XV.—*On Variability in Human Structure, with Illustrations, from the Flexor Muscles of the Fingers and Toes.* By Wm. Turner, M.B. (Lond.), F.R.S.E., Senior Demonstrator of Anatomy in the University of Edinburgh.

(Read 19th December 1864.)

Deviations from the usually described arrangements of the parts, of which the human body is composed, have from time to time attracted the attention of the anthropotomist. In many anatomical text-books, as well as in sundry memoirs specially devoted to the subject, numerous examples of such variations have now been recorded. To the scientific anatomist these have always had a certain value, but of late years this department of anatomical inquiry, more especially in connection with variations in the muscular system, has had additional importance and interest attached to it, on account of the attention which has been directed to the correspondence, or want of correspondence, in the muscular arrangements in man and the other mammalia, more particularly the apes.

Into this aspect of the question it is not my intention to enter in this communication. My object on this occasion is rather to compare certain structures in one human body with corresponding structures in others, and to point out the extent of variability which may occur in similar parts in different individuals.

Every one is conscious that of the multitude of individuals he may meet with in the course of a day's experience, no two are alike. Leaving altogether out of consideration all mental differences, each possesses some peculiarity of form and gait which enables him at once to be distinguished from those around him, and that these external manifestations of variability are in their prominent features correlated with internal structural differences will, I suppose, be generally admitted. That diversities in the shape of the skull, for example, occasion corresponding diversities in the form of the head and face, so as to impart to them characters diagnostic not only of the race, but of the individual, have been recognised from the time of Blumenbach and Camper. But the osseous is not the only organic system in which distinct evidence of structural variability may be traced; the muscular, vascular, nervous, and visceral systems all exhibit it. In some cases, undoubtedly, the departure from what may be termed the standard method of arrangement, as set forth by descriptive writers, is greater than in others, but evidence of its existence to a greater or less degree in every individual may be obtained not only by the examination of the systems taken as a whole, but of the separate structures of which they are composed. But though some of the best marked examples of internal structural variations are cor-

related with corresponding variations in the external configuration of the body, yet there are a large number which, either from their minuteness, or from being situated in the deeper seated parts, give no sign externally, and to distinguish them requires close and careful dissection. For many years I have been in the habit of preserving a record of the most remarkable "irregularities," as they are often called, which have come under my notice; and I could cite many cases from my note-book in which, in the course of dissection, variations in the different organic systems were noted. During the present winter session, for example, four arms have been met with in which that very curious process of bone, known as the supra-condyloid process, projected from the inner part of the shaft of the humerus. In all, this process was connected to the inner condyle by a ligament. The process, the ligament, and the shaft of the humerus, covered by the brachialis anticus muscle, formed collectively the boundaries of a supra-condyloid foramen. In all the median nerve went through the foramen. So far these limbs, though varying greatly from the usual arrangement of parts in the human upper arm, corresponded closely with each other, but in other respects they differed considerably amongst themselves. In three specimens the pronator radii teres muscle arose from the process and the ligament connecting it to the condyle; in the fourth the pronator muscle did not arise from these structures, but the ligament gave origin to some of the fibres of the brachialis anticus muscle. In one specimen the brachial artery, after giving off an accessory radial artery high up in the limb, accompanied the median nerve through the supra-condyloid foramen; in another the brachial artery, after giving off its ulnar branch of bifurcation high up in the limb, also passed along with the median nerve behind the process; in the third, the brachial artery pursued its usual course along the inner margin of the biceps to the bend of the elbow previous to its bifurcation, and sent simply a small branch through the foramen along with the median nerve; in the fourth not only was the brachial artery not deflected from its customary course, but it did not even send a small branch through the foramen, through which, consequently, the median nerve proceeded unaccompanied by any vessel.* In three of the specimens, also, a muscular slip arose along with the

* The four cases described in the text of the occurrence of a supra-condyloid foramen in the human upper arm are not the only specimens which have come under my notice in the dissecting-room. In former years I had observed five specimens, in three of which both brachial artery and median nerve passed through the foramen, in the remaining two I had unfortunately not preserved a note of the arrangement. But by far the most complete account of the anatomy of the supra-condyloid foramen which has yet appeared has been drawn up by Professor WENZEL GRUBER in an elaborate memoir presented to the Imperial Academy of St Petersburg. Vol. viii. 1859. This anatomist has collected from the works of previous writers, as well as from material which has come under his own observation, sixty-two cases in which this foramen was noticed in the human body, and in which there was at the same time a greater or less amount of variation in the arrangement of the pronator teres, the median nerve, the brachial artery or some of its branches. One of the chief features of interest connected with the supra-condyloid foramen is the circumstance that it furnishes, as an occasional occurrence in human structure, an approximation to an arrangement

flexor sublimis digitorum from the coronoid process of the ulna. This slip terminated on a tendon, which in one specimen became blended with the tendon of the flexor profundus passing to the middle finger; in another with the tendon of the same muscle going to the ring finger; and in the third with the tendon going to the little finger. In the fourth specimen the flexor sublimis was not connected to the flexor profundus by any intercommunicating structures. In one specimen the middle, ring, and little finger tendons of the flexor profundus were connected together by a network of intertendinous bands; in another such bands only connected the middle and ring finger tendons of that muscle; in the remainder these structures were absent. In one of the specimens the abductor pollicis received a distinct slip of origin from the styloid process of the radius, whilst in another the abductor minimi digiti received a slender muscular slip, which arose in the lower part of the forearm from an accessory palmaris longus tendon.

