed on from author to author without renewed investigation, if only, in the first instance, it has been stamped with the approval of a recognised authority, and second, that these descriptions were originally constructed with little or no reference to the facts of comparative anatomy. It is only by a series of careful comparisons that we can arrive at a proper understanding of the homologies of individual muscles or of groups of muscles in the human subject.

I propose, therefore, to direct special attention to the "Dorsal Interosseous" muscles of the human hand for the purpose of showing that they have been incompletely dissected, and as a result imperfectly described in current anatomical text-books; and that, when this group of muscles is accurately treated, the number of "Palmar Interosseous" muscles is greatly increased, and the palmar group takes its place as the *Intermediate Stratum* of the intrinsic muscles of the manus, and as such should be described under the term SHORT FLEXORS of the various digits.

The present views regarding the attachments and functions of these groups of muscles, as recorded in the works of GRAY,* MACALISTER,† CUNNINGHAM,‡ and QUAIN,§ may be briefly summarised as follows:—

First.—There are *four* Dorsal Interosseous and *three* Palmar Interosseous muscles, and the former are larger muscles than the latter.

Second.—Each dorsal muscle possesses two heads of origin, the fibres of which con-

* GRAY'S *Anatomy, Descriptive and Surgical*.

† MACALISTER, *A Text-Book of Human Anatomy*, 1889.

‡ CUNNINGHAM, *Manual of Practical Anatomy*, 1893.

§ QUAIN'S *Anatomy*, 10th ed., vol. ii. part ii., 1892.

verge in a bipennate manner to a common tendon of insertion. QUAIN* says each dorsal muscle arises "from both of the metacarpal bones between which it is placed, but most extensively from that supporting the finger upon which it acts." This description is endorsed by the other authorities mentioned.

Third.—Each palmar muscle possesses one head of origin, and, according to QUAIN, it arises "from the corresponding lateral surface of the body of the metacarpal bone of the finger on which it acts,"—a statement which closely resembles what is given by other authors.

Fourth.—As regards the functions performed by these muscles, one may say that there is unanimity of opinion so far as the movements of *Abduction* and *Adduction* are concerned. Both of these movements take place in the radio-ulnar or horizontal plane around an antero-posterior axis with reference to an imaginary line bisecting the middle digit, and being prolonged upwards to the wrist,—the dorsal muscles being the *Abductors* and the palmar muscles the *Adductors*. In addition to these actions, however, various writers† claim that the interosseous muscles assist the *Extensors* and *Lumbricales* in producing *flexion* of the first and *extension* of the second and third phalanges.

It is important to note that *flexion* of the first phalanges takes place around a radio-ulnar axis, which is at right angles to the axis in which abduction and adduction occur; and further, that the latter movements are regarded as of primary importance, while flexion is referred to as a secondary action dependent upon their mode of insertion. Now, although we are familiar with movements occurring at an articulation around axes at right angles to each other, as, for example, at the radio-carpal joint, yet such movements are produced by *combinations* of muscles which individually usually act in opposition to each other; and it is rather startling to find that the power of producing movements in two directions at right angles to each other is claimed for an individual muscle.

Turning now to my own dissections of these muscles, it is necessary to observe that the shaft of each metacarpal bone, with the exception of that for the pollex, is described as prismatic, and regarded as presenting a dorsal surface of triangular outline (having the apex towards the carpal end, while the base is directed towards the phalanges), and two lateral surfaces which are separated from each other on the palmar aspect by a smooth ridge occupying the proximal two-thirds of the shaft, but in the distal third of the shaft this smooth ridge bifurcates and leaves a small triangular area towards the head of the metacarpal bone. Muscular fibres do not arise either from the larger dorsal triangular area or from the smaller palmar one. The lateral surfaces are therefore prolonged to both the dorsal and palmar aspects of the shaft, and it is from them that the dorsal and palmar muscles take origin. If we now examine any lateral surface which, according to current descriptions, accommodates the entire origin of a palmar interosseous muscle, and one head of a dorsal interosseous muscle, we shall find the area

* *Loc. cit.*

† (1) QUAIN, *loc. cit.* (2) GRAY, *loc. cit.* (3) DUCHENNE, *Physiologie des Mouvements*, quoted by GRAY and QUAIN. (4) CLELAND (*Jour. of Anat. and Phys.*, old series, i. 85).

