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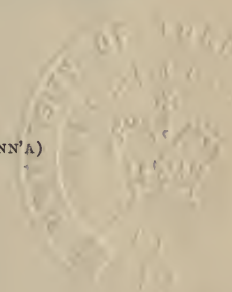


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THE
ANATOMY AND FUNCTIONS
OF THE
MUSCLES OF THE HAND
AND OF THE
EXTENSOR TENDONS OF THE THUMB.

BY
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STATES

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ERRATA.

PAGE 12.—For “front of the front of the carpus” read “*front of the carpus.*”

PAGE 31.—For “no more or less” read “*more or less.*”

PAGE 32.—For “second Palmar” read “*third Dorsal.*”

PAGE 33.—For “Hence it is that the second Dorsal Interosseus has no attachment to the base of the first phalanx, while the third Dorsal has a slight one; strong abduction to the radial side by it is not required” read “*Hence it is that the third Dorsal Interosseus has no attachment to the base of the first phalanx, while the second Dorsal has a slight one; strong abduction to the ulnar side by it is not required.*”

PAGE 43.—For “indirectly” read “*directly.*”

PREFACE.

THE following observations were made in a dissection of fifty-three hands. If it be asked why a special study of parts of the Human Body, which have been long known, should occupy the attention of the anatomist, when there are so many opportunities for fresh research, I will say that the investigator will be amply rewarded in thus re-examining regions that have been studied by former anatomists; he will often discover serious misconceptions of previous observers, and be able to correct descriptions which *have for years been accepted as true ones.*

J. F. W.

CAMDEN, N. J.

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CONTENTS.

	PAGE																														
Preface	III.																														
Extensor Tendons of the Thumb	5																														
Muscles of the Thumb	9																														
Functions of the Abductor, Flexor Brevis and Opponens Pollicis .	14																														
Muscles of the Little Finger	20																														
Interosseous Muscles	25																														
Lumbrical Muscles	35																														
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%; vertical-align: middle;"> DESCRIPTIONS OF ANATOMICAL WRITERS: </td> <td style="width: 5%; vertical-align: middle;">}</td> <td style="width: 10%; vertical-align: middle;">(ANALYSES AND CRITICISMS OF—)</td> <td style="width: 75%;"></td> <td style="width: 10%;"></td> </tr> <tr> <td></td> <td></td> <td></td> <td>Extensor Tendons of the Thumb</td> <td style="text-align: right; vertical-align: bottom;">37</td> </tr> <tr> <td></td> <td></td> <td></td> <td>Muscles of the Thumb</td> <td style="text-align: right; vertical-align: bottom;">37</td> </tr> <tr> <td></td> <td></td> <td></td> <td>Muscles of the Little Finger</td> <td style="text-align: right; vertical-align: bottom;">43</td> </tr> <tr> <td></td> <td></td> <td></td> <td>Interosseous Muscles</td> <td style="text-align: right; vertical-align: bottom;">45</td> </tr> <tr> <td></td> <td></td> <td></td> <td>Lumbrical Muscles</td> <td style="text-align: right; vertical-align: bottom;">48</td> </tr> </table>		DESCRIPTIONS OF ANATOMICAL WRITERS:	}	(ANALYSES AND CRITICISMS OF—)						Extensor Tendons of the Thumb	37				Muscles of the Thumb	37				Muscles of the Little Finger	43				Interosseous Muscles	45				Lumbrical Muscles	48
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			Interosseous Muscles	45																											
			Lumbrical Muscles	48																											
Bibliography	50																														

THE ANATOMY AND FUNCTIONS

OF

THE MUSCLES OF THE HAND

AND OF

THE EXTENSOR TENDONS OF THE THUMB.

EXTENSOR TENDONS OF THE THUMB.

EXTENSOR OSSIS METACARPI POLLICIS.

About an inch above its insertion it divides into two portions of unequal size. The larger one is inserted into the upper outer surface of the base of the metacarpal bone of the Thumb; some of its fibres occasionally running into, and giving attachment to, the upper part of the belly of the Abductor Pollicis. The smaller, between one-third and one-half of the size of the other, is attached to the upper outer edge of the Trapezium, and, by a few fibres, to the capsular ligament of the Trapezo-metacarpal articulation (Fig. 1, Nos. 8 and 9).

Varieties. Not infrequently the tendon is split into three parts, two of which reunite above the wrist and are inserted as one tendon into the metacarpal bone, while the other has the usual insertion into the Trapezium; or the three remain distinct throughout, one, the largest, being inserted into the metacarpal bone; another, next in size, into the Trapezium; and the third, into the capsular ligament. In some cases the portion attached to the Trapezium is the largest of the three. Now and then four divisions of the tendon will be found, which reunite to form two or three final tendons.

In those cases in which there are two, the normal number of divisions, the one inserted into the Trapezium is, in a small number, larger than the other; while, on the other hand, more frequently it is much smaller than usual, and the one attached to the metacarpal bone is correspondingly increased in volume.

In a small proportion of subjects the attachment to the Trapezium is wanting.

Function. The muscle through its double insertion has two special or primary functions to perform, and not only one as its name would imply. By its tendon of insertion into the base of the metacarpal bone of the Thumb it draws this towards the Radius in a purely lateral plane; that is, it *abducts* the metacarpal bone, and consequently the Thumb. By that into the Trapezium it acts as a radial abductor of the wrist and consequently of the whole hand; and, when acting in conjunction with the Extensores Carpi Radiales, it assists

in the radial extension of the wrist ; its tendency to draw the carpus toward the Radius in a directly lateral plane being overpowered by the extending influence of the two extensors.*

The tendon inserted into the metacarpal bone can secondarily—that is, after its primary act has been performed—produce radial abduction of the wrist, and assist in the radial extension of the same. If the primary function be prevented, as by applying the Thumb firmly against the Index Finger, then these movements are more readily accomplished by it.

Both tendons can assist secondarily, to a slight degree, in the supination of the hand. If the Thumb be fixed as just stated, this will be the more active.

Faradisation of the muscle produces the abduction of the Thumb and wrist.

The name of Abductor Pollicis Longus, given to the muscle by some anatomists, is a much better one than that of Extensor Ossi Metacarpi Pollicis. Extension proper of the metacarpal bone and Thumb is a complex movement, as will be shown, and not due solely to this muscle. Still the former name does not imply the full function.

EXTENSOR PRIMI INTERNODII POLLICIS.

The disposition of this tendon is apt to vary. The following is the arrangement which most frequently exists :** the tendon, about one-third the size of that of the Extensor Secundi Internodii, at the metacarpo-phalangeal articulation of the Thumb joins the latter, the two being bound closely together, but not commingling their filaments. At this point it sends some filaments downward in a curved line from its outer aspect, which strengthen the capsular ligament*** of the joint, and then splits into two portions or layers, an upper superficial one and a deep one (Fig. 1, Nos. 5 and 6). The former, usually a little larger than the other, continues onward over the shaft of the first phalanx to the base of the second in company with the tendon of the Extensor Secundi Internodii, to which it is firmly united ; forming with it a strong aponeurosis, along the dorsum of the Thumb, which is attached to the base of the second phalanx. Apparently, all the fibres composing the tendon of the Extensor Primi Internodii, with the exception of those running downward to strengthen the capsular ligament, proceed to the second phalanx, because the deep division, the one inserted into the first phalanx, is covered over by the superficial one. In order to expose the former to view a special preparation is required : with a knife the tendon of the Extensor Primi must be separated from that of the Extensor Secundi, from the point where the two come into contact, carefully over the metacarpo-phalangeal articulation to a short distance below the base of the first phalanx. The external edge of the slit is then turned over and outward, when, from the under surface of the Extensor Primi Internodii, an off-shoot will be discovered, which, becoming expanded, is attached to the posterior surface of the base of the first phalanx.

Another arrangement, next in frequency to the above, occurring in about one-fifth of the subjects, is for the tendon to be inserted only into the first phalanx, having first given off some filaments laterally to the capsular ligament.

Other less common varieties are the following : the tendon after giving off the fibres to the capsular ligament proceeds to the second phalanx without

*Move the pronated hand, placed mid-way between flexion and extension, in a direct line toward the Radius and put a finger over the tendon of the Extensor Ossi Metacarpi ; it will be found to be tense. Now produce radial extension of the wrist ; the tendon still remains tense, but less so than in the former position.

**It will be found in a little over fifty per cent. of all subjects examined.

***By the capsular ligament I mean the various ligamentous bands or processes which taken as a whole constitute a capsule for the synovial membrane.

furnishing any attachment to the base of the first; or both the extensor tendons are attached to the base of the first as well to that of the second phalanx.

Variations as to the size of the tendon are of rather frequent occurrence; generally, in such cases, it is reduced in volume while that of the Extensor Secundi Internodii is correspondingly increased; but when it increases in size the latter diminishes in proportion. There appears to exist a close relationship between the two tendons in this respect.

Usually in those cases in which both tendons are attached to the first as well as to the second phalanx, they are about equal in size.

Function. In the majority of persons the muscle has two direct or primary functions, viz: extension of the second and extension of the first phalanx, and not only one, as its name indicates. By secondary action it takes part in the same movements as does the Extensor Ossis Metacarpi: namely, abduction of the Thumb, abduction of the hand, radial extension and supination of the hand.*

The name Extensor Minor Pollicis sometimes given the muscle is a much better one than that of Extensor Primi Internodii Pollicis.

EXTENSOR SECUNDI INTERNODII POLLICIS.

At the metacarpo-phalangeal articulation it furnishes some filaments to the inner side of the capsular ligament and then proceeds over the dorsum of the Thumb, in company with the superficial portion of the tendon of the Extensor Primi Internodii, to be inserted into the posterior surface of the base of the second phalanx (Fig. 1, No. 3, and Fig. 3, No. 4).

Varieties. Under the previous heading all the variations of the two extensor tendons have been mentioned, with the exception of one. In this the Extensor Primi is reduced to a mere filament and simply furnishes a few filaments laterally to the capsular ligament. The Extensor Secundi Internodii, in such cases, is much larger than usual and is inserted into the first phalanx as well as into the second one; the disposition of the former attachment being identical with that of the Extensor Primi Internodii in the normal condition. It seems, in these cases, as if the greater portion of the latter tendon had been absorbed by the other one.

Function. By direct action it extends the second phalanx. Indirectly, or by secondary action, it extends the first phalanx and draws the metacarpal bone, and consequently the whole Thumb, backward and inward toward the ulnar side of the hand. It also assists in the radial extension of the hand, and slightly in its supination.

If the three muscles, the Extensor Ossis Metacarpi Pollicis and the Extensores Primi et Secundi Internodii Pollicis, act simultaneously, *extension* proper of the Thumb takes place, that is, the movement which is the direct opposite of flexion. The Extensor Ossis Metacarpi and the Extensor Primi Internodii counteract the tendency of the Extensor Secundi Internodii to draw the Thumb backward and inward, and the latter prevents the former two from producing a simply lateral movement toward the outer side of the hand; the result is direct extension of this finger.

*The abduction of the Thumb and of the hand by these two muscles is due to the dispositions of their tendons in a compartment of the annular ligament, which is situated nearer to the anterior than the posterior surface of the hand, at the lateral aspect of the wrist. The bellies of the muscle are posterior to the plane of their insertions, and hence when contracting the force would naturally be in a line obliquely backward. But this is diverted, as on a pulley, to a purely lateral and straight course by means of the above arrangement.

Owing to the peculiar position which the Thumb holds, viz.: with its palmar surface looking laterally instead of downward, extension and abduction of it are, to a certain degree, similar movements. In its extension it is also, necessarily, drawn away or abducted from the rest of the fingers; still not to the fullest extent. Hence that act alone should be called abduction which carries the Thumb away from the other digits as far as it is possible, and in a direct line.

When the Thumb is abducted as a solid rod, that is, with its phalanges extended, the Extensor Secundi Internodii has a share in the movement. It contracts slightly to keep the second phalanx extended on the first but not sufficiently to interfere with the lateral motion.*

The name Extensor Major Pollicis is much preferable to that of Extensor Secundi Internodii Pollicis.

*Draw the Thumb away from the Index Finger in a straight line and the tendons of the Extensor Osis and Extensor Primi Internodii will be found to become very tense, while that of the Extensor Secundi Internodii is moderately so. Now make extension proper of the Thumb and the latter will be felt to increase its tension very much and the others, to maintain their previous condition.

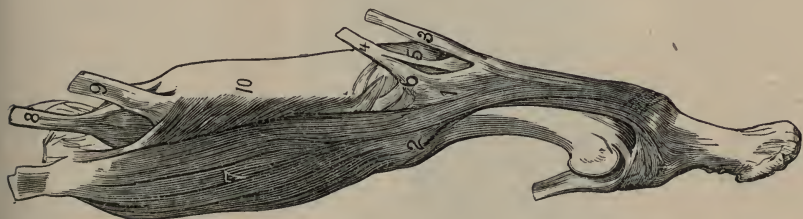
MUSCLES OF THE THUMB.

ABDUCTOR.

It arises from the upper two-thirds of the anterior surface of the outer half of the Volar Ligament,* and, in a semi-circle, from the sheath of the Flexor Carpi Radialis tendon, just as this enters the groove in the Trapezium. Here the sheath is attached on each side to the outer edge of the Scaphoid bone, so that the Abductor virtually has origin from this bone. The muscle is of a rudely triangular shape; broad at its origin, it tapers toward its insertion. It is not thick, but flat and ribbon-like. (Fig. 1, No. 7).

It has a double insertion. The tendon which is short, flat and thin, but quite stout, at the metacarpo-phalangeal articulation gives off from its upper

FIG. 1.



1. Tendinous fibres from the upper portion of the tendon of insertion of the Abductor Pollicis, joining the aponeurosis on the dorsum of the first phalanx of the thumb, which is inserted into the base of the second phalanx. 2. Insertion of the Abductor into the outer surface of the base of the first phalanx. 3. Tendon of the Extensor Secundi Internodii Pollicis. 4. Tendon of the Extensor Primi Internodii Pollicis. 5. Its insertion into the base of the first phalanx. 6. The upper division of this tendon which, joining and entering into the composition of the Dorsal Aponeurosis, is inserted through it into the base of the second phalanx; it also furnishes some filaments laterally which strengthen the capsular ligament of the metacarpo-phalangeal joint. 7. Belly of the Abductor Pollicis. 8. Insertion of the Extensor Ossis Metacarpi Pollicis into the Trapezium. 9. Insertion of the same into the metacarpal bone. 10. Insertion of the Opponens Pollicis.

*By the Volar Ligament I mean that process of fascia which stretches across the hollow of the hand and is attached on one side to the salient points of the Trapezium and Scaphoid bones, and, on the other, to those of the Unciform and Pisiform. Some anatomists call this the Anterior Annular Ligament, while others give this name to the band which runs transversely across the fore-arm immediately above the wrist, and still others apparently consider both as constituting the Annular Ligament. I think it is better to make a clear distinction and name the one Volar Ligament and the other Anterior Annular Ligament; or, what would be better, Anterior Annular Fascia. The process corresponding to the latter at the dorsum of the lower end of the fore-arm I should name the Posterior Annular Fascia.

portion a process of filaments which joins the extensor aponeurosis at the dorsum of the Thumb and, with it, is inserted into the base of the second phalanx at its outer side (Fig. 1, No. 1). The remaining part of the tendon is attached to the external lateral surface of the base of the first phalanx (Fig. 1, No. 2).

