The last pointing was made very near the end of the field and has therefore a smaller weight than the others. Taking the mean of the three with weights 1, 1, ½ we find: $\delta = +13°\,12'\,12''30$; reducing to the mean of the two circles and the four positions of the instrument we get: $\delta = +13°\,12'\,12''41$; finally we find for the declination

reduced to AUWERS's system:	$\delta = +13°\,12'\,12''25$	Time of observ. $23^h45^m9^s4$ M.T. Greenw.
„ „ NEWCOMB's „ :	$\delta = +13°\,12'\,12''37$	

A comparison with the Nautical Almanac gives:

Observ.— Calcul.: AUWERS's system: — 3″.58
NEWCOMB's „ : — 3″.46.

II. TRANSIT OF MERCURY ON NOVEMBER 7 1914.

Using the great refractor of the observatory (aperture 266 mm.) I tried to observe the moments of inner and outer contact. At the first two contacts the sky was clouded over, so that only the last two could be observed. The power used was 170. As the moment of inner contact I took the breaking of the thread of light.

The times observed are

last inner contact: $2^h\ 6^m\ 24^s.8$ M.T. Greenwich
„ outer „ : 2 8 43 „ „

A comparison with the Nautical Almanac gives as the difference calculation minus observation:

last inner contact $+16^s.7$
„ outer „ $+11^s$.

Leiden, April 1915.

Anatomy. — "*On the structure of the muscular abdominal wall of Primates.*" By W. A. MIJSBERG (Communicated by Prof. Dr. L BOLK).

(Communicated in the meeting of April 23, 1915).

In the publications relating to the myology of Primates, the muscles of the abdomen are usually discussed very superficially, and where that discussion is a more elaborate one, that greater elaboration is as a rule restricted to an excessively accurate description of the origins of these muscles. Less attention however is paid to the way in which these muscles contribute to the formation of the sheath of the M. rectus; no publication is even known to me, in which

something is communicated about the comparative anatomy of the rectal sheath of Primates. This subject however deserves greater attention, as from a few stray communications it appears, that the structure of the sheath of the different species of Primates can show rather considerable differences.

I shall communicate here shortly the results of an investigation into the comparative anatomy of the sheath of the rectus muscle made by me in the Anatomical Laboratory of Amsterdam. In this communication I shall leave Prosimiae entirely out of consideration, and consequently restrict myself to Simiae (Platyrrhini and Katarrhini) and Hominidae.

On the Membrana abdominis intermedia.

As the first result of my investigation I can communicate, that with all monkeys examined by me, both Katarrhini and Platyrrhini, a fourth element participates in the formation of the sheath of the M. rectus, besides the three flat muscles of the abdomen. Between the M. obliquus externus abdominis and the M. obliquus internus abdominis a fascial membrane is namely found. This membrane is solid, admits of a good free preparation, consequently it distinguishes itself obviously from the flimsy connective tissue, which is found in man between the flat muscles of the abdomen. In the literature this membrane is not mentioned, I shall designate it as *Membrana abdominis intermedia.* The anatomical lines of demarcation of this membrane can distinctly be indicated. In the caudal part the origin is immediately connected with that of the M. obliq. int.: the membrana interm. is attached to the fascia lumbodorsalis, crista iliaca, spina iliaca anterior and follows also in a caudal direction the origo of the M. obliq. int., so that — with a powerful development of the membrane — its last fibres are attached to the ramus superior ossis pubis. Sometimes however it cannot be followed as far as the origins indicated here; in these cases it is closely connected with the M. obliq. int., because it originates in the perimysium externum of the latter at some distance from the origo of that muscle. In the cranial part the origin of the membrane cannot be indicated so exactly: it is namely continued between the M. obliq. ext. and the thoracal wall, and looses itself in the flimsy connective tissue that is found here. An origin from ribs can consequently not be ascertained.

In a median direction the membrane passes into the sheath of the M. rectus in the forming of which it takes part with the three flat muscles of the abdomen.

What is now the signification that must be attributed to this membrane occurring so constantly in monkeys?

One might be inclined to regard the membrane as a condensation of the intermuscular connective tissue; for likewise in man one often sees that from the flimsy connective tissue between the abdominal muscles fascial membranes can develop to increase the solidity of the abdominal wall. There are however objections that tell against this view: in the first place it cannot be explained in this way, why in many Simiae such a membrane does exist between the M. obliq. ext. and the M. obliq. int., but no vestige of fascial tissue between M. obliq. int. and M. transv. is to be found; secondly it cannot be comprehended in this way, why the membrane possesses such distinct anatomical lines of demarcation; thirdly the great independence that this membrane possesses tells against this view. With most Platyrrhini e. g. the membrane runs in the cranial part behind the M. rectus, in the caudal part in front of it; it changes consequently its course with regard to this muscle and moreover independently of the abdominal muscles between which it is situated.

