ON THE ANATOMY OF *HYÆNA STRIATA*.

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(*Continued from page 105.*)

PART II.

Myology.

IN Plates 129–142 of Cuvier and Laurillard's *Myology*, the muscular anatomy of *Hyœna striata* is fully illustrated, and descriptive accounts of individual muscles have been given by Meckel, Cuvier, and others. These accounts, however, are incomplete, and in not a few instances the muscles in our specimen were found to differ from the descriptions given. We have, therefore, thought it advisable to supplement the records of previous dissections of the muscular system of *H. striata* by that of our own, especially as, in so doing, we are able to avail ourselves for purposes of comparison of more complete descriptions of the muscles of the nearest allies of *H. striata* than was formerly possible.[1]

Muscles of the Head and Neck.—The *platysma myoides* and also the muscles of the face and of the auricles correspond in every respect with those of *H. crocuta.*

The muscles of mastication are also as described in the Spotted Hyæna with this exception, that the *masseter* is more easily separable into two layers. A well-defined tendinous lamina intervenes between the layers. Meckel states that this is less marked in Hyæna than in the Cat. Murie, however, found the muscle clearly divisible in *H. brunnea.*

The *sterno-cleido-mastoid* is arranged much as in other *Hyœnidœ* and in *Proteles*, and differs from that of *Viverra Civetta*, in which the sterno-mastoid and cleido-mastoid are throughout distinct. As described in *H. crocuta* the fibres rise from the pro-sternum, and the muscle soon divides into two parts.

The fibres of the internal and larger portion arise in common

[1] See page 90, Part I.

with the corresponding fibres of the fellow-muscle of the opposite side, not only from the pro-sternum, but also from a tendinous raphe in the middle line of the neck, which extends from the pro-sternum to the larynx. In this way a muscular sling is formed for the soft tissues of the neck. The internal fibres converge to an insertion into the basi-occiput, whilst in *H. crocuta* they reach the base of the mastoid process.

The external and remaining portion of the muscle is inserted into the cervical fascia.

The *scaleni*, anterior *recti*, and *longus colli* muscles are exactly as in *H. crocuta*. The *splenius* of *H. striata* arises as in *H. crocuta*. The fibres from the spines of the first two dorsal vertebræ are, however, inserted into the third and fourth cervical transverse processes. In this respect *H. striata* agrees with *Viverra* and with the Dog, and differs from *H. crocuta* and *Proteles*, in which there is no splenius colli.

H. striata differs also from *H. crocuta* and *Proteles* in the possession of a *complexus*, divisible into complexus proper and digastric. There is, however, no complexus tertius as in *H. crocuta*, but there is a distinct trachelo-mastoid.

The *spinalis colli*, the posterior and lateral *recti*, and the *oblique* muscles are exactly similar to the same muscles in *H. crocuta*, as are also the strong, cervical, *intertransverse* muscle.

Muscles of Back, Thorax, and Abdomen.—The *panniculus carnosus* does not extend so far posteriorly or ventrally as in *H. crocuta*, but in other respects is similar.

The *trapezius* is small as in *H. crocuta* and *Proteles*, and is similarly limited in its origin to the ligamentum nuchæ and the anterior dorsal spines. In *H. striata*, however, the fibres are separated at their origin into two portions, a strong fibrous layer intervening; they are united at their insertion into the spine of the scapula. Meckel describes a trapezius in *H. striata*, consisting of two portions almost entirely separated, the posterior only of which corresponds to the trapezius of *H. crocuta*, and to that described by us, Meckel's anterior portion being regarded as the levator humeri.

The *latissimus dorsi* reaches back as far as the iliac crest, but in other respects is as in *H. crocuta*. It also gives off a dorso-epitrochlearis.

The *rhomboideus* is single. Meckel describes an occipital origin in *H. striata;* this does not exist in our specimen, which in this respect agrees with *H. crocuta, Proteles,* and *Viverra.*

The *serrati,* anterior and posterior, are quite distinct, as in *H. crocuta* and *Proteles,* whilst in *H. brunnea* and *Viverra* they are combined.