FIG. 2.



1. Abductor Pollicis. 2. Outer portion of the outer head of the Flexor Brevis Pollicis; and 3. Inner portion of the same. 4. Inner head of the Flexor Brevis. 5. Adductor Pollicis.

Varieties. The belly of the muscle is, in most cases, distinct from those of the contiguous muscular masses; but not infrequently there is an interchange of fibres between it and the subjacent Opponens, which sometimes makes a clear differentiation of the two muscles impossible except just at the insertion. Occasionally it is more or less closely united to the outer head of the Flexor Brevis.

The additional origin of the muscle from the tendon of the Extensor Ossis Metacarpi has been mentioned. Sometimes, but not often, its muscular fibres arise direct from the outer edge of the Scaphoid bone, instead of indirectly through the sheath of the Flexor Carpi Radialis. Once, in an illy-developed subject, I noticed the attenuated Abductor having origin in two distinct portions; the outer one arising from the extension of the tendon of the Extensor Ossis Metacarpi and slightly from the sheath of the Flexor Carpi Radialis; the inner, from this sheath and from a limited part of the Volar Ligament.

FIG. 3.



1. Aponeurotic expansion of the tendon of the inner head of the Flexor Brevis which joins the aponeurosis at the dorsum of the thumb. 2. Insertion of the Extensor Primi Internodii Pollicis into the base of the first phalanx. 3. Insertion of the same into the base of the second phalanx, by means of the dorsal aponeurosis of which it forms a component part. 4. Tendon of the Extensor Secundi Internodii Pollicis.

Longitudinal furrows may often be observed dividing up the superficial surface of the belly. The number of grooves varies. The most constant one is that which when traced downward, toward the insertion, will be found to distinguish those muscular fibres which run into the Extensor Aponeurosis from those which are inserted into the base of the first phalanx. The process of tendinous fibres which joins the Extensor Aponeurosis is not always clear and distinct. In those subjects whose muscles are poorly developed it is often hard to define, being more or less blended with the surrounding common fascia of the finger.

FLEXOR BREVIS.

It is composed of two portions or heads having distinct insertions (Fig. 2, Nos. 2, 3 and 4). The outer portion, or Outer Head as it is called, is divided by a groove or furrow, which in most cases runs completely through the muscular mass, into two distinct bellies. The outer one of these (Fig. 2, No. 2) has origin from the lower fourth of the radial half of the anterior surface of the Volar Ligament and slightly from the lower edge of the tuberosity of the Trapezium, and from the continuation of the Volar Ligament which is attached to the front of the carpus on the outer side of the hand.*

The inner one (Fig. 2, No. 3) arises from the inner part of the last named process (its fibres here being often continuous with those of the outer division) and, in common with the Inner Head of the muscle, from the sheath of the Flexor Carpi Radialis, from the inner, lower corner of the anterior surface of the Trapezium, from a slight portion of the anterior surface of the Trapezoid, from the lower part of the anterior surface of the Os Magnum and from the base and upper one-fourth, about, of the anterior surface of the body of the metacarpal bone of the Index Finger. It runs obliquely downward and outward and joins the outer belly a short distance above the metacarpophalangeal articulation, forming a stout muscular mass which is inserted by a short, thick tendon into the outer half of the anterior surface of the base of the first phalanx of the Thumb, and partly into its radial lateral surface, below and slightly beneath the tendon of the Abductor.

The Inner Head (Fig. 2, No. 4) besides the points of origin which it has in common with the inner portion of the outer head,** arises from the anterior surface of the base of the metacarpal bone of the middle finger and slightly from the outer aspect of the base of the metacarpal bone of the Ring Finger;*** it also receives a number of filaments from the metacarpal bone of the Thumb, which are usually collected into a rounded belly springing from the inner surface of the base, which joins the inner head a short distance from the insertion, running obliquely upward and inward, deep, beneath all the other muscular fibres. It is inserted by short tendinous fibres into the inner half of the anterior surface of the base of the first phalanx and into the whole of the

*This ligament from its points of attachment to the Scaphoid and Trapezium sends a process of filaments downward and inward, in a curved manner, to the front of the carpus, where it commingles with the ligamentous fascia about here, and assists in the formation of the sheath of the Flexor Carpi Radialis. It is named the "Ligamentum Carpi Volare Proprium" by some writers.

At the inner side of the hand a similar process starts from the points of the Unciform and Pisiform, running downward and outward to the front of the carpus. It is not as well marked as the other.

**Aponeurotic fibres run over the surface of the common origin of the two heads, which commingle above with the ligamentous fascia binding the carpal bone together. They afford attachment to some of the muscular fibres.

***These have a continuous origin with the fibres springing from the points already mentioned.

ulnar lateral surface of the base by direct muscular attachment ; the insertion being disposed in a rude semi-circle, with the concavity looking upward, below and around the insertion of the Abductor. Some of the posterior fibres, besides, run into a quite broad, thin aponeurosis which joins the Extensor Aponeurosis at the dorsum of the Thumb (Fig. 3, No. 1) and is inserted into the base of the second phalanx in the same manner as is the expansion of the Abductor.

A small sesamoid bone is developed in the tendon of the Outer Head, and another one in that portion of the insertion of the Inner Head which is directed to the anterior surface of the base of the first phalanx.

Varieties. Outer Head. There may be no origin from the outer continuation of the Volar Ligament, the two portions of this head being widely separated at their origin ; this does not occur very often. More frequently the outer belly has a limited attachment to this process externally, and the inner one, a corresponding one internally ; there still being, however, a considerable fissure between them. As before stated, the two portions may have a continuous origin, though separated below by an incomplete fissure which extends downward but a short distance, when there is but one muscular bundle. In a few cases the outer belly, arising from the Volar Ligament and the tuberosity of the Trapezium, alone is present and constitutes the whole of the Outer Head, the fibres of the inner belly being absorbed by the Inner Head. A few times I have seen some fibres, springing from the front of the Os Magnum, run across the inner belly and join the outer one, being a transposition of muscular tissue from the former to the latter. The insertion of the muscle is not always distinct from that of the Abductor, its upper border sometimes blending with that of the latter.

Inner Head. The manner of origin from the metacarpal bone of the Thumb is apt to vary ; thus, there may be no distinct belly springing from this bone, but a number of separate filaments which join the main mass of the Inner Head at different places and which spring from the inner side of the base of the bone ; or from the base and a ligamentous arch stretching from the base of the metacarpal bone of the Thumb to that of the Index Finger ; or from the inner surface of the upper one-half of the shaft ; or from this and the base ; or from all three of the points.

Occasionally the origin from the Index Finger is not confined to its anterior surface but extends a little over the outer lateral surface encroaching slightly on the attachment of the first dorsal interosseous muscle. The origin from the base of the metacarpal bone of the Ring Finger is sometimes wanting. In rare cases the Inner Head sends off from its upper or external border a small slip which, running obliquely across the tendon of the Flexor Longus Pollicis, joins the Outer Head a short distance above its insertion. Those fibres arising from the bases of the metacarpal bones of the middle and Ring Fingers and even those from the inner portion of the front of the Os Magnum do not always join the Inner Head, but go to form a part of the Adductor. These variations, as they bear a direct relation to the latter muscle, will be considered in connection with it. The insertion into the second phalanx by the aponeurosis is sometimes ill defined, the edge of the latter being hard to distinguish from the surrounding fascia ; this does not occur as often as in the case of the Abductor. In a few subjects the usual number of muscular fibres do not run into the aponeurosis, when the Adductor supplies the deficiency by sending some of its fibres to this process. Not infrequently a few of the short tendinous filaments of the upper or outer portion of the insertion find attachment to the inner side of the sheath of the Flexor Longus Pollicis ; a corresponding attachment to the outer side of this sheath being furnished by the Outer Head.

OPPONENS.

Arises from the anterior or outer surface of the tuberosity of the Trapezium for nearly its whole length, and from about the middle two-fourths of the anterior surface of the radial one-half of the Volar Ligament. The greater portion of the muscle is covered by the Abductor, its outer edge only being free (Fig. 1, No. 10). At its inner border it is closely associated with the outer belly of the outer head of the Flexor Brevis, so that a complete separation of the two muscular masses cannot be effected, except immediately above the insertion where they naturally separate. But notwithstanding this intimate union there is still the appearance of two distinct muscles, for the fibres of the one, taken as a whole, have a different direction from those of the other viewed in the same manner. It is inserted by fleshy fibres into the whole length of the radial edge of the shaft of the metacarpal bone of the Thumb, and also into the outer half of its anterior surface in an oblique manner, the attachment being slight above and confined to its outer limit, but increasing gradually below from without inwards, until, near the head of the bone, it covers the whole extent. The uppermost fibres also have attachment to the outer edge of the base of the bone; these run almost transversely from their origin to their insertion and are necessarily the shortest, while the others gradually increase in obliquity and length from above downward (Fig. 1, No. 10).

Varieties. Occasionally it derives a few filaments from the under surface of the Abductor. Sometimes, though not often, the muscle is divided into two, the upper transverse fibres which are inserted principally into the outer surface of the base of the metacarpal bone being separated from those below; the result is two bellies of unequal size, the upper about one-fourth the size of the lower one. The insertion may encroach on the anterior surface of the shaft of the metacarpal bone at its upper part so that there is not so great a difference in the areas covered by the upper and lower fibres; this occurs in about one-fourth of all subjects.

Functions of the Abductor, Flexor Brevis, and Opponens. I have deferred the consideration of the functions of these muscles until now for the reason that they are all three concerned in one very important act, viz: opposition of the Thumb to the other fingers.

If this movement be carefully studied it will be found that it is accomplished through a combination of several minor movements. Holding the hand midway between pronation and supination with the Thumb in the easiest position, namely, separated from the Index Finger, with its phalanges slightly flexed, let the reader attempt to oppose the Thumb, say to the little finger. The first act noticed is extension of the second phalanx on the first, and the latter on the metacarpal bone. The two phalanges, thus fixed, then move as a solid rod laterally, toward the medial line of the body, on the head of the metacarpal bone. Almost, if not quite, simultaneously with the latter act the metacarpal bone is rotated forward on its long axis, on the Trapezium. The result of these movements is that the pulp of the Thumb is brought opposite to that of the little finger. Flexion of the metacarpal bone on the Trapezium now follows, and finally, flexion of the two phalanges as a solid rod* upon the metacarpal bone—the little finger at the same time coming forward—and the act is complete.

The extension of the phalanges and their lateral rotation are performed by the Abductor; the former, by means of the fibres which join the extensor aponeurosis at the dorsum of the Thumb and are attached to the base of the second phalanx; the latter, to a certain extent, by these fibres, but mainly by those which are inserted into the lateral aspect of the base of the first phalanx. We have seen that it is the upper fibres of the belly of the Abductor which

*That is, with the second phalanx extended on the first.

terminate in the tendinous expansion which joins the Extensor Aponeurosis. This process, from its commencement to its attachment to the latter, is placed to the lateral surface of the metacarpo-phalangeal articulation and slightly posteriorly to its transverse axis, nearly on a line with the muscular fibres which proceed to it (Fig. 1, No. 1); hence when these contract the force of the contraction will be directed along the lateral surface of this joint, posteriorly to its transverse diameter. The result is a lateral movement with extension of the first phalanx; while the second phalanx is extended by the direct insertion of the tendinous process into the posterior surface of its base, and is carried laterally by the movement of the first phalanx.* These movements can be imitated, in most cases, on the dead subject by making traction with a string tied to the belly of the Abductor, previously freed from its origin, in the line of its action. Sometimes, however, the expansion is but slightly developed, and, on pulling the string, will be found to have but little influence in extending the phalanges. It might be argued from these cases that this extension is not a very important function, as the tendinous fibres are not always sufficiently developed to produce it readily. The reader must bear in mind, however, that in the dead subject, where the tissues are more or less hardened and matted together any movement produced will be hindered in its action, and what is slowly and inaccurately performed by the observer, might, by the living person have been accurately and smoothly executed. I have not infrequently seen the outer interosseal aponeurosis of the Index Finger but illy-defined, so that it could only with difficulty be distinguished from the surrounding fascia; when traction upon the proper muscle but slowly extended the two last phalanges; yet, no one can say that these acts are not important with regard to this finger.**

Rotation of the metacarpal bone on its axis, and its flexion on the Trapezium are performed by the Opponens; the former act, by those fibres of the muscle which are attached along the radial border of the base and body of the bone, especially the upper ones which are nearly transverse; and the latter, by the whole muscle, but particularly by the fibres which are inserted into the anterior surface of the shaft. The Abductor and the Flexor Brevis may assist in the flexion secondarily. These two muscles have the movable metacarpal bone between their origins and insertions; hence, when they have completed the movements which are peculiar to them, by virtue of their insertions, they can act on this bone. This secondary action will, on the part of the former, be a little later than, if not simultaneous, with the commencement of the action of the Opponens; while, on the part of the latter, it will occur toward the end of the contraction of the Opponens, if not entirely after it.

Flexion of the phalanges as a solid rod on the metacarpal bone or, rather, extension of the second phalanx on the first and flexion of the first on the metacarpal bone, is executed by the two heads of the Flexor Brevis acting together, but not equally; aided by the Abductor. When opposition to the little finger is made the Outer Head acts more strongly than the Inner, and when to the Index Finger, vice-versa. The extension of the second phalanx is produced by the tendinous expansion which is inserted into the posterior surface of the base of this bone (Fig. 3, No. 1) and the flexion of the first by

*Apply the Thumb to the Index Finger and then draw it away in a directly lateral plane. It will be found on placing a finger of the opposite hand on the belly of the Abductor that in this act it remains perfectly flacid, it does not contract. But now make the movements above described and immediately it will be felt to become hard and tense.

This proves conclusively that the muscle is not engaged in abduction proper.

**Let the reader attempt to make opposition of the Thumb with its phalanges flexed and he will find it to be much constrained, and much less easily executed than with the phalanges extended.

the direct attachment of the two heads into the anterior surface of its base and also by the tendinous expansion which, on its way to join the common extensor aponeurosis, runs anteriorly to the transverse axis of the metacarpal-phalangeal articulation, unlike the corresponding process of the Abductor which is situated posteriorly to this axis. Now, the latter muscle may aid the Flexor to keep the second phalanx extended on the first by virtue of its tendinous expansion; especially when the Outer Head, which is only attached to the first phalanx, is called into the stronger action, as instanced above. But in so doing the Abductor would tend to keep the first phalanx extended as well; this tendency would be overcome by the stronger Flexor drawing the bone directly downward.