very unequally distributed between them, for, whereas the palmar muscle is comparatively powerful, the dorsal head is almost membranous in its dimensions in all the inter-metacarpal spaces except the first; and, since the dorsal muscles—as at present described—project as far towards the palm as the palmar muscles, their difference in size is not so pronounced as one would suppose from an examination of the surface which accommodates a palmar interosseous muscle and one of the heads of a dorsal interosseous muscle. From such a remarkable disparity in the size of the two heads of a dorsal muscle as the foregoing facts elucidate, one might naturally entertain doubts as to whether the larger head was in reality all it is credited with being, viz., dorsal interosseous muscle. These and other reasons have led me to make careful dissections of all the dorsal interosseous muscles of which I could avail myself. Quite recently I have dissected the first half-dozen hands*—representing as many subjects—that were available, in order to test my earlier results, and in every instance my earlier dissections have been verified. These results I shall now proceed to specify in detail.

The feature of a Dorsal Interosseous muscle which I regard as its most distinctive character is the *bipennate* arrangement of its muscular fibres, an appearance best seen from its dorsal aspect, from which point of view it is usually figured. In this respect it presents a marked contrast to the more or less longitudinal nature of the fibres of a Palmar Interosseous muscle. If, however, a careful dissection be made of each Dorsal Interosseous muscle *from its palmar aspect*, then we shall find that each member of the group possesses no small share of longitudinal fibres which do not coincide with the general bipennate arrangement; and although the two sets of fibres are continued to a common insertion, yet the longitudinal fibres maintain their palmar position even at the point of insertion into the first phalanx. In this way, the First Dorsal Interosseous muscle (Abductor indicis) yields a substantial muscular mass whose fibres take origin from the palmar aspect and radial side of the radial lateral surface of the shaft of the second metacarpal bone, just as the First Palmar Interosseous muscle arises from corresponding areas on the ulnar lateral surface of the same bone. Similarly, the Second Dorsal Interosseous muscle (Abductor medii digiti, radiad) yields a set of longitudinal fibres arising from the palmar aspect and radial side of the radial lateral surface of the third metacarpal bone. In the same manner the Third Dorsal Interosseous muscle (Abductor medii digiti, ulnad) and the Fourth Dorsal Interosseous muscle (Abductor annularis v. quarti digiti) yield longitudinal masses which arise from the palmar aspects and ulnar sides of the ulnar lateral surfaces of the third and fourth metacarpal bones respectively. In each instance these longitudinal bundles maintain their palmar positions, although each fuses with and is inserted in common with the dorsal interosseous muscle in front of which each is found, and of which these longitudinal fibres have been regarded as forming an integral part.

At first sight, these detached longitudinal muscular masses appear to increase the number

* My heartiest thanks are due to Sir WILLIAM TURNER for placing his private collection at my disposal for the purpose referred to.

of Palmar Interosseous muscles from three to seven. Now, various forms of increase in the number of Palmar Interosseous muscles have been recorded, and in Professor MACALISTER's * great work on muscular abnormalities there are references to each of the four longitudinal bundles I am describing. The point of distinction is, that Professor MACALISTER records as abnormalities, structures which I desire to show are constantly present and capable of more or less easy separation in every hand. The fact that under certain circumstances these muscles are so distinct that they have been observed and noted as abnormalities shows that I am not introducing an unknown element into the human hand, although I claim its constant presence as the normal condition.

From this standpoint the questions naturally arise : what position should be assigned to this series of Palmar Interosseous muscles ?, and what nomenclature is most applicable to their description ?, both of which questions can only be answered by reference to the facts of comparative anatomy. Our knowledge of the comparative anatomy of the intrinsic muscles of the manus is principally based upon Professor CUNNINGHAM's Challenger Report.† These muscles are divided into three strata, viz., Dorsal, Intermediate, and Palmar. Considered according to the actions performed by them, they are Abductors, Short Flexors, and Adductors respectively. In the human hand the *Dorsal* or *Abductor* stratum consists of six muscles, of which the *Medius* digit possesses two in virtue of its being situated in the middle line of the hand. With the exception of the Abductor pollicis (brevis) and the Abductor minimi digiti, the other members of the group are interosseous in position, and each is bipennate in the arrangement of its fibres.