From these objections appears distinctly, that the membrane may by no means be regarded as a simple local condensation of intermuscular connective tissue. Most admissible it is to consider it as a rudiment of a muscle that has existed on this spot with lower vertebrates. With this hypothesis all the properties of the membrane — as its sharp anatomical lines of demarcation, its independence — can easily be explained. The correctness of this view is moreover proved by a discovery with Siamang. With a Siamanga syndactylus I found namely muscular fibres running in the membrane; these muscular fibres form a bundle of 8 mm. wide and 4.5 cm. long, which bundle is situated between the point of the last rib and the crista iliaca. The fibres do however not originate in the rib, but about $^3/_4$ cm. caudally from the point of the last rib the muscular fibres appear in the membrane. The fibres run almost vertically downward, their direction corresponds with that of the fibres of the M. obliq. ext. The fibres are inserted into the crista iliaca, a little behind the spina iliaca anterior. The muscle possesses moreover still a smaller head, arising from the fascia lumbodorsalis.

As now, in the direction of the ventral medianline, the membr. interm. is directly connected with this muscle, and as moreover the origin of the muscular fibres is not situated at the last rib, but the fibres appear in the membrane at a little distance caudally from the rib, it is clear that this muscle with Siamang is the last remaining part of a muscle which, with phylogenetically older forms, was

situated on the spot of the membrane. Indeed we know, that with Urodele Amphibia and with Reptilia the abdominal wall is composed of more muscles than with Primates. The ontogeny and phylogeny of the abdominal muscles of lower Vertebrates (Pisces, Amphibia, Reptilia) has been accurately explained to us by the investigations of MAURER [1]). It is especially the structure of the muscular abdominal wall of the Urodele Amphibia that is of great interest for us; the abdominal muscles of Pisces still show very simple conditions, whilst the conditions of the abdominal muscles of Anure Amphibia and Reptilia can very well be deduced from those of Urodeles.

Urodele Amphibia possess four collateral abdominal muscles. Most superficially are situated two muscles, the fibres of which have an obliquely descending direction: a M. obliq. ext. superficialis and a M. obliq. ext. profundus. The direction of the fibres of these muscles differs little; that of the deep muscle is somewhat less oblique. Under the Musculi obliq. ext. one finds a M. obliq. int. with an obliquely ascending direction of the fibres, and abdominally from it lies the M. transversus, the fibres of which run in a transversal direction. MAURER distinguishes these muscles in primary and secondary ones. The primary muscles: M. obliq. int., M. obliq. ext. prof. and M. rectus profundus occur with the larva; the secondary ones: M. obliq. ext. superfic., M. transv. and M. rectus superficialis come into existence at the end of the larva-life by delamination of the younger cells at the surface of the primary muscles. From the development it is obvious, that the M. obliq. int. and the M. obliq. ext. prof. are dorsally connected with each other in the myotome and can never extend beyond the line of demarcation between the ventral and the dorsal musculature, the lateral line; ventrally both muscles are connected in the M. rectus profundus. The direction of their fibres changes here gradually from an oblique one into the longitudinal one of the M. rectus prof. The M. obliq. ext. superf. and the M. transv. however can extend dorsally from the lateral line, and from the beginning they possess an aponeurosis which runs before, resp. behind, the system of the Musculi recti to the linea alba.

[1]) F. MAURER, Der Aufbau und die Entwicklung der ventralen Rumpfmuskulatur bei den urodelen Amphibien und deren Beziehung zu den gleichen Muskeln der Selachier und Teleostier. Morph. Jahrb. 18 Bd. 1892.

F. MAURER. Die ventrale Rumpfmuskulatur der anuren Amphibien. Morph. Jahrb. 22 Bd. 1894.

F. MAURER. Die ventrale Rumpfmuskulatur einiger Reptilien, eine vergleichend-anatomische Untersuchung. Festschrift zum 70 Geburtstage von CARL GEGENBAUR, 1896.

Which are now the homologies between the abdominal muscles of Primates and those of lower Vertebrates? That the M. transv. and the M. obliq. int. of man are homologous with the homonymous muscles of Urodela is obvious, on account of the corresponding direction of the fibres and the corresponding direction of the intercostal nerve between the two muscles. There are however different views concerning the M. obliq. ext. GEGENBAUR reckons this muscle together with the Musculi intercostales externi to the layer of the M. obliq. ext. prof. of Urodeles; in this case the M. obliq. ext. superf. of Urodeles could be found back in the Musculi serrati postici of man. According to EISLER [1]) the M. obliq. ext. and the Musculi serrati postici belong to the layer of the M. obliq. ext. superficialis; the M. obliq. ext. prof. of Urodeles is to be found back in the Musculi intercostales externi and the "tiefe Zacken des M. obliq. ext. abdominis". By these EISLER understands small bundles of muscles, which, as he communicates, occur frequently under the cranial origins of the M. obliq. ext. of man. They originate likewise from the ribs, are separated by some connective tissue from the M. obliq. ext. lying superficially from them, have an almost transversal direction and lose themselves at last in the anterior lamella of the sheath of the M. rectus.