The *erector spinæ,* both as regards size and subdivision, resembles the same muscle in *H. crocuta* and *H. brunnea.* The outer column includes a *sacro-lumbalis* and a *musculus accessorius.* There is no *cervicalis ascendens.* In the Civet the latter muscle is feebly represented.

The *longissimus dorsi* is prolonged forwards by a strong *transversalis cervicis,* and there is a well-defined *trachelo-mastoid.* This latter muscle is not present in *H. crocuta,* but exists in *Viverra.* In *H. striata* it arises from the articular processes of the last five cervical and the first dorsal vertebræ, and is inserted into the mastoid process beneath the splenius capitis.

The *spinalis dorsi* is very large, and reaches the last two cervical spines.

The *multifidus spinæ, rotatores spinæ, interspinales,* and *levatores costarum* differ in no way from the account given in the description of *H. crocuta.*

The *serratus magnus,* the *intercostals,* the *triangularis sterni,* and the *diaphragm* are also as in *H. crocuta.*

The muscles of the abdominal wall are almost identical with those of *H. crocuta.* The *external oblique* has, however, only ten costal attachments. The *internal oblique* and *transversalis* are easily separable, and the latter muscle is limited to a zone skirting the posterior limit of the thoracic wall. There is no *pyramidalis.* The *rectus abdominis* is strong, and reaches from the pubes to the cartilages of the anterior seven ribs. The *supra costalis* is inserted anteriorly into the first rib, whilst in *H. crocuta* it is attached to the rib cartilage.

The *coccygeus, levator ani,* and tail muscles are as in the Spotted Hyæna.

Muscles of the Fore Limb.—The *pectoralis major* includes a superficial and a deep stratum of muscular fibres. It is much

as described by Meckel, and as in *H. crocuta,* but in our specimen the insertion of the superficial portion is even more extensive, and reaches from the great tuberosity down to the lower extremity of the humerus. The deep stratum is further divided into an anterior portion inserted into the tuberosity, and a posterior portion inserted into the shaft of the humerus.

There is no *pectoralis minor.*

Deltoid.—Meckel describes a deltoid in *H. striata,* consisting of two portions; one of these, however, forms part of the levator humeri. Including this element the deltoid in our specimen agrees with Meckel's description, and also with what obtains in *H. crocuta* and *Viverra.* Excluding this element the deltoid consists of fibres from the acromion, and of scapular fibres which arise from the fascia over the infraspinatus; these apparently constitute the clavicular portion of Meckel rather than those which form the levator humeri, as stated in the account of the deltoid in *H. crocuta.*

The *levator humeri proprius* arises as in *H. crocuta* by two heads, which unite in front of the shoulder-joint to form a strong fleshy mass. The insertion is into the ulna with the biceps; in this respect it apparently agrees with *H. brunnea.* In *Proteles* the insertion is into the radius and ulna, whilst in *H. crocuta* and in *Viverra* the insertion is into the lower end of the humerus.

The scapular muscles are arranged as in *H. crocuta.* The *teres minor* is small but distinct from the *infraspinatus,* so it is in *H. crocuta* and *Viverra.* In *Proteles,* on the contrary, these muscles are inseparable. A strong *teres major* is inserted, as in *H. crocuta, Proteles,* and *Viverra,* with the latissimus dorsi.

The *levator scapulæ* (trachelo-acromial) from the transverse process of the atlas is inserted into the acromion. In *Proteles* it is chiefly inserted into the fascia covering the infraspinatus. *H. crocuta* and *Viverra* agree with *H. striata.*

The *biceps,* though single headed as in *H. crocuta* and *Proteles,* arises from the margin of the glenoid cavity and from the rudimentary coracoid. It is inserted into both radius and ulna.

The *brachialis anticus* is inserted into the ulna alone, such

also is the case in *H. crocuta*, *Viverra*, and in the Dog. In *Proteles* the muscle is inserted into both radius and ulna.