The *Palmar Stratum* consists of *Adductors* of the various digits. Their principal source of origin is *the middle line* of the hand, but the individual muscles of this stratum are subject to much variation, both as regards number and size, in different animals. In the case of Man, only one member of this group is present, namely, the Adductor pollicis, which, however, has become so specialised that it is usually observed and described in two portions, called *Obliquus* and *Transversus* respectively. The full number of muscles belonging to this group is four, and these may be seen in the *Gibbon*,‡ in which the *Pollex*, *Index*, *Annularis*, and *Minimus* digits are so provided. This entire group has been termed "Contraahentes digitorum."§

The *Intermediate Stratum* embraces a series of muscles, situated for the most part between the dorsal and palmar strata, and acting as *short flexors* of the various digits. They are generally regarded either as derived from or as producing the members of the dorsal stratum by a process of cleavage or segmentation. Each member of this stratum consists of *two separate portions* or *heads of origin*, which are associated with both lateral surfaces of the shaft of the metacarpal bone which carries the digit upon which

* MACALISTER, "Muscular Anomalies in Human Anatomy," *Trans. Roy. Irish Acad.*, vol. xxv., Science.

† CUNNINGHAM, "Challenger" Reports, Zoology, v.

‡ HEPBURN, "Comparative Anatomy of the Muscles and Nerves of the Superior and Inferior Extremities of the Anthropoid Apes," *Journ. Anat. and Phys.*, vol. xxvi.

HALFORD, *Lines of Demarcation between Man, Gorilla, and Macaque*, Melbourne, 1864.

they act. In the hands of Man and the Anthropoid Apes there is recognition of certain of these facts in current anatomical descriptions, so far as the Pollex and Minimus digits are concerned. Thus we have *M. flexor brevis pollicis* and *M. flexor brevis minimi digiti*, while those other muscles regarded as the incomplete members of this stratum are classified under the title *Palmar Interosseous*, and to them is relegated the action of Adductors.

I shall now discuss those members of this stratum for which the name "Short Flexor" is definitely accepted, and then show how the other individuals of the same group deserve a similar descriptive term in place of "Palmar Interosseous."

M. flexor brevis pollicis nominally possesses two heads,—radial and ulnar,—yet much variation is known to exist, and the ulnar head is not always present in Man, in whom its development and growth may be retarded or altogether prevented by the relatively large proportions and unrestricted energy of the *M. adductor pollicis obliquus et transversus*. Long before the true nature of this ulnar head was clearly established, its presence was regarded as an abnormality, and it was described as the *Interosseous primus volaris* of Henle. Indeed, its recognition by modern text-books is usually confined to a short paragraph under the foregoing designation.

Among the Anthropoid Apes,* the same muscle is subject to similar variation. In my memoir already referred to, I have recorded the presence of both the radial and ulnar heads in the Gibbon and Orang-utan; the rudimentary condition of the ulnar head in the Chimpanzee, and its absence in the Gorilla. My dissection of the Gorilla dealt with the right hand, but I have since dissected the left hand of the same animal, and feeble rudiments of the ulnar head were present. In a recent dissection of a Chimpanzee by Dr DWIGHT,† no trace of this ulnar head of the Flexor brevis pollicis was found.

The *M. flexor brevis minimi digiti*, both in Man and in all the Anthropoid Apes, is described as presenting only one head of origin, viz., its ulnar head; while the radial head, although really present as a constant structure, is artificially detached from its morphological position by a nomenclature which assigns to it the term *Third Palmar Interosseous* muscle. Such a mode of description could only have arisen from regarding the function of a palmar interosseus muscle as quite distinct from that of a short flexor. That the interosseous position does not debar a muscle from being a short flexor is evident from the position of the ulnar head of Flexor brevis pollicis, and therefore there is no serious obstacle in the way of restoring the innermost palmar interosseous muscle to its proper place, and speaking of it as the radial head of the short flexor of the little finger.

Palmar interosseous muscles are therefore presented in their correct anatomical positions when they are considered as members of the *Intermediate stratum* of short

* HEPBURN, *loc. cit.*

† DWIGHT, "Notes on the Dissection and Brain of the Chimpanzee, 'Gumbo,'" *Memoirs of the Boston Society of Natural History*, vol. v. number ii. p. 38, 1895.

flexors, and each becomes either the radial or ulnar head of the short flexor muscle of a specific digit.