The anatomy of the ventral trunkmusculature of man however cannot give us certainty with regard to the origin of the M. obliq. ext. As, however, with other Primates between this muscle and the M. obliq. int. a membrane occurs that can be conceived as the remaining part of an abdominal muscle, the situation becomes clearer. Superficially from the M. obliq. int. we find first a muscle reduced to a membrane and then a well developed muscle entirely independent of each other; it is thus without more obvious, that the more superficial one of these two layers must be homologous with the M. obliq. ext. superfic., the deeper one with the M. obliq. ext. prof. of Urodeles. Consequently the M. obliq. ext. of Primates is homologous with the M. obliq. ext. superfic., whilst the Membrana abdominis intermedia is the homologon of the Musculus obliq. ext. profundus of Urodeles.

The direction of the fibres of the M. obliq. ext. prof. of Urodeles differs little from that of the M. obliq. ext. superfic. The abdominal muscle, which with ancestral forms of Primates was found in the place of the Membrana intermedia, will also in all probability, with, regard to the direction of its fibres, have corresponded with the M. obliq. ext. (superficialis [1]) of Primates.

[1]) P. EISLER. Die Muskeln des Stammes. Jena 1912.

In accordance with this is the fact, that the fibres of the "M. obliq. ext. prof." — for this name should be applied to the muscle — found by me with Siamang show a direction that is almost parallel with that of the fibres of the M. obliq. ext.

Further I will still remark in this connection, that according to TESTUT [1]) and LE DOUBLE [2]) several investigators have described by different names, and especially by that of "M rectus lateralis" as variations muscles of man, situated between the Musculi obliq. externus and internus and corresponding in the direction of their fibres with the M. obliq. ext. In the most typical cases this "M. rectus lateralis" originates from the 9th to the 11th rib, runs then almost vertically downwards and is inserted into the crista iliaca. It is obvious that we have to do here with the remaining part of the M. obliq. ext. prof., occurring as atavism, which muscle normally has been entirely reduced in man, whilst not even a membrane has remained. The variation has been described by the name of M. rectus lateralis. This name, though with regard to the direction of the fibres very correct, is however not preferable, as it could give rise to the entirely wrong notion, that this muscle is connected in some way or other with the M. rectus abdominis. In fact the two have nothing to do with each other. Consequently we had better call this variation M. obliq. ext. profundus, a name to which, as comparative anatomy teaches us, it has an indisputable right.

In conclusion be remarked that, in accordance with EISLER, I think it likely, that the deep origins of the M. obliq. ext. (vide before) described by him, can also be considered as remaining parts of the M. obliq. ext. prof.

It still remains to trace the relation the Membr. abdominis intermedia bears to the M. rectus: the membrane namely, as I communicated already takes part in the formation of the sheath of the M. rectus. With the description of the structure of the sheath of the different monkeys the relation of the membrane to the M. rectus will consequently likewise be discussed.

On the structure of the sheath of the M. rectus of Primates.

The relations the four elements, that compose the rectal sheath, bear to the M. rectus with the different monkeys will be briefly

[1]) L. TESTUT. Les anomalies musculaires chez l'homme, expliquées par l'anatomie comparée, leur importance en anthropologie. Paris. 1884.

[2]) A. F. LE DOUBLE. Traite des variations du système musculair de l'homme et de leur signification au point de vue de l'anthropologie zoologique. Paris. 1897.

described with the help of text-figures, representing diagrammatic transversal sections through the sheath. In all sections the M. obliq. ext. is represented by a dotted line, the Membrana abdominis intermedia by a point-dash-line, the M. obliq. int. by an uninterrupted line, and the M. transversus by a dash-line.

The structure of the rectal sheath of Primates shows considerable differences. It is however possible to unite all those cases under one point of view; it will appear that in this way a more primitive condition and relations that have removed from the original condition, can be distinguished. The succession in which the rectal sheath of the different Primates will be described is such, that I shall begin with a condition of which afterwards it will appear, that it is the most original one, and conclude with the description of the structure of the sheath of such monkeys, which have farthest removed from the primitive condition.