Opposition of the Thumb to the other fingers is the most important act of the hand; and it forms the basis, as it were, or enters into, in a more or less modified manner, many of its other important movements. It requires the conjoint action of three muscles. There are other motions which call into simultaneous play two of these; for instance, in writing. After the pen has been seized by the opposition of the Thumb to the Index Finger it is brought into position by the slight contraction of the Flexor Longus Pollicis; this contraction has the effect of flexing the second phalanx but of throwing back or extending the first and the metacarpal bone, for the reason that the first-named bone, in its flexion meets a point of resistance in the pen, when there is generated a return force having, of course, an opposite direction, namely, backward; and this being received on the articulating head of the first phalanx throws it backward, the metacarpal bone being carried with it. The downward stroke of the pen is made by the Flexor Longus increasing its contraction, whereby the above movements are exaggerated. The opposite, upward stroke, is produced by the simultaneous action of the Abductor and the Flexor Brevis, which causes extension of the second phalanx and flexion of the first and the metacarpal bone; the tendency of the Abductor to extend the first phalanx being overcome by the stronger Flexor.* In this way the vertical lines of the written characters are made. The horizontal ones are executed through slight ab-or Ad-duction of the whole hand; and the combinations of these two; that is the oval or round lines, by a combination of these motions. Sometimes the Abductor or the Flexor Brevis is called into play singly; thus in playing the piano, the hand being held in pronation, the outer lateral surface of the Thumb is brought down upon the keys by the Abductor simply; while in grasping an object of considerable size in the palm of the hand flexion only of the Thumb is required, and the Flexor Brevis alone contracts. But I know of no movements in which the Opponens assumes isolated action; it seems to serve rather as an adjunct to the other two muscles.

To sum up. The function of the Abductor is to extend the second phalanx on the first, and the first on the metacarpal bone; then to carry these two bones, so disposed, as a straight rod, laterally over the outer lateral surface of the head of the metacarpal bone; and finally to flex, secondarily, the metacarpal bone in the same direction. That of the Opponens, to rotate the metacarpal bone on its long axis, and to flex it. That of the Flexor Brevis, to extend the second phalanx on the first, and flex the first on the metacarpal bone; and, secondarily, to flex the metacarpal bone in the same direction.

Faradisation of the three muscles produces movements analogous to those above described. It is not possible to confine the electric current completely to a single one of them at one time, because they are so close to each other. Still, when the poles of the battery are applied over the belly of the Abductor these movements predominate which have been ascribed to this muscle; when over the Opponens along the edge of the metacarpal bone, where, alone, it is

*Place a finger over the bellies of the Abductor and Flexor when the upward stroke is made and they will be found to contract strongly.

not covered by the Abductor, rotation of the metacarpal bone on its long axis is the most striking act; and when over the Flexor Brevis, extension of the second phalanx on the first, flexion of the first on the metacarpal bone, and finally flexion of the latter.

The Abductor homologically represents, in part, the abductor interosseous muscle of the Thumb, and, in so far, its name is appropriate; but, with regard to its function, the appellation is entirely unsuitable and is misleading, evidently having been given to it under a misapprehension of its proper office. So also is the name *Opponens* objectionable, and for the same reason; the muscle does not perform the whole movement of opposition. It would be a difficult matter to give to the former a concise name expressive of its function; the latter might be named the *Flexor Ossis Metacarpi Pollicis*, but this does not describe the whole scope of its action.

ADDUCTOR.

It arises from the whole length of the anterior surface of the metacarpal bone of the middle finger (its fibres having attachment, between the origins of the two interosseous muscles of this finger, to a narrow ridge,) and also, to a slight extent, from the fascia about the metacarpo-phalangeal articulation. The muscle is triangular in shape, broad at its origin, it becomes narrower and thicker toward its insertion, the fibres converging to this point (Fig. 2, No. 5). It is placed to the inner side of the inner head of the Flexor Brevis for its whole length. Above, the deep palmar branches of the radial artery run between the two muscles and separate them from each other; but a short distance below they are in juxta position and firmly bound together, a tendinous line being the only demarcation between them.

It is inserted into the ulnar lateral surface of the base of the first phalanx, in an oblique manner, from above downward and forward; the insertion of the inner head of the Flexor Brevis embracing it below in a rude semi-circle. The insertion cannot be completely separated from that of the Flexor, but nevertheless it can readily be distinguished from it; the fibres of the one having a little different direction from those of the other.

Varieties. These are of frequent occurrence. Indeed the arrangement described above does not occur in the majority of subjects, though it is the commonest one.

Sometimes the inner head of the Flexor is fused with the Adductor for its whole extent, above the entrance of the deep radial vessels into the palm as well as below; the only means of distinguishing the one from the other being the tendinous line, which, in some cases, is much broadened and resembles an aponeurosis that, on being traced downward, will be seen to be attached to the inner half of the anterior surface of the base of the first phalanx of the Thumb and to the inner side of the sheath of the Flexor Longus Pollicis; fibres of the Flexor Brevis being attached to its upper surface, and to its lower, those of the Adductor. A disposition oftener found is the following: the lower portion of the inner head of the Flexor is grooved or furrowed so that some of its fibres, arising from the anterior surface of the base of the metacarpal bone of the middle, and, slightly from the outer aspect of the base of the metacarpal bone of the Ring finger, are partly separated from the main body; below the radial vessels these can be traced downward to the ulnar side of the tendinous line between the Flexor and Adductor, and hence are incorporated in the latter muscle; so that, besides its origin from the shaft of the metacarpal bone of the middle finger, in these cases the Adductor has an additional one from the bases of this bone and that of the metacarpal bone of the Ring Finger, at the expense

of the Flexor Brevis.* Occasionally the number of fibres separated from the Flexor is greater, and include, not only all those springing from the bases of the metacarpal bones just mentioned but also a few which arise from the anterior surface of the Os Magnum. Sometimes the tendinous dividing line is absent; in these cases it is impossible to make a clear distinction between the two muscles and, only for the fact that the fibres of the one, taken as a whole, run in a little different direction from those of the other and have an attachment to a different portion of the base of the first phalanx, they might be considered as practically constituting but a single muscle. Sometimes the strip of muscle which separates from the inner head of the Flexor Brevis runs to the ulnar side of the radial vessels in order to join the Adductor, instead of proceeding along their radial side.

The extent and manner of origin from the shaft of the metacarpal bone of the middle finger are not constantly the same. In the majority of subjects these are as described in the arrangement given above, but the following anomalies may be found. The muscle arises from the lower one-half, or two-thirds or one-third of the anterior surface of the shaft, a quantity of loose cellular and of adipose tissue lying between it and the inner head of the Flexor Brevis; or from the upper one-half, one-third or two-thirds, when it lies in apposition to the latter as usual.** Or the belly of the muscle is split into two or three distinct portions. When there are two divisions the upper one is the larger and arises from the upper part of the shaft of the metacarpal bone, and sometimes from its base; it runs downward, closely bound to the inner head of the Flexor Brevis below the entrance of the deep radial vessels into the palm, and is joined by the smaller division, springing from the lower one-fourth or one-third of the anterior surface of the shaft and from the fascia about the metacarpo-phalangeal articulation, a short distance above the insertion; adipose tissue fills up the space between the two heads. When there are three divisions the upper one is the smallest and the middle one the largest; the former has origin, in common with the inner head of the Flexor Brevis, from the anterior surface of the base of the metacarpal bone (being separated from the latter muscle by the vessels afore-named) and slightly from the upper part of the anterior surface of the shaft; the latter arises from the upper and central portions of the anterior surface of the shaft; and the third, from the lower one-fourth, about, of the same and from the fascia. The three bellies unite in the palm and are inserted into the first phalanx in the same manner as when the muscle consists of only a single belly.

Occasionally the Adductor has a slight insertion into the extensor aponeurosis at the dorsum of the Thumb; and two or three times I have seen a good portion of the muscle so inserted, while the insertion of the Flexor Brevis into this process was very inconsiderable. In a few subjects some of

*An arrangement which, without close inspection, would be taken for this one sometimes obtains as follows: a small slip of the Flexor Brevis' inner head, springing from the bases of the metacarpal bones of the Ring and middle fingers, is divided off from the main mass by a furrow, and comes into contact with the Adductor immediately below the point at which the radial vessels enter the palm. A short distance below this the rest of the inner head and the Adductor come together, and from this point the dividing tendinous line commences which is carried down to the insertions of the muscles. Now if the fibres composing the small slip be carefully traced downward they will be found to run to the upper or flexor side of the line, and hence properly to belong to the Flexor Brevis.

**Sometimes there is the usual extent of origin of muscular fibres from the anterior surface of the shaft, but those arising from the upper part of it, say the upper fifth are absorbed by the inner head of the Flexor, which consequently, in these cases is larger than usual.

This does not often happen.

the fibres of the former will be found running across the tendon of the latter to be attached to the anterior surface of the base of the first phalanx.

Function. It produces direct adduction of the Thumb, acting as an antagonistic muscle to the Extensor Ossis Metacarpi Pollicis and Extensor Primi Internodii Pollicis when these combine to produce abduction. Simple adduction is not an important movement of itself, except in so far as it replaces the Thumb in its usual position after abduction of it has been completed. But the adductor may be associated with the other intrinsic muscles of this finger in the performance of very important movements: for instance, in making a hollow or scoop of the palm of the hand, it and the Flexor Brevis act together to form the radial portion or side of the hollow, aided by the Flexor Longus Pollicis which causes flexion of the second phalanx; overpowering the tendency of the Flexor Brevis to cause extension of this same bone.

Faradisation produces direct adduction of the Thumb.

MUSCLES OF THE LITTLE FINGER.

ABDUCTOR.

It arises from the lower half of the Pisiform bone; the upper half being covered by the tendon of the Flexor Carpi Ulnaris.

Anatomically the muscle may be said to have origin from this bone, but physiologically the last named tendon affords the point of attachment.

The Pisiform bone is so movable that a great deal of the power of the contracting, short Abductor would be lost in drawing the bone down so as to make it a fixed point from which a purchase could be derived. To obviate this the stronger and longer Flexor Carpi Ulnaria contracts simultaneously with the Abductor, just sufficiently to draw up the bone and fix it.*

The Abductor is the largest muscle of the little finger; it runs along the ulnar edge of the palm to the outer side of the Flexor Brevis to which, in most cases, it is firmly bound for about the lower one-fourth or one-half of its extent. It is inserted into the ulnar lateral surface of the base of the first phalanx, encroaching slightly up on the anterior surface besides, while some of its posterior or dorsal fibres proceed upward and forward, in the manner of an interosseous muscle, to be lost in a tendinous expansion (Fig. 4, No. 4) which uniting with the Common Extensor tendon, is inserted into the bases of the second and third phalanges, posteriorly. Usually this expansion is not very clearly defined, and sometimes it is hard to distinguish its edge, it being confused with the common fascia of the finger.

Varieties. The above arrangement occurs in about a half of all subjects; in the majority of the rest this muscle and the Flexor Brevis are fused into a single belly (Fig. 4, No. 2) as will be described under the head of the latter. In rare cases the Abductor receives a small slender strip of muscular tissue which arises from the inner part of the deep fascia of the fore-arm, about an inch above the wrist, runs downward over the anterior surface of the carpus in the groove between the Pisiform and Cuneiform bones, and joins the muscle a short distance below its origin from the Pisiform. About as often it has an additional origin by a few fibres from the inner lower surface of the Cuneiform. Sometimes a few of its inner filaments run obliquely downward and outward across the Flexor Brevis and are inserted with it near the centre of the inner half of the anterior surface of the base of the first phalanx.

Function. Extends the third phalanx on the second and the second on the first; then it may abduct the finger, with the phalanges extended, in a directly lateral plane; or it may flex the first phalanx and abduct it at the same time, causing an oblique flexion of the finger, while the two last phalanges remain extended. The tendinous process (Fig. 4, No. 4) which leaves the belly of the muscle and joins the common extensor aponeurosis at the dorsum of the finger, in its course to the posterior surface of the base of the third phalanx runs anteriorly to the transverse axis of the metacarpophalangeal articulation, posteriorly to that of the first phalangeal joint, and necessarily, posteriorly to that of the second one. The result is that when the Abductor contracts, extension of the two last phalanges with simultaneous flexion of the first occurs by virtue of this process, while the flexion is aided by those muscular fibres which have a direct attachment to the small portion of the anterior surface of the base of the first phalanx; and abduction of the

*Place a finger of one hand over the tendon of the Flexor Carpi of the other one and then make abduction of the little finger of the latter. Simultaneously with this movement the tendon will be felt to become tense.

finger is produced by those inserted into the ulnar lateral aspect of the same bone. But if the Extensor Communis, or rather that portion of it which runs into the tendon to the little finger, acts in unison with the Abductor, then flexion of the first phalanx is prevented and the extended phalanges are simply drawn laterally by the latter.

FIG. 4.



1. Deep branch of the Ulnar nerve. 2. Additional head of origin of the Abductor Minimi Digiti from the unciform process of the Unciform bone and from the adjacent portion of the Annular Ligament, the Flexor Brevis being absent. 3. Insertion of the muscle into the base of the first phalanx. 4. Lower edge of the aponeurotic expansion of the same, which is disposed in the same manner as that of an interosseous muscle.

FLEXOR BREVIS.

Its origin is from the upper outer portion of the Unciform process of the Unciform bone and from the middle part of the anterior surface

of the ulnar half of the Volar Ligament. At its origin it is separated from the Abductor by the deep branches of the ulnar artery and nerve. But below, it runs to its inner side, in most cases being closely bound to the muscle, as previously stated. It is attached to the ulnar half of the anterior surface of the base of the first phalanx of the little finger, and slightly to the inner portion of the sheath of the large flexors.

Varieties. In nearly one-third of all subjects the disposition portrayed in Fig. 4, obtains. Here the Flexor and the Abductor practically constitute but a single large muscle, having origin on one side from the Pisiform, on the other from the Unciform and Volar Ligament, and insertion into the ulnar anterior lateral surface of the base of the first phalanx, and into the posterior surfaces of the bases of the second and third, in the manner described above. In these cases, if the course of the Fibres composing the belly be scrutinized, it will be found that the outer ones, those arising from the Unciform bone and Volar Ligament, are attached to the anterior surface of the base of the first phalanx, while those starting from the Pisiform are attached mainly to the lateral surface of this bone, and go to form the tendinous expansion; so that there is no change in the origin or destination of the muscular fibres from the arrangement first given, only a difference in the manner of their procedure from the point of their origin to that of their insertion. Sometimes, in about one-sixth of all cases, there is a change, however, in the position of the fibres. The following arrangements may be found. They are mentioned in order of their frequency.

(No. 1.) The origin from the Pisiform is larger than usual while that from the Unciform and Volar Ligament is correspondingly diminished in size; there is a continuous origin of muscular fibres from a ligamentous band stretching over the deep branches of the ulnar artery and nerve from the Pisiform to the Unciform process of the Unciform, so that the belly, at its commencement, is in the form of a horse-shoe, the two salient points being at the Pisiform and the Unciform.

