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# A Comparison of Mammal Skin Tissues

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# A COMPARISON OF MAMMAL SKIN TISSUES

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# A COMPARISON OF MAMMAL SKIN TISSUES

# I INTRODUCTION

This paper or problem will be devoted to a study of the histology of mammal skins. The human skin or integument will be written up in detail, for many research studies have already been made on this structure. The written work of other skin tissues, such as dog, bat, cow, rabbit and squirrel will be the research of this student.

The microphotographs and free-hand drawings are original visual aids included to supplement this research study.

## II HUMAN INTEGUMENT

According to Edwards, the skin, or integument, envelops the entire surface of the body. The integument even covers the conjunctiva or surface of the eyeball, and is continuous with the mucous membranes of the nostrils, mouth, anus, and genital openings.

Many books estimate that the area of skin on a medium size adult male would cover approximately 18 square feet, but would vary from individual to individual because of their size differences.

The skin also varies considerably in thickness on different parts of the body. The thickest portion is on the palms of the hands and soles of the feet, where the thickness increases due to use, as is evident by the presence of corns and calluses. The skin is thinnest in areas such as the conjunctiva of the eyeball, where light waves are allowed to pass through readily. The eyelids are also quite thin, which a person may observe by closing his eyes and facing the light.[1]

Maximow and Bloom contend that the integument functions for the body in various ways. It protects the body from injurious external forces, excretes a variety of chemicals, and helps to regulate the body temperature of warm-blooded animals. Additional structures such

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[1]L. F. Edwards, Concise Anatomy (2nd ed. rev.; New York: McGraw-Hill Book Co., Inc., 1956), p. 95.

as hair, nails, and glands are prevalent in or on the skin. Numerous ridges can be seen with the naked eye on the surface of the skin. These ridges pass in various directions, form a network by crossing each other, and sometimes unite. On the soles, palms, and surfaces of the fingers and toes, man portrays a regular pattern of parallel ridges which form complicated configurations. These patterns or ridges are commonly known as fingerprints.[2]

The skin is composed of two distinct portions. The external region, the epidermis, is composed of stratified epithelial tissue. The inner region, the dermis or corium, is composed of a more fibrous tissue.

The epidermis is divided into at least two layers. The outermost layer is known as the stratum corneum and the innermost layer is subdivided into the strata germinativum and malpighi. The strata granulosum and lucidum are only recognizable in certain situations, as in the palm and the sole.

The stratum corneum is composed of stratified squamous epithelium. This represents a modification of the stratum germinativum, which is composed of basal columnar epithelium. In the palms and soles, the thick stratum corneum consists of many layers of cornified cells. Edwards also expresses that, "the intercellular bridges found in other strata are absent, and the spinous margins of the densely packed cells are

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[2]A. A. Maximow and William Bloom, A Textbook of Histology (4th ed. rev.; Philadelphia and London: W. B. Saunders Co., 1943), p. 335.

in close contact. The mass which fills the cells of the horny layer is keratin, a product of the transformation of eleidin."[3]

The most peripheral layers of the stratum corneum, sometimes called the stratum disjunctum, are constantly being eliminated. The cells lost in this way are constantly being replaced by new ones from the lower layers. The intensity of desquamation of the stratum corneum is directly coorelated to the number of mitotic figures in the malpighian layer.

The stratum lucidum and the stratum granulosum consistute the next two layers. Walters and Sayles state,

> "The apparently homogenous stratum lucidum, which lies just outside the stratum granulosum and is derived from it, owes its semi-transparency and comparative resistance to all ordinary histological stains to the fact that the keratohyaline of the stratum granulosum becomes changed at this point into a different chemical compound, called eleidin. This layer is usually wanting except where the skin is thick, but it reaches a conspicuous development in the nails, which it composes."[4]

According to Nonidez, the stratum granulosum is several cells in thickness and lies next to the malpighian layer. It derives the name granulosum from its appearance of greater density than the surrounding layers. The density is due to the breakdown of the malpighian

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[3]Edwards, loc. cit.

[4]H. E. Walter and L. P. Sayles, Biology of the Vertebrates (3rd ed. rev.; New York: Macmillan Co., 1949), p. 204.

nuclei, which form keratohyalin granules. The granules account for the apparent density of this stratum.

The lower layer of the epidermis is the stratum germinativum. It is also commonly known as the malpighian layer. The malpighian layer underlies the stratum corneum in a somewhat equal band, but it does emit projections into the corium. The thickness of the cornified layer may vary from region to region, but this is not true of the malpighian layer.[5]

The epidermis and corium are composed of dense fibrous connective tissue and stratified squamous epithelium. These two regions are different however, in the vascular and nerve content. The epidermis is completely void of blood vessels and nerve endings. It is not until you reach the corium that blood and lymphatic vessels and nerves are found. The corium also contains hair follicles, sweat glands and muscle bundles. This layer is so richly supplied with nerve endings, that many people consider it a sense organ of the body, dealing with the sense of touch, pain, and etcetera.

The deepest layer of skin is called the corium or dermis. It consists of two main layers, the papillary stratum and the reticular stratum. The papillary stratum is located next to the epidermis and the reticular stratum blends into the subcutaneous tissue. The line

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[5]J. F. Nonidez and W. F. Windle, Textbook of Histology (2nd ed. rev.; New York: McGraw-Hill Book Co., Inc., 1953), p. 285.

between these two layers is almost impossible to differentiate, thus making the origin of the subcutaneous layer difficult to find.