Fig. 1*a* represents a transversal section through the sheath of the M. rectus of *Ateles paniscus*, close under the caudal edge of the

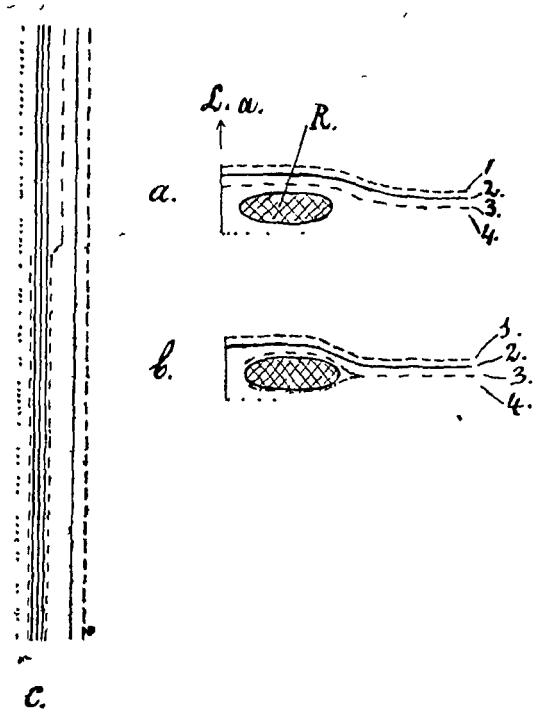

Fig. 1. Ateles paniscus.

L. a. = Linea alba.
R. = Musc. rectus abdominis.
1. = M. transversus abdominis.
2. = M. obliquus internus abdom.
3 = Membrana abdominis intermedia.
4. = M. obliquus externus abdom.

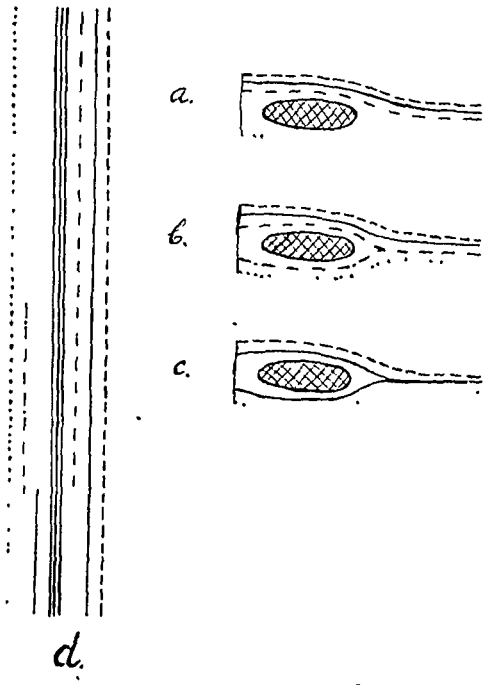

Fig. 2. Ateles hypoxanthus.

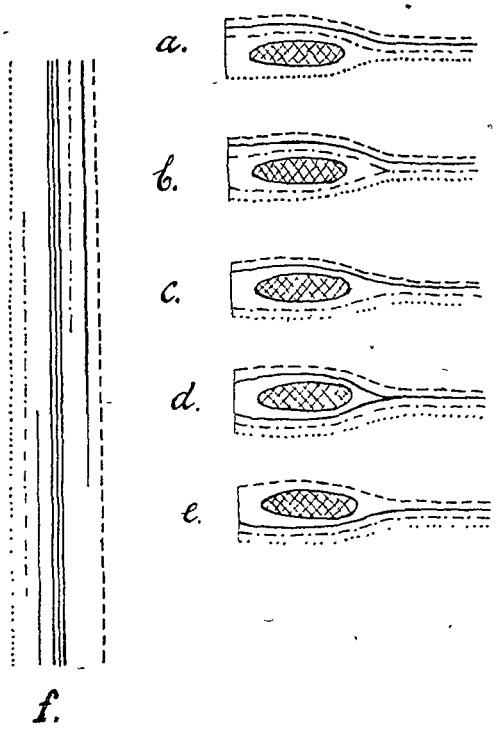

Fig. 3. Cebus capucinus.
(Scheme of Platyrrhini).

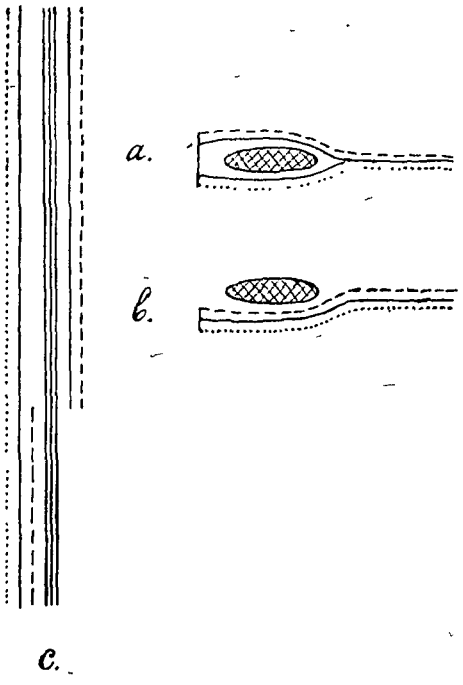

Fig. 4. Homo.