(No. 2.) The abductor or pisiform head has an additional origin from the anterior surface of the capsular ligament uniting the Pisiform to the Cuneiform.*

(No. 3.) There is no flexor head, all the fibres spring from the Pisiform; the belly thus formed receiving a few filaments, below, from the Opponens muscle, which, on being traced upward, will be found to be derived from the Volar Ligament.

Occasionally the Flexor is divided, one portion composed of fibres arising from the Unciform bone, joins the Abductor high up, as described in the second arrangement given; while the other, comprising fibres both from the Unciform and the Volar Ligament, proceeds downwards, as the Flexor does when complete, to be inserted into the base of the first phalanx; or the former may consist of fibres coming from both the Unciform and the Volar Ligament, while the latter, much the smaller one, arises solely from the Ligament.

In these cases, also, there is no change but in the course of the muscular fibres.

Function. When acting singly it will produce flexion of the first phalanx in a straight line. But its chief use, I believe, is to aid the Abductor in causing flexion of this bone, when the latter, being the stronger muscle, at the same time draws it obliquely inward.

The question arises: can the muscular fibres arising from the Unciform bone and the Volar Ligament act independently of the Abductor, in the manner of the Flexor Brevis, when closely bound to this muscle as in the second arrangement described? I think they can, taking into consideration the fact that they have the same insertion as when isolated. But in those

*Sometimes, when the Flexor and Abductor are separate these additional origins are found.

cases in which there is a transposition of filaments, as it were, in which a larger proportion or all arise from the Pisiform bone, then such of these as are inserted into the anterior surface of the base of the first phalanx can only contract simultaneously with those which are attached to the lateral surface. It is of no special importance whether direct flexion can be performed by the muscular mass situated on the inner side of the little finger or not; for in case oblique flexion only can be executed by it, when the former movement is required the interosseous muscle on the opposite side of the finger, by acting in unison with the combined Abductor and Flexor, will prevent any abduction of the finger by its own tendency to produce duction in the contrary direction. But it is of some moment that the Abductor proper should be able to act independently of the flexor fibres, that is, that it should have as little insertion as possible into the anterior surface of the base of the first phalanx; for if its attachment to this area is considerable, as it is when nearly all or all the muscular filaments arise from the Pisiform, then the flexing tendency of the muscle is increased, and when simple abduction of the finger is to be executed the Extensor Communis must be called into stronger action than otherwise it would, in order to overcome this greater flexing power of the Abductor. But the tension of the Extensor tendon, must, to some extent, interfere with lateral motion, so that the less this is necessary the more easily will abduction be performed. Hence, in those subjects in whom the anomalous transposition of filaments exists abduction of the little finger is not as readily or as smoothly done as in those in whom the flexor fibres are distinct from the abductor ones.

Faradisation of the Flexor and of the Abductor is not very satisfactory in its results partly for the same reasons as stated with regard to the muscles of the Thumb. If the poles of the battery be held over the former, however, flexion in a straight line will occur slowly; if over the latter, slight extension of the two last phalanges with flexion of the first obliquely inward may be observed.*

OPPONENS.

It arises from the lower portion of the unciform process of the Unciform bone, below the origin of the Flexor, and from the inferior part of the ulnar half of the anterior surface of the Volar Ligament. It is placed beneath the other two muscles; its fibres running obliquely downward and inward to be inserted into the whole length of the inner edge of the metacarpal bone of the little finger, and into the corresponding half of the anterior surface; the latter attachment being slight above but increasing downwards, so that at the head of the bone it reaches to the median line. The obliquity of the fibres is greater below than above; the uppermost ones are almost transverse.

Varieties. Occasionally the upper and more transverse fibres are split off from the lower ones so as to constitute a distinct belly, the muscle being thus divided into two portions of unequal size, the higher one of which is much the smaller and is attached solely to the inner edge of the metacarpal bone.

Function. Flexes the metacarpal of the little finger on the Unciform and at the same time rotates it on its long axis. These movements are necessarily limited, especially the latter, as there is but little freedom of motion in the carpo-metacarpal articulation. In making a hollow of the palm of the hand, the inner wall of it is produced by the slight flexion and rotation of the metacarpal bone; and in opposing the Thumb to the little finger, the interosseous muscle of the latter is aided by the Opponens in bringing it in contact with the former; for the little finger is so far removed from the Thumb

*If the Flexor Carpi Ulnaris be stimulated to contract at the same time so as to draw up the Pisiform bone, these acts are more readily accomplished.

that the mere flexion and lateral rotation of its first phalanx, as produced by the Interosseous, is not sufficient to place it in good apposition.

There could not be a more inappropriate name given to this muscle than that of *Opponens Minimi Digiti*. In the first place, the fifth finger is not free to move toward the others in the manner that the Thumb is ; and in the second place, even if this motion were possible it would not be brought about by a single muscle. The name *Flexor Ossis Metacarpi Minimi Digiti* is much better, though not describing the full function.

INTEROSSEOUS MUSCLES.

The origins of these muscles may be stated to be grossly as follows: a Palmar Interosseus arises in single belly from the anterior or palmar two-thirds of the antero-lateral surface,* turned *toward* a line drawn through the centre of the middle finger, of that metacarpal bone which sustains the phalanges upon which the muscle operates. A Dorsal Interosseus arises by two bellies; the larger one is attached to the whole extent of the antero-lateral surface, turned from the line just mentioned, of that metacarpal bone which sustains the phalanges upon which the muscle acts; the smaller one, to the posterior third of the antero-lateral surface of the contiguous or opposite metacarpal bone, with the exception of that of the first Dorsal, which springs from the upper or proximal one-half of the posterior part of the inner or ulnar

FIG. 5.



1. First Dorsal Interosseus. 2. First Palmar Interosseus. 3. Palmar belly of the second Dorsal Interosseus. 4. Palmar belly of the third Dorsal Interosseus. 5. Second Palmar Interosseus. 6. Palmar belly of the fourth Dorsal Interosseus. 7. Third Palmar Interosseus.

*By the antero-lateral surface I mean that space which is included between the ridge along the centre of the metacarpal bone anteriorly and that one which defines the posterior surface of the bone on one side or the other. At about the lower fourth the median ridge divides the two portions of it including between them a small triangular surface which is partially free of muscular attachment. Thus the whole of the posterior and a small part of the anterior surface of the metacarpal bone are free, comparatively, of muscle. (See Figs. 5 and 6.)

antero-lateral surface of the metacarpal bone of the Thumb.* The anterior and posterior surfaces of the bases of these bones also afford slight origin.

In no case, however, are the muscles strictly confined to these areas. The bellies of the Dorsal Interossei will, some of them, encroach on the posterior surfaces of the metacarpal bones; their lesser heads may extend their origins over the lateral surfaces of the metacarpal bones, pushing forward those of the Palmar Interossei and diminishing the extent of their attachments, or vice-versa, the latter may encroach on the former. The body of a Palmar, or one of the bellies of a Dorsal Interosseus may not be restricted to one side of a metacarpal bone, but may extend over and have origin from the anterior portion of the opposite side; thus in the majority of subjects, the first Dorsal will be found to cover a small part of the upper or proximal half of the inner or ulnar antero-lateral surface of the metacarpal bone of the Index Finger, as well as the whole of its outer or radial one; very often the third Palmar arises from the upper or proximal part of the inner, or ulnar antero-lateral surface of the metacarpal bone of the fifth finger as well as from the anterior or palmar one-half of the outer or radial one. In the palm the Interossei Palmares and the palmar bellies of the Dorsales frequently interchange filaments; so that a clear differentiation of all of the two sets of muscles is never possible.

It seems to me that this is a compensatory arrangement. Take for example a case in which the second Dorsal Interosseus has an increased origin, by its dorsal belly, from the inner or ulnar lateral surface of the metacarpal bone of the Index Finger; the first Palmar suffers a corresponding diminution in its extent of attachment to this bone, and will receive a supply of filaments from the palmar belly of the former, arising from the metacarpal bone of the middle finger, which supplies the deficiency; so that neither muscle has gained or lost in the amount of its tissue. In figure 5 a fair specimen of the average disposition of the muscles at the palm may be seen. No. 1.—The first Dorsal Interosseus—arises by additional fibres from the inner side of the anterior surface of the base and from the upper portion of the anterior aspect of the inner antero-lateral surface of the metacarpal bone of the Index Finger. No. 2.—The first Palmar—being encroached upon by the first Dorsal, has an extra origin from the outer side of the base and from the outer antero-lateral surface of the third metacarpal bone at its upper or proximal half. No. 3.—The second Dorsal—arises by a few fibres from the upper anterior or palmar portion of the inner antero-lateral surface of the third metacarpal bone in common with the palmar belly of the third Dorsal, by which it is partly covered, and receives filaments from the belly of the adjacent first Palmar, the two muscles being closely fused as far as their insertions, nearly. No. 4.—The third Dorsal—is the most nearly regular in its origin of all the muscles, but at its upper or proximal half it interchanges filaments with the contiguous second Palmar; No. 5.—The second Palmar—crosses obliquely over the fourth metacarpal bone and has an extra origin from the inner or ulnar side of the anterior surface of the base of this bone, and from the corresponding antero-lateral surface, at its upper part, while its fibres com-

*Thus the first Dorsal arises from the outer antero-lateral surface of the metacarpal bone of the Index Finger, and from that of the Thumb as above stated; the first Palmar, from the anterior two-thirds of the inner antero-lateral surface of the former; the second Dorsal, from the posterior one-third of the inner antero-lateral surface of the metacarpal bone of the Index Finger and from the whole of the outer one of the metacarpal bone of the middle finger; the third Dorsal from the whole of the inner antero-lateral surface of the latter and from the posterior one-third of the outer one of the metacarpal bone of the Ring Finger; the second Palmar from the anterior two-thirds of the latter; the fourth Dorsal from the whole of the inner antero-lateral surface of the metacarpal bone of the Ring Finger and from the posterior one third of the outer one of the fifth metacarpal bone; and the third Palmar from the anterior two-thirds of the latter.

mingle with those of the third Dorsal on the opposite side; No. 6.—The fourth Dorsal—has no origin from the lower third of the outer antero-lateral surface of the fifth metacarpal bone, but, above, it covers more than its usual share of the bone.* No. 7.—The third Palmar—arises from the entire extent of the outer antero-lateral surface of the fifth metacarpal bone at its lower or distal third, but from less than usual of it at the upper or proximal two-thirds. At the dorsum of the hand the arrangement of the muscles is more regular (Fig. 6.) The two heads of a Dorsal Interosseus come together in a rudely bi-penniform manner in the greater number of cases; but sometimes one head overlaps the other as the Third Dorsal in Fig. 6. Besides the points of origin which have been given, at the back of the hand the three inner Dorsal Interosseous muscles are strongly attached to the deep fascia covering them,

FIG. 6.



1. Third head of the second Dorsal Interosseus.

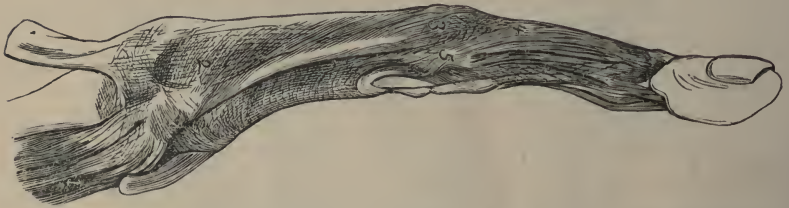
and, at the palm, the first Dorsal is quite firmly bound by its inner head to the deep fascia covering it, which is thickened at this place (see Fig. 5, No. 1). The third Palmar has a constant origin from a small portion of the outer lower edge of the Unciform process of the Unciform bone.

Varieties. In rare cases a Dorsal Interosseus has but one head, that which arises from the metacarpal bone which sustains the finger into which it is inserted; but it receives a good supply of filaments from the belly of the opposite Palmar Interosseus which covers the whole of one antero-lateral surface of a metacarpal bone instead of the anterior two-thirds of it. Not infrequently the outer head of the first Dorsal has origin, in common with

*It is not often, however, that the inner or Dorsal head of the Fourth Dorsal does not arise from the whole length of the fifth metacarpal bone.

some of the fibres of the inner head of the Flexor Brevis Pollicis, from the ligamentous arch stretching from the base of the metacarpal bone of the Thumb to that of the Index Finger;* very rarely its inner head has a slight attachment to the anterior surface of the inner lower edge of the Trapezium; in poorly developed subjects the inner head may not arise from the whole of the outer or radial antero-lateral surface of the metacarpal bone of the Index Finger, the lower portion of the bone being free. Very often the second Dorsal has a third head situated at the dorsum of the hand (Fig. 6, No. 1), which, when well developed, arises by a thin, flat tendon (about three-fourths of an inch long and a quarter wide) from the lower inner corner of the posterior surface of the Os Magnum; the belly also flat and thin (about an inch and a half long and a quarter wide) runs downward and obliquely outward and joins the inner head of the muscle a short distance above its insertion; when not well developed, its tendon of origin cannot readily, if at all, be defined from the common deep fascia covering the carpal bones. Occasionally the *third* Dorsal has a third head resembling the above, but which arises directly from the posterior surface of the base of the metacarpal bone of the Ring Finger, and, slightly from the carpal bone above; having no tendon of origin. These anomalous heads are really prolongations upward of the tissue of the muscles which have become differentiated from the main masses.

FIG. 7.



1. Belly of the third Dorsal Interosseus. 2. Fibres of the expansion or aponeurosis of the muscle, which, running obliquely upward and forward, are lost in the tendon of the Common Extensor. 3. Fibres of the same aponeurosis which are inserted into the base of the second phalanx. 4. The thin tendinous band which is attached to the base of the third phalanx, composed of the remaining fibres of the aponeurosis and of the thick rounded portion of the tendon of the Interosseus, with a few fibres from the lateral edges of the tendon of the Common Extensor; this is also joined by a process of filaments (5) coming from a bony ridge on the lateral aspect of the shaft of the first phalanx, just below its articulating surface.

Insertions. The three Palmars are inserted alike.** The muscular belly opposite the lateral surface of a metacarpo-phalangeal articulation ends in a stout tendon placed slightly anteriorly to the transverse axis of the joint. From this point it proceeds forwards and posteriorly in an oblique manner, toward the dorsum of the finger. On its way it sends off filaments from its upper surface in a radiating or fan-like manner (Fig. 7, No. 2.—This represents a Dorsal Interosseus, but it will answer equally well for a Palmar) which

*In these cases the muscle also arises from the inner aspect of the base of the metacarpal bone of the Thumb.

**The first one, into the inner side of the Index Finger; the second, into the outer side of the Ring Finger; and the third, into the outer side of the little one.

constitute a distinct aponeurosis; so that the tendon may be said to be composed of two portions, one thin and aponeurotic, the other thick and cord-like.

The fibres of the former at first run upward and slightly backward* in a curved manner, and join the lateral expansion of the Common Extensor tendon; then they proceed more and more transversely upward toward the Extensor tendon, and finally (by far the greater portion of them) they are directed obliquely forward toward the distal end of the finger. The transverse filaments are, for a greater part, lost in the tendon of the Common Extensor, intertwining with its component filaments; but some of them run over it and commingle with the corresponding fibres of the tendon of the interosseous muscle on the other side of the finger. Of the filaments turned forward, the first and more oblique ones are disposed in the same manner as the transverse ones; but the last, which run almost directly forward, are inserted into one side of the posterior surface of the base of the second phalanx, being united with the lateral surface of the Common Extensor tendon.

