

Height at shoulder $36\frac{1}{2}$ inches; from nose to root of tail over curves of body 58 inches; tail $4\frac{1}{2}$ inches. Length of horns 6 inches.

Named after Sir Frank Swettenham, Resident-General of the Federated Malay States, whose specimen appears to be the first ever shot by a European.

Mr. L. Wray, of the Perak Museum, has seen an adult male in the flesh, too decomposed to be preserved, but of which he kept the skeleton. I once had an opportunity of watching one in jungle for a minute or so not more than fifteen paces distant; and quite recently a kid was captured alive by coolies on the Larut Hills, having strayed into a wired-in tennis-court. All these were similar in colour to the one described, which may therefore be taken as a typical specimen of the Malayan species. The kid differed from the adult only in having a very narrow ring of rufous round the top of the hoof. This youngster Mr. Wray and I were particularly anxious to send home alive to the Society's Gardens under the charge of Mr. Keilich, of the Perak Museum, who was shortly proceeding to England, but unfortunately it died after five or six days' captivity. The specimen is now in the Museum along with the adult.

Although this Serow is so little known to Europeans the horns are occasionally obtained from the Sakai tribes of the hills, and I have notes of a dozen pairs as follows:— $8\frac{1}{4}$ inches, 8, $7\frac{1}{2}$, $7\frac{1}{4}$, $6\frac{3}{4}$, $6\frac{3}{4}$, $6\frac{1}{2}$, $6\frac{3}{8}$, $6\frac{3}{8}$, $6\frac{1}{8}$, 6, 6. Eight inches appears to be a good head.

The Malay name for this animal is "Kambing grun," *i. e.* "Cave-Goat."

It is found on the mountains of the Peninsula from 2000 ft. to 4000 ft. altitude, and is said also to occur on various isolated limestone hills of much lower elevation.

The peculiar circumstances under which Sir Frank shot his specimen were narrated in the 'Sketch' of April 26, 1899, p. 22, the article being illustrated with a photo of the mounted animal. Sir Frank was taking a photograph one afternoon when the Serow was noticed on the hill beneath him, apparently quite fascinated by the appearance of the cloth-covered camera on its tripod. It remained motionless, still gazing intently at the camera, while a rifle was sent for, when an accurate shot brought it to bag.

3. The Significance of the Hair-Slope in certain Mammals.

By WALTER KIDD, M.D., F.Z.S.

[Received March 27, 1900.]

The following observations were suggested by a study of the well-known peculiarity as to the direction in which the hairs slope on the extensor surface of the human fore-arm. In 'Nature,' vol. lv. p. 236, I drew attention to certain considerations affecting the "vestigial" character of this hair-slope, and pointed out that most hair-clad mammals, except Ungulates, present much the

same direction of slope of hair in this region as Man. From this I was led to suggest that the direction in question is due to pressure of the weight of the fore part of the body acting downwards and forwards, and that the resultant of these two forces, in the cases of Carnivores and other animals accustomed to a "couchant" attitude when at rest, would tend to direct the slope of the hair away from the manus on the extensor surface of this limb-segment. As a matter of fact this slope is found in nearly all Carnivores, wild and domesticated, in which the hair is short enough to allow of its observation. On the other hand, in most Ungulates one finds that the slope on this extensor surface does not present the reversed curl of hair found in Carnivores and Primates. This rule is far from universal: *e. g.*, the Elk, Domestic Horse, and 4 Antelopes present on this limb-segment, over the distal fourth, a slope towards the radial border; and further, 11 Antelopes and 20 Cervidæ examined have a slope hardly differing from that of Carnivores (see subsequent remarks, p. 686). From this basis of fact I suggested that the hair-slope in Ungulates assumes this direction, which is more in accordance with the general slope of hair in other regions of the limbs, and so differs from that of Primates and Carnivores, because of the attitude assumed by Ungulates when at rest. These animals so commonly rest with the extensor surface in question resting on the carpus and manus in flexion, in other words with the fore-limb doubled underneath the body, that any pressure downwards on this area of hair serves only to confirm its manus-ward slope, there being no horizontal force acting with the vertical to produce a forward slide, as must always be the case in the "couchant" attitude of Carnivores.