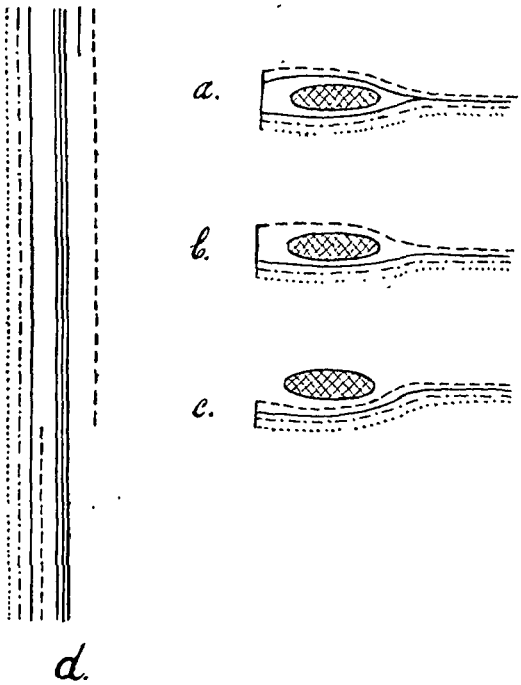

Fig. 5. Cercopithecus cynosurus.

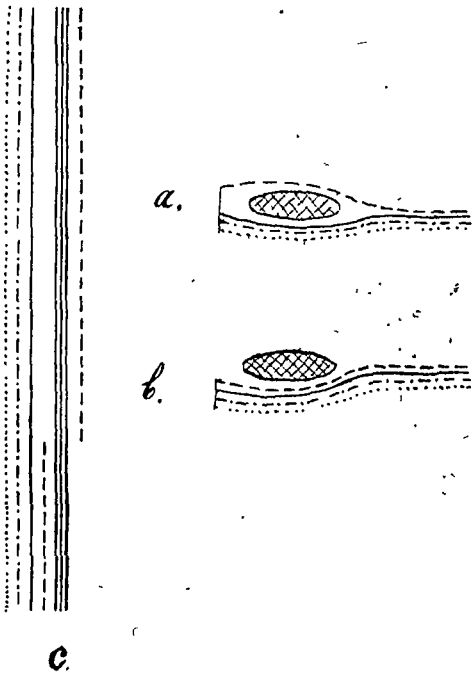

Fig. 6. Semnopithecus entellus.
(Scheme of Katarrhini).

sternum. The M. obliq. ext. (4) passes in front of the M. rectus, the Membr. interm. (3), the M. obliq. int. (2) and the M. transv. (1) form the posterior lamella of the sheath. These relations exist however only in the cranial $^3/_8$ part of the sheath; in the caudal part the M. obliq. ext. remains before the M. rectus, the M. obliq. int. and the M. transv. behind it, but the Membr. interm. passes at the lateral edge of the M. rectus into the perimysium externum of this muscle, (fig. 1*b*). These relations continue to exist till the symphysis. (Compare the sagittal section, fig. 1*c*).

With an *Ateles hypoxanthus* examined by me the relation of the M. obl. int. and Membr. intermedia to the M. rectus was different from that with *Ateles paniscus*. The M. obliq. ext. passes entirely before, the M. transv. entirely behind the M. rectus; the relations the Membr. interm. and the M. obliq. int. bear to the M. rectus are however not the same in all the parts of their course; in the cranial part both run behind the M. rectus (fig. 2*a*). About 6 cm. caudally from the inferior edge of the sternum (the total distance sternum-symphysis amounts to 12 cm.) the membrane splits into two layers one of which is passing before, the other behind the M. rectus. The M. obliq. int. continues to send its aponeurosis into the posterior lamella of the sheath (fig. 2*b*). $2^1/_2$ cm. cranially from the symphysis the two layers of the membrane terminate almost simultaneously; at the same time the M. obliq. int. changes its relation to the M. rectus: from here its aponeurosis divides itself into two layers, which include the M. rectus (vide fig. 2*c*). Fig. 2*d* gives an illustration of these different anatomical relations.