The cord-like portion, starting from the metacarpo-phalangeal articulation, runs along the lateral surface of the shaft of the first phalanx in a direction obliquely upward toward the dorsum of the finger, which it reaches a short distance from the first phalangeal joint. On its way it gives off the filaments which constitute the aponeurosis just described; hence, as it progresses forward it becomes thinner and thinner until at the proximal limit of the last named joint, it breaks up into a number of filaments and is lost (See Fig. 7.)

FIG. 8.



1. Insertion of the first Dorsal Interosseus into the outer half of the base of the first phalanx.** 2. Under surface of the aponeurotic expansion at the dorsum of the finger, formed principally by the spreading of the tendon of the first Lumbrical, but also by a supply of filaments from the Interosseus. 3. Belly of the first Lumbrical turned up. 4. Tendon of the Common Extensor. 5. Belly of the first Dorsal Interosseus. 6. Tendon of the Flexor Sublimis Digitorum.

Of these filaments the upper ones (No. 3, Fig. 7) are inserted into one side of the posterior surface of the base of the second phalanx with those already mentioned; while the lower ones, having been joined by some fibres coming from the side of the Common Extensor tendon just previous to its insertion into the base of the second phalanx, proceed along the postero-lateral surface of the first phalangeal articulation forward to the dorsum of the second phalanx, where, a short distance above its base, they are met by corresponding fibres coming from the Interosseous muscle on the other side of the finger and from the other side of the Common Extensor tendon; these various filaments meet

*By "backward" I mean toward the root or proximal end of the finger.

**It hides from view the lateral ligament of the joint.

at an acute angle leaving a small triangular free space of bone between. A thin, ribbon-like, tendinous band is thus formed (Fig. 7, No. 4) which runs along the posterior surface of the second phalanx and is inserted into the centre of the posterior aspect of the base of the third.

The manner of insertion of the Common Extensor is as follows: just previous to reaching the metacarpo-phalangeal joint it contracts a little; it then sends off from each side a tendinous expansion which proceeds downward and forward and is attached to the edge of the anterior fibro-cartilage of the joint and to the adjacent surface of the base of the first phalanx; the posterior free edge of this expansion is curved (Fig. 7). After this the tendon broadens a little and becomes flattened, to adapt itself to the smooth posterior surface of the first phalanx; it passes over the metacarpo-phalangeal articulation, forming with its lateral expansions a covering for the joint which encloses all but the anterior or palmar portion of it, which is occupied by the anterior fibro-cartilage. It then runs along the posterior surface of the first phalanx to the posterior aspect of the base of the second, to the central portion of which it is inserted. (On each side of it the thin aponeurosis of an interosseous muscle is attached the entire length, as already described; the whole making a sheath for the dorsal surface of the first phalanx). Before its insertion into the second phalanx, however, at the first phalangeal joint, the tendon gives off from each

FIG. 9.



1. Tendon of the Common Extensor; its lateral expansion over the metacarpo-phalangeal articulation being cut away. 2. Belly of the fourth Dorsal Interosseus. 3. Its tendon of insertion into the lateral aspect of the base of the first phalanx. 4. Its second tendon which expands into the broad aponeurosis covering the dorsum of the finger. (A good portion of this expansion has been cut away in a rounded manner, so as to expose to view the insertion of the muscle into the base of the first phalanx (No. 3) which, in the natural state, is entirely covered by it. The attachment to the Extensor tendon (No. 1) of the expanded tendon of the interosseous muscle on the other side of the finger can be seen in the figure. A line carried downward from this to No. 4 will show the point at which the latter becomes expanded). 5. The flexor tendons of the finger.

lateral margin a few filaments which run downward and forward, beneath the fibres of the interosseal tendon which are attached to the second phalanx, and join those of the latter which proceed to the base of the third phalanx. In order to demonstrate this arrangement it will be found necessary to divide the Extensor tendon in the middle and turn outward the two halves, for it is completely hidden in the natural state of the parts.

There is a process of filaments (Fig. 7, No. 5) starting from the lateral ligament of the first phalangeal joint and from the ridge on the upper portion of the lateral surface of the shaft of the first phalanx, below its head, which

joins the ribbon-like band that is inserted into the base of the third phalanx. It is easily destroyed in a dissection, as it is not readily to be distinguished from the surrounding common fascia; but by dissecting off the skin of the finger from the tip downward and carefully removing this fascia it can clearly be demonstrated.

The four Interossei Dorsales will be considered separately from one another.

The *First Dorsal* is inserted almost wholly into the base of the first phalanx, covering the outer or radial half of the anterior or palmar surface of the base and the whole of its outer lateral surface (Fig. 8, No. 1). Those of its fibres which have origin from the anterior surface of the metacarpal bone of the Index Finger can be traced to the former attachment, and those from the outer lateral surface of the same bone and from the metacarpal bone of the Thumb, to the latter.

But this finger is not devoid, on its outer side, of the delicate aponeurosis which, on its inner side, is furnished by the first Palmar, in the manner above described. Every finger has one on each side. Here, however, it is not so well developed and is composed mainly of the expanded tendon of the first Lumbrical muscle, a limited number of filaments from the muscle under consideration joining it (Fig. 8, Nos. 2 and 3).

The *Second Dorsal* is inserted in a totally different manner. Opposite the outer or radial surface of the metacarpo-phalangeal joint of the middle finger the greater portion of its fibres collect into a stout tendon which almost immediately expands in the same manner as does that of a Palmar Interosseus and is disposed exactly as it is. A small number of its fibres, coming from the upper or dorsal portion of the belly, end in a somewhat flattened tendon which is inserted into the radial lateral surface of the base of the first phalanx, midway between its anterior and posterior surfaces; it runs on a plane superior to that of the thickened portion of the other tendon, but is completely covered over by the expanded aponeurotic part, so that, in most cases, there is nothing to indicate the presence of the second tendon, and the muscle has the appearance of being inserted just as a Palmar Interosseus. Not infrequently, however, the muscular belly, at some distance from its tendon, shows a tendency to separate into two portions, an upper and a lower one, the latter being the larger; this might direct the attention of the dissector to the above arrangement.

The *Third Dorsal* is disposed in exactly the same manner as is a Palmar Interosseus, having no attachment to the base of the first phalanx. Sometimes its belly divides as the Second one does (See Fig. 7) giving the muscle the appearance of having two tendons of insertion as the latter has. It is situated on the inner side of the middle finger and hence inserted on its ulnar side.

The *Fourth Dorsal* is inserted precisely as the Second is; its insertion into the first phalanx being, perhaps, more clearly defined. In most cases there is no more or less of a separation into two bellies, which sometimes extends for about a half of the length of the muscle. In Fig. 9, the parts have been specially prepared to show this second tendon. A portion of the expansion of the lower belly has been cut away, leaving exposed the tendon of the upper one. This, as will be seen, is attached to the first phalanx almost in a straight line with the muscular fibres which run into it* and crosses obliquely over the internal Lateral Ligament of the joint in its course. (The finger is so placed in the cut that its anterior surface looks away from the observer; consequently No. 3, the upper head, appears larger than No. 4, the lower one, because all that mass of muscle arising from the anterior portion of the metacarpal bone is cut off from

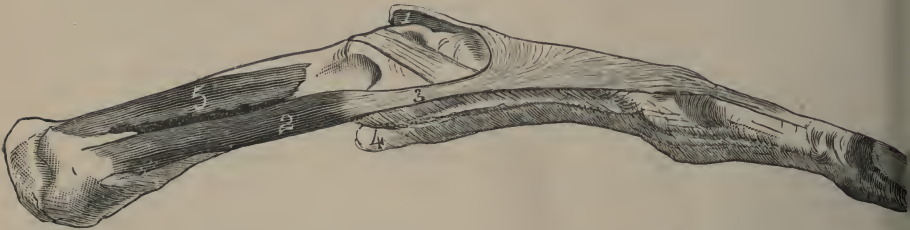
*The first phalanx is, in the Fig., slightly flexed on the metacarpal bone so that this is not so apparent as it would be if the finger were extended.

view; besides the tendon of the latter has been to a great extent pared off, giving the appearance that but few muscular fibres proceed to it). Now compare this figure with Fig. 10, that of a Palmar Interosseus, which has been treated in the same manner, and the difference in the dispositions of the two muscles is striking; here all the filaments of No. 2, the belly, run into No. 3, the tendon which expands into the fan-like aponeurosis.

The tendons of both the Palmar and Dorsal Interosseous muscles at the metacarpo-phalangeal joint are loosely bound by fibrous tissue to the side of the anterior fibro-cartilage, in conjunction with the sheath of the flexor tendons of the finger.

Varieties. Occasionally a Palmar Interosseus has a direct attachment to the base of the first phalanx; the third one usually being the one which is so disposed. The second Palmar also, occasionally has this insertion. The outer head of the first Dorsal, instead of joining the inner head, sometimes runs directly to and is *inserted* into the posterior edge of the metacarpal bone of the Index Finger, above the *origin* of the inner head which it partially covers; or else a part of it has this insertion, while the rest of it joins the other head; these are rare anomalies.* Frequently the tendon of insertion into the second and third phalanges commences some distance above the metacarpo-

FIG. 10.



1. Tendon of the Common Extensor. 2. Belly of the second Palmar Interosseus. 3. Tendon of the same. 4. Tendons of the flexor muscles of the finger. 5. Inner head of the Third Dorsal Interosseus.

A large part of the expanded portion of the tendon of the second Palmar Interosseus has been cut away (as, in Fig. 9, the Dorsal Interosseus is treated).

phalangeal joint, from the central portion of the body of an interosseous muscle, forming a fibrous line along the centre of it, superficially, to which muscular fibres are attached above and below.

Functions. When the finger is extended as a solid rod, that is, with all three phalanges straight, the extension of the second and third is performed by the two Interossei acting together; they accomplish this by means of their insertions into the posterior surfaces of these two bones.

The extension of the first phalanx is due to the Common Extensor, which also assists, to a slight degree, in straightening the second and the third.** But this muscle performs, at the same time, another very important function;

*I found this arrangement three times in the subjects examined.

**The extension of the first phalanx is owing partly to the expansion on each side of the finger of the tendon of the Common Extensor. This is attached to the edges of the anterior fibro-cartilage of the metacarpo-phalangeal joint and to the base of the first phalanx near it. This arrangement hinders its action on the second phalanx by interfering with the freedom of its play over the posterior surface of the first phalanx, so that while it has a considerable insertion into the former its influence over it is not at all commensurate.

while the two Interossei are making traction on the second and third phalanges they tend also to flex the first, for the reason that their tendons are placed anterior to the transverse axis of the metacarpo-phalangeal joint; this is counteracted by the stronger Common Extensor drawing in the opposite direction.

When a single Interosseus acts with the Common Extensor the result is the *drawing of the finger in a state of extension to one side or the other*, towards an imaginary line through the middle finger or away from it according as a Palmar or a Dorsal Interosseus is brought into play. If it is the former, the lateral movement is due mainly to the thick or cord-like portion of the interosseal tendon; this, from the metacarpal phalangeal joint to a short distance below the first phalangeal one, runs, in an oblique manner as already described, along the lateral surface of the first phalanx, consequently it is well adapted to produce lateral motion; those fibres which are attached to the bases of the second and third phalanges, which are the direct continuation of the cord-like portion, of course are as much concerned as the latter itself, but those which, starting from it, are inserted into the Common Extensor tendon or into the base of the second phalanx near the centre, only assist to a slight degree. If it is the latter, not only is the cord-like portion concerned, but also the tendon of insertion into the lateral surface of the base of the first phalanx; this, as has been stated, is placed in its course across the metacarpo-phalangeal joint, nearly parallel with the longitudinal axis, and the muscular fibres which run into it are from their origin to their ending in it, on the same plane; so that the disposition is especially for lateral motion.

Adduction, or the drawing of the fingers together, that is, of the Index, Ring and little fingers toward the middle one, is a movement in which much strength is not required; it might be called a passive one, its main purpose being to replace the fingers after they have been abducted. Abduction, on the other hand, is an active motion requiring, in many instances, considerable force; for example, when an object which is larger than the palm of the hand, say a good-sized ball, is to be grasped, the first act is strong abduction of the Index, Ring and little fingers, and, to a less degree, of the middle one *to the ulnar side*; at the same time the Common Extensor contracts and keeps them extended. After this the flexors of the fingers come into play, the Common Extensor remaining contracted, so that the two last phalanges are flexed while the first remains extended, and the object is seized. The middle finger, it will be noticed, is abducted to the ulnar side; the reason of this, I think, that the hand when held in pronation inclines to the ulnar side, and, between abduction to the radial or the ulnar aspect, the finger more readily performs that which corresponds to the direction which the hand assumes. Hence it is that the Second Dorsal Interosseus has no attachment to the base of the first phalanx, while the third Dorsal has a slight one; strong abduction to the radial side by it is not required. But not only is Abduction a stronger movement than Adduction, it is also a more rapid one, for this reason: the mechanism of the duction of the finger by means of the cord-like portion of the interosseal tendon is that of a lever of the second class in which there is gain of power but loss of speed, while that of the same motion by means of the tendon attached to the base of the first phalanx is of a lever of the third class in which there is gain of speed but loss of power; consequently, a Dorsal Interosseus acquires not only added force in its action by this second insertion, but also increased celerity of movement.*

*In the extension of the two last phalanges the tendinous fibres producing it, naturally tend to spring up and toward the central portions of the bones they cover when they become taut; to prevent this, I fancy, is the function of that *process of filaments* which starts from the *ridge below the head of the first phalanx and joins the interosseal tendon* as above described (Fig. 7, No. 5). It keeps the latter down and applied to the posterior lateral surface of the first phalangeal joint.

Flexion of the finger as a solid rod, that is, with the two last phalanges extended on the first, is accomplished by the combined action of the two interosseous muscles of a finger. The bending is in a direct line downward, the one muscle counteracting the tendency of the other to produce lateral motion. But the power of the two to produce duction are not equal, as has been shown above; so it would seem that the abductor interosseous muscle should overpower the adductor one and cause at least slight movement to one side. The reason it does not is this: In the act of flexion, which is more powerful than that of abduction, the tendon of insertion into the base of the first phalanx (Fig. 9, No. 3) changes its position, and from being about parallel with the longitudinal axis of the metacarpo-phalangeal joint it now becomes anterior to it; consequently the direction of the muscular power is no longer in a straight line along the lateral surface of the finger but in an oblique one, from below upward toward the dorsum, along the anterior portion of the joint and in the line of flexion. The two muscles are thus left with equal power to produce lateral motion and counterbalance each other.

The mechanism of the extension of the phalanges has been explained.