It would be quite possible for me to multiply examples to serve as additional illustrations of variations occurring in several of the most important organic systems in the same body,—variations so well marked, indeed, that though, as in the cases above cited, it is probable no outward evidence of their existence was manifested, yet they furnished the individuals in whom they occurred with characters as distinctive as any peculiarities of external configuration. Hence we may conclude that in the development of each individual a morphological

which is very frequently met with in some of the Mammalia. For there has now been recorded a considerable number of instances in which a distinct canal, generally with bony walls, existed in this locality in various Quadrumana, in Galeopithecus, in the Edentata and Monotremata, in many Carnivora, Marsupialia, Rodentia, and in some of the Pinnepedia; whilst it would appear to be absent in the Ruminantia, Solidungula, Multungula, and Cetacea. But though the canal would seem to occur almost constantly in all the genera of some orders and families of the Mammalia, yet it by no means follows that in other orders and families, though it may occur in one genus, that it exists in all, or even though it may occur in one species of a genus, that all the species of the same genus should possess it. Thus, as Professor OWEN has shown (Article *Marsupialia* in "Cyclopædia of Anatomy and Physiology"), whilst it exists generally amongst the Marsupialia, yet it is absent in Dasyurus and Thylacinus; and though most of the species of Phalangista possess it, yet it does not exist in *Phalangista Cookii;* and whilst GRUBER saw it in *Erinaceus auritus*, he did not find it, and I have not seen it, in *Erinaceus europæus*. In the Pinnepedia also it has been described by various anatomists as present in the *Phoca vitulina*, and GRUBER has seen it in other species of the same genus. In a common seal which I dissected, I found that it only transmitted the median nerve, neither the brachial artery, nor any of its branches passed through it; in the Walrus (Trichechus), however, anatomists agree in stating that it does not occur, a fact which I have observed in three skeletons of that animal which have come under my observation. Again, in some of the Mammalia variations in its occurrence take place in individuals of the same species, a circumstance which has been noticed not unfrequently amongst the Quadrumana, though it has not as yet been seen, I believe, in the humeri of any of the Anthropoid Apes. Thus, whilst TIEDEMANN describes it as present in *Cercopithecus sabæus* and *Cercocebus fuliginosus*, MECKEL and OTTO state that it is wanting in those species; a discrepancy of statement which may probably be explained by regarding the arrangement as a variety present in one individual but absent in another. Of the skeletons of the Quadrumana personally examined, I have found the foramen absent in two specimens of the Orang, in a Chimpanzee, in two specimens of the Gibbon, in *Cercocebus fuliginosus* (agreeing thus with MECKEL and OTTO), in *Macacus cynomolgus*, in *Cynocephalus maimon*, *Hapale jacchus*, and *Ateles paniscus;* whilst I have found it present in a species of Cebus, and in the prosimian *Stenops tardigradus*.

specialisation occurs both in internal structure and external form, by which distinctive characters are conferred, so that each man's structural individuality is an expression of the sum of the individual variations of all the constituent parts of his frame.

But it is not essential that, for the demonstration of this specialisation of structure in the individual, we should extend our inquiries over all the organic systems. Any one, if carefully examined, will afford us sufficient evidence of its existence. The muscular system is the one I have especially selected for illustration. There are some parts of this system in which, from the mode of arrangement of single muscles, and from the manner in which they are collected into groups, we are enabled to study more precisely than in other localities the extent of variation which is permitted, and the various forms which it assumes. None are better fitted for this purpose than the flexor muscles of the fingers and toes; for not only can we define with great exactness the arrangement of these muscles and their tendons, but we can employ in connection with them a method of description precise enough to convey a conception, not only of the stronger and best marked varieties, but of the more minute deviations from their usually recognised disposition. During the past twelve months, I have made a series of special dissections of these groups of muscles, and I shall now record the general results which I have arrived at in the examination of these parts. It must be understood that all the dissections were made on the bodies of the inhabitants of these islands, natives of either Great Britain or Ireland.