The third fig. relates to the rectal sheath of *Cebus Capucinus*. The M. obliq. ext. passes entirely before, the M. transv. entirely behind the M. rectus. The Membr. interm. passes in the cranial part, just like the M. obliq. int, behind the M. rectus (fig. 3*a*); in a caudal direction it splits into two layers, enclosing the M. rectus. the M. obliq. int. does provisionally not change its relation to the M. rectus (fig. 3*b*). Then the dorsal layer of the membrane disappears and thereupon the membrane passes entirely into the anterior lamella of the sheath (fig. 3*c*). A little farther caudally the aponeurosis of the M. obliq. int. splits into two layers (fig. 3*d*); then the deep layer disappears, so that in the caudal part the posterior lamella of the rectal sheath consists only of the aponeurosis of the M. transversus, whilst the other three elements pass in front of the M. rectus (fig. 3*e* and 3*f*).

With the condition of the rectal sheath found with *Cebus capucinus*, corresponds the structure of the sheath of all other

Platyrrhini (Mycetes niger, Chrysothrix sciurea and Hapale).

In fig. 4 are represented sections through the sheath of the M. rectus of *Man*. The M. obliq. ext. passes entirely in front of the M. rectus, the Membr. interm. fails. Cranially from the linea Douglasii the M. obliq. int. possesses two layers, and the M. transv. extends behind the M. rectus (fig. 4*a*), caudally from the linea semicircularis the aponeuroses of the three flat muscles of the abdomen are situated on the anterior surface of the M. rectus (fig. 4*b* and 4*c*).

The 5th figure relates to the sheath of a *Cercopithecus cynosurus*. As appears from the sections, the M. obliq. ext. and the membr. interm. pass entirely in front of the M. rectus, the M. obliq. int. which runs also before the M. rectus. possesses moreover in its most cranial part for a short distance a layer which passes behind the M. rectus (fig. 5*a*); soon however this layer ceases (fig. 5*b*). The M. transversus, which in the cranial part extends behind the M. rectus, sends in the caudal third part its aponeurosis likewise before the M. rectus (fig. 5*c* and 5*d*).

Figure 6 relates to the vagina M. recti of *Semnopithecus entellus*. The M. obliq. ext., the Membr. interm. and the M. obliq. int. pass entirely in front of the M. rectus. The M. transv. however runs in the cranial $^3/_4$ part of the sheath behind the M. rectus (fig. 6*a*), in the caudal 4th part its aponeurosis takes part in the forming of the anterior lamella of the sheath (fig. 6*b* and 6*c*). A condition of the vagina M. recti as represented in fig. 6, can be admitted as normal for *Katarrhini*; I found it with Cercopithecus patas, Macacus cynomolgus, Colobus gueresa, Semnopithecus entellus, Cynocephalus hamadryas, Siamanga syndactylus, Orang utan.

From this short description it appears that monkeys show great differences with regard to the composition of their rectal sheath, differences of such importance, that it seems in the beginning difficult to see a connection between all the conditions that present themselves. It will consequently be our task to try and find such a connection founded on the evidences given above. With this purpose we shall trace of each of the four elements that take part in the forming of the sheath separately how the relation is it bears to the M. rectus with the different Primates.

With Platyrrhini the *M. transversus* passes entirely into the posterior wall of the sheath, with Katarrhini and with man this condition exists only in the cranial part; in the caudal third or fourth parts the M. transv. takes part in the forming of the anterior wall of the sheath; with a Macacus rhesus I dissected, the aponeurosis

possessed at this passage for a short distance two layers, with the other Katarrhini and with man the M. transv. suddenly, with an acute line, modifies its course behind the M. rectus into a course in front of the latter.

The condition of the M. transversus, as it shows itself with Katarrhini and with man, is certainly not a primary one. The anatomy of the sheath of the M. rectus of Amphibia and Reptilia teaches us that there the M. transv. runs entirely behind the M. rectus, and the ontogeny of the abdominal musculature of Urodeles shows us that this condition is the primary one. As now moreover with all Platyrrhini the M. transv. passes behind the M. rectus, there can no longer exist any doubt; decidedly the relation which with Katarrhini and with man the M. transversus bears to the M. rectus is a secondary one. With ancestral forms of monkeys of the old world and of man the M. transversus ran behind the M. rectus, as it does still with Platyrrhini. In the phylogenetical development of these groups of Primates an influence has been at work, in consequence of which the M. rectus pierces in the caudal part the M. transv., so that the latter muscle in the caudal part is found on the anterior surface of the M. rectus.

With most Katarrhini the M. transv. modifies its relation to the M. rectus suddenly, in an acute line; with Macacus rhesus the aponeurosis of the M. transv. possessed at the modification of its direction for a short distance two layers, i.e. the M. rectus does not pierce the M. transversus here abruptly, at right angles, but gradually, so that the M. rectus is situated for a short distance in the mass of the M. transversus.