Nonidez and Windle state,

> "The papillary stratum of the corium contains many elastic fibers and reticular fibers, some of which form a basement membrane for the epidermis. This basement membrane is very thin and is usually impossible to differentiate in ordinary histologic specimens. The papillary stratum derives its name from the fact that it is thrown into projections, the dermal papillae, for papillae of the corium, which fit themselves into the basal surface of the epidermis, alternating with inward projections of the epithelium. In the thick skin of the palms and soles, the dermal papillae are arranged in a regular pattern. On other parts of the body, the papillae are scattered in a hit-or-miss fashion."[6]

Upon reading several histology textbooks, this writer found that not all authors agree on the presence of a basement membrane. "The opinion that the tonofibrils of the epidermis are directly connected with the collagenous fibers of the derma has not been proved."[7]

Bremer states that the tissue just below the skin is known as the stratum subcutaneum. This stratum is composed of large areas

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[6]Nonidez and Windle, op. cit., p. 282.

[7]Maximow and Bloom, op. cit., p. 340.

of fat cells and areolar tissue. The stratum subcutaneum, at its lowest level, finally connects to the fascia around the muscles and in some places with the periosteum.[8]

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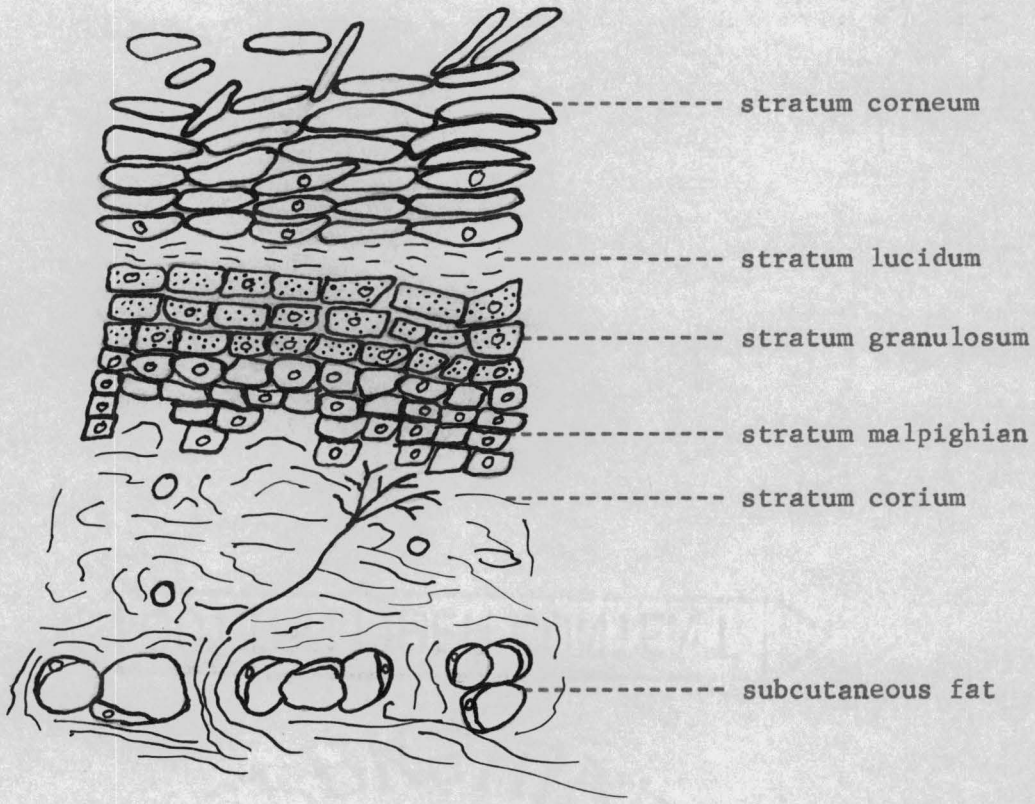
[8] J. L. Bremer and H. L. Weatherford, A Textbook of Histology (6th ed. rev.; Philadelphia: Blakiston Co., 1948), p. 568.

ANATOMY OF THE SKIN (HUMAN)




This drawing, "Diagram of the Skin,"[10] is inserted to supplement the previous written material.

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[10]Walter and Sayles, op. cit., p. 203.

## III HUMAN SKIN TISSUE

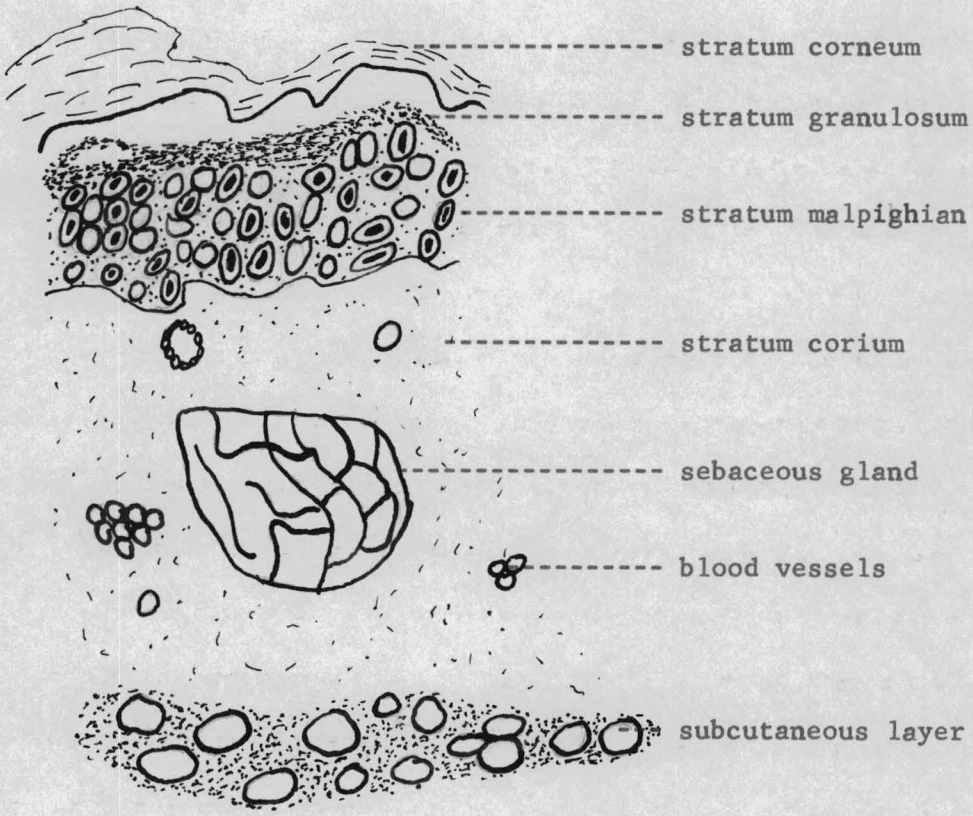
The only type of tissue available was skin taken from the penis after a circumcision was performed by a local physician. It was immediately fixed in Allen's solution, a modification of Bouin's fixative, for 48 hours. It was then taken up the alcohol ladder at two hour intervals with lithium carbonate added to take out the yellow. After two hours in absolute alcohol, the next step was to insert the tissue in a 50-50 percent solution of xylol and toluol. Chips of paraffin were added, after two hours, until the solution was saturate. It was then allowed to stand for a 24 hour period. Two pure paraffin baths were next, and then the tissue was embedded and cut at 10 microns.