The flexor muscles in the forearm and hand, to which my attention has especially been directed are the flexor longus pollicis, the flexor sublimis digitorum, the flexor profundus digitorum, and the lumbricales. The long flexor muscles exhibited numerous variations in their bulk, in the extent of their attachment to the bones of the forearm (the extent of the radial origin of the superficial flexor was especially variable), and to the interosseous or other fibrous membranes from which they arose. The superficial and deep flexors of the fingers also varied as to the mode in which they divided into their terminal bundles; in some cases the division took place lower down in the forearm than in others. This was especially the case with the deep flexor, in which it was not unfrequent to see the separation between the more internal of its terminal tendons still incomplete at the carpal end of the forearm, or beneath the annular ligament. In one specimen in my possession, the muscle divided into five bundles, two of which afterwards united to form the tendon for the ring finger.* But, in addition, other variations were met with of a more remarkable

* Multiplication of the bundles of this muscle has been recognised by Arnold, Henle (Muskellehre, p. 196, 1858), and Theile (Traité de Myologie), 1843, p. 246. Theile also states that it sometimes receives a special head of origin from the inner condyle of the humerus; and Theile, Hallett (Ed. Med. and Surg. Journ. vol. lxxii. p. 12), and Henle state that it sometimes receives fibres from the radius.

character. A more clear conception of their nature may perhaps be formed if we conceive the long flexors of the digits as composed of muscles situated on two planes, a superficial and a deep, and then bear in mind that both sets of muscles are subdivided into bundles, each of which terminates in a tendon possessing a distinct attachment to its proper digit. Now, between the different subdivisions of the muscle or muscles, situated on the same plane, and between the muscles situated on different planes, tendinous or musculo-tendinous bands not unfrequently proceed so as to connect them together. Thus, whilst it is customary to consider the flexor sublimis as dividing into four distinct bundles, each ending in a tendon, I not unfrequently saw a tendinous or musculo-tendinous slip proceed between adjacent bundles, and keep up a lateral communication between the divisions of the muscular mass situated on the same superficial plane. In a similar manner, the divisions of the muscular mass situated on the deeper plane were not unfrequently connected together by lateral bands. In the flexor profundus digitorum these lateral connecting bands presented various arrangements in different individuals. Sometimes the three inner tendons were closely tied together in the forearm, either by simple bands passing from one to the other, or by a more complicated reticular structure. At others only the two inner tendons; at others again the tendons for the middle and ring fingers were intimately connected (fig. 1), whilst the little and index tendons were quite free. As a rule, indeed, the index tendon appeared to be less liable to form a connection with the tendon of the same muscle than was the case with the other subdivisions of the flexor profundus. But on the other hand, I saw several specimens in which the index division of the deep flexor was intimately connected to the flexor longus pollicis,* a junction of considerable interest, as it approximates in their arrangement these muscles in the forearm and hand with the flexor hallucis and flexor communis digitorum in the foot. The nature of this union varied considerably in different specimens. In some it consisted of a muscular bundle, passing obliquely downwards from the fleshy part of the flexor of the thumb to the fleshy part of the index division of the deep flexor; in others it consisted of a musculo-tendinous slip proceeding obliquely downwards from the muscular part of the former to the tendon of the latter (fig. 1); and in some of these

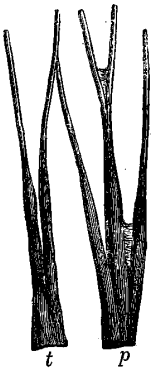

Fig. 1.†

* Various anatomists have recognised the occasional connection of these tendons, without, however, specialising its different forms. See THEILE, p. 246; M'WHINNIE, Lond. Med. Gaz., vol. xxxvii. p. 191; HENLE, p. 196; WOOD, Proc. Roy. Soc. of London, p. 301, 1864. I am disposed to regard the connection in one or other of its forms as more common than is usually supposed.

† Fig. 1, *t*, flexor longus pollicis; *p*, flexor profundus digitorum. It shows the connection of the index tendon of the latter muscle with a strong musculo-tendinous band from the former, also the close union for some distance of the middle and ring-finger tendons of the deep flexor. This, and the other illustrative figures, have been drawn from the dried preparations of my dissections by my pupil, Mr RICHARD CATON.

cases the connecting slip was in great measure, though not altogether, formed of the fibres of the rounded head of the flexor longus pollicis, which arose from the coronoid process of the ulna. In one case the connecting slip received almost one-half the fibres of the long flexor muscle, a specimen which illustrates how large and important this intermuscular tendon may at times become. In one very remarkable specimen the bond of union passed in the opposite direction from those above described—viz., from the index tendon of the flexor profundus to the tendon of the flexor longus pollicis (fig. 2).

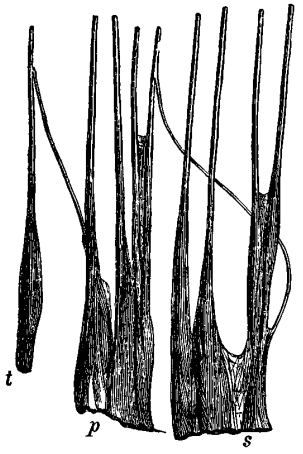

Fig. 2.*

Amongst the intermuscular structures which not unfrequently connect together the superficial and deep flexor muscles of the forearm, I am disposed to place that rounded musculo-tendinous band, which is so often met with, as a second head of origin of the flexor longus pollicis, for it arises along with the flexor sublimis from the coronoid process of the ulna, and ends inferiorly in the inner part of the long flexor of the thumb. But the superficial is also not unfrequently connected to the deep flexor of the fingers by intermuscular bands. For I have frequently seen a slip of muscle arise from the coronoid process, along with, and apparently forming a part of, the flexor sublimis, which, after it became tendinous, blended in five specimens with the tendon of the flexor profundus going to the little finger (*e.g.* fig. 2), in one with the tendon passing to the ring-finger, in four with the tendon of the same muscle going to the middle finger, and in one it divided into three slips which joined the deep tendons for the middle, ring, and little fingers. The blending usually occurred opposite, or slightly below, the carpal articulations.†