According to current descriptions there are *three* palmar interosseous muscles in Man's hand, and they occupy the second, third, and fourth inter-metacarpal spaces respectively. In the Gibbon, Orang-utan, and Gorilla a similar number has been described;* but in the Chimpanzee I have recorded the presence of three additional muscles belonging to this series, making a total of six, so disposed as to place two in each of the second, third, and fourth inter-metacarpal spaces; while DWIGHT,† in his recent dissection, has described a total number of *seven*. He says:—"The smallest of these is the first. It arises from the radial side of the metacarpal bone of the index, internal to the belly of the dorsal." . . . "I have called it a palmar interosseous, because it seems to me a distinct muscle; still its mode of termination gives support to those who would call it a part of the first dorsal."

Whatever may be said concerning the supposed incomplete condition of the short flexor stratum in Man's hand, it must be quite evident that, so far as the Chimpanzee's hand is concerned, there is no occasion to distinguish between short flexors and palmar interosseous muscles, because between them the stratum is completed, and each digit possesses its short flexor muscle presenting a radial and an ulnar head of origin. It must now be abundantly clear that the four palmar slips of muscle, which I have described as capable of being dissected in the human hand, in addition to the three palmar interosseous muscles already accepted, produce a condition exactly parallel to that seen in the Chimpanzee's hand; but, instead of considering them merely as so many additions to the group of palmar interosseous muscles, my opinion is that the nomenclature should be amended so as to conform to accepted facts of comparative anatomy, and that the general term "Short Flexors of the digits" should supersede the present use of "Palmar Interosseous." Thus, each digit would present its short flexor, consisting of a radial and an ulnar head, while the entire series would resemble the dorsal stratum in occupying interosseous positions, with the exception of those portions on the radial and ulnar borders of the hand, viz., radial head of Flexor brevis pollicis and ulnar head of Flexor brevis minimi digiti. In each case, the short flexor would be distinguished by the distinctive name of the digit on which it acted. In this way we should recognise *M. flexor brevis pollicis* as consisting of the *Radial* and *Ulnar* heads at present described.

M. flexor brevis indicis consists of a radial head, separable from the Abductor indicis, and an ulnar head (First Palmar Interosseous). The insertions of these two portions are found in opposite sides of the base of the first phalanx of the index digit.

M. flexor brevis medii digiti consists of a *radial* head, separable from Abductor medii digiti (radiad), and an *ulnar* head, separable from Abductor medii digiti (ulnad). These are inserted into opposite sides of the base of the first phalanx of the middle digit.

* HEPBURN, *loc. cit.*

† DWIGHT, *loc. cit.*

M. flexor brevis annularis consists of a *radial* head (Second Palmar Interosseous) and an *ulnar* head, separable from Abductor annularis. These are inserted into opposite sides of the base of the first phalanx of the ring finger.

M. flexor brevis minimi digiti consists of a *radial* head (Third Palmar Interosseous) and an *ulnar* head, which at present appropriates the entire name. These are inserted into opposite sides of the base of the first phalanx of the little finger.

From this description it will be seen that each *Abductor* in the dorsal stratum is intimately associated at its *insertion* with one of the heads of a short flexor, and it is to this association that I attribute the fact that these portions of the short flexors have not hitherto received due recognition. Undoubtedly there are cases when the fusion is more complete than at other times, and hence, under favourable circumstances, *additional* palmar interosseous muscles have been recognised and recorded as abnormalities. In my endeavour to prove the existence of a flexor muscle situated in a position where it is more or less fused with an abductor muscle, I regard it as of great importance that, even by current descriptions, a flexor action has always been claimed for an abductor muscle, situated in an interosseous space, and that the flexor portions, which I consider capable of separation from abductor muscles, always occupy the palmar aspect of the hand. There has never been any difficulty in recognising those portions of the short flexors which possess an independent insertion. From this statement we must except the ulnar head of the short flexor of the Pollex, which has become overshadowed, and in some cases suppressed, by the Adductor pollicis muscle.

It is important to note that there are *three* nerve twigs sent into each interosseous space for distribution to the three separate portions of muscle which I consider each space contains.

These views regarding the strata of intrinsic muscles in Man's hand have been impressed upon me by many careful dissections, and they have led me to re-examine my earlier dissections of the corresponding muscles in the hands of the Anthropoid Apes, especially the so-called palmar interosseous muscles, with the results that I shall now briefly indicate.