The tissue drawn on the following page was stained in Mallory's triple stain. Harris's haemotoxylin and iron haemotoxylin were used as alternate stains for observation.

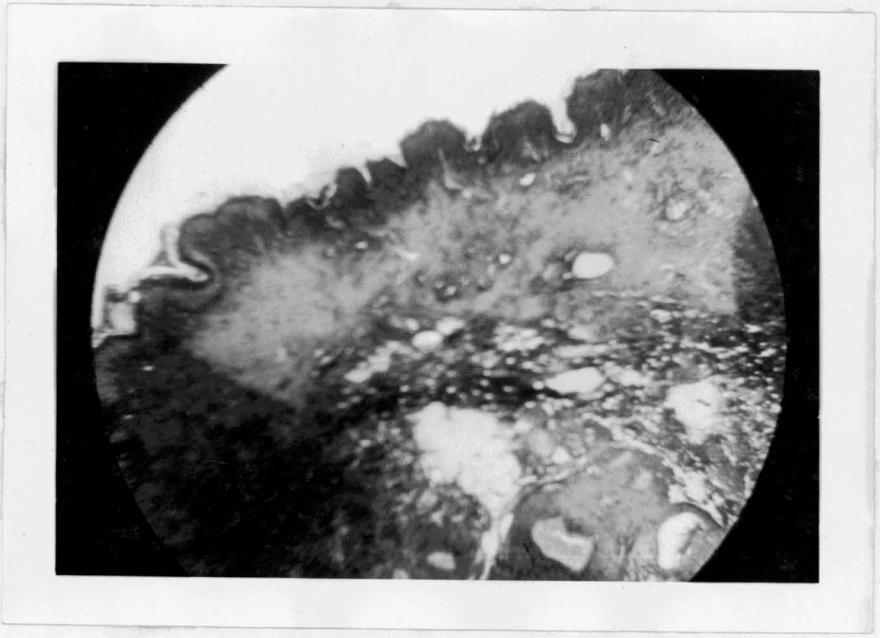
Upon study of these slides, all four strata of the epidermis were present. This would dispute the data earlier stated in this paper. The stratum granulosum showed very well in iron haemotoxylin and the stratum lucidum was present in a few regions, but was indistinct. Hair follicles and sweat glands were not numerous in this area, but that is a logical expectation. The malpighian layer shows readily and the dermal papillae are prominent. All the strata discussed in Chapter II are evident in this tissue.

# HUMAN SKIN TISSUE

(Sectioned from the Penis)



HUMAN SKIN TISSUE



This microphotograph is included as a supplement to the drawing on the previous page. The photograph was taken through a low power (10X) objective and a ten power eyepiece. The drawing was obtained through a high power (43X) objective, from this area of the tissue.