Following up this point, in 'Natural Science,' Nov. 1897, p. 357, I made a short note of the bearing of these facts on the doctrine of the non-inheritance of acquired characters.

This matter has now been investigated somewhat further in a different region of the bodies of hair-clad mammals, namely, the frontal, nasal, and premaxillary areas. I find among the different mammalian orders some singular divergences in the arrangement of this hairy surface. Here is a part of the body very much open to inspection, and one which from its prominent position must be subject to the action of tolerably constant external forces, differing necessarily in different forms, according to their environments.

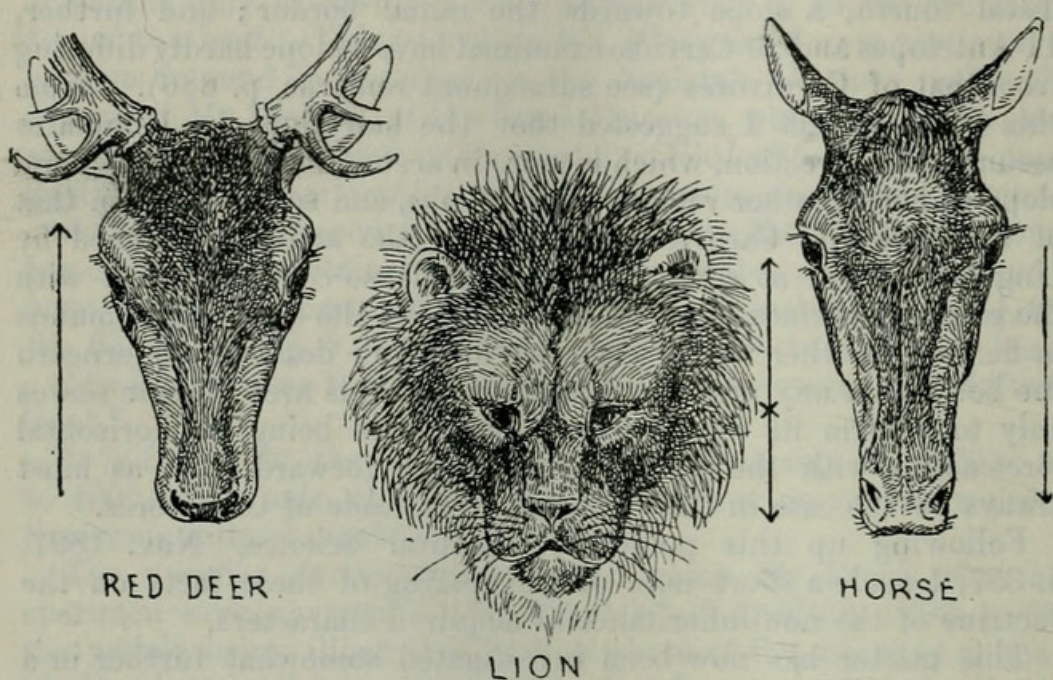
It is not possible to understand enough of the daily lives of many of the animals referred to below, but of some we may claim to know certain forces which cannot but act upon them in certain directions. A few of these will be considered later.

The most common hair-covered mammals occur among Primates, Insectivores, Carnivores, Ungulates, Rodents, Marsupials, and Monotremes.

The great majority of these conform to a certain general distribution and slope of the hair in this region of the head. This slope ordinarily commences in the premaxillary area just above the

muzzle with a small whorl or star, and the hair passes in two streams along the nasal up to the frontal area, diverging on its way in a fan-shaped fashion, to coalesce on either side with the hair round the orbits and that of the face and neck. In many forms, chiefly those with short hair, a clearly defined "parting" is found in the middle line of the nasal and frontal regions; in those with longer and thicker hair no such "parting" is visible. At about the junction of the frontal and parietal bones there is commonly a further whorl or star, at which point further divergences of hair-streams take place. This, which I would call for convenience the Ordinary Type, can be seen in many hair-covered mammals, especially those in which the hair is rather short. (See fig. 1, Red Deer.)