The *coraco-brachialis* is a *C. brevis* (Wood) as in *H. crocuta*, *Proteles*, *Viverra*, and Cat.

The *triceps* is somewhat irregular in *Hyænidæ*. In *H. crocuta* four heads exist. So also in the Civet, whilst in *Proteles* a fifth head is described. In *H. striata* only three heads are distinguishable, a long scapular head, an outer head which corresponds to the second and third heads of *H. crocuta* conjoined, and an inner head, which is merely a small muscular slip from the inner border of the humerus near the insertion of the latissimus dorsi. The fourth head of this muscle in *H. crocuta* is in *H. striata* separate from the triceps, and combined with the *anconeus*, which extends from the posterior surface of the humerus for about an inch above the olecranon fossa, and from the back of the external condyle, to the outer side of the olecranon process.

There is no *supinator longus*, nor is there any tendinous vestige of this muscle such as is found in *H. crocuta*. *Proteles* resembles *H. striata* in this respect, but *Viverra* presents a small but well defined supinator longus.

Meckel rightly describes the *extensores carpi rad. longior and brevior* as separate and distinct throughout, the tendons of insertion being united by a transverse band.

The remaining extensor muscles of the wrist and digits, and also the *supinator brevis*, are arranged exactly as in the Spotted Hyæna, with this exception, that the *extensor indicis* in *H. striata* is distributed to the index, middle, and ring digits, whereas in *H. crocuta* it is limited to the first of these.

The two *pronator* muscles of the fore-arm are also precisely as in *H. crocuta* and *Proteles*. In the Civet the pronator quadratus is much more limited, whilst the pronator teres is relatively larger and stronger.

Of the radial and ulnar flexors of the wrist the former is as described in *H. crocuta*, the latter (*flex. carp. ulnaris*) has, however, both humeral and olecranoid heads, and beyond its connection with the pisiform bone is prolonged to the outer metacarpal bone. Meckel found the prolongation more extensive, and noted its ligamentous connection with the four outer

metacarpal bones. Meckel states that the palmaris longus in Hyæna and the Bear is intimately united with the superficial flexor of the digits. In our specimen it is quite separate as in *H. crocuta* and *Proteles*. In *Viverra* it is double, and forms two slender muscles.

Flexores digitorum.—The superficial and the deep flexors form a large muscular mass closely resembling the corresponding structure in *H. crocuta, Proteles,* and *Viverra*. The muscular fibres, however, arise exclusively from the humerus and ulna, and there is no radial attachment. One group of fibres from the humeral condyle is prolonged as the superficial flexor, its deeper fibres join the deep flexor, which obtains additional fibres from the humerus, from the coronoid process and from the whole length of the posterior border of the ulna; the last named fibres are supplied by the ulnar nerve, whilst the nerve supply of the rest of the mass is derived from the median. The flexor perforatus or superficial part of the muscle ends in four tendons, which are distributed to the four outer digits; before their insertion into the second phalanges they form tubular sheaths for the deep flexor tendons which pass to the terminal phalanges of the same toes. Meckel found the superficial flexor of the outermost digit springing from the palmar fascia, and he describes from an expansion of this head accessory slips distributed to the superficial tendons which aid in the formation of the sheaths for the deep tendons. In our specimen, however, there is no such arrangement, but slender accessory slips pass directly from the palmar fascia to the superficial flexor tendons.

Meckel affirms the existence in Hyæna of a very small and thin *flexor longus pollicis*. We were unable to verify this statement. The muscle is also absent in *H. crocuta,* and in *Proteles* it is not separable from the deep flexor.

Lumbricales.—There are only two lumbricales. They are connected with the deep flexor tendon before its division, and with the superficial flexor tendons of the middle and ring digits. This arrangement is precisely the same as in *H. crocuta,* in which, however, there are four lumbrical muscles. In *Proteles* there are only three. In the Civet four lumbrical muscles exist, but they have no connection with the superficial flexors.