## IV DOG SKIN TISSUE

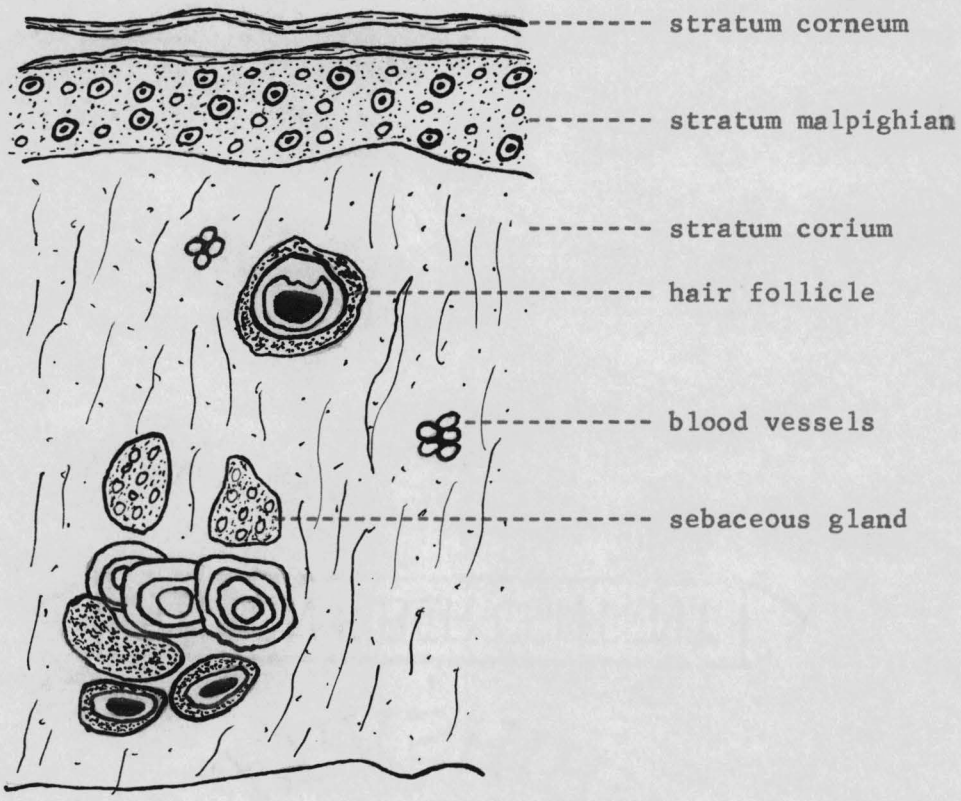
This tissue was obtained from a local veterinarian. After assisting in the amputation of the animal's hind leg, skin from the shank region was procured for this study. It was immediately fixed in Allen's solution, a modification of Bouin's fixative, for 72 hours. The tissue was taken up the alcohol ladder, starting at 70 percent, at two hour intervals. The tissue was cleared in an equal mixture of xylol and toluol, soaked in a saturate solution of clearing solution and paraffin, run through two pure paraffin baths, and embedded. The next step was to section the tissue at 10 microns and stain. The better slides of this tissue were obtained from iron haemotoxylin. Mallory's triple stain was too readily absorbed and the slides were too dark for good histological study. Harris's haemotoxylin was not as effective with this tissue as some of the other stains.

Upon study of this tissue, the corneum and malpighian layers were found to be prominent. The corneum took the stain too readily, so the stratum granulosum and lucidum do not show or are not present. One major difference between this skin and the human skin is the presence of many hair follicles in the corium. There is a distinct difference in the depth of the layers, however, no comparison can be drawn, for the skins were not all obtained from the same location on the body.

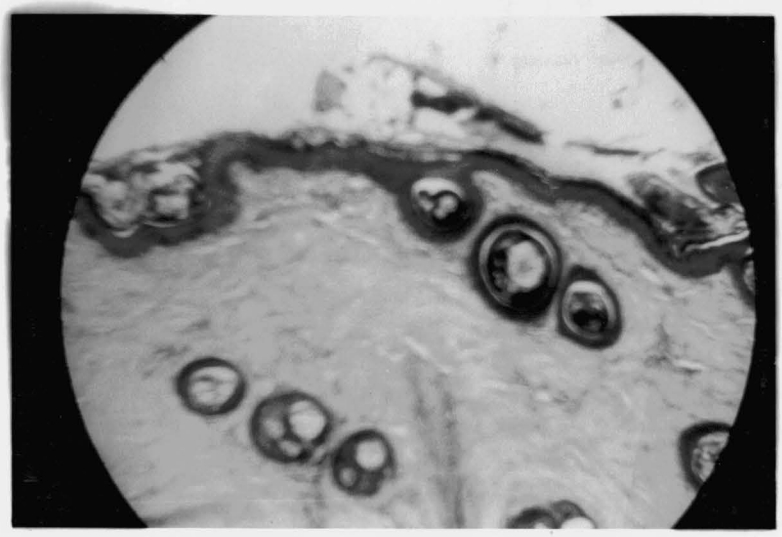
In final comparison, the dog tissue is very similar to human tissue. The only differences observed were the lack of sweat glands and the abundance of hair follicles.

DOG SKIN TISSUE

(Sectioned from the Shank Region)



DOG SKIN TISSUE



This microphotograph is included as a supplement to the drawing on the previous page. The photograph was taken through a low power (10X) objective and a ten power eyepiece. The drawing was obtained through a high power (43X) objective, from this area of the tissue.

## V COW SKIN TISSUE

The tissue was collected at the local slaughterhouse. The animal had just been killed and the hide half-stripped from the body. This student thought that the tissue had been obtained in adequate time. However, the results tended to refute this notion.

The skin was fixed in Allen's solution, a modification of Bouin's fixative, for 48 hours and immediately taken up the alcohol ladder, with lithium carbonate added in higher alcohols to eliminate the yellow color. It was then cleared, left to stand in a saturate solution of xylol-toluol-paraffin, embedded, and cut at 10 microns. This tissue seemed to cut well on the microtome, but was examined and found to be partially mutilated. Iron haemotoxylin and Harris's haemotoxylin were used in staining. Only two or three slides were obtained using iron haemotoxylin, for most of the sections fell off in the stain.