Fig. 1.



Types of heads showing hair-slope on frontal and nasal regions, arrows indicating general direction of slope.

I need do no more than enumerate those groups of animals which conform to the Ordinary Type.

1. MONOTREMES.—The fur of *Ornithorhynchus* and the spines of *Echidna* present this ordinary type of slope.
2. MARSUPIALS.
3. RODENTS.
4. INSECTIVORES.
5. UNGULATES.—Among the representatives of this great order, Ovidæ; Antilopidæ (except those mentioned below); Cervidæ; Capra; Suidæ (except one form noted); Camelidæ and Giraffidæ (peculiar and noted more particularly below); Hyracoidea; so far as observed, all present the Ordinary Type.

6. CARNIVORES.—Among these, Ursidæ; Procyonidæ (except the Great Panda); Mustelidæ; Otariidæ; Phocidæ; Trichechidæ; Viverridæ, and Canidæ conform to the Ordinary Type.
7. PRIMATES.—Lemuridæ mostly present this type, thus differing from the type found in Monkeys and Anthropoid Apes and in Man, which will be described later.

It is more particularly those instances among Carnivores and Ungulates, departing from the Ordinary Type, to which I desire to draw attention.

So far as I have been able to ascertain from a great number of specimens, living and dead, among Carnivores the great majority follow the Ordinary Type. The exceptions observed are somewhat remarkable—viz., *Felis leo*, *F. tigris*, *F. pardus*, *F. onca*, *F. concolor*, *F. lynx*, *F. jubatus*, and the Domestic Cat. In these animals so decidedly marked off, by their deep and massive muzzle, from the smaller and more numerous allies of the Felidæ, the direction of the slope of hair on the nasal region is towards the external nares, beginning from a whorl which is situated about midway between the level of the orbits and the external nares. From this whorl there is no interruption to the straight line taken by the hair-slope till it reaches the muzzle. (See Lion, fig. 1, p. 678.)

One singular exception to the Ordinary Type is found in the Panda (*Æluropus melanoleucus*), and in this animal the whorl is found slightly nearer to the external nares than that of the larger Felidæ, and the slope thence to the nares resembles theirs. The Panda and the larger Felidæ, it may be remembered, have all massive, deep muzzles.

As to Carnivores, then, it appears that all Dogs, Foxes, Wolves, Jackals, Smaller Cats, nearly all Bears, Racoons, Seals, Walruses, Weasels, Badgers, Otters, Skunks, present the Ordinary Type of hair-slope on the nasal and frontal regions.

These are all animals with elongated, more or less pointed snouts. The exceptions brought forward—Lion, Tiger, Leopard, Puma, Jaguar, Lynx, Cheetah, Panda—are those of animals with deep, massive snouts.

UNGULATES furnish a greater number of exceptions to the Ordinary Type than any other group of mammals. It has been seen that the majority even of this order are, so to speak, normal.

The exceptions which have been noted are as follows:—

Bovidæ, or True Oxen.

<i>Bos indicus</i> ,	} present a uniform slope from a whorl between the insertion of the horns to a point just above the margin of the muzzle, where a secondary small whorl is found.
<i>Bos frontalis</i> ,	
<i>Bos sondaicus</i> ,	
<i>Bos taurus</i> (or	
Congo Buffalo),	

Bos depressicornis.—Slope passes from a whorl close below the

level of the orbits to the margin of the muzzle, where a secondary whorl is found.

Bos taurus or Chillingham Wild Cattle.—Of two specimens, one shows the whorl above, the other below the level of the orbits.

Bos bubalis, } present a bi-lateral whorl below the level of
Bos mindorensis, } the orbits.

Bos coffer.—Here the hair slopes uniformly from the whorl at the base of the great united horns to the small secondary whorl close to the margin of the muzzle.