The intrinsic muscles of the hand include—

1. A palmar group of adductors.
2. An intermediate group of flexors.
3. A dorsal group of abductors.

The palmar group consists of an *adductor minimi digiti* and an *adductor indicis*. The first named is thin and flat; it rises, superficial to the adductor indicis, from the palmar surface of the carpus about the middle line, and passes to the radial side of the proximal phalanx of the outermost digit. The adductor indicis arises beneath the adductor minimi digiti by two heads, one from the middle of the carpal ligaments, the second from the radial side of the origin of the flexor brevis of the ring digit. The two heads are separated by the deep division of the ulnar nerve.

The intermediate layer of *flexores breves* is made up of four strong double bellied muscles; the muscular bellies are arranged in pairs along each metacarpal bone. Arising from their proximal ends by single pointed tendinous origins, they pass to the bases of the first phalanges, reaching as far as the extensor tendons.

The dorsal layer is represented by a single muscle, the *abductor minimi digiti*, which passes from the pisiform bone to join the extensor expansion on the first phalanx of the fifth digit. In *H. crocuta* there is no adductor indicis, but there is an adductor of the middle digit; in other respects it resembles *H. striata*. *Proteles* also agrees with the latter.

Nerve Supply of the Muscles of the Anterior Extremity.—Of special interest in the nerve supply of the muscles of the upper extremity is the fact that the musculo-cutaneous nerve, besides supplying the biceps, coraco-brachialis, and brachialis anticus, also gives branches of supply to the flexor carpi radialis and the pronator teres. The flexor carpi ulnaris and the ulnar origin of the deep flexor are supplied by the ulnar nerve; with these exceptions all the muscles on the front of the fore-arm are supplied by the median.

The lumbrical muscles, which correspond to the second and third of the human hand, are both supplied by the median nerve.

The ulnar nerve supplies all the intrinsic muscles of the hand.

In a recent paper on the "Nerve Supply of the Lumbrical Muscles of the Hand and Foot,"[1] Dr H. St John Brooks suggests that a struggle is going on between the median and ulnar nerves for the possession of the intrinsic muscles of the hand, including the lumbricals, and he advances the hypothesis that the pressure to which the superficial nerve (the median) is exposed places it at a disadvantage, and that as a consequence it is losing its grasp over some of the muscles, which are gradually passing into the domain of the deep nerve (the ulnar). It is perhaps not very important which nerve supplies these muscles, as it is clear from the researches of Ferrier and Yeo,[2] and Herringham,[3] that they are supplied by the eighth cervical, and perhaps the first dorsal nerve, fibres of which are found both in the median and ulnar nerves,[4] but it is certain that pressure can have nothing to do primarily with the change of supply; for the nerves are in position before the muscles are differentiated from the mesoblastic matrix of the limb, and the branches of the nerves become connected with the muscles long before any pressure is brought to bear on the extremities. Further, as the nerves are in position before the muscles are developed, any change in the supply of a muscle must be due to an alteration in the number of fibres which pass to form the trunks of the respective nerves at the time when, as Paterson[5] has shown, the ventral branches of the spinal nerves in the region of the upper extremity have formed a plexus from which fibres proceed for the formation of the various peripheral nerves. Thus the contest resolves itself into a struggle between two nerves, as yet non-existent, for the possession of the fibres which are eventually to form them.

Accepting as correct the statement that the domain of the ulnar nerve is gradually increasing at the expense of that originally belonging to the median, the occurrence is probably due to the perpetuation of an accidental variation which has proved serviceable to the possessor. Such a variation may have

[1] *Jour. of Anat. and Phys.*, vol. xxi.
[2] *Proceedings of the Royal Society*, Mar. 1881.
[3] *Proc. Roy. Soc.*, vol. xli. 1886.
[4] Quain, vol. i. 1882, p. 606.
[5] "On the Fate of the Muscle Plate," *Quart. Jour. Mic. Sci.*, vol. xxviii.

occurred in one of two ways. Either the myotomes involved in the constitution of the muscles may have varied, and as each myotome is supplied by its own nerve this would necessarily be associated with a change of nerve supply; or, as is more probable, the variation is due to a change in the course of some of the fibres passing from the brachial plexus to the median and ulnar nerves. Thus, after the eighth cervical nerve unites in a plexus with the other nerve going to the fore limb, its fibres may pass into any of the peripheral trunks, and if fibres which at one time passed into the median nerve, are at another directed into the ulnar, the domain of the latter will be increased at the expense of that of the former.