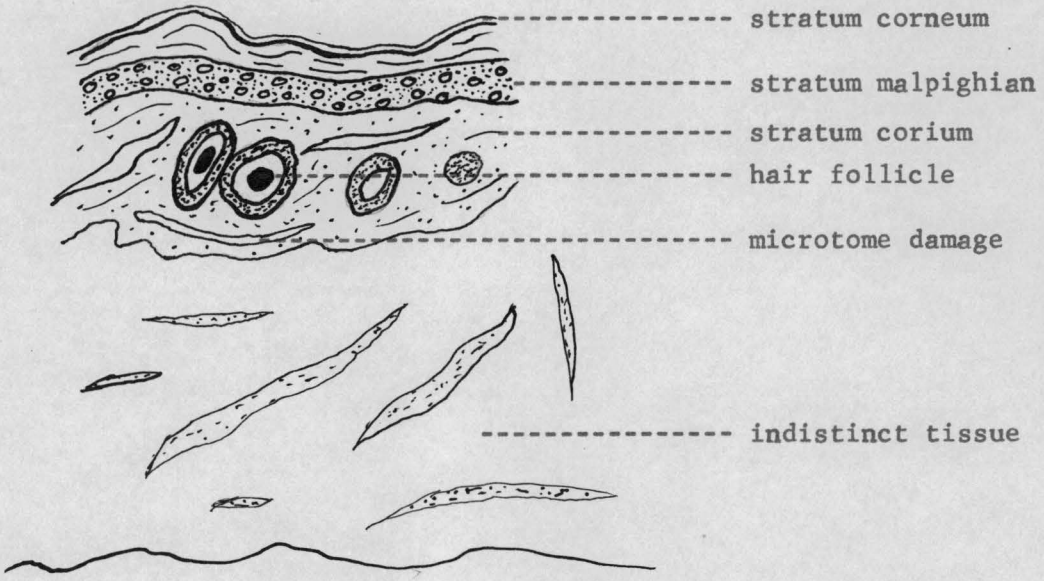
On examination of the slides, a small portion of the epidermis, which was partially fragmented, remained intact. A large area of corium and subcutaneous tissue were present, but they were badly torn. The corium and subcutaneous strata seemed enlarged, but that would be reasonable, for the cow was fattened for slaughter. The tearing apart of the corium may have been due to a dull microtome

blade or poor technique in the preparation for sectioning. The epidermis cut well throughout, even though the sections were small. Hair follicles and blood vessels were prominent in the damaged sections of the corium.

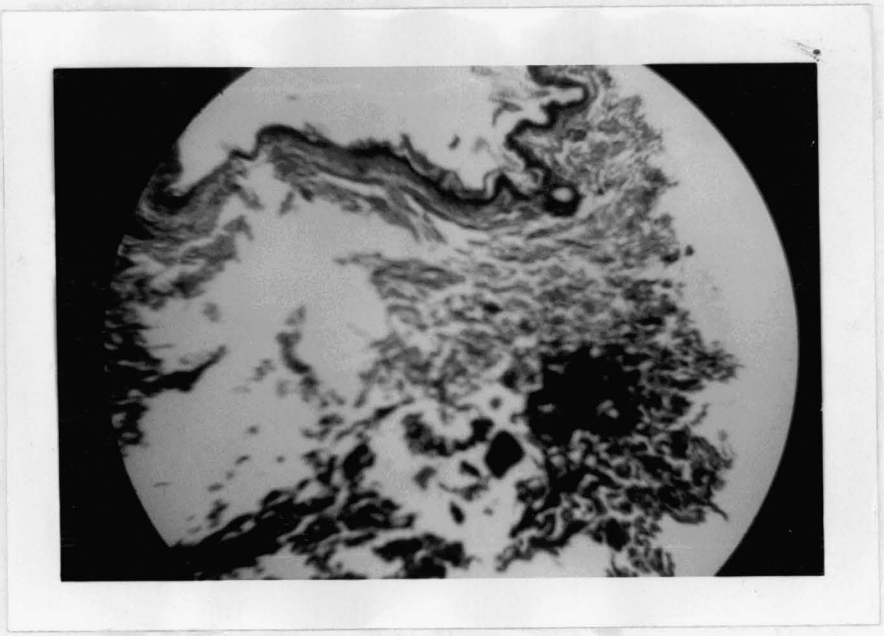
In final comparison of the two skin types, the similarity of cow skin to human skin would have been more apparent with better tissue sections.

COW SKIN TISSUE

(Sectioned from the Abdominal Region)



COW SKIN TISSUE



This microphotograph is included as a supplement to the drawing on the previous page. The photograph was taken through a low power (10X) objective and a ten power eyepiece. The drawing was obtained through a high power (43X) objective, from this area of the tissue.

## VI RABBIT SKIN TISSUE

This animal was killed and tissue from the abdomen and the ears was collected by this student. The tissues were fixed in Bouin's modification and Gilson's fixative. The abdominal tissue was fixed in Gilson's fixative for 48 hours, washed for 24 hours, and run through the alcohol ladder. The tissue was cleared in xylol, bathed in paraffin, embedded, and cut at 10 microns. This tissue failed to cut properly, even after returning to paraffin twice.

The ear tissue in Bouin's modification was fixed for 96 hours, run through the alcohol ladder, cleared in a 50-50 percent mixture of xylol and toluol, allowed to stand in a saturated solution of clearing agent and paraffin, taken through two pure paraffin baths, embedded, and sectioned at 10 microns.

The second tissue sectioned better, but all of this tissue was from the ears. The sections were stained in iron haemotoxylin and Harris's haemotoxylin. The iron haemotoxylin resulted in a better stain, but the procedure in forcing it to destain evenly was difficult, (using a 50-50 percent mixture of iron alum and distilled water).