That of the flexion of the first phalanx is as follows: the cord-like portion of the interosseal tendon from its starting point to its termination follows an oblique line which when traced downward will be found to be placed anterior to the transverse axis of the metacarpo-phalangeal joint; so that when it is drawn tight, it will flex the first phalanx while its terminal filaments extend the two last. But this is not all; those filaments which spread out from it, forming the thin aponeurosis, in the fan-like manner (Fig. 7, No. 2) and which are attached to the Common Extensor tendon, also draw the first phalanx downward.

These latter filaments have also another office to perform;* they keep the cord-like tendon applied to the surface of the first phalanx and prevent it from slipping downward, which it would otherwise do when drawn tight in flexion, for it would naturally spring into a direct line between the points of its attachments, viz: the body of the muscle and the base of the second phalanx; the tendon would move toward the anterior or palmar aspect of the hand more and more as the flexion increased, and interfere with the action of the muscle.

When a single interosseous muscle acts, unimpeded in the full scope of its action by its fellow on the other side or by the Common Extensor, the result is *flexion of the finger as a solid rod with its duction to the radial or ulnar side of the hand*. Whether it is a Palmar or a Dorsal Interosseus which acts the lateral movement is due to the cord-like portion of the tendon and the expansion from it. In case it is the latter, the tendon which is attached to the base of the first phalanx does not assist in the duction of the finger, its ability to produce this movement being destroyed by the flexion in which, in fact, it now assists, as has been already explained.

Faradisation of the muscles will produce the movements which have been described; but, of course, it can never be determined by this what are the separate functions of different portions of a muscle and its tendon. In the dead subject the motions can be imitated in a rude fashion.

By cutting away all the insertions of a Dorsal Interosseus except that into the side of the base of the first phalanx (Fig. 9, No. 3) it can be shown by pulling on the belly of the muscle, that this tendon is for lateral motion or abduction, for the finger will be drawn quickly to one side; but if the finger be given a slight tilt forward, so as to bring the tendon, in the slightest degree, anterior to the transverse axis of the metacarpo-phalangeal joint it will be flexed with a sudden jerk, and not abducted. Now destroy in another Dorsal Interosseus the attachment to the base of the first phalanx and preserve the

*Those fibres which loosely bind the tendon to the metacarpo-phalangeal joint have the same use.

other insertions; on making traction, abduction is still produced, but, at the same time, the two last phalanges are extended and the first one flexed, imperfectly, of course, as the matting of the tissues in the dead subject interferes very much with the free movement of the delicate tendinous tissue.

LUMBRICALS.

The first one, which is by far the largest, arises from the radial side of the tendon of the Flexor Profundus which belongs to the Index Finger; it covers about three-quarters of an inch of its surface, commencing in the upper portion of the palm. *The second one* arises from the radial side of the tendon of the Flexor Profundus which runs to the middle finger, springing from about the same extent of surface as the first one, but commencing a little higher up in the palm. *The third one* has origin by two heads; the smaller one comes from the ulnar side of the Flexor Profundus tendon to the middle finger, and the larger one from the radial side of that to the Ring Finger; the former covers about one-half inch or less of surface, the other, a little more. Between the two heads a few straggling fibres may be seen to arise from the fascia which extends from one tendon to the other. The origin of this muscle as well as that of the following one is on a slightly lower level than that of the other two. *The fourth one* also has two heads; the outer one, by far the larger, arises from about an inch of the ulnar surface of the Flexor Profundus tendon to the Ring Finger, and the inner from about one-fourth of an inch of the radial surface of that to the little finger. A few fibres also spring from the inter-tendinous fascia.

The bellies of the muscles as they lie in the palm are flacid and wrinkled, owing to the fact that they are a little longer than the spaces included between their origins and attachments. Every one of them runs downward along the radial side of that tendon of the Flexor Profundus which corresponds to the finger into which the Lumbrical is inserted; and, a short distance from the head of the metacarpal bone, ends in a rounded tendon. This runs beneath the Transverse Ligament which binds together the heads of the metacarpal bones (excepting that of the first one, there being no ligament here) and joins the tendon of the Interosseus, which runs above the ligament, at the side of the metacarpo-phalangeal joint. The tendon of the first Lumbrical is the largest and strongest; it joins that portion of the tendon of the first Dorsal Interosseus which is attached to the bases of the second and third phalanges and which expands into the delicate aponeurosis; indeed it constitutes the greater portion of this, the Interosseus being mainly inserted into the antero-lateral surface of the base of the first phalanx and sending but few filaments to the other attachments, as already described; the Lumbrical might be said to form this tendon and to be reinforced by some fibres from the first Dorsal Interosseus (see Fig. 8, Nos. 2 and 3). The tendons of the three inner Lumbricals join, respectively, the tendons of the second Dorsal Interosseus, and the second and the third Palmar Interossei;* they form integral portions of them, and consequently are inserted into the bases of the second and third phalanges, and into the Common Extensor tendon along the dorsal surface of the first phalanx; a few of their fibres also run over and join the corresponding expansion on the other side of the finger.

Varieties. I have never seen the first Lumbrical varying either as to origin or insertion. *The third one* is the most subject to variation; not infrequently its tendon is divided, one portion, the larger one, joining the second Palmar Interosseus, and the smaller, the Third Dorsal, while in rare cases the larger

*That which joins the Second Dorsal Interosseus has no insertion into the base of the first phalanx, but is disposed in the same manner as the First Lumbrical. The other two, which join the tendons of the two inner Palmar Interossei, necessarily have no such attachments, as the Interossei themselves have no insertions here.

division proceeds to the latter ; very rarely both heads arise, at different levels, solely from the flexor tendon to the Ring Finger ; occasionally the one which springs from the tendon to the middle finger is of equal size with the other. The *fourth one*, in rare instances, has an attachment, but very slight, to the side of the base of the first phalanx ; its tendon is sometimes divided, one portion going to the inner side of the Ring Finger, the other to the outer side of the little one, this seldom happens. The *second one* sometimes has a double origin, the extra head coming from the inner side of the Flexor tendon to the Index Finger.

Function. The Lumbricals extend the two last phalanges, at the same time flexing the first one on the metacarpal bone and drawing the whole finger to the *radial* side of the hand.

Opposition or apposition of the Thumb to the other fingers is *par excellence*, the movement which makes the hand so useful a member. Now, when the Thumb is brought toward another finger the latter moves to meet it, and in so doing it executes the motions just mentioned, that is, the finger is flexed as a straight rod on the metacarpal bone and drawn to the radial side of the hand. I believe it is the especial function of a Lumbrical to facilitate this act of opposition, by aiding an Interosseus in the production of the flexion and *radial* duction of the finger. It is well adapted for celerity and dexterity of action, but not for strength of it ; for the reason that its belly is situated on a plane anterior to that of its insertion and that it is longer than the space between its origin and insertion.

Taking this view of the use of these muscles, the fact of their being all situated and inserted on the radial side of the fingers has a meaning. And not only is the muscular tissue so disposed as to give every facility for the accomplishment of the movement of opposition, but the bones also are arranged in such fashion as to aid in its production. If the metacarpo-phalangeal articulation be examined it will be found that its transverse axis is not exactly level or horizontal but that it runs slightly downward toward the outer or radial side of the hand ; hence, when the first phalanx is flexed it will naturally tend to fall slightly toward the Radius.*

I do not mean to say that the Lumbricals are absolutely essential for a complete performance of Opposition, for then the two inner ones would not vary as to their insertions. But I believe that of two hands of which one has the normal and the other the abnormal disposition of one or both of the two inner Lumbricals, the former will be more dexterous than the latter and its possessor will have more manual dexterity than that of the other.

As to the first Lumbrical it cannot be said to assist the Interosseus, the extension of the two last phalanges is due almost entirely to the former, the interosseous muscle having but slight influence over these bones. Hence the first Lumbrical may be said to have a special function.

*The reader will find that radial duction of the finger flexed on the head of the metacarpal bone is much more easily executed than ulnar duction.

DESCRIPTIONS OF ANATOMICAL WRITERS.

While making the dissections, the results of which I have described above, I consulted a number of anatomical works (a list of them will be found on the last page). In examining these I was surprised to find how often and frequently, how widely anatomists differed in their descriptions of parts whose anatomy and uses one would suppose were by this time accurately defined.

In the following pages I will make as brief summary as possible of their descriptions so as to allow comparisons to be made between theirs and mine.

EXTENSOR TENDONS OF THE THUMB.

The later anatomists ignore the attachment of the Extensor Ossis Metacarpi Pollicis to the Trapezium; Sappey, however, says that it "frequently" is inserted here by a tendinous slip. Several of the earlier authors, as Horner, Bell, and Harrison give the double insertion. Luschka and Aeby, of the later ones, give it.

Not an author gives an accurate account of the disposition of the tendon of the Extensor Primi Internodii Pollicis. The later writers confine themselves, in the main, to the statement that it is attached to the posterior surface of the base of the first phalanx. Hyrtl says that the tendon is inserted into the aponeurosis at the dorsum of the Thumb, but does not mention to what bony points it is attached; Langer, that it is inserted into the second phalanx only; Cheselden, that it is attached by a few fibres to the first phalanx, but its chief attachment is to the second phalanx. Bell's description would give the impression that it has no insertion into the first phalanx, but in the summary the first and second phalanges are mentioned as the points of insertion.

All the authors except Bell and Aeby agree that the tendon of the Extensor Secundi Internodii is attached solely to the second phalanx; but they take no pains to carefully trace its fibres and to notice its relations to that of the Extensor Primi. Aeby says that the "tendons of this and the previous muscle fuse together at the thumb and are inserted into the first and second phalanges;" Bell, that the tendon of the Extensor Secundi Internodii "appears split like those of the fingers; it goes along the ulnar side of the first bone of the thumb, reaches the second and is implanted there by a small slip of tendon; and being expanded it still goes forward to be inserted once more into the third bone of the thumb at its root." Both these writers have hit upon anomalous arrangements of the tendon for their descriptions.

The description of the functions of these muscles vary considerably; not a single author giving a description that covers all their uses. The distinction between abduction and extension of the Thumb is not considered, the one being evidently thought to be identical with the other; thus Luschka says that the Extensor Ossis Metacarpi abducts and extends the metacarpal bone, as though abduction and extension could be accomplished in one and the same movement. The slight difference in movements which result from the combined action of the Extensor Primi Internodii with the Extensor Ossis Metacarpi, and that of the Extensor Secundi Internodii with the latter, and that of all three are not noted.

Of the few authors who mention the second insertion of the Extensor Primi Internodii only Luschka considers the muscle to have an extending influence over the second phalanx.

MUSCLES OF THE THUMB.

The descriptions vary greatly as to these muscles. One reason of this is that the writers differ in their divisions of the muscular tissue about the Thumb. Thus one will include a portion of the outer head of the Flexor Brevis, as I

have described it, in the Abductor; another, the whole of the outer head; and another will ascribe to the Adductor a part of the inner head of the same muscle, and so on. The greater number, however, make the same divisions of the tissue as I have made.

But of those who agree as to what muscular fibres constitute the Abductor, what the Flexor Brevis, etc., all do not describe the same points of origin or the same manner of insertion of these fibres; strangely enough there is considerable difference in their descriptions.

Abductor. Origin. I have counted as many as ten different ways of describing the origin of the muscle. The most common mode is to say that it springs from the Trapezium and Annular Ligament. Now, those authors who include a portion of the outer head of the Flexor Brevis in the Abductor are right in mentioning the Trapezium as affording an origin; but those, and they are in the majority, who ascribe to the muscle such amount of tissue as I have done, are wrong in so doing; the Abductor so constituted has no attachment to this bone, as can readily be determined by dividing its belly across at its middle and turning back the upper half; it will be found that this can easily be separated from the bone without any injury to its substance. Hyrtl, Leidy, and Aeby are the only writers who confine the origin to the Annular Ligament.

A few include the Scaphoid bone as a point of origin; but none, the sheath of the Flexor Carpi Radialis, through which the muscle indirectly has attachment to the Scaphoid.

The origin from the tendon of the Extensor Osis Metacarpi Pollicis is frequently referred to; by some being considered as normal.

Insertion. Nearly all the writers describe but a single insertion; which is variously stated to be into the first phalanx, the radial side of this bone, the radial side of the base of it, the base of it, or partly into the base and partly into the External Sesamoid bone or entirely into the latter. A few, besides giving one of the above insertions, say that the tendon joins the extensor tendon at the dorsum of the Thumb; they are Cloquet, Sappey, Horner, Aeby, Luschka, and Henle. None of them, however, trace the tendinous filaments farther than the Extensor tendon, evidently considering this their final destination.

Harrison is more exact, he says that "the Abductor is inserted by an expansion into the back of both phalanges;" but he is wrong as to the attachment to the first phalanx, it is to the outer surface of it and not to its back, and not by an expansion.

Bell says that "the tendon bends gradually around the thumb, and is at last inserted into the back of the first joint, just above the head of the metacarpal bone. But it does not stop here, for this flat tendon is now expanded into the form of a fascia, which surrounding the first bone of the thumb* goes forward upon its back part, quite to the end, along with the common extensor tendon." Meyer, in one portion of his work, describes the muscle as attached solely to the first phalanx, but in another portion, under the heading of "the Ab-and-Ad-ductors and the Interossei" he ascribes to it the same insertions as an Interosseus muscle has, forgetting that the Thumb has only two phalanges. Langer does the same.

Function. Nearly all describe abduction or the drawing away of the Thumb from the other fingers as the office of the muscle. Besides abducting, Meckel says it may extend the Thumb a little; while on the other hand Ellis says it may assist slightly the short flexor of the Thumb in bending the metacarpo-phalangeal joint. Bell says it can extend the first phalanx on the metacarpal bone as well as abduct. Langer and Meyer consider its uses as identical with those of the Interossei. But, as before stated, they forget that

*The metacarpal bone.

the Thumb has only two phalanges. Moreover, it does not flex the first phalanx.

Cruveilhier distinctly asserts that the muscle "is an Adductor and not an Abductor," it "draws the Thumb forward and inward." Cloquet says that it draws the Thumb forward and *outward*; and Quain, simply forward. Quain comes nearest, I think, to a true description.

The muscle, by no means, has an *adducting* power.

Sappey denies that the muscle is anything but an Abductor in the true sense of the word. He says, "authors have declared that this muscle carries the first metacarpal bone and the thumb outward and a little forward. Duchenne, however, considers that it carries the one and the other forward and inward. It will thus be an adductor and not an abductor; an opinion which appears to me erroneous. This observer constantly supposes, in his electro-physiological experiments, that all the muscles can act singly; now I cannot too often repeat that though some can, indeed, act singly, there are many which are grouped together physiologically, and whose actions are simultaneous; when it is not the result of the isolated contraction of this or that muscle which is to be taken into consideration, but the effect of their combined action; and this applies to the present case. Two muscles are necessary for the movement of abduction, the long* and short abductors; apply the pulp of the finger over these muscles at the moment when this movement occurs, you will ascertain that they become hard in contraction, that they both act at the same time; attempt to make one act singly, as can readily be done by means of electricity, and you will not succeed. I persist then in maintaining with the greater number of anatomists, that the abductors do really carry the thumb outwards, and merit the names which have been given them." This is an erroneous assertion. A muscle may act in conjunction with another in the performance of a certain movement, but it is not necessary, because of this simultaneous action, that the one should assist the other in the performance of the entire movement; indeed it may, to a certain extent, interfere with the main purpose of the act, as in this case. The Abductor Pollicis does act slightly in conjunction with the Extensor Ossis Metacarpi, but not to aid it in abducting the Thumb, but simply to assist in keeping the phalanges extended. It interferes with the movement of abduction proper; not seriously, however, as the Extensor is so much the more powerful muscle. As Sappey asserts, in the movement which he describes the belly of the Abductor does become hard; this is partly due, however, to the stretching which it undergoes when the Thumb is drawn from the other fingers, and partly to slight contraction. This hardness is not to be compared though, to that which the muscle assumes when the movements which I have ascribed to it take place, movements which would tend to relax the muscular fibres were they not in vital contraction.