Bos grunniens, } present thick long hair sloping to the small
Bos bonasas, } secondary whorl above the muzzle-margin,
Ovibos moschatus, } from the base of the horns, no primary whorl
Bos americanus, } here being visible.

Antelopes. Among these the exceptions are :—

Oryx beisa, }
Bubalis swaynei, } primary whorl ranging from a position
Bubalis tora, } just below the base of the horns to the
Bubalis tragocamelus, } level of the orbits, and small secondary
White-bearded Gnu, } whorl close to muzzle.
Blue-brindled Gnu, }

Saiga tartarica.—Muzzle shaped like that of Tapirs. Hair slopes from bilateral whorls, situated a little below the level of the orbits, towards the nares. Just above the nares is found a secondary whorl, in one female specimen; and in a male specimen there is a third whorl between the two other whorls. In this specimen the downward slope is thus broken up in its course.

Reindeer (*Cervus tarandus*).—Shows a whorl immediately above the margin of the muzzle, from which the stream of hair passes very closely in the long axis of the head over the convex rounded upper lip to the level of the horns.

Equidae.—All of those that I have been able to examine are exceptions to the Ordinary Type. (See fig. 1, Horse.)

Zebra has the whorl varying slightly above or slightly below the level of the orbits.

Quagga has the whorl nearer to the ears than *Zebra*.

Equus asinus (African Wild Ass) has the whorl at the level of the orbits.

Equus hemionus (Asiatic Wild Ass) has the whorl below the level of the orbits.

Equus caballus, at the level of the orbits.

The *Domestic Horse*, *Ass*, and *Mule* differ one from the other as to the position of the whorl as follows :—In the Horse it is at or just below the level of the orbits. In the Domestic Ass, which appears to be the tamed *Equus asinus*, it is midway between the level of the orbits and the muzzle. (In this connexion the great

relative size of the head of the Ass may be noted.) In the Mule it is not quite so far towards the muzzle as in the case of the Ass.

In the Tapirs the snout is elongated and curved gently towards the ventral surface in a very uncommon form. It thus differs from other elongated snouts, which are not only elongated but straight as a rule. In Tapirs the direction of the hair-slope is uniformly towards the muzzle.

Among the *Suidæ*, the only exception observed was the *Phacochoerus* or Wart-Hog, which presents a notable bristling whorl of hair, unusually far from the snout for a pointed head, such as this form shares with other *Suidæ*. This whorl is nearly midway between the nares and the level of the orbit.

The *Giraffidæ* and *Camelidæ* show the Ordinary Type of slope in the nasal and frontal regions, but on the broad thick upper lip the hair is arranged in a fan-shaped way, diverging from the level of the nares to the margin of the upper lip.

Primates.—In the case of the Primates, the whorl from which the hair of the frontal, nasal, orbital, and facial regions diverges is situated in most forms at the level of the orbits; and thus this great group, including Man, conforms to the exceptional type.

It is not claimed that these observations are exhaustive for all hair-covered mammals, but they are certainly quite representative. It comes then to this, that from the great majority of mammals there stand out in marked contrast to them, in respect to this character, seven *Felidæ*, one of the *Procyonidæ*, one of the *Ursidæ*, seven Antelopes, all Tapirs and *Equidæ* examined, thirteen *Bovidæ*, and one of the *Suidæ*, and Primates except *Lemuridæ*.

It appears desirable to ascertain, if possible, what characteristics are common to these rather divergent types of animal life, or what is common to them in the way of habits or environments.

In the first place, it may be suggested that this exceptional slope of hair is correlated with a deep, massive, somewhat truncated muzzle. It is clear that the more ordinary type is found in animals with pointed muzzles. It is equally clear that the larger *Felidæ* and the Domestic Cat have the exceptional form of hair-slope, correlated with the different types of muzzle referred to. This is also found in the Panda (*Ailuropus melanoleucus*). But among the *Antelopidæ* and *Bovidæ* specified, the Tapirs, and *Equidæ*, this type of snout is not marked enough to enable one to generalize as to this correlation. It is relatively not nearly so massive or deep as in *Felidæ*. It can, then, hardly be maintained that the exceptional slope is merely correlated with a certain type of snout.

