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Some Morphological Observations on Two Hair Types in the Shepherd Dog¹⁾

By

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(With 24 Textfigures and 2 Tables)

As regards the nature of hairs in the shepherd dog, it is generally known that the pelage can be divided into two kinds, namely the short-coated and the long-coated, the former being the common type, while the latter occurs rather frequently in kennel. The writer at the suggestion of Prof. T. Uchida began to study the mensural difference of the hairs and continued the histological work of them under the supervision of Prof. S. Makino. It must be noted that shepherd dog with long coats are not welcomed, because they are far apart from the standard type. They are generally removed two or three weeks after their birth. According to Whitney (1937), the long-coated pelage in dogs is almost completely recessive to the short-coated in inheritance.

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Histological Observations

So far as the hairs in domestic and laboratory mammals (Toldt 1912, Röther 1923, Abe 1930, Shackelford 1948, etc.) have been histologically studied, the pelage of these animals consists of two extremely distinct types of hairs which can be designated apparently as the underfur and the guard hair. Several investigators classify the guard hair again into the first guard hair (or over hair) and the secondary guard hair (or middle hair). The hairs composing the underfur are shorter, thinner, and more numerous than the guard hair. In general the guard hairs project over the

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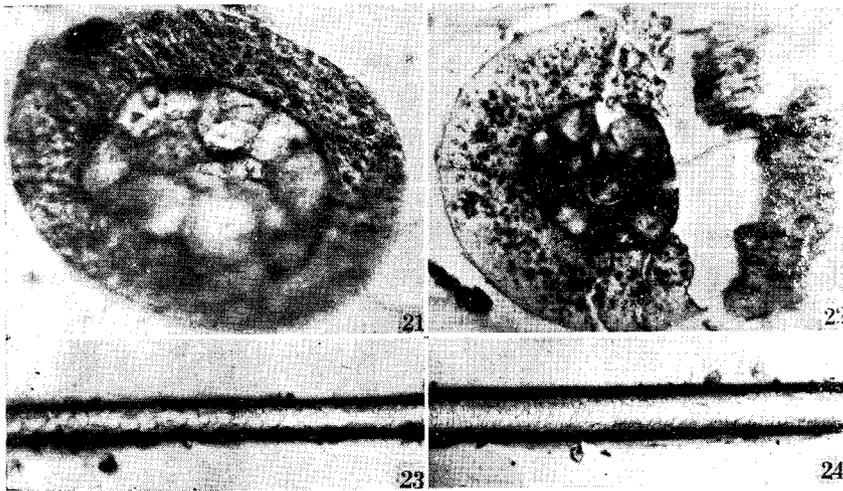
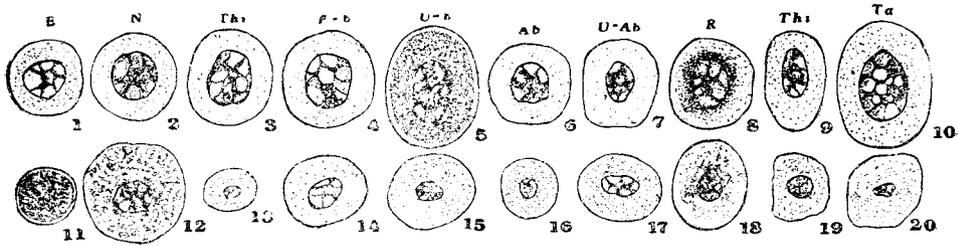
underfur about one fourth or one third of their total length.

When microscopically studied, there can be seen in the definitive hair of the dog, three distinct parts as in other mammals. The outermost layer is composed of a cuticular layer and cuticular scales arranged in shingle fashion on the surface with the overhanging edges toward the tip of the hair. The central part, which is called as the medulla surrounded by the cortex of keratinized cells, is composed of cells loosely arranged with many intercommunicating spaces. There are heavily scattered pigment granules near the circumference of the medulla. In the hairs of the underfur the medulla usually discontinuous throughout its total length.

Since the guard hair seems to be diagnostic for comparison of its nature, the present observations have been limited to hair of this type. Whole amounts and cross sections of the guard hairs have been taken for microscopical study. The samples of hairs were plucked from eleven parts of the body such as the root of the ear, neck, back, rump, thigh, throat, front-breast, under-breast, abdomen, the under side of abdomen, and the ventral side of tail. They were obtained from fourteen living animals in early summer of 1948 after the completion of the spring moult. The hairs of these areas are highly remarkable in appearance, being comparatively longer in length than those of found in other places, except for the root of the ear. The hair is one of very difficult materials to section without tearing. The following method was attempted to obtain undamaged cross sections according to the advice of Professor S. Makino. After having been cleaned by washing and allowed to dry at room temperature, both ends of the hair were binded to a little "コ" shaped wire as a bowstring, so as to hold the hair straight. They were dipped in a mixture of xylol and creosote for two or three hours, and allowed to soak in cedar oil overnight. Then they were washed in xylol about five minutes, and imbedded in paraffin in the usual manner. The sections were prepared ten micra thick at the part 10-20 mm far from the root. They were stained in Delafields haematoxylin with a counter-staining of eosin. For the surface observation of hair, the SUMP-method was applied.

The microscopical observations on cross sections of hairs revealed that in general the hairs from the throat, the root of the ear and the back were slender in appearance. Strictry to say, the hairs of the dorsal parts of body such as the root of ear, neck, back, and rump are in cross section evidently nearly round, having rather thick medulla, whereas the hairs of the thigh and the ventral parts of body such as the throat, breast, abdomen, and tail are characterized as a whole in having somewhat irregular outline in section, not fairly round, carrying the thin medulla. In the hairs heavily pigmented the three structural components, the medulla, cortex and cuticle, are rather conspicuous, while in these little or not

pigmented a border between the cortex and cuticle is much less distinct than in the former.