The lumbricales muscles exhibit many forms of variation in size, number, extent, surface of origin, and mode of insertion; but as both THEILE and HENLE have entered fully into these varieties, I need do no more than state that I have seen, in addition to most of the forms which they have described, a variety in which an accessory first lumbricalis arose tendinous from the flexor sublimis.

* Fig. 2, *t*, flexor longus pollicis; *p*, flexor profundus digitorum; *s*, flexor sublimis digitorum. The connection of the first and second muscles by a tendinous band passing from the index tendon of the latter to the long flexor of the thumb, is shown; also a tendon connecting the ulnar side of the superficial with the tendon of the deep flexor for the little finger; also a close connection low down the limb between the ring and little finger tendons of both the superficial and deep flexor muscles.

† The presence of slips proceeding between the flexor sublimis and F. profundus, though without precise statement as to their connections, has been recognised by COWPER (Myotomia reformata), THEILE, and WOOD.

I may in this place also refer to an arrangement which I saw on one occasion in the left forearm. A slender fasciculus of muscular fibres proceeded from the flexor sublimis immediately to the inner side of the palmaris longus. It ended on a tendon which passed beneath the palmaris, and joined the tendon of the supinator radii longus at the lower end of the forearm.

After a course of about two inches it became muscular, and then ran parallel to the first lumbricalis, and was inserted along with it.

The flexor muscles of the toes, the arrangements of which I have more especially studied, were the flexor brevis digitorum, the flexor communis digitorum, the flexor longus hallucis, the flexor accessorius, and the lumbricales,—an important group of muscles, the different members of which are more or less intimately related to each other in the sole of the foot. In order to form as precise a conception as possible of their mode of arrangement in the foot I carefully dissected fifty specimens, taking them without selection from the subjects which came in my way in the ordinary course of my anatomical work, so that the variations described must not be regarded as unusual or abnormal forms. The results I have arrived at differ in many respects from the descriptions of these muscles usually given in treatises on anatomy. Of these fifty specimens no two were exactly alike, so that it would be necessary, in order properly to bring out the extent of individual variation which they presented, that each should have a separate description; but as this would be tedious both to writer and reader, it may suffice if I adopt some method of arrangement which may exhibit their most important variations.

In all the specimens the tendon of the flexor longus hallucis gave off, in the sole of the foot, a slip or band which connected that tendon either to one or more of the subdivisions of the flexor communis digitorum, or in part to that tendon, and in part to the flexor accessorius. In its size this connecting slip varied somewhat, and though at times flattened and membrane-like, yet was mostly in the form of a rounded band. In every specimen it took a more or less important part in the formation of the deep flexor tendons for one or more of the four outer toes. In eleven specimens it ended solely in the deep flexor tendon for the second toe; in twenty specimens it bifurcated and ended in the deep flexor tendons for the second and third toes; in eighteen specimens it trifurcated, and ended in the deep flexor tendons for the second, third, and fourth toes; in one specimen it divided into four parts, and ended in the deep flexor tendons for the four outer toes.

Of the eleven specimens in which the connecting band went solely to the second toe, it formed about one-half the deep flexor tendon for that toe in four cases (fig. 9), the remaining half being formed partly by the flexor communis and partly by the flexor accessorius. A much larger proportion than one-half in six cases (fig. 11); and in one case it and the flexor accessorius together formed the whole of the deep flexor tendon for the second toe, in the construction of which the flexor communis did not consequently enter (fig. 3).

Of the twenty specimens in which the connecting slip went to the second and third toes, it contributed a larger share to the second than the third toes in twelve specimens, in one of which it formed, with the addition of a few fibres

from the flexor accessorius, the whole of the deep flexor tendon for the second toe;* it was divided almost equally between the two in six specimens (fig. 4); and in two specimens it and the flexor accessorius together formed almost the whole of the deep tendons for these toes, the share taken in their construction by the common flexor being limited to a few fibres (fig. 5).

Of the eighteen specimens in which the connecting slip went to the second, third, and fourth toes, it contributed a larger share to the second than to either

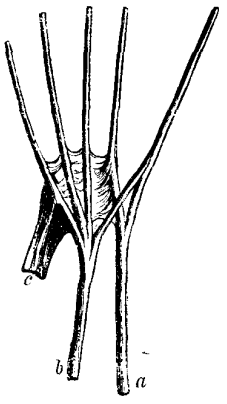

Fig. 3.†

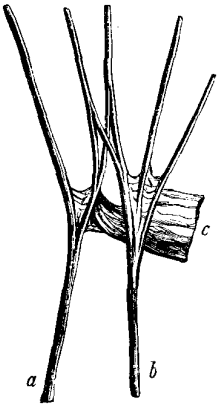

Fig. 4.