Again, the *pose* of the head in rest, or its carriage when in motion, may have a bearing on the point. It cannot be that the *pose* of the head can effect the "set" of the hair in many cases by the action of gravity, for most of these are short-haired. But it is a fact that the larger *Felidæ*, the Panda, the specified Antelopes, *e. g.* the Gnus, the *Bovidæ*, Tapirs, and *Equidæ* carry their heads more set at an obtuse, or some at a right, angle to the longitudinal

axis of the body than those animals with pointed snouts. To such a rule there must be many exceptions, but a rule it is.

The fore-end of animals is necessarily subjected to numerous forces in the course of their wild life, and it seems a fair inference to draw, that the differences of "set" of hair on this prominent region are determined by different factors, such as the prevailing attitude of the head, habits, and environments. The hair-slope must break or "part" somewhere in the frontal or nasal region, and it may need but little in the way of difference in the angle of incidence of wind, tropical rain, pressure against undergrowth, burrowing in the ground, rooting in swamps or marshy ground, and, finally, method of cleaning the fur, to determine that point at which a whorl shall be established, and inherited in the course of many generations. These are no more than suggestions to account for some singular divergences in a very insignificant character, which have come about by some means or other, and they agree, in their way, with the suggested reason for the peculiar hair-slope on the extensor surface of the forearm of Man, certain Monkeys, and Carnivores.

There is some support for this view in the striking whorl with divergence of colour, so generally seen over the tuberosities of the ischia of short-haired Dogs, and the bare spots and callosities on the corresponding parts of many Monkeys, for both of these forms of animals are notoriously fond of sitting on their haunches. Another "abnormality" of set of hair for which one can see no explanation, is that strange slope towards the cephalic end, which is seen on the middle line of the dorsal region of some Antelopes. This may even start from a whorl over the sacral region, and pass thence right up to the horns, as in *Oryx beisa*, or from a whorl in the mid-dorsal region, as in *Cobus ellipsiprymnus*. In cases such as these, it may be that a fuller knowledge of the habits of such animals would provide a reason for so strange a departure.

APPENDIX.

I have ventured to make a short addition to this paper containing some notes illustrated by two diagrams, which, I think, lead to similar conclusions. They represent three regions of the domesticated Horse, an animal especially useful for investigation on account of the great numbers of individuals open to our inspection, and because it is an animal whose business in life is to walk, trot, canter, or gallop, and since it has been domesticated by man it has probably led, more than any other animal, a locomotive life.

Three regions of the Horse's body are illustrated :—

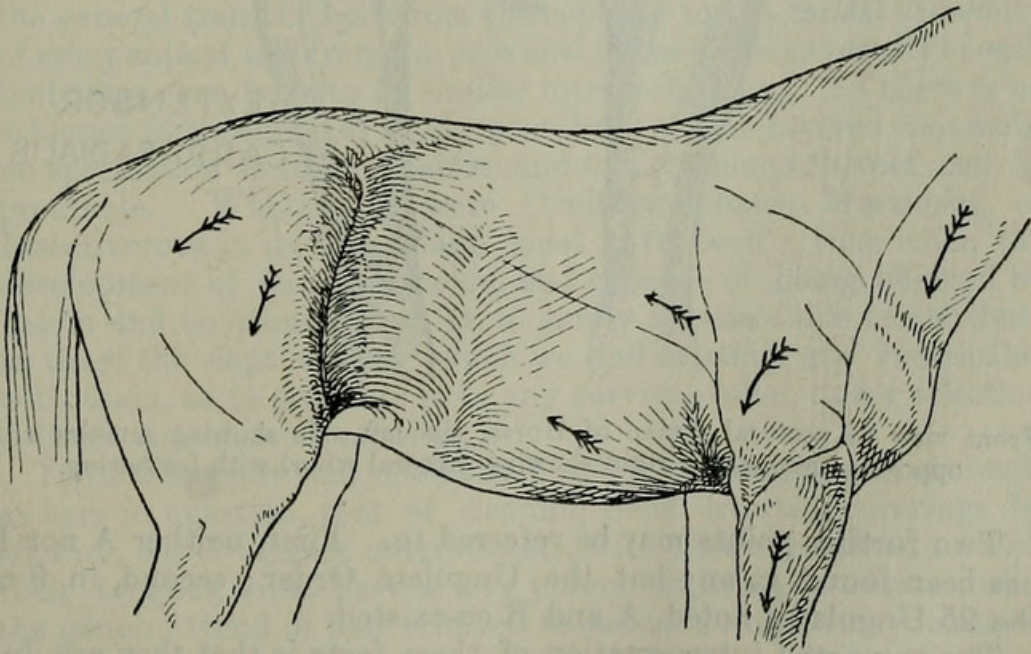
A. *Inguinal*.—Here is exhibited the well-known whorl from which a "feathering" starts, at the edge of the skin-fold of this region, opposite to the level of the patella, extending up the hollow of the flank, with a feather-shaped arrangement of the hair, to the level of the crest of the ilium, where it terminates, sharply