The relation of the *M. obliquus internus* to the M. rectus shows with the different monkeys also great differences. With Katarrhini the M. obliq. int. runs entirely before the M. rectus; with Ateles paniscus on the contrary entirely behind that muscle. With all Platyrrhini, with the exception of Ateles paniscus, with man and also with a Cercopithecus cynosurus I examined, we find conditions in which the relation of the internus aponeurosis to the M. rectus is quite different in the cranial part from that in the caudal one. With the majority of Platyrrhini we find that the internus apeunorosis runs in the cranial part behind the M. rectus, and in the caudal part before the M. rectus; consequently the M. rectus pierces the M. obliq. int.; usually the piercing takes place gradually at an acute angle, so that the internus aponeurosis possesses for a short distance two layers. With Ateles hypoxanthus the aponeurosis runs in the cranial part behind the M. rectus and includes in the caudal

part this muscle with two layers; with man and with Cercopithecus cynosurus on the contrary the M. obliq. int. shows in the cranial part two layers, and passes caudally entirely into the anterior wall of the Vagina M. recti.

In the relation the M. obliq. int. bears to the M. rectus consequently three types can be distinguished: the M. obliq. int. runs either entirely behind the M. rectus, or passes entirely into the anterior lamella of the sheath, or behaves differently, with regard to the M. rectus, in the cranial part than in the caudal part; now the question rises which of these conditions is the original one. It is self-evident, that the condition of the M. obliq. int. in which the relation to the M. rectus in the cranial part is so quite different from that in the caudal part will not have existed with the ancestral forms of Primates. With these doubtless the relation of the M. obliq. int. to the M. rectus will have answered to one of the two other types; consequently the M. obliq. int. has originally taken part either in the forming of the anterior or in that of the posterior lamella of the sheath of the M. rectus.

As we are compelled to admit with regard to the M. transversus, that this muscle was pierced in the course of the phylogeny by the M. rectus, it is a priori very likely that the piercing of the M. obliq. int. will depend upon the same cause that also brings about the modification in the course of the M. transv. From this simple consideration results the conclusion that originally the M. obliq. int. passed presumably behind the M. rectus.

Comparative anatomy can likewise support our view, that originally with Primates the M. obliq. int. is situated behind the M. rectus. If namely we consider the relation of this muscle to the M. rectus with different Vertebrates (MAURER) we find that with Urodeles the M. obliq. int. passes continuously into the M. rectus, with Anures this muscle exists only in the larva, with Reptiles, however, we find, that, where a M. obliq. int. exists as such, it has disengaged itself from the system of the Musculi recti and possesses an aponeurosis, that runs behind the M. rectus abdominis.

The *Membrana abdominis intermedia* with all Katarrhini takes part in the forming of the anterior lamella of the sheath; this cannot be otherwise, as both the M. obliq. ext. and the M. obliq. int. pass in front of the M. rectus. In case, however, as with Platyrrhini, the M. obliq. int. in the cranial part lies behind the M. rectus, the membrane also lies in the cranial part behind it. In the caudal part we find nowhere the membrane behind the M. rectus: with Ateles paniscus it is connected at the lateral edge with the peri-

mysium externum of this muscle, with the other Platyrrhini it runs in the caudal part in front of the M. rectus.

Again the question rises what the original relation of the membrane to the M. rectus was. As in secondary situations of the Musculi obliq. int and transversus the membrane is found in front of the M. rectus, and in the primary condition on the contrary, the membrane, — in the cranial part at least — passes behind the M. rectus, we may suppose, that, most likely, the Membr. abdominis intermedia was originally situated behind the M. rectus. This view is strengthened by considerations of the same nature as those, which we communicated regarding the M. obliq. int.; only the comparative anatomical argument cannot be applied here.

With all examined Primates the *M. obliquus externus* passes in front of the M. rectus.

The four elements that compose the sheath of the M. rectus will have taken part in the forming of the sheath, as ancestral forms of the now living Simiae and of man possessed, in such a way that the M. obliq. ext. passed in front of the M. rectus, whilst the three other elements formed the posterior lamella of the sheath.

In the phylogenetical development, however, an influence appeared, which brought about a variation in this structure, in consequence of which the M. rectus began to show an inclination to pierce the three elements, lying behind it. This piercing begins in the caudal part. The first modification that occurs, consists in the fact, that the Membr. intermedia changes the relation it bears to the M. rectus and is found to be situated in the caudal part in front of the M. rectus. Whilst the piercing-process in the membrane is continuing, the M. obliq. int. in the caudal part begins to modify its direction with regard to the M. rectus.