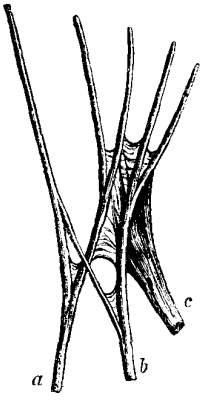

Fig. 5.

the third or fourth in seven specimens (fig. 6), in one of which the process for the deep flexor tendon of the second toe was much larger than that supplied by the flexor communis; a larger share to the second and third than to the fourth in five specimens; a larger share to the second and fourth than to the third in one specimen; and about equally to these three toes in the remainder.

In the solitary specimen in which the connecting slip went to the four outer toes, the subdivisions for the second and third toes were larger than those for the fourth and fifth, that for the fifth being a comparatively slender thread (fig. 7).

In none of the fifty specimens did the connecting band join the tendon of the common flexor previous to the subdivision of the latter tendon. In every instance it proceeded either single, bifurcated, trifurcated, or in four subdivisions, to its appropriate toe or toes, and in its course joined the divisions of the flexor communis, or the portions of the flexor accessorius passing to the same toe or toes. To the deep tendons for the second and third toes, more especially, it not unfrequently contributed quite as much as the flexor communis, and occasionally it and the flexor accessorius together, entirely or almost entirely, were substituted for

* The flexor communis in this case trifurcated for the third, fourth, and fifth toes.

† Fig. 3. In this and the succeeding figures, *a*, is the flexor hallucis longus tendon; *b*, the flexor communis digitorum tendon; *c*, the flexor accessorius. In figure 3 the flexor communis forms no portion of the deep tendon for the second toe, and after giving a slip to the flexor hallucis tendon, trifurcates for the three outer toes.

the flexor communis in the construction of the deep flexor tendons for those toes.*

In nine specimens a band, sometimes of considerable size, proceeded from the

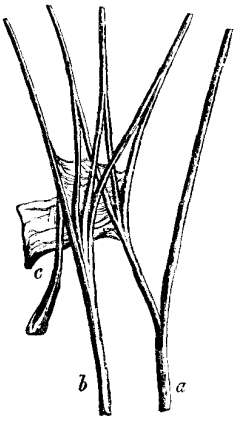

Fig. 6.

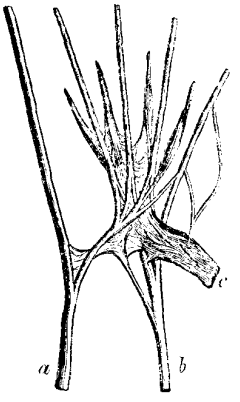

Fig. 7.

common flexor tendon previous to its subdivision, which joined the tendon of the flexor hallucis longus beyond the origin of the connecting slip for the common

* That the tendon of the long flexor of the great toe gives off a band more or less strong to the common flexor of the toes in the sole of the foot has been almost universally recognised by anatomists, but the exact nature of the connection between them has not at all times been clearly expressed. Amongst the older anatomists, VESALIUS describes this band as passing from the tendon of the great toe to the tendon proceeding to the second toe, and sometimes in an equal degree to the tendon of the common flexor for the middle toe. DIEMERBROECK again states that sometimes the long flexor of the great toe is divided in the sole into two parts, one of which goes to the great, the other to the second toe, and then the common flexor sends but three tendons to the other toes. COWPER and BIDLOO simply describe a connecting band passing from the proper to the common flexor, without specialising its mode of termination, and this method of description has been followed by most systematic writers in the latter part of the last century, and in the present, as INNES, MONRO, SABATIER, BICHAT, BOYER, JOHN BELL, FYFE, CLOQUET, CRUVEILHIER, DODD, QUAIN, HARRISON, HYRTL, LEDWICH, ELLIS, KNOX, HOLDEN, HEATH, and GRAY. MECKEL employs, in his description of the long flexor of the great toe almost the same method as DIEMERBROECK, but, in addition, states that the long flexor tendon for the second toe is for the most part formed by the connecting band and the flexor accessorius. THEILE follows very closely the latter statement of MECKEL, but, under the head of anomalies, he describes the connecting band as dividing for the second and third toes. ARNOLD gives the connecting band as strengthening the tendon for the second toe, though it often goes also to the third toe. HENLE states that the strong process from the proper to the common tendon is for the most part, and at times altogether, continued into the tendon destined for the second toe. Mr CHURCH, in a recent monograph on the myology of the Orang (*Natural History Review*, 1862), has also directed attention to the connection of the band from the flexor hallucis with the second and third toes. Professor ROLLESTON has advanced evidence to the same effect. Last of all, Mr HUXLEY (*Reader*, 13th February 1864) states, as the results of his dissections, that the tendon of the flexor hallucis longus, besides giving off the tendon to the great toe, furnishes distinct slips to the two or three succeeding digits, uniting with the tendons of the flexor digitorum and flexor accessorius. That considerable variability occurs in the mode of termination of the connecting band might almost be inferred from the different descriptions given of it by the numerous anatomists just quoted, each apparently, of those at least who go into details, basing his description on the specimen or specimens he may more particularly have examined. A more exact conception, however, of the extent of this variability may be gathered from the analysis of the fifty specimens recorded in the text.