and with great uniformity, in a raised ridge of hair. The "feathering" diverges on each side, that on the gluteal region merging easily into the general hair-stream of this part, and the stream which passes on to the thorax sweeps more widely forward and curves again to the ventral surface, uniting with the hair-stream of the thorax.

This character in Horses is universal, and I have found it present, more or less marked, in 25 other forms of Ungulates (see Notes, p. 686).

B. *Post-humeral or axillary*.—This whorl, with occasionally a "feathering" arising from it, lies in the hollow between the great mass of extensor muscles of the fore-limb and the muscles of the thorax. It has been found by me in 87 Horses out of a very large number examined. In two of these it was unilateral; and of these 87, 57 were cart-horses, though the proportion of cart-horses examined was very small. In regard to this fact, it may be noted that in cart-horses the action of the shoulder-joint preponderates considerably over that of the carpal and metacarpophalangeal joints. One special group of 2159 Horses examined gave 42 cases of this feature, or nearly 2 per cent. I would suggest that this is a specially interesting case of a new character, like the more stable inguinal and pectoral whorls, being developed before our eyes. This whorl has also been noted in 16 other forms of Ungulates. (See Notes, p. 686.)

Fig. 2.

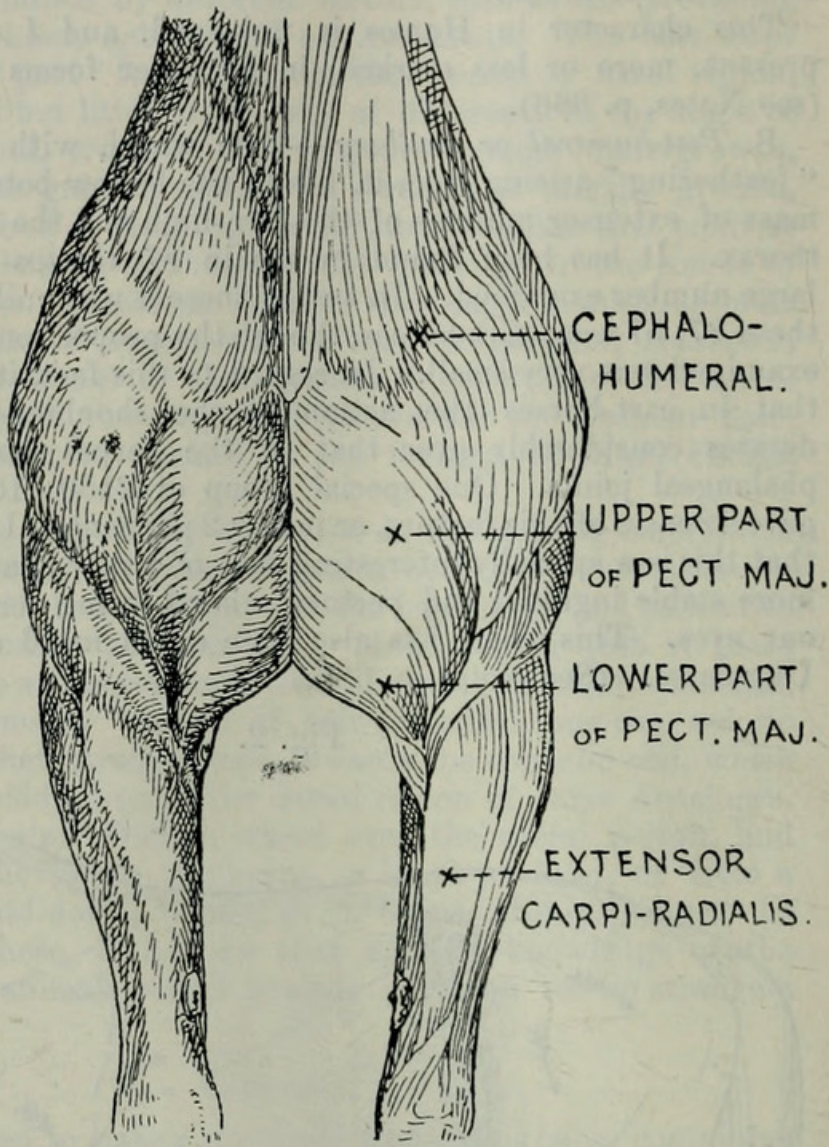


View of Horse showing post-humeral and inguinal whorls with feathering, arrows indicating directions of opposing muscles.

C. *Pectoral*.—This whorl (see fig. 3, p. 684) with oval "feathering" is bilateral, and extends from a point about at the level of the olecranon process over the mass of the pectoral muscles in a

line nearly parallel with the mesial plane. This is universal in Horses, and much more general than either A or B, being found in most Ungulates and Carnivores.

Fig. 3.



Front view of pectoral region of Horse, the left side showing muscles with opposing actions, the right showing pectoral whorl with feathering.

Two further points may be referred to. First, neither A nor B has been found in any but the Ungulate Order; second, in 9 of the 25 Ungulates noted, A and B co-existed.