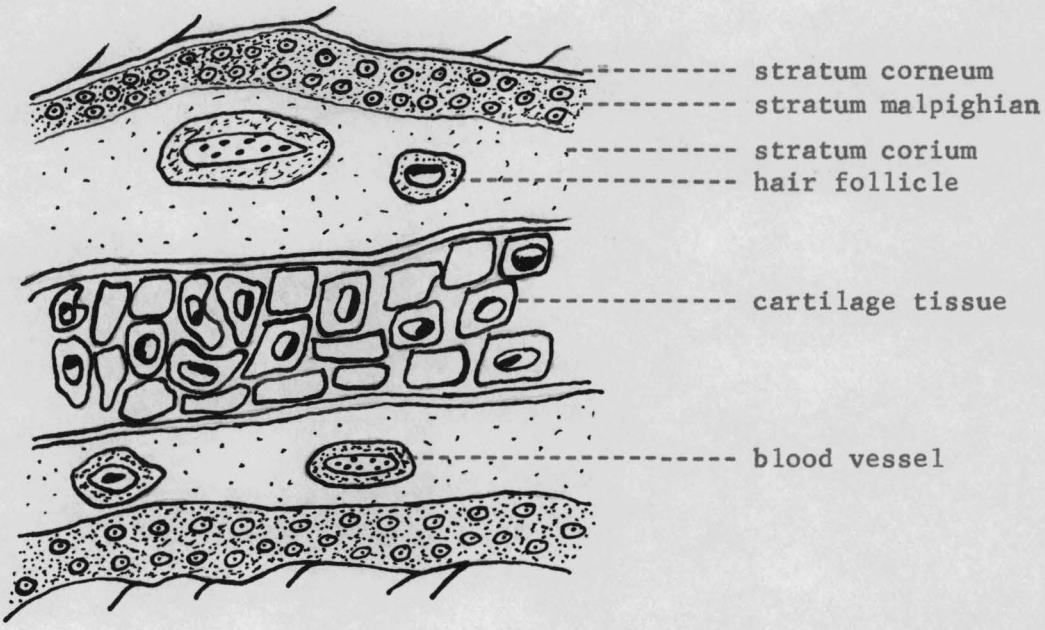
Upon study of this skin, ear tissue, the presence of an upper and lower epidermis was noted, with a middle layer of cartilage

tissue. The malpighian layer is distinct. The corium or dermis is prominent, with no projections of the dermal papillae; but the corneum is very thin, which one would expect in this area. The hair follicles seem to be almost entirely on one side, which is probably due to the lack of hair on the inside of the ear. No sweat glands are visible in this region.

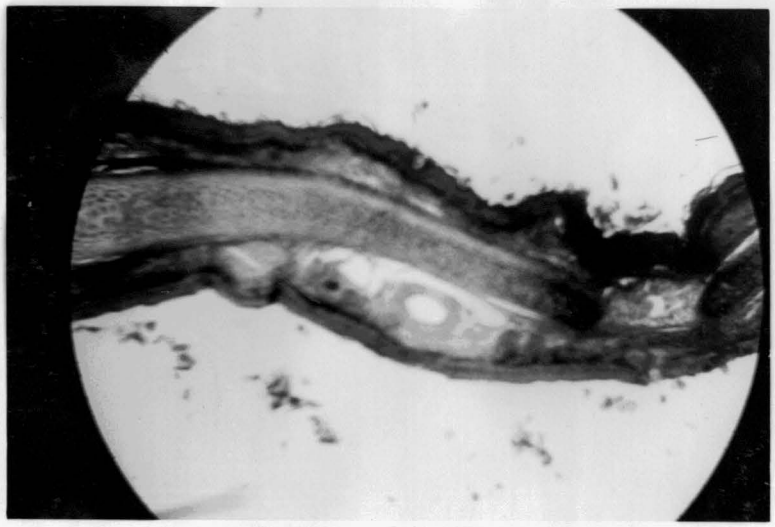
In concluding the study of this tissue, the similarity to human tissue is evident, but with fewer hair follicles than the bat or dog. Had the abdominal skin sectioned properly, more follicles would have appeared.

# RABBIT SKIN TISSUE

(Sectioned from the Ear Region)



RABBIT SKIN TISSUE



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## VII SQUIRREL SKIN TISSUE

This tissue was also obtained by this student. Samples of the tissue were fixed in Gilson's and Allen's fixative for 72 hours. The tissue in Gilson's fixative was removed and washed for a period of 24 hours, and then taken up the alcohol ladder. The skin was cleared in xylol, immediately taken to the paraffin baths, embedded, and sectioned at 10 microns. After one unsuccessful attempt, the tissue was returned to the clearing agent, but this time a 50-50 percent mixture of xylol and toluol was used. Next, the solution was saturated with paraffin, placed in two pure paraffin baths, embedded, and cut at 10 microns. This tissue sectioned better than the rabbit tissue fixed in Gilson's fixative. The squirrel sections produced the best results of all the skin types studied, which was a surprise after several failures in technique. The sections were stained in Harris's haemotoxylin and iron haemotoxylin. Harris's haemotoxylin turned out to be the better stain.