flexor tendon from it (figs. 3, 5, 8, 10). In these cases, therefore, the tendons were doubly connected by intertendinous bands.*

The flexor accessorius varied greatly in its mode of termination on the flexor tendons. In but a few instances (fig. 5, for example) could it be said to end in the manner usually described in the text-books, by joining the outer border and upper, and sometimes the under surface of the tendon of the flexor communis. In many cases it had no connection whatever with the outer border of that tendon; in several of these it contributed no fibres to the tendon for the little toe, and in a few it had no connection with the tendons for the fourth and fifth toes. In other cases, however, it gave off a distinct tendinous or musculo-tendinous bundle, sometimes of considerable size, to the deep tendon for the little toe (figs. 3, 6, 7). In a few cases the deep flexor tendon for that toe was almost entirely (fig. 10), and in one case (fig. 8) apparently, entirely formed of a tendon proceeding from the flexor accessorius, the common flexor tendon sparingly in the former (fig. 10), and not at all in the latter case (fig. 8), entering into its construction. In most cases the accessory flexor ended partly on the flexor communis, and partly on the connecting slip from the flexor hallucis, and through one or both of these contributed materially to the formation of the deep tendons for the second, third, and fourth toes. In one case it sent, in addition, a few fibres to the primary tendon of the flexor hallucis, and in another all its fibres terminated on the connecting slip, and through it were transmitted to the deep flexor tendons of the second and third toes. In one case it gave off a distinct slip, which, separating into two parts, gave one to each process of bifurcation of the tendon of the flexor brevis digitorum for the third toe.

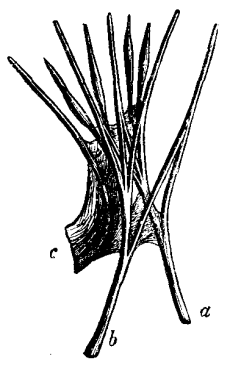

Fig. 8.†

In two cases the flexor accessorius had an accessory muscle connected to it, which arose from the deep fascia of the back of the leg in its lower third, concealing at its origin the posterior tibial vessels and nerve. It passed downwards, and ended in a rounded tendon, which extended through the inner ankle beneath the abductor pollicis, and joined the inner margin of the flexor accessorius (fig. 9).‡

* It would almost appear as if some of the systematic writers of the last century had recognised the band proceeding from the flexor communis to the flexor hallucis, but not the one passing in the opposite direction. *Vide* ALBINUS, WINSLOW, TARIN, SANDIFORT, and DOUGLAS. Several of the more recent writers have described an arrangement similar to the one recorded in the text.—*Vide* SABATIER, ARNOLD, and THEILE.

† Fig. 8 shows the deep flexor tendon for the little toe entirely formed of the flexor accessorius. The flexor communis, after sending off a connecting band to the flexor hallucis, trifurcates for the second, third, and fourth toes, to which the connecting band from the flexor hallucis also proceeds.

‡ The two specimens described in the text were found amongst the fifty specimens specially analysed, but I have in former years, and in other subjects, met with additional instances of an accessory muscle in this locality. The region of the inner ankle appears, indeed, to be frequently the seat of such accessory muscular structures, *e.g.*

The lumbricales muscles presented many variations, some of the leading forms of which it may be advisable to particularise, more especially that FROMENT (with whom HENLE seems to agree) states that variations in the arrangement of these muscles are extremely rare. The first lumbricalis, in the specimens under analysis, arose sometimes from the tibial side of the deep tendon for the second toe, after the junction of the connecting slip from the flexor hallucis with the division of the common flexor tendon for that toe. Sometimes only from the tibial side of the connecting slip; sometimes only from the division of the common flexor to the second toe; in one case from the expanded part of the common flexor before it divided into its terminal tendons; in other cases by a continuous origin both from the tibial side of the second toe tendon, and from the expanded part of the common tendon; and in two cases by two distinct heads,—one from the tibial side of the connecting slip from the flexor hallucis, the other from the expanded part of the common flexor before its division into the terminal tendons. In one case no lumbricalis was present in the first metatarsal space, but two were situated in the second space (fig. 8). In another case the second lumbricalis was absent. In several cases, not only did the second, third, and fourth muscles arise from adjacent sides of the tendons between which they were situated, but also from special slips derived from those tendons. Sometimes their fibres of origin extended for some distance backwards over the general expansion of the common flexor tendon. In other instances the fibres of the fourth lumbricalis, or of the third and fourth lumbricales, were continuous with (or received fasciculi from) those of the flexor accessorius; in others they

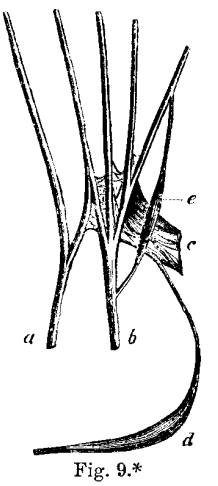

Fig. 9.*

1*st*, A large slip springing from the inner side of the soleus, and passing quite distinct from the tendo Achillis, to be inserted into the inner concave surface of the os calcis.