Figs. 1-20. Camera-lucida drawings from cross sections of guard hairs plucked out of various parts of body by way of comparison between two forms of dogs. E; root of the ear. N; neck. Thr; throat. F-b; front-breast. U-b; under-breast. Ab; abdomen. U-Ab; under-abdomen. R; rump. Thi; thigh. Ta; tail.

Figs. 21-22. Photomicrographs of cross sections of guard hairs taken from the backs of the short-coated (21), and long-coated (22).

Figs. 23-24. Superficial views of the outermost scales of the guard hairs from the rumps of the short-coated (23), and long-coated (24), by SUMP-method.

The comparison of the guard hairs indicated some noticeable differences as regards the nature of medulla between two forms of the shepherd dog, namely the long-coated and the short-coated. Though the hairs of both forms are approximately round or oval in cross section and the same is said with the shape of medulla, but the striking difference exists in the fact that the medulla of hair in the long-coated dog is characterized in

being extremely thinner in diameter than that in the short-coated dog, irrespective of the thickness of hair. Therefore, the former is seen in general appearance to be more pliant as compared with the latter which seems rather fragile in nature. Moreover, the cells composing the medulla are more numerous in number in the hair of the short-coated dog than in that of the long-coated animal. There can be seen some differences in the arrangement of cells in the medulla which is more complicated in the hair of the long-coated dog than in the short-coated dog. Besides, the outermost scales covering the cuticle are strikingly larger in the short-coated than in the long-coated, when examined the hairs taken from the rump of animal. The series of events above mentioned may be well understood by reference to the annexed figures given in Figs. 1-24.

Mensural Observations

As is mentioned above, from cross sections of the guard hair it can be pointed out some histological differences between the long-coated and the short-coated dogs under study. The mensural study involving both length and thickness of hair also furnished here the data which suggest some differences between the two forms of dogs herein considered.

Out of fourteen animals, which were chosen for this study ten are short-coated and the remaining four are long-coated. Ten hairs in each were plucked as samples from the eleven parts of the body in the same manner as described in the previous section. They were fixed with paste on a white cardboard to hold them straight. The length of hairs was measured from the root to the tip with the aid of the vernier calliper. The measurement of thickness was made under microscope with the whole amounts of hairs which were prepared on a slide glass. The so-called short- or long-haired dogs are not only determined by the length and thickness of their hair, but also by other factors such as the direction of hairs growing from the skin and the nature of hairs, curled or straight. However, the writer has given the results of measurements regarding the length and thickness of hairs from various parts of body as is summarized in Table 1 and Table 2.

As is obvious by referring to the above tables, the long-coated dogs show a general tendency to possess the longer hair than the short-coated dogs. But, it is not always true that the long-coated dogs are characterized by having the longer hair in all parts of body than the short-coated dogs. For instance, the hairs from the tail are generally longer in the short-coated dogs than in the long-coated ones. It is also notable from Table 2 that the hairs composing the pelage of the short-coated dog are slightly thinner in thickness than those of the long-coated dog.

Table 1. Results of measurement of hair length in various parts of body, showing the range of variation. (Average from 10 specimens in the short-coated, and from 4 specimens in the long-coated).

	Short-coated(mm)	Long-coated(mm)
Root of ear	25.97 - 30.57	54.52 - 62.89
Neck	57.15 - 62.76	80.87 - 90.73
Back	54.66 - 62.61	81.10 - 89.42
Rump	56.14 - 61.12	63.55 - 88.79
Thigh	84.92 - 90.70	123.64 - 132.86
Throat	41.25 - 47.33	65.27 - 72.82
Front-breast	38.53 - 45.10	61.92 - 68.25
Under-breast	54.19 - 63.89	86.33 - 97.16
Abdomen	68.72 - 60.31	92.79 - 102.08
Under-abdomen	62.60 - 69.06	57.06 - 92.44
Tail	112.17 - 118.29	111.00 - 117.83

Table 2. Average value of thickness of hair.

	Short-coated(μ)	Long-coated(μ)
Root of ear	6.65	5.32
Neck	9.60	10.22
Back	7.46	4.89
Rump	9.09	9.79
Thigh	10.07	9.20
Throat	9.44	6.39
Front-breast	8.79	7.67
Under-breast	8.64	7.67
Abdomen	7.88	8.09
Under-abdomen	7.31	9.79
Tail	10.52	10.86

Summary

The present study deals with some histological and mensural differences of hairs in the pelage of the long-coated and short-coated forms found in shepherd dogs.

The comparison of the guard hair revealed some notable differences in regard to the nature of medulla between the two forms under study. The medulla of hair in the long-coated dog is extremely thinner in diameter than that in the short-coated dog, irrespective of the thickness of hair. The cells forming the medulla are more numerous in number in the hair of the short-coated dog than that of the long-coated animal. The arrangement of cells in the medulla of the hair of the long-coated dog is more complicated than in the short-coated dog. The outermost scales covering the cuticle are strikingly larger in the short-coated dog than in the long-coated.

The results of measurements of both length and thickness of hairs

from various parts of body are given in Tables 1 and 2. Noticeable is that it is not always true that the long-coated dogs are characterized by having the longer hair in all parts of body than the short-coated dogs.

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