In the Chimpanzee the intermediate stratum of short flexor muscles is found at its fullest development, so far as regards the fingers, for, as already mentioned, the Flexor brevis pollicis possessed only a rudimentary ulnar head in my dissection. In this ape, the short flexors separate with perfect ease from the dorsal interosseous muscles, so that each finger is provided with a short flexor presenting a radial and an ulnar head of origin. In the original description of my dissection,* I recorded this condition of parts as existing in the Medius, Annularis, and Minimus digits, but not in the Index. A renewed examination of the dissection, however, convinces me that the *radial* head of *M. flexor brevis indicis* is also present. At the same time, it was more closely adherent to the palmar aspect of the Abductor indicis than any of the other short flexors were to their respective dorsal interosseous muscles.† This fact,

* HEPBURN, *loc. cit.*

† *Vide* DWIGHT quoted *ante*.

coupled with the general acceptance of the current text-book descriptions of the dorsal interosseous muscles of Man's hand, led me, in the first instance, to overlook its presence. In this explanation we may also find the reason why different observers have recorded so much variation in the number of palmar interosseous muscles seen in different dissections of the hand of the Chimpanzee. In the Orang-utan and Gorilla the conditions closely approximate to those found in Man. With care it can be shown that each dorsal interosseous muscle carries upon its palmar aspect one head of a short flexor, so closely fused as readily to escape observation, although capable of separation by fair dissection. In the Gibbon, the difficulty of separating the dorsal interosseous muscles from those heads of short flexors fused with them is extremely great, and I cannot claim to have been successful. The difficulty is undoubtedly due to the cylindrical nature of the shafts of the metacarpal bones rather than to the absence of the muscular slips, because in every case muscular fibres, which took no part in forming the bipennate muscle, arose from the palmar surfaces of the shafts of the metacarpal bones. The three so-called palmar interosseous muscles were distinguished without any trouble, because their insertions are independent, and are not obscured by fusion with contiguous muscles, as is the case with certain heads of the short flexors which are inserted in common with the individuals of the dorsal or abductor series.

CONCLUSIONS.

1. The shaft of each metacarpal bone, with the exception of the first, presents two triangular areas, a larger on the dorsal aspect and a smaller on the palmar aspect, neither of which affords origin to muscular fibres. It follows, therefore, that the palmar aspects of the various metacarpal bones are more fully occupied by muscles than the dorsal aspects.

2. The dorsal interosseous muscles—which are Abductors in function—are smaller than current descriptions lead us to believe. This is quite in accordance with the comparatively feeble nature of the abductor movements.

3. Each digit is provided with a short flexor muscle presenting radial and ulnar heads which are capable of acting *independently*, and thereby producing a certain amount of abduction and adduction according to their position with regard to the middle line of the hand.

4. Every muscle of the Dorsal or Abductor series is inserted in common with *one of the heads* of a short flexor muscle, and, in consequence of their close fusion, the line of separation between them is somewhat obscured, and has been overlooked.

5. The members of the Palmar or true Adductor stratum have all disappeared from the human hand, with the exception of the Adductor pollicis obliquus et transversus, hence this action has been thrown upon certain heads of the short flexors, and in con-

sequence these heads stand out more distinctly, especially as their insertions are isolated from, and not masked by fusion with, any other muscle, either abductor or adductor.

6. Whenever true Adductor muscles are found, as in certain of the apes, they are inserted in conjunction with those heads of the short flexors which are capable of supplementing this action.

7. In the case of the human Pollex, which possesses the one true Adductor muscle of Man's hand, not only is this muscle inserted in common with one head (the ulnar) of the Flexor brevis pollicis, but in consequence that head is always obscured and in many cases extinguished.

POSTSCRIPTUM.

I have not yet made an exhaustive examination of the human foot with regard to its intrinsic muscles in the light of the results obtained from the hand, but with due allowance for the narrower and more crowded state of the intermetatarsal spaces, I have no doubt the same conditions prevail there also.

EXPLANATION OF PLATE.

- Fig. 1. The *Abductor stratum* of muscles is shown from the dorsal aspect with special reference to the bipennate nature of the Dorsal Interossei.
- Fig. 2. The *Dorsal Interossei*, according to current descriptions, are shown from the Palmar aspect. The *Abductor pollicis* and *Abductor minimi digiti* are partly figured.
- Fig. 3. The *Palmar Interossei* of current descriptions.
- Fig. 4. The series of muscles for which it is proposed to utilise the name *Flexores breves digitorum*. The divided muscles are the *Abductor pollicis* and *Abductor minimi digiti*. Part of the *Opponens minimi digiti* is also shown on the shaft of the 5th metacarpal bone.

D^r HEPBURN ON THE INTEROSSEOUS MUSCLES OF THE HUMAN HAND.