Muscles of the Hind Limb.—Except that in *H. striata* the posterior portion of the *gluteus maximus* joins the biceps flexor cruris much sooner than in *H. crocuta*, the gluteal group of muscles and the tensor fasciæ femoris are alike in the two species. Meckel noted the existence of a gluteus quartus in *H. striata*.

The deeper placed external rotator muscles, *e.g.*, pyriformis, obturator internus and gemelli, obturator externus and quadratus femoris, are arranged as in *H. crocuta* and *Viverra*, but in *Proteles* there is only a single gemellus.

The *semimembranosus*, not unfrequently united, in Carnivores, more or less closely with the adductor mass, is, as Meckel describes, separate and distinct. It is also separate in the Civet, whilst in *H. crocuta* and *Proteles* it is inseparable from the adductor magnus.

The *semitendinosus* is inserted into the anterior border of the tibia immediately below the tubercle; apparently this insertion is higher and more anterior than was found by Meckel.

The *biceps* arises from the ischial tuberosity, and is joined by fleshy fibres from the anterior three caudal vertebræ, which constitute the posterior part of the double gluteus maximus of *H. crocuta*.

The *sartorius* is double, as in *H. crocuta;* the outer portion joins the rectus, and constitutes an additional element in the common extensor of the knee. In *Proteles* and *Viverra* the sartorius is single.

The *adductor magnus* is not united with the semimem-

branosus as in *H. crocuta*, and, consequently, its insertion is solely femoral. The *adductor brevis*, the *gracilis*, and *pectineus* are exactly as described in the Spotted Hyæna.

The *rectus femoris* in *H. crocuta* and *Viverra* arises by two heads. In *H. striata* and in *Proteles* the two heads are not distinct. There is no differentiated crureus, but the *vasti* muscles are easily separable.

The *gastrocnemius* is well developed, but the soleus is wanting; so also in *H. crocuta* and *Proteles*. In *Viverra* a separate and distinct soleus exists.

The *plantaris* has no attachment to the os calcis but is prolonged into the sole, where it divides into four slips, one for each toe. Each slip is strengthened by processes from the plantar fascia, is subsequently perforated by a corresponding tendon of the flexor perforans, and is ultimately inserted into the second phalanx of the toe. This represents the *flexor brevis digitorum* (perforatus). The accessory muscular fibres from the fourth metatarsal bone, noted by Meckel, are not present in our specimen. In *H. crocuta* and *Proteles* the plantaris ends at the os calcis; in the former of these there is a separate tendinous flexor brevis digitorum, which is confined to the sole of the foot. In *Proteles* the flexor brevis is also tendinous, but is continuous at its origin with the plantaris tendon. The Civet corresponds more closely to *H. striata*, but receives accessory muscular fibres from the os calcis.

The *flexor longus digitorum* (perforans), together with the flexor longus hallucis, is arranged and attached as in the Spotted Hyæna. The *popliteus* and *tibialis posticus* are also similar.

A musculus accessorius is not present in *H. striata*. It exists in *H. crocuta*, also in *Viverra*, but is absent in *Proteles*.

The *lumbricales* are three in number, but two pass to the superficial flexor tendon of the middle toe; and of these one—the second—is tendinous. The third lumbrical goes to the superficial flexor of the ring digit. The arrangement is very similar in *H. crocuta*. In *Proteles* there are three lumbricals which pass to separate toes, while in *Viverra* four lumbricals are distributed in the usual manner.