2*d*, A muscle arising from the deep fascia of the back of the leg, and inserted into the inner side of the os calcis, close to the inner head of the flexor accessorius; this apparently constitutes the accessorius ad calcaneum of GANTZER.

3*d*, Two muscular bundles connected to the deep fascia of the back of the leg, one as high as the middle of the tibia, the other close to the origin of the flexor hallucis longus from the fibula; these bundles united to form a muscle which passed beneath the internal annular ligament to the sole where its tendon bifurcated, one slip joining the tendon of the flexor hallucis longus, the other the tendon of the flexor communis digitorum. A corresponding arrangement was found in both limbs.

4*th*, A well-marked muscle arose from the deep surface of the soleus tendon. It concealed the tendons of the deep muscles, and the posterior tibial vessels and nerves in the lower third of the leg, and was inserted into the deeper surface of the tendo Achillis, immediately above the os calcis. A similar case to this has been described by R. QUAIN.

Other irregularities in this locality have been recorded by MAYER, ROSENMÜLLER, GANTZER, MECKEL, HALLETT, THEILE, HENLE, and JOHN WOOD.

* Fig. 9. *d*, the accessory muscle to the flexor accessorius. It has been bent out of its proper direction so as to occupy less space in the wood block. *e*, the displaced fasciculus of the flexor brevis for the little toe, which simply blends, without bifurcating with the deep flexor tendon for that toe.

received a special fasciculus of fibres, arising from the process sent by the connecting slip of the flexor hallucis to the third or fourth toes; in one case the fourth lumbricalis was absent.

Variations in the mode of arrangement of the flexor brevis digitorum were also noted. The tendon passing to the little toe was sometimes not perforated by the tendon of the common flexor. In one case it was blended and inserted along with it; in others it was so thin as to be lost in the fascia of the foot; in one it was altogether absent. In five cases the short flexor tendon for the little toe was displaced at its origin, and arose from the common flexor tendon previous to the subdivision of that structure (fig. 10).* At its origin it either consisted partly of fibres continuous with those of the common flexor tendon, and partly of distinct muscular fibres attached to and springing from that tendon, or it arose tendinous, and then muscular fibres appeared in it, which again terminated

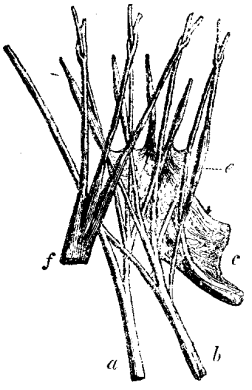

Fig. 10.*

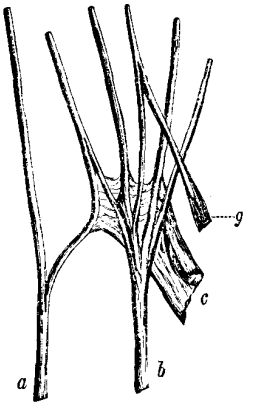

Fig. 11.†

on the tendon of insertion. In three of these cases the tendon bifurcated, to allow the common flexor tendon for the little toe to pass through and beyond (fig. 10); in the other two it blended with the common flexor tendon for that toe, and was inserted along with it (fig. 9). In one specimen the tendon for the

* Fig. 10. In this drawing, *f* is the flexor brevis digitorum, which divides into fasciculi for the second, third, and fourth toes, the fasciculus for the fifth toe, *e* arises from the tendon of the flexor communis. In this figure the deep flexor tendon for the little toe is formed almost entirely from the flexor accessorius, the flexor communis contributing but a few fibres. The connecting slip from the flexor hallucis trifurcates for the second, third, and fourth toes, and the flexor communis gives off a connecting band to the flexor hallucis. BRUGNONE, MECKEL, THEILE, HYRTL, HENLE, CHURCH, and HUXLEY, have all recognised the occasional origin of the short flexor tendon for the little toe from the flexor communis. In another subject I saw the fasciculus forming the short flexor tendon for the little toe arise in part from the external inter-muscular septum, and in part through fibres continuous with the muscular part of the flexor accessorius.

† Fig. 11, *g*, the tendon of the flexor brevis for the third toe, its junction with a slip from the expanded part of the flexor communis is represented. In both feet of a subject not included in the above analysis, I saw an arrangement similar to that represented in fig. 11, except that the slip from the common flexor tendon bifurcated before joining the two branches of bifurcation of the flexor brevis.

third toe received a strong tendinous slip from the expanded part of the common flexor tendon, and the two were blended and inserted together (fig. 11). In another, the short flexor tendon for the third toe received an additional slip from the flexor accessorius.

In the foot, therefore, as in the forearm and hand, intermuscular structures not unfrequently connected together not only the flexor muscles situated on the same plane, but those situated on the superficial and deeper planes.