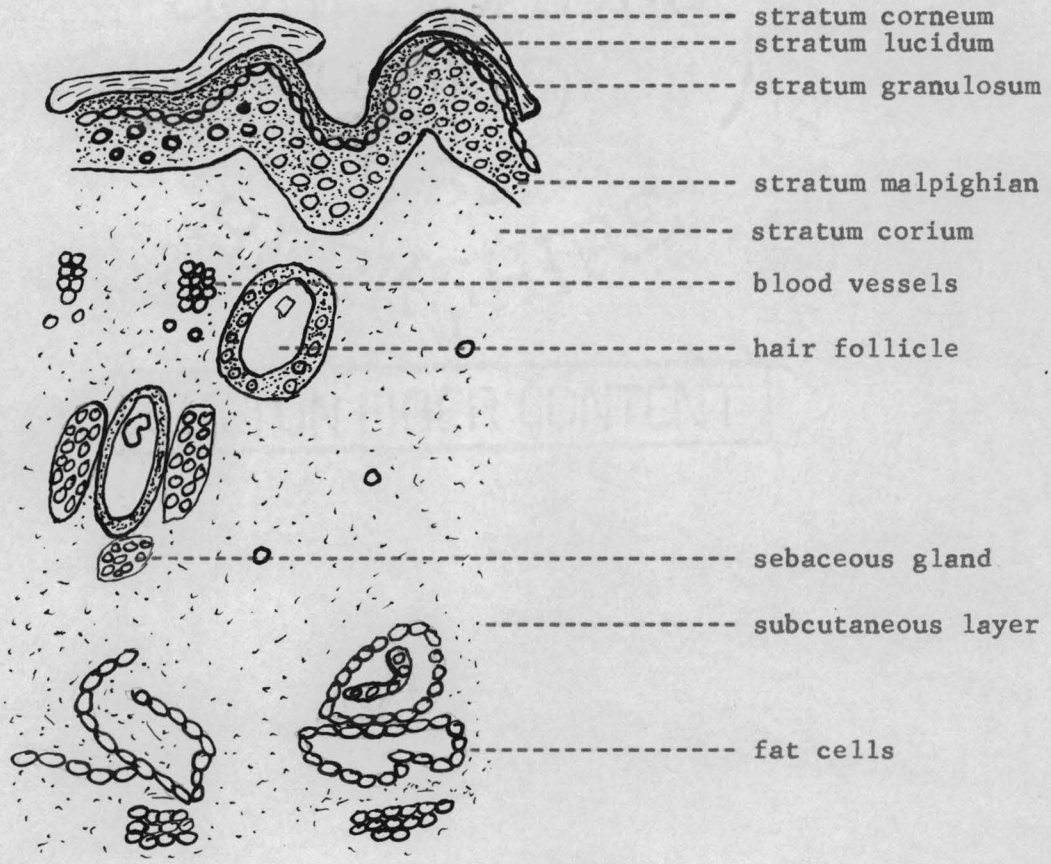
On examination of this tissue, distinct stratification was observed. The corium, malpighian, corneum, and subcutaneous layers were extremely visible. The hair follicles were distributed in a manner similar to that of the dog tissue, even though they are from

different areas, (the dog skin sample was taken from the leg and the squirrel skin from the abdomen). The blood vessels and sebaceous glands are readily apparent in the corium. In fact, they are more prominent in this tissue than any of the other mammal tissues studied.

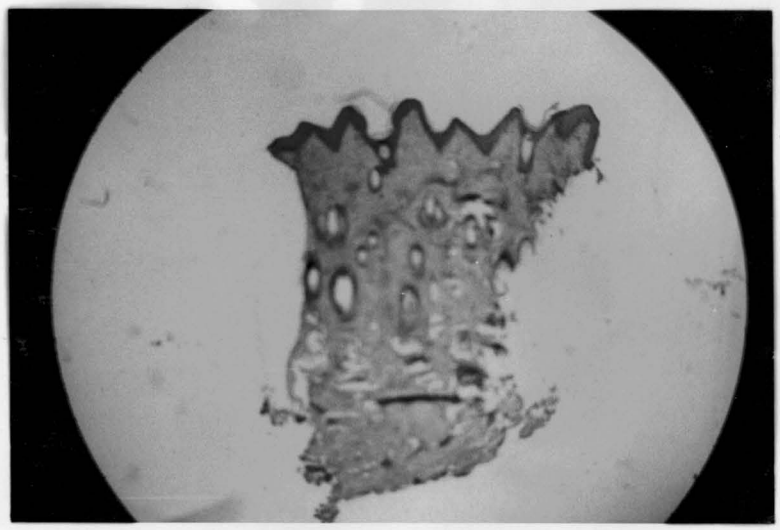
The conclusion of this study is that squirrel skin is remarkably similar to the human tissue, except for the excess of hair follicles.

# SQUIRREL SKIN TISSUE

(Sectioned from the Abdomen)



SQUIRREL SKIN TISSUE



This microphotograph is included as a supplement to the drawing on the previous page. The photograph was taken through a low power (10X) objective and a ten power eyepiece. The drawing was obtained through a high power (43X) objective, from this area of the tissue.

## VIII BAT SKIN TISSUE

This skin was obtained from a young red bat. The skin was taken from the abdominal area and fixed in Allen's solution, a modification of Bouin's fixative. It was taken out of the fixative, after 48 hours, and taken up the alcohol ladder at two hour intervals. Lithium carbonate was added to the higher alcohols to remove the yellow color. A 50-50 percent mixture of xylol and toluol was used for clearing. The skin was allowed to stand in the clearing agent, which was super-saturated with paraffin, for 72 hours. The tissue was then processed through two pure paraffin baths, and then embedded. Next, it was sectioned at 10 microns on the microtome and mounted.

The tissue was stained in iron haemotoxylin, Harris's haemotoxylin, Delafield's haemotoxylin and Mallory's triple stain. After observing the results, the conclusion was drawn that this writer had made an error in technique, because no stratification could be observed. The tissue was processed again, using the method mentioned above. The results of the second procedure turned out to be identical to that of the first, a mass of hair follicles.