The intrinsic muscles of the foot are represented by two layers, the palmar layer of adductors and the intermediate layer

of flexors. There is no dorsal layer of abductors, and no trace of fusion of the abductor minimi digiti with the short flexor of the little toe, similar to that described by Cunningham in the Dog,[1] could be found.

As in the hand, the palmar group of adductors is represented by two small muscular bundles, one an adductor of the little toe, the other of the index digit. These two muscles bear the same relative positions to each other as in the hand, and similarly the adductor of the index digit has a double origin, the two heads are separated by the continuation of the external plantar nerve to the flexor brevis indicis.

The intermediate layer of short flexors is constituted by four bicipital muscles, each single at its origin from the base of the metatarsal bone on which it lies; the separation of the two bellies is low down, and each of these is inserted into the sides of the first phalanx of the same toe and into the extensor expansion. Cunningham ascribes the absence, in some animals, of the dorsal layer to its fusion with a primitively separate intermediate layer. In *H. striata* there is no trace of this fusion.

The *extensor longus digitorum* does not divide into two distinct bellies, as Meckel found in his specimen, but is single, as in *H. crocuta*, *Proteles*, and *Viverra*.

The *tibialis anticus* is a single muscle inserted into the metatarsal bone of the second toe. There is no extensor hallucis; in *Proteles* and in *H. crocuta* a slip from the tibialis anticus represents this muscle, whilst in *Viverra* a separate extensor hallucis proprius exists.

The *extensor brevis digitorum* terminates in four tendons. Of these, the first is to the second toe, the second and third to the third toe, and the fourth tendon goes to the fourth toe, but gives also a slender slip to the fifth toe. Meckel found three tendons only, distributed as in *H. crocuta*. In *Proteles* two tendons pass to the second and third toes respectively. In the Civet four tendons are distributed to the four inner toes, whilst in the Dog they pass to the four outer toes.

The *peroneal* group of muscles usually includes, in Carnivora,

[1] "Intrinsic Muscles of the Mammalian Foot," *Jour. of Anat. and Phys.*, vol. xiii. p. 9.

a peroneus longus, peroneus brevis, and extensor quinti digiti. It is not uncommon, however, for the last two muscles to be more or less united, as, *e.g.*, in *H. crocuta* and the Dog. In *H. striata* these muscles are separate.

The *peroneus longus* arises from the upper extremity of the tibia and the external lateral ligament of the knee-joint, in this respect intervening between *H. crocuta*, Nasua, and the Badger on the one hand, in which the peroneus longus rises from the external condyle of the femur, and *Proteles*, the Civet, the Lion, and the Wolf on the other, the muscle in the latter group of animals gaining origin from the head of the fibula and the fascia of the leg. The second head of origin, which, as found by Ruge [1] in *Mustela* and *Leo*, is separated from the first by the peroneal nerve, is not present in *H. striata*. The tendon of insertion passes over the front of the external malleolus, a position generally found in Carnivora; it then crosses the peroneus brevis, giving a strong slip to the base of the fifth metatarsal bone, and passes across the sole to reach the second metatarsal.

The insertion of the muscle appears to vary greatly in Carnivores. In *H. crocuta* and *Proteles* it is attached to the fifth metatarsal only, in the Civet to the first and fifth, in the Fox and Dog to the cuboid and fourth and fifth metatarsals.

Ruge states that in Carnivora the *peroneus brevis* usually rises from the lower portion of the fibula, and this is certainly true of *H. striata*. In *Viverra*, however, it rises from the upper two-thirds of the shaft, and in *H. crocuta* from the middle portion. Its tendon passes behind the external malleolus, and is inserted into the base of the fifth metatarsal bone. This insertion seems to be universal in Carnivora.

The *extensor quinti digiti* takes origin from the head of the fibula, and from the shaft of the bone above and behind the peroneus brevis. Its tendon of insertion passes behind the external malleolus, and then divides into two parts, one of which is inserted into the base of the fifth metatarsal bone, whilst the other joins the extensor expansion on the fifth toe. The muscle is absent in *H. crocuta*, but is very generally present in Carnivores.