The fifty specimens of the flexor muscles of the foot, the special analysis of the mode of arrangement of which I have now recorded, will be sufficient, I think, to show that in the construction of this group of muscles an amount of variation existed much greater than might at first sight have been supposed. In a portion of one muscle alone, viz., the connecting band from the tendon of the flexor hallucis longus, a considerable number of modifications occurred. In the flexor accessorius also great variability was displayed, and in some proportional relation, apparently, to the extent of variation in it and the connecting band, did the flexor communis digitorum undergo certain modifications in its arrangement, so much so, indeed, in certain cases, as to permit those structures to be to a great extent substituted for it in the formation of the deep flexor tendons for some of the toes.

Variability in the construction of parts, however, was not manifested merely in different individuals, but in the same individual the corresponding structures on opposite sides of the body were by no means symmetrically disposed. Thus, in two of the four examples recorded in the earlier part of the paper in which a supra-condyloid process existed, it occurred only in one arm of each subject in two cases; whils in a third subject, though both humeri exhibited the process, yet the relations of the brachial artery to it on the two sides were by no means symmetrical. The tendons in the left foot, in many of the individuals in whom both feet were examined, varied also more or less from those in the right foot, so that in the construction of the limbs, as well as in the form and arrangement of the organs contained in the great cavities of the body, an asymmetrical disposition of parts is to be looked for. Thus, we arrive at the conclusion that the plan on which the human body is constructed, although constant in all its essential characters, yet admits of variations (within itself as it were) in certain directions and within certain limits. Neither form nor structure is absolutely stereotyped, but modifications occur which, when regarded singly, may be considered, perhaps, as slight and of comparatively little importance, yet when viewed collectively, are sufficient to give to the individual well-marked distinctive characters.

Much has been said and written of late years on the existence of structural differences between the fair and coloured races of mankind, more especially between the white man and the negro,—differences which, according to some

writers, are so great as to constitute an actual specific distinction between them. But those who have advanced and supported this view seem to me to have ignored, or at least not to have taken sufficiently into consideration the fact, that in the white races themselves, nay, as we have shown in this paper, in a limited section of them even, variations occur in the arrangement of certain of the soft parts so great as to permit of the office usually performed by one muscle to be, in a great measure, or even altogether, exercised by another. But the extent of variation which the white races may exhibit is by no means exhausted by what we have detailed in this communication. Numerous isolated examples of variations, both in the muscular and other systems, have been recorded elsewhere by myself and other anatomists, and additional observations in the same profitable field of inquiry will, I have no doubt, add many other forms to our already extensive list. Until, however, the deviations from the usually described arrangements in the fair races are more systematically inquired into than has hitherto been the case, we cannot hope to reach an accurate conception of the latitude which may be allowed them.

Of the extent of the structural variability which may exist in the soft parts of the dark races, we as yet know but little. It is seldom that their bodies have been critically examined; and of many of the coloured races, indeed, the number of dissections has been too small to permit of any satisfactory conclusions to be arrived at, for opportunities of making the necessary observations seldom fall in the way of the European anatomist. His dissections are made and his descriptions are based on the examination of the inhabitants of his own continent. Our knowledge of the comparative anatomy of the soft parts of the races of men is still in its infancy. To make good, indeed, the proposition that the negro is specifically distinct from the white man, it would be necessary to show that any peculiarities of arrangement which may be exhibited in the construction of his body, are either constant, or, if variable, that the variations are not in accordance with those which have been or may be met with in similar parts in the bodies of men of the fair races. For until we have determined not only the amount of structural variability in the different races, but the comparative frequency of occurrence of its principal forms, we shall not be in a position even to discuss the question of specific difference on anything like positive scientific data, still less to pronounce dogmatically on the subject.

From the special difficulties which surround the study of human anatomy, it will not be an easy matter to determine with precision the laws which regulate the development of these structural variations. In some cases, indeed, it would appear that a variation in one structure is not unfrequently correlated with variations in adjacent parts. Thus in the four specimens described in the early part of this communication in which, in conjunction with a supra-condyloid process, a foramen existed above the inner condyle of the humerus, the median nerve

passed through that foramen. The deflection of the nerve from its course and the existence of the process were, it is evident, not only from these but from many similar cases, correlated events. Again, in the flexor tendons of the foot, a deficiency in the size of the flexor communis digitorum was not unfrequently correlated with an increase in the size of either the connecting-band from the flexor hallucis, or of the flexor accessorius, or it might be of both; and an absence of a tendon from the flexor brevis digitorum for the little toe was not unfrequently correlated with the presence of a fifth tendon from the flexor communis digitorum.

To how great an extent the conditions of life of the individual, in whom these and other varieties present themselves, may be concerned in their production, or how far they may be transmitted from parent to offspring, and thus be considered as family peculiarities, are questions which for the present at least must be left undetermined. But in regard to the variations in the muscular arrangements which have been specially illustrated in this communication, it may safely be stated that the power of performing the appropriate movements of the part must be modified in accordance with the modifications in its structure.