When then the caudal part of the M. rectus has taken its place between the Musculi obliq. and transv., the piercing-process can begin to extend itself also over the M. transversus. The modification of direction of the latter is always restricted to the caudal part, the piercing of the Membr. interm. and of the M. obliq. int. by the M. rectus can however become a complete one, i. e., the piercing can go so far, that in the end both elements are situated entirely in front of the M. rectus.

In the phylogenetical development which has taken place in the different genera of Primates, the factor, that modified the topography of the flat abdominal muscles with regard to the M. rectus, made itself felt in varying degrees, so that the Primates that live at the present moment, find themselves in all sorts of phases of transformation.

The original condition of Membr. interm., M. obliq. int. and M. transv. has least changed with Ateles paniscus. With this monkey the M. transv. and the M. obliq. int. still show their original relation to the M. rectus; the Membr. interm. lies in the cranial part also behind the M. rectus, passes then, however, into the perimysium externum of that muscle. This relation must be regarded as a condition, in which the M. rectus is situated in the mass of the membrane, in other words there exists here a beginning piercing of the membrane by the M. rectus. With the other Platyrrhini the piercing process has gone further than with Ateles paniscus, and the membrane lies then in the caudal part before the M. rectus. At the same time the piercing-process has with them extended over the M. obliq. int.; the M. transversus, however, passes still entirely behind the M. rectus.

The monkeys of the old world have removed farthest from the original condition of the structure of their sheath: with them the piercing of the Membr. interm. and of the M. obliq. int. is complete, whilst the M. transv. in the caudal part also modifies its direction with regard to the M. rectus. The structure of the sheath of the M. rectus of man forms the connecting link between those of Platyrrhini and Katarrhini. This vagina is less original than that of Platyrrhini, as in man the piercing-process extends also over the M. transversus, but because the piercing of the M. obliq. int. by the M. rectus is not yet complete, the sheath of man is at the same time more original than that of Katarrhini.

The linea semicircularis Douglasii is the line along which the transversus aponeurosis modifies its direction with regard to the M. rectus; it is formed by the last fibres of the M. transversus, which proceed behind the M. rectus towards the linea alba (with man the last fibres of the posterior layer of the aponeurosis of the M. obliq. int. take moreover part in the formation of the linea). The possession of a linea Douglasii does consequently mean, that the piercing-process that takes place in the sheath of the M. rectus, has advanced so much, that also the M. transversus is pierced in the caudal part by the M. rectus. By this explanation a new light is thrown on the dark question about the signification of the linea, a question, that, notwithstanding the different hypotheses that have been suggested, in order to explain this phenomenon in the posterior lamella of the rectal sheath, has not yet found a satisfactory solution. We need by no means be astonished at this fact, as, indeed, all investigators, who have hitherto occupied themselves with this quest-

ion, have regarded the formation of the linea Douglasii as an independent process, because they were not acquainted with the considerations communicated above, from which appears that the formation of the linea is but part of a more comprehensive process, which takes place in the rectal sheath.

Among the different theories that have been suggested about the signification of the linea Douglasii, that of GEGENBAUR has become most generally known. His hypothesis, in which the views of RETZIUS and HENLE are united, makes the Vesica urinaria and the Vasa epigastrica inferiora responsible for the occurrence of the linea Douglasii.

Objections have been made against this theory and against those of DOUGLAS and of SOLGER, from which objections we must conclude that these hypotheses are incorrect Only the theory of EISLER [1]), which is supported by the results of ontogeny and comparative anatomy, stands unattacked at the present moment. EISLER seeks the cause of the formation of the linea in the protuberation of the anterior abdominal wall, indicated as processus vaginalis, because this processus compels the fibres of the Musculi obliq. int. and transversus, which run cranially from the processus behind the M. rectus to give way ventralwards there, where the processus is, and to remove before the M. rectus.

It is obvious that the hypothesis of EISLER cannot be correct, for it tries likewise only to find a cause for the piercing of the M. transversus by the M. rectus; like all other theories previously suggested, it regards the formation of the linea Douglasii as an independent process, whilst it must only be regarded as the last phase of the piercing process that takes place in the rectal sheath.

It is consequently completely irrational to indicate for the formation of the linea Douglasii a cause that does not explain at the same time the other modifications occurring in the construction of the sheath. The question about the cause of the linea semicircularis must be replaced by the question about the inclination of the M. rectus to pierce the three elements, that originally formed the posterior lamella of the sheath of the M. rectus. Further investigations will perhaps give an answer to this question; for the present moment only the fact of the piercing can be ascertained.

[1]) In P. EISLER. "Ueber die nächste Ursache der Linea semicircularis Douglasii Verhandl. der Anat. Gesellschaft 1898" one finds described all the theories about the cause of the linea, indicated here.