THE MICROSCOPIC ANATOMY OF THE SKIN OF MONGREL DOGS

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Alfreda W. Johnson

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THESIS

This is to certify that the

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THE MICROSCOPIC ANATOMY OF THE SKIN OF MONGREL DOGS

By

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INTRODUCTION

Very little information concerning the microscopic structure of the skin of dogs appears in current literature. Due to the dearth of material on this subject, the author hopes that this paper will serve as a reference for the anatomist.

Since the pathologist is better able to determine the abnormal if the normal is known, a detailed histological description of the skin of the dog should be of value to him.

Skin diseases of the dog are prevalent and are often difficult to diagnose. Upon the basis of standards describing normal microscopic structure of dog skin, the author feels that a better approach to diagnosis and treatment will be possible.

It was with these views in mind that the problem was undertaken.

REVIEW OF LITERATURE

Most of the literature concerning skin structure pertains to the human species. Little has been reported on the skin of domestic animals, particularly that of the dog. A careful search of the literature revealed German books on the histology of the domestic animals by Ellenberger (1906) and Trautmann and Fiebiger (1931). These authors gave detailed descriptions of dog skin. In 1925 Muto reported on the sweat glands of animals which included the dog. Portions of the works by Sisson and Grossman (1938) and Varićak (1941) were devoted to the dog. Speed (1941) thoroughly investigated the sweat glands of the dog. Miller (1948), St. Clair (1949), Hansen et al. (1950), and Aoki and Wada (1951) confined their studies to the dog.

According to Ellenberger (1906), the skin of the dog showed extensive differences in thickness. Sisson and Grossman (1938) pointed out that it was remarkably loose on the dorsal aspect of the neck and trunk where it could be thrown up in large folds. In a small area represented by the perineum were displayed four types of skin which were present throughout

the body (Miller, 1938). Miller added that over tuberosities of the ischium, the skin was a thick, tough, resisting type. The scrotal skin was very thin and almost transparent. Anal skin presented a modified type. There was a general body type of skin over the sides of the perineum. Miller (1948) found loosely attached skin on the dorsum of the neck and the thorax. It was thickest in the neck region, thinner over the sternum and thinnest on the venter of the abdomen. Ham (1950) described the skin of man and concluded that skin covering extensor surfaces usually was thicker than that covering flexor surfaces. The skin of the eyelid was thinnest (0.5 millimeter or less) and that of the shoulders and back was thickest (up to 5 millimeters). According to Piper (1951), bellies of pups had the thinnest skin and the least coat of hairs.

Epidermis

The skin is the outer covering of the body. It consists of two layers, a superficial layer called the epidermis and a deep layer, the dermis or corium. The epidermis which is stratified squamous epithelium, is derived from ectoderm; the dermis, composed of densely packed fibro-elastic tissue is

derived from mesoderm. Beneath the dermis is a layer of loose connective tissue with varying amounts of fat, the superficial fascia or tela subcutanea (Bailey, 1948; Lambert, 1948; Maximow and Bloom, 1948; Ham, 1950).

The boundary between the epithelial layer and the connective tissue portions of the skin is well pronounced. The basement membrane, which serves as the line of demarcation, has been concluded by Robb-Smith (1946) to be a reticulum, although it may be formed by other specialized cells which are unable to form collagen directly or from ground substance. Dick (1947) described the reticular fibers which occupied the space between the dermis and epidermis. Dempsey (1948) confirmed the view that the basement membrane was a reticulum since it could be impregnated with silver and could be seen in tangential section to consist of a network of fibers.

According to Varićak (1941), the epidermis of dogs and cats resembled that of man, but the superficial translucent layer seldom occurred. The lower stratum lucidum was generally present.

Ham (1950) stated that the nature of the keratohyalin granules in the cytoplasm of cells of the stratum granulosum

was not known. Meirowsky and Behr (1948) called the keratohyalin a prokeratin which was converted into keratin.

Cowdry and Thompson (1944) described the occurrence of mitoses in the spinous layer and the basal layers of the epidermis. From a comparative study of the epidermis of the rat and mouse, Hanson (1947) reported that differentiating cells did not normally divide. Studies on the quantitative analysis of growth of epidermis were made by Hoffman (1949). The regeneration of epithelium occurred during periods of rest according to Cooper and Franklin (1940), since the greatest mitoses occurred at night in man and during the day in nocturnal rats.