The suggested interpretation of these facts is that they are due to the effect on the plastic hair-streams of the markedly divergent traction of the underlying muscles. These are seen to have a striking opportunity of influencing the structures lying over them, in each of the three regions alluded to, by a reference to the diagrams.

All the characters of hair-slope here referred to may be taken as congenital. Being then inherited they may have arisen in certain ancestors in one of the three ways:—

1. They may have been due to selection (*Natural*, i. e. *Personal*, *Sexual* or *Germinal*).

2. They may have arisen from the action of habits or environments—Lamarckian factors; or,

3. They may be vestigial.

Considering that, so far as it is possible to understand animal life, the survival-value of these differences of hair-slope is *nil*, natural selection and germinal selection may be put aside as accounting for them.

Though the slope on the extensor surface of the fore-arm is claimed to be vestigial, these peculiarities are not so claimed, and cannot be, in the face of the very tangled relationships which are presented.

The possibility of accounting for them by sexual selection must be considered; but as some of these divergences of slope are difficult for a human eye to discover at close quarters, and as usually no markings or coloration are attached to them¹, this theory cannot be seriously entertained.

If it may be fairly held that these exceptional forms of slope of hair found on the head, dorsal region, fore-arm, and gluteal region, indicate the working of certain Lamarckian factors, there is a much greater body of evidence pointing in a similar direction, viz., all those hairy mammals which conform to the ordinary type. Indeed the general trend of hair from the cephalic to the caudal extremity of every animal, and from the proximal to the distal extremity of each limb, may even be open to similar interpretations. As there is no evidence forthcoming as to the prototype of hair-covered mammals, no speculation as to the habits and environments thereof can be profitable. Whether it were Ornithodelphous, Marsupial, or Insectivorous in its type, there must have been a time when the development of hair was feeble, and capable of being affected by habits and environments. It is surely as reasonable to attribute to these the slope of hair which we find existing, and compatible with them, as to attribute it to any survival-value, under selection—if not considerably more so.