Again, can it be possible, as this author asserts, that a muscle, whose action, if it could be isolated, would produce a movement in one direction, will, when acting in physiological conjunction with another muscle, *directly* assist in the production of a precisely contrary one?

Of those authors who mention the aponeurotic expansion of the tendon, only Langer and Meyer appear to consider that it has any use; they ascribe to it the same functions as the interosseal aponeurosis has.

Flexor Brevis. The descriptions of this muscle vary more than those of any other muscle of the hand; there are hardly two authors who describe it, in its origin and disposition of bellies, exactly alike.

Gray, Harrison, Bichat, Cloquet, Coste, Holden, Quain, Wilson, Bell, Hyrtl, Heath, Horner, Wistar, and Aeby describe the muscle as consisting of two portions or heads of origin. But of these, only Quain and Wilson give

*The Extensor Ossis Metacarpi Pollicis and the Abductor Pollicis. (W)

the formation of the outer head as I have done, viz: by the fusion of two muscular bundles, the inner one being an off-shoot from the inner head.

Holden, Harrison, Hyrtl, Morton, Bell, Heath, Horner, and Wistar seem to consider the two heads to be entirely distinct, from origin to insertion; which arrangement is occasionally to be found as an anomaly.

The rest describe the two heads as uniting into a single mass which subsequently splits into an inner and outer belly; this disposition can be obtained in any subject by an incomplete dissection. Of these authors, Ellis says that the "muscle consists of two pieces (inner and outer) at the insertion, but these are united at the origin." He evidently has hit upon a subject for his description in which there was, as not infrequently happens, a continuous origin from the Trapezium across to the Os Magnum. The others limit the Flexor to different portions of the muscular tissue which I have described as the Flexor; thus, Sappey considers only the outer head as I have described it as constituting the complete muscle, the rest of the muscular tissue he gives to the Adductor. Consequently these descriptions differ greatly from mine.

I should except Langer, however, who refuses to recognize the Flexor at all as a distinct muscle. He asserts that it is a mass of "flesh capable only of artificial definition." But if this is true of the Flexor, so also is it then of the Opponents, and yet he considers this an independent muscle. I have found no more difficulty in defining the Flexor than in defining any other muscle about the Thumb.

Henle says that it "cannot accurately be defined what fibres belong to the abductor, what to the flexor and what to the adductor, because the ab- and the ad-ductor flex as well as perform their peculiar functions, and the flexor may ab-or ad-duct as well as flex."* I do not believe this; the fact that the muscular mass about the Thumb is differentiated into distinct bundles having separate insertions is, I think, proof that each one of the muscles has a special function, which it performs by acting as a whole, and that one set of fibres cannot act independently of others included in the same muscular bundle. If a portion of one bundle could act independently of the rest of it to produce a movement which the bundle next to it is capable of performing, why should there be any division at all of the flesh?

With regard to the points of origin of the muscle there is a great diversity in the descriptions, even of those who agree as to what particular portion of tissue constitutes the Flexor. There is not a single writer of those who include in the muscle the same tissue as I do who gives all the origins.

The Scaphoid, Cuneiform and Unciform have been mentioned as points of attachment. I have never seen any muscular fibres which have insertion into the Thumb arise from the two latter bones. Those writers who mention the Scaphoid possibly include in the Flexor some fibres of the Abductor which indirectly arise from this bone.

Insertion. The descriptions of course vary according as the writers consider this or that muscular mass to form the Flexor. Those who designate two bellies or heads say that one is inserted into the outer and the other into the inner side of the first phalanx, or the base of it, or into the outer and inner sesamoid bones, or partly into the latter and partly into the two sides of the phalanx. Not a single one mentions the aponeurotic expansion of the inner head.

Function. Flexion of the first phalanx and of the metacarpal bone is the function usually given to the muscle; but nothing is said with regard to its action in combination with the other muscles of the Thumb. Theile, however, says that it "above all aids the Opponents." Flexion and a forward and

*The author, nevertheless, describes the Flexor as a distinct muscle. The inner division of the outer head, as I have described it (Fig. 2, No. 3) he considers the Flexor proper.

inward movement of the Thumb is described by a few. But simple flexion of the Thumb necessitates the latter movement because of the peculiar relation which this finger holds to the palm. Cruveilhier says that it opposes and adducts the Thumb, it does not flex; and Sappey, that it carries the Thumb forward and inward, at the same time causing the metacarpal bone to rotate on its axis. These two authors, it will be remembered, only consider the outer head as forming the Flexor. But allowing that this muscular mass could act entirely independently of the other—the inner head as described by me—it would not rotate the metacarpal bone, nor would it produce opposition of the Thumb.

Quain says that "when the thumb is opposed to the other fingers, the metacarpal bone is drawn forwards chiefly by the Opponens, the adductor and flexor brevis"; so that he recognizes that opposition is not the result of the action of a single muscle; but he does not inform the reader as to the particular duty of each muscle concerned in the act. He is in error in mentioning the Adductor as an agent in the movement, he should substitute the Abductor for it.

Luschka says "it assists the Abductor, and with the simultaneous contraction of the so called outer head and Abductor, assists in the flexion of the thumb." He considers the inner division of the outer head the Flexor, but this bundle could not assist the Abductor in performing its peculiar functions.

Adductor. Origin. I have counted sixteen different descriptions of the manner of origin of the Adductor. As has been previously stated, some of the authors include a portion of the inner head of the Flexor in this muscle, consequently their descriptions should differ from those of the authors who limit the origin to the metacarpal bone of the middle finger. But the latter (they constitute a large majority) differ very much among themselves as to the extent of surface from which the muscle has origin. This, I believe, is in great part due to the fact that the muscle not infrequently varies in this respect; and I have found as anomalies several of the dispositions given by them as normal ones.

Now there are some writers who though they contract the volume of the Flexor Brevis at its inner part, yet do not correspondingly increase that of the Adductor; consequently there is a considerable number of muscular fibres left between the two muscles. But these they completely ignore, for they do not describe them as a separate muscle nor do they give them to any adjacent muscular belly. Thus Von-Behr includes in the Flexor only the outer portion of the outer head, and yet he describes the Adductor as arising only from the metacarpal bone of the middle finger and from the Trapezium, all the intermediate tissue he makes no account of; Luschka includes in it only the inner portion of the outer head, but ascribes no origin from the Carpus to the Adductor; Meckel, the whole of the outer head, and yet says that the Adductor arises only from the metacarpal bone of the middle finger and from the Os Magnum.

Henle considers the inner division of the outer head to form the Flexor; the Adductor he describes as arising only from the metacarpal bone of the middle finger; and the intervening tissue he names the First Palmar Interosseous muscle, counting four of these instead of three.

Meyer describes the Adductor as arising by an additional head "not always present, coming from the ulnar side of the upper part of the metacarpal bone of the thumb." This bundle of fibres properly belongs to the inner head of the Flexor as I have described it. Meyer, and Henle who considers this bundle a part of what he calls the first Palmar Interosseus muscle, are the only authors who recognize the origin of muscular fibres from the metacarpal bone of the Thumb.

Henle's first Palmar Interosseus can only be produced by the most arbitrary dissection; there is no natural definition of such a muscle.

Insertion. It is described as into the base of the first phalanx, or the inner side of the base with the Flexor Brevis, or the internal sesamoid bone, or the internal sesamoid and the inner side of the base, or the inner side of the edge of the base, or the internal sesamoid and the lateral edge of the Thumb. Morton is the only author who correctly says that the Adductor is inserted into the inner side of the base of the first phalanx above the internal sesamoid; but he does not accurately define the manner of attachment.

Those authors who include portions of the inner head of the Flexor in the Adductor are not incorrect in describing the tendon of the latter as being in relation to the internal sesamoid, but all the rest are wrong. Those muscular fibres which arise from the metacarpal bone of the middle finger, whatever may be the name given them, are inserted into the inner side of the base of the first phalanx clear above the internal sesamoid bone.

Cruveilhier, Sappey and Luschka mention a tendinous expansion, which, they say, proceeds from the tendon of the Adductor to be attached to the extensor aponeurosis of the Thumb. Bichat and Cloquet say that it *often* is present. Langer describes the Adductor in common with the Interosseous muscles, so it is to be inferred that he recognizes the expansion also. According to their definitions of the Flexor Brevis and the Adductor, Cloquet and Luschka should have described the aponeurosis in connection with the former and not the latter; the others may be correct as they include in the Adductor portions of the Flexor.

Function. The majority of the writers describe it as a simple drawing of the Thumb toward the other fingers. But this does not give an idea of the exact movement which the muscle executes. Cruveilhier is the only author who accurately defines its action; he says that "it draws the thumb toward the middle line of the hand as represented by the middle finger." But this author should mention flexion of the first phalanx as one of the primary uses of the muscle, as he includes a large portion of the Flexor Brevis in it.

Meckel erroneously says that "it also rotates the metacarpal bone on its axis".

Langer considers its uses in common with those of the Interossei. He seems to be the only author of those who describe an aponeurotic expansion of tendon that thinks it has any use.

Meyer includes a portion of the Flexor Brevis' function.

Opponens. Origin. All describe it as from the Trapezium and Volar Ligament, except Bichat who says the muscle has an additional origin from the *inter-muscular* fascia, and Paxton who mentions the Scaphoid bone as well as the other two points. I have never seen the inter-muscular fascia sufficiently well-developed to afford any attachment to muscular fibres; nor have I ever seen any portion of the Opponens taking origin from the Scaphoid.

Insertion. There is not a single description which accurately defines the manner of attachment of the fibres to the metacarpal bone and their arrangement previous to insertion. Sappey's is the most careful one, but it is incorrect in that it makes the attachment to the anterior surface of the metacarpal bone equal throughout. He says the fleshy fibres "run obliquely downward; the lower ones being longer and more vertical, the upper ones shorter and more horizontal; they constitute, in their entirety, a small radiated muscle, very thick, which attaches itself to the *external half* of the anterior surface of the first metacarpal bone throughout its whole extent."

Theile, curiously, says the insertion is into the first phalanx.

Function. The opinion seems general that the Opponens alone accomplishes the opposition of the Thumb to the other fingers. Quain says that "it carries the metacarpal bone forward in conjunction with the Flexor Brevis and Adductor;" and Langer, "that it hollows out the palm of the hand in conjunction

with the corresponding muscle of the little finger; the *Adductor* is the true "confronter."

Meyer says it flexes the first phalanx as well as opposes the Thumb. In what way it flexes the phalanx he does not explain; he does not describe any insertion into this bone. Theile, who does describe such an insertion, should be the one to include flexion of the phalanx, but he does not.

MUSCLES OF THE LITTLE FINGER.

Abductor. Origin. About one-third of the writers describe it as from the Pisiform bone only; another third, about, from the Pisiform and Volar (Annular) Ligament; and an equal number, from the Volar Ligament and a tendinous expansion of the Flexor Carpi Ulnaris.

It cannot be said that this muscle arises directly from the tendon of the Flexor Carpi Ulnaris; its fibres are directly attached to the lower part of the Pisiform bone, while the tendon of the latter is indirectly inserted into the upper portion of the same. Practically, as already explained, it does arise from this tendon. Of the authors who describe this origin from the tendon not one seems cognizant of the fact that the Flexor Carpi Ulnaris must contract simultaneously with the Abductor in order to afford the latter a "point d'appui". Velpeau,* in his surgical anatomy, recognizes this.

Those authors who mention the Volar Ligament as a point of origin have taken for their descriptions the arrangement, which frequently occurs, in which a portion of the Flexor Brevis Minimi Digiti is incorporated in the Abductor; but then they should have also mentioned the Unciform bone.

Bell says it has an origin from the fifth metacarpal bone. I have never seen this.

Insertion. The descriptions are about equally divided between two arrangements; the one being an insertion into the base, or the inner side of the base of the first phalanx; the other, into this point and into the extensor tendon of the finger by means of a tendinous expansion. But Langer is the only writer who traces the fibres of the expansion beyond the tendon of the common extensor of the finger to their final destination, namely, the bases of the second and third phalanges. He includes the Abductor in his description of the Interosseous muscles.

Function. Simple abduction of the little finger is usually described. Flexion of the finger is added by a few authors. All those who include portions of the Flexor in the Abductor should certainly mention flexion as a part of the function of the muscle, but only a few do.

Langer is the only writer who attributes any use to the aponeurotic expansion of the tendon. He considers the Abductor to have the same functions as an Interosseus. And Meyer and Cheselden do also, though they ascribe to the muscle but a single insertion, into the base of the first phalanx.

Flexor Brevis. Origin. Usually described as from the Unciform or the Unciform process of the Unciform bone and from the Volar (Annular) Ligament. A few authors mention the Unciform bone only. Paxton says it is from the Volar Ligament and the Cuneiform bone; Sappey, from the Unciform bone and a fibrous arch which extends from the Unciform to the Pisiform.

I have never seen an origin from the Cuneiform bone direct. The arrangement Sappey gives is to be found as an anomaly.

Drake, Cheselden and Langer make no mention of the Flexor Brevis. They evidently considered it a part of the Abductor. Meyer says that it cannot be considered a true, distinct muscle; in some cases it is a portion of the Abductor and sometimes of the Opponens.

*The name of this author appears in the Bibliography solely on this account.

I have never seen such a disposition of the muscular mass about the little finger as that the Flexor might be considered as forming a portion of the Opponens.

The tendency of the muscle to vary is noted by many of the writers; they say it is frequently absent, in which case the Abductor is larger than usual; but they fail to specify whether the latter retains its single origin from the Pisiform or whether it gains additional points of attachment.

Sappey says that the Opponens is much developed when the Flexor is wanting, but this is erroneous; there exists no such relation between these two muscles.

As with the muscles of the Thumb so with those of the little finger, there are a few authors who fail to account for certain portions of muscular tissue; thus Henle and Aeby describe the Abductor as arising from the Pisiform bone and the Flexor from the Unciform, and say nothing of those filaments coming from the Volar Ligament.

Luschka and Cruveilhier make the Flexor a strip of muscular tissue which lies between the two heads of the Abductor; for they say that the latter muscle springs from the Pisiform bone and the Volar Ligament, while the former they describe as taking origin from the Unciform, which is situated between the Pisiform and the Ligament. Such an arrangement I have never witnessed.