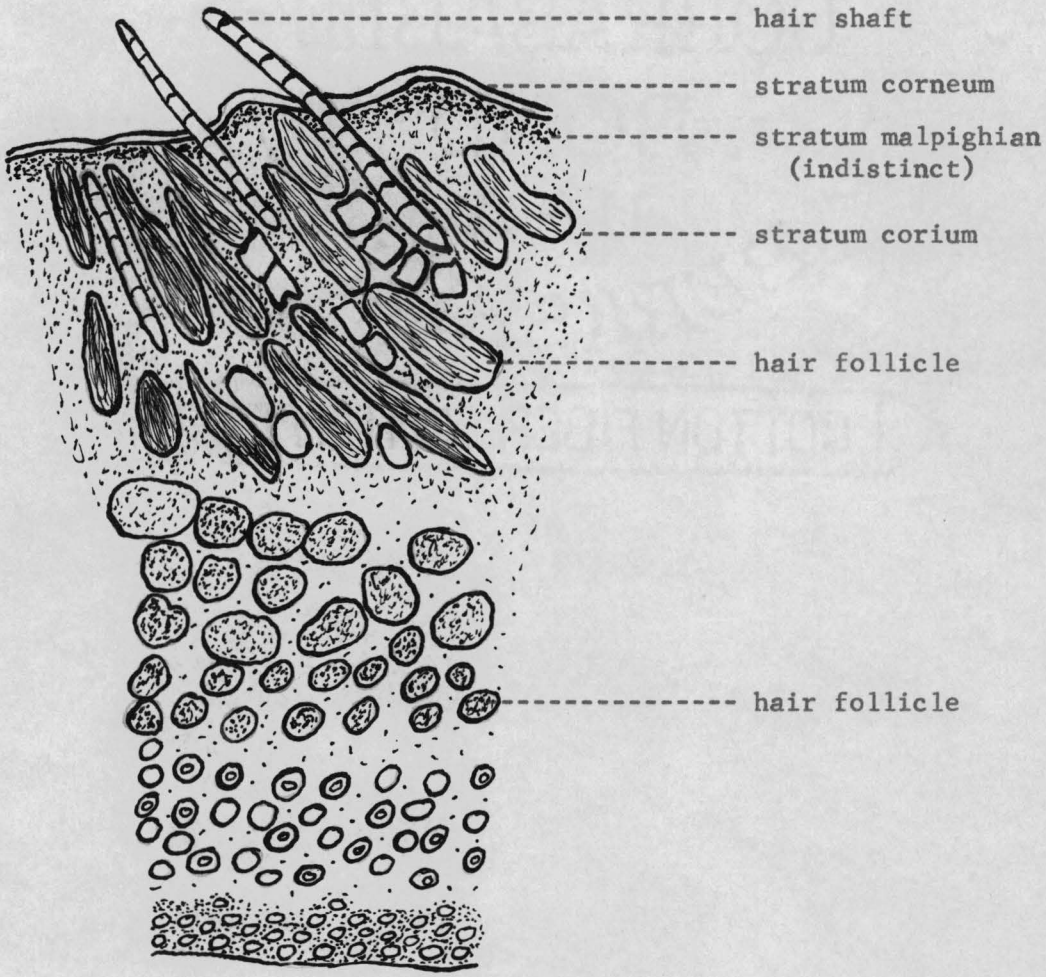
The tissue revealed no distinct layering or strafification, as in the other tissues. Most of the section was a mass of hair follicles

with large air spaces between them. No similarity between this skin and any of the other skins could be distinguished. On the slides stained with iron haemotoxylin, the outer-most extremity stained darker than the rest of the section. The stratum corneum was distinct. Part of the darker area may have been the stratum malpighian, but it is too indistinct to be certain.

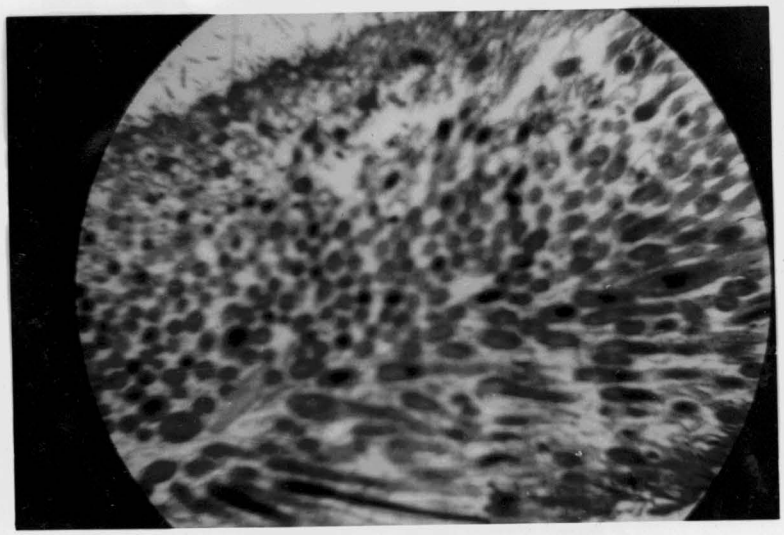
Blood vessels, hair follicles, a few adipose cells and intercellular spaces are the predominant structures of this tissue. The production of summer hair may be an explanation for the presence of excess hair follicles.

BAT SKIN TISSUE

(Sectioned from the Abdomen)



BAT SKIN TISSUE



This microphotograph is included as a supplement to the drawing on the previous page. The photograph was taken through a low power (10X) objective and a ten power eyepiece. The drawing was obtained through a high power (43X) objective, from this area of the tissue.

## IX FINAL DEDUCTIONS

The tissues studied in this research paper were examined and noted to be very similar. All but one tissue, the bat, revealed distinct stratification or layering.

The corneum was evident in all six tissues. The only difference noted was the spaces due to the protrusion of the hair shafts. Few hair shafts were noted in the human skin tissue, thus few spaces were evident. Many hair shafts were found in the bat skin tissue, thus many spaces were evident.

The stratum lucidum and granulosum were not present in most of the tissues examined, except for the human skin. These strata were not easily stained and were only found in thick skin tissue. They may or may not have been present, due to variation in staining techniques.

The stratum malpighian was evident in all the tissues, with the exception of the bat. The presence of this layer was not observed, because of the numerous hair shafts obstructing the view.

The corium or dermis was similar in all of the tissues examined. The blood vessels, hair follicles and sweat glands were the prominent structures of this strata.

While as stated above, the skin tissues of the animals studied were quite similar. However, no two animals had exactly similar skin in minor details.

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