I would suggest that one habit which is common to such animals as here in question, that of cleaning their external coverings by friction, either against other objects, with their fore-paws, or with their tongues, must have a very potent influence in determining the general trend of hair referred to as found on all hairy animals. It is obvious that such forces must in the main act in the direction indicated.

¹ The "star" or "blaze" on Horses is one of the comparatively few instances of markings in this region; but *Equus caballus* is not an animal in a state of nature, and has been so much modified by artificial selection as to prevent this combination of markings and exceptional hair-slope from being brought under Sexual Selection.

In view of these considerations, it seems difficult to deny that cases of inheritance of acquired characters have been brought forward. It would appear at any rate to be a choice between this Lamarckian interpretation and the view of Professor Weismann, that these useful directions of variation have been produced by the adaptive requirement, by means of selectional processes within the germ.

NOTES.

Exceptions found among Ungulates to ordinary slope on extensor surface of ulna are as follows:—

Oryx gazella. *Oryx beisa*. *Strepsiceros kudu*. *Oreas canna*. *Alces machlis*. *Raphicerus campestris*. *Raphicerus melanotis*. *Ourebia nigricaudata*. *Ourebia hastata*. *Tetracerus quadricornis*. *Nesotragus moschatus*. *Cephalophus grimmi*, *C. rufilatus*, *C. leucogastris*, *C. abyssinicus*, *C. doriae*. *Pudua humilis*. *Moschus moschiferus*. *Xenelaphus antisiensis*. *Hydropotes inermis*. *Dorcelaphus bezoarticus*, *D. americanus*, *D. hemionus*. *Cervulus muntjac*, *C. reevesi*, *C. lachrymans*. *Capreolus caprea*. *Elaphodus michianus*. *Cervus alfredi*, *C. porcinus*, *C. axis*, *C. duvauceli*, *C. elaphus*, *C. dama*, *C. cashmirianus*.

Also certain Chevrotains and Suidæ noted.

Re A. Ungulates in which an Inguinal Whorl is found.

Bubalis caama. *Rangifer tarandus*. *Cervicapra fulvorufula*. *Cervicapra arundinum*. *Cobus thomasi*, *C. buffoni*, *C. vardoni*, *C. leche*. *Equus hemionus*. *Bos sondaicus*, *B. indicus*. *Ovis ophion*, *O. ammon*, *O. sairensis*, *O. poli*. *Capra pyrenaica*. *Saiga tartarica* (present in male, absent in female). *Gazella granti*, *G. mhorr*. *Antilocapra americana*. *Cephalophus dorsalis*. *Cervus kuhli*, *C. elaphus*. *Camelus bactrianus*. *Lama huanacus*.

Re B. Ungulates in which a Post-Humeral Whorl is found.

Strepsiceros kudu. *Rangifer tarandus*. *Cobus leche*. *Equus hemionus*. *Equus burchelli* (young). *Bos sondaicus*, *B. depressicornis*. *Ovis ophion*, *O. ammon*, *O. sairensis*, *O. poli*. *Antilocapra americana*. *Dorcelaphus americanus*, *D. dichotomus*. *Elaphurus davidianus*. *Lama huanacus*.

4. On the Structure and Anatomy of the Musk-Ox (*Ovibos moschatus*). By Dr. EINAR LÖNNBERG.

[Received April 25, 1900.]

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 „ 2. Description of the Hoofs, p. 694.
 „ 3. Description of the Skull, p. 695.
 „ 4. Comparison between the Skull of *Ovibos* and that of *Budorcas*,
 p. 715.

In further elucidation of the relationships of the Musk-ox, I beg leave to offer the following remarks in continuation of those read before the Society on February 20th last¹.

¹ See P. Z. S. 1900, p. 142.



Kidd, Walter Aubrey. 1900. "The Significance of the Hair-Slope in certain Mammals." *Proceedings of the Zoological Society of London* 1900, 676–686.
<https://doi.org/10.1111/j.1096-3642.1890.tb01732.x>.

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