Insertion. Various described by the majority of the authors, as into the first phalanx, base of the first phalanx, ulnar side of the phalanx, or ulnar side of the base. Bichat and a few others correctly describe it as into the inner and anterior portion of the base. Henle says "it is attached by a wide surface into the convex side of a tendinous arch which stretches over the Flexor tendons of this finger;" but this is nothing but the loose attachment which the muscle has, at the metacarpo-phalangeal articulation, to the anterior fibro-cartilage and adjacent fascia,—the base of the first phalanx is the true destination of the muscle.

Theile says that some fibres which belong either to the Abductor or to the Flexor are always inserted into the metacarpal bone of the little finger. I have never seen this.

Function. Simple flexion of the first phalanx or flexion of it with abduction of the little finger are usually described; the former, may be, a little more frequently than the latter.

Sappey says that "it flexes the little finger and appears to contract simultaneously with the opponens of which it may be considered a reinforcing fascicle." Now, the Flexor certainly does act in unison with the Opponens in some movements, as in making a hollow of the palm, when it assists by secondary action in flexing the metacarpal bone; but in performing its direct function it bears no relation at all to the Opponens.

Ellis and Meckel ascribe directly opposite movements to the muscle. The former says it flexes and carries the little finger toward the palm; and the latter, that it flexes and carries it away from the same. But Meckel apparently includes some of the Abductor fibres in the Flexor so that he is correct in describing abduction as one of the acts of the latter.

Opponens. Origin. Described by nearly all as from the Unciform bone or Unciform process of it and the Volar Ligament. Von-Behr and Langer erroneously describe the Unciform bone as the sole point of origin; and Henle and Aeby the Pisiform. Sappey says the muscle arises from the Unciform, Volar Ligament and a tendinous arch stretching from the latter to the Pisiform. This latter origin is certainly not a usual one. Paxton mentions the Cuneiform bone as affording an origin; but I have never seen this.

Insertion. Various described as into the metacarpal bone of the little finger; side of the metacarpal bone; ulnar edge of it—the greater number of the writers give this attachment; the outside of the metacarpal bone (Bell); fore-part of the metacarpal for its whole length (Morton); inner side and anterior part of it (Innes); anterior surface of the head and ulnar edge of the body of it (Henle); internal aspect of the body of it (Sappey).

There is not a single writer who gives an accurate description of the manner of arrangement of the muscular fibres as they become attached to the metacarpal bone. Sappey takes more pains than any of the others; he says “the fibres are oblique from above downwards and from without inward, approaching nearer the vertical as they become inferior.” The area of the metacarpal bone which the insertion covers is better described by Henle than by any of the other writers, though he is not quite correct.

Function. Opposition of the little finger to the others, or to the Thumb solely, is most frequently mentioned; the statement being made by some authors that this muscle is to the little finger what the *Opponens Pollicis* is to the Thumb. Now, as far as the production of flexion and rotation on its axis of the metacarpal bone is concerned the one muscle is the direct counterpart of the other; but these movements do not lead to the same results in the two fingers, on account of the different positions which they hold in relation to the hand. Flexion and rotation on its axis of the metacarpal bone of the Thumb brings the pulp of this finger opposite to that of any one of the others, according as the rest of the muscles of the Thumb act. Not so with the little finger; it can be brought into opposition to the Thumb only, and not to any one of the rest of the fingers. But, as has been described, being so far removed from the Thumb, it cannot well reach the latter unless its metacarpal bone moves with the phalanges.

That this movement of the metacarpal bone of the little finger is of considerable importance can be demonstrated in the following manner: fix the fifth metacarpal bone of one hand between the Thumb and Forefinger of the other and then attempt to bring the Thumb in opposition to the little finger. The movement is laborious and results only in the tips of the fingers barely touching each other. Now let the metacarpal bone go loose and firm opposition can at once be accomplished.

This motion of the fifth metacarpal bone can also assist the Ring Finger in becoming opposed to the Thumb. In its flexion it carries the metacarpal bone of the latter slightly forward with it, as can be determined in the same manner as above described.

Many of the writers seem to consider that the muscle's first use is to aid in the hollowing of the palm of the hand. But this is only one of the several movements in which it may assist.

Sappey is the only writer who directly states that flexion and rotation on its axis of the metacarpal bone are the motions which the *Opponens* produces. A few mention flexion of the metacarpal bone but omit its rotation, or the rotation and omit the flexion. But Sappey considers that these movements direct the finger into opposition with the *others*.

INTEROSSEOUS MUSCLES.

In all the illustrations and in all the descriptions of the different anatomists these muscles are represented as having fixed areas of origin from the metacarpal bones. In the former they are shown to be disposed in the most accurately regular manner—a beautiful bi-penniform arrangement of muscular fibres at the dorsum of the hand and a uni-penniform one at the palm. Now of the fifty-three hands which I dissected not one exhibited this regularity of disposition of the interosseal muscles.

INTEROSSEI PALMARES.

Wistar, Horner, Fyfe, Henle, Harrison, Innes, and Shaw count four Palmar Interosseous muscles. The extra Palmar of all these but Henle is the inner head of the first Dorsal Interosseus, as usually reckoned; which they have split off from the outer head in a very arbitrary manner. Henle, as already described, separates some fibres from the inner head of the Flexor Brevis Pollicis and calls them the first Palmar Interosseus. The insertion of the muscle is, according to Henle, into the inner side of the first phalanx of the Thumb; according to the others, into the outer side of the Index Finger.

As to the three other Interossei, the descriptions of these authors do not differ from those of the rest.

Origin. The extent of origin, from a metacarpal bone, of a muscle is not defined by the majority of the writers; as a rule they give the impression that it covers the whole of one side of a bone. Sappey and Von-Behr say that it arises from the anterior two-thirds of it; Bichat, that the two first spring from the anterior two-thirds of the second and fourth metacarpal bones, and the third, from the whole of the external surface of the fifth.

The bases of the metacarpal bones are not mentioned as points of origin except by Wilson; but he says the whole of a muscle arises from the base,—a most erroneous statement.

Insertion. Nearly all the writers describe the insertion as into the base of the first phalanx, or into the Extensor tendon of the finger, or into both. A few say that the muscle is inserted into the first phalanx and joins the Common Extensor by an aponeurotic expansion, or some such process. Bell, Sappey, Cruveilhier and Duchenne are the only ones who seem to consider that the fibres composing this tendinous expansion of the Interosseus have a destination further than the Extensor tendon, that is, they trace the filaments beyond their union with this tendon. The three latter writers say the muscular belly divides into two portions, one of which is attached to the base of the first phalanx and the other joins the Extensor tendon and with it is attached to the bases of the second and third phalanges.* Bell says the tendons "twist around and are inserted with the tendons of the Lumbricals and Extensors into the back of the finger".

Sappey, however, is the only author who traces the filaments with any minuteness. He says "the tendon at the metacarpo-phalangeal joint divides into two portions, one of which is inserted into the base of the first phalanx, the other spreads out and becomes continuous with the Extensor tendon of the finger. The latter is composed of three sets of fibres; those of the first set proceed transversely upward, running over and closely adhering to the extensor tendon, and becomes continuous with corresponding ones on the opposite side; those of the second or middle set are oblique and cover the lateral portions of the same tendon in order to attach themselves posteriorly to the upper extremities of the second phalanges; those of the third are lower fibres which proceed almost vertically onwards, reinforcing the lateral portions of the extensor tendon, and which are inserted posteriorly into the superior extremities of the third phalanges."

The above description is incorrect in the following particulars: a Palmar Interosseus has no attachment to the base of the first phalanx** and therefore its tendon does not divide into two portions; the loose attachment to the anterior fibro-cartilage of the metacarpo-phalangeal articulation is not

*Cruveilhier does not mention the second phalanges, however; he says that "some of the fibres are inserted into the central part of the extensor tendon, while the rest join the lateral divisions of this tendon and are inserted into the third phalanges".

**This description which the author gives refers to a Palmar as well as to a Dorsal Interosseous.

mentioned; the transverse fibres of the tendinous expansion do not all run over to commingle with those of the other side of the finger; the process of filaments starting from the lateral aspect of the distal portion of the first phalanx (Fig. 7, No. 5) and joining those filaments of the interosseal tendon which are inserted into the base of the third phalanx is not described.

Duchenne, in his work, has an illustration which represents the double insertion—one into the base of the first phalanx and the other into the extensor aponeurosis at the dorsum of the finger—of an Interosseous muscle. This has been copied into several anatomical works. Now if the reader will refer to it he will find that it has been sketched from a fourth Dorsal Interosseus, which always has the insertion into the first phalanx by a special tendon. This muscle, then, has been taken by Duchenne as the type of all the Interossei; he evidently believing that Palmar and Dorsal Interosseous muscles are inserted alike.

INTEROSSEI DORSALES.

Wistar, Horner, Innes, Shaw and Bell consider the whole, and Harrison, a part, of the inner head of the first Dorsal to form the first Palmar, as we have seen. The remainder of the muscle is described as a special one of the Index Finger, and they count only three Interossei Dorsales. They say this special muscle arises from the outer surface of the metacarpal bone of the Index Finger and from the Trapezium. But I have never seen this portion of muscular tissue taking origin from the latter point.

The three inner Interossei they describe in the same manner as the other writers do.

Origin. Over one-half of the authors simply refer to the origins as from the opposite surfaces of two contiguous metacarpal bones, not recognizing, evidently, that these attachments are unequal as to extent. Of those who describe unequal origins from the two bones, Gray, Quain, Cruveilhier, Sappey, Coste, Theile, and Bichat say that the larger head comes from that metacarpal which supports the finger upon which the muscle acts; but they are not agreed as to the areas of origin from them. The first Dorsal is separately described by only a few authors. But this Interosseus is never disposed in exactly the same manner as are the others.

The frequently present third head of the second Dorsal is not mentioned by any.

The slight origins from the bases of the metacarpal bones are not described. But Wilson, Wistar, Innes, Horner and Shaw say that the entire muscles arise from the bases—a grievous error.

Luschka and Henle are the only ones who include the deep fascia in the points of origin.

Insertion. The same as that of the Interossei Palmares.

In describing the Palmar and Dorsal Interosseous muscles as inserted alike the authors are doubly in error. In the first place the insertions of the two sets are not alike; and in the second place the Interossei Dorsales are not inserted alike.

Function. The descriptions of the uses of an Interosseus are for the most part very crude and incorrect. Incorrect, in that they only partially describe its function, or else ascribe to it a movement or movements which it is incapable of performing.

Ab- or ad-duction, flexion of the first phalanx and extension of the two last are mentioned by Cheselden, Luschka, Quain, Sappey, Langer, Duchenne, Cruveilhier, Ellis and Meyer.

But of these authors none go into the detail which the subject deserves. Most of them confine themselves to the single statement that such movements are performed by the Interossei.

Meyer's description is the most elaborate. He says that the muscles ab-or ad-duct when the fingers are extended and partially flex the first phalanx. The aponeurotic expansion which joins the Extensor tendon can assist slightly in flexion; the inner part of this aponeurosis at the same time, exercises an extending influence and straightens the finger, so that with the flexion of the first phalanx there is simultaneous extension of the others. As the insertion of the aponeurosis is into the Extensor tendon which is itself inserted into the last phalanx extension of the Interosseus must be performed on the last phalanx by direct traction and on the second by indirect lateral motion.

This description of the mechanism of the several acts performed by an Interosseus is essentially wrong; as is also that of the disposition of the Extensor tendon and of the tendon of the Interosseus.

Duchenne and Langer are the only other writers who describe a mechanism of the movements. The former says that flexion of the first phalanx is performed by the tendon of insertion into the first phalanx, and extension of the two other phalanges, and ab-or ad-duction of the finger by means of the expansion which joins the tendon of the Extensor Communis. The latter, that ab-or ad-duction is performed by the tendon which is attached to the first phalanx, and flexion of the first and extension of the second and third phalanges by means of the aponeurosis. Langer comes nearest to a true description. He recognizes that the attachment to the base of the first phalanx is for lateral motion; but he and the others are wrong in making no distinctions between the several Interossei. Wilson and Hunter* describe flexion of the first and extension of the other phalanges as the functions of the Interossei but omit the lateral movement of the finger.

Bichat says that when the fingers are extended the extension is increased by the Interossei and, on the other hand, when flexed the flexion is increased by them.

LUMBRICAL MUSCLES.

Origin. About one-half the writers simply say that these muscles arise from the deep Flexor tendons. The rest describe the two outer as arising from the radial side of a single tendon of the Flexor Profundus, and the two inner ones, from the opposite surfaces of two contiguous tendons. The areas of origin are rarely given.**

Insertion. I have counted five different descriptions of the insertion. They are as follows: into the tendon of the Extensor Communis; into the tendon of an Interosseous; into the lateral surface of the base of the first phalanx; into the back part of the metacarpo-phalangeal articulation; into the dorsum of the first phalanx.

About two-thirds of the writers give the first named insertion.

Not a single author traces the filaments composing the tendon to their final attachments to the bases of the second and third phalanges.

Function. Sappey, Wilson, Hyrtl, Harrison, Simmons, Quain and Cruveilhier are the only authors who recognize that a Lumbrical is capable of performing flexion of the first and extension of the other phalanges. The rest do not seem to have the least idea of its function.

But of the former Cruveilhier says that the main use of a Lumbrical is to maintain the extensor tendon applied to the phalanx; Harrison, that the

*This author's name appears in the Bibliography solely for his description of the uses of the Interosseous and Lumbrical muscles.

**This is also true with regard to the other muscles of the hand. Rarely does an author take the trouble to give the extent of surface which a muscle covers at any point of origin.

muscle can only flex the first phalanx when the flexors are tense, and extend the others when the Common Extensor is in action; Wilson, that it is only an accessory to the deep Flexor. All erroneous statements.

Sappey and Wilson are the only ones who consider the mechanism of the action of a Lumbrical. The former says that "these muscles produce the movements of extension by a mechanism without parallel in the human body; on one hand by applying themselves to the lateral portion of the tendon of the Extensor in order to act directly on the second and third phalanges; on the other by loosening, that is, by relaxing the flexor tendons." (Now, the mechanism of the action of the Lumbrical is identical with that of an Interosseus muscle which has no attachment to the first phalanx; it influences the second and third phalanges by virtue of its direct insertion into these bones. What special virtue there is in relaxing the flexor tendons and how this is accomplished by a Lumbrical I cannot understand.) The latter says that the Lumbrical has the double power of flexion of the first and extension of the other phalanges "in consequence of being inserted partly into the bases of the first phalanges and partly into the expansion of the extensor tendons".

But, as I have shown, a Lumbrical has no attachment to the first phalanx; it flexes the first phalanx not by virtue of an attachment to its base, but because of its tendon being anterior to the transverse axis of the metacarpophalangeal joint.

What I believe to be the peculiar use of the Lumbrical, namely, to aid the Interosseous muscle in bringing a finger to the Thumb when opposition is made, I do not find mentioned by any writer.

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39

413

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