[1] *Morph. Jahrbuch*, 1878, Bd. iv. p. 617.

Nerve Supply of the Muscles of the Lower Extremity.

The muscles of the buttock and the front and back of the thigh are supplied in the usual manner.

We are able to confirm Ruge's[1] description of the peroneal nerve in Carnivora, and to distinguish the branches which he has named deep, superficial, and accessory. The latter, in *H. striata* as in *Mustela*, ends in the peroneus brevis, after supplying the extensor of the fifth digit. The deep peroneal branch supplies the short extensors of the toes. The muscles of the back of the leg are supplied by the posterior tibial nerve. The deep branch of the external plantar supplies the intrinsic muscles of the foot. The lumbricales are supplied by the internal plantar.

The intrinsic muscles of the hand and foot have been described as forming palmar, dorsal, and intermediate groups—a method of classification which has been most ably advocated by Professor Cunningham,[2] to whom it is mainly due. Cunningham looks upon the tri-laminar arrangement as "typical," and considers that each digit should be furnished with three independent muscles, one from each layer, the medius being an exception, since it obtains two muscles from the dorsal layer; and he considers that "deviations from the typical arrangement of these muscles take place, in the majority of cases, either by suppression or fusion of certain elements of the different layers."

It has been already pointed out[3] by one of us that the typical arrangement is met with in its most complete form in animals whose extremities are highly specialised for grasping, holding, and manipulating; and, more particularly, that individual elements of the groups are always best developed in connection with the digits which have become most individualised.

Want of knowledge of the steps by which these muscles are developmentally produced, and the insufficiency of observations on their adult condition, render it impossible at present to arrive at definite conclusions concerning them; but the facts so far obtained seem to show that the type arrangement described by Cunningham is typical of the highest form of muscular

[1] *Morph. Jahrbuch*, Bd. iv.

[2] *Loc. cit.*, p. 2.

[3] Young, "Intrinsic Muscles of the Marsupial Hand," *Jour. Anat. and Phys.*, vol. xiv. p. 160.

differentiation yet arrived at, and that, although there is no doubt that in some cases, due to change of circumstances in the life-history of groups of animals, variations from the typical or tri-laminar arrangement of the muscles will be found that are due to suppression or fusion; still, as a general rule, when any of the various groups are wanting, their absence must be imputed to non-differentiation rather than to suppression or fusion. For, as it is certain that the intrinsic muscles of the hand and foot—we speak from careful examination of the hands and feet of human embryos and the embryos of rats and mice—are differentiated from an uniform mass of mesoblastic cells, and as the ontogenesis of the individual represents to a great extent the phylogenesis of its class, we cannot but deem it improbable that Nature would depart so far from her ordinary course of evolving the more perfect from the less perfect as to produce suddenly, a highly differentiated typical series of muscles from which most of her future elaborations should deviate by degeneration.

Again, it is at times difficult, when the various muscles have wandered from their origin, or are more or less inseparable from their neighbours, to say to which group they belong. Ruge,[1] in his paper "On the Intrinsic Muscles of the Foot," states that all the muscles lying superficial to the deep branch of the external plantar nerve belong to the palmar or adductor group; Brooks[2] supports this statement, and applies a similar law to the muscles of the hand, the deep branch of the ulnar nerve being taken as the separating structure. If this be the case, then the adductor of the index digit in the hand of *H. striata*, and the adductor of the corresponding digit in the foot, must be looked upon as being derived partly from the adductor and partly from the flexor layers, for, as we have shown, it takes origin by two heads, one of which is superficial to the deep nerve, whilst the other, which rises from the fascia on the radial side of the flexor of the ring digit, is deeper than the nerve; as, however, the muscle is single at its insertion, and as from the direction of its fibres it is an adductor muscle, we have placed it in the palmar group.

[1] *Morph. Jahrbuch*, Bd. iv. p. 645.

[2] "Morphology of the Intrinsic Muscles," *Jour. Anat. and Phys.*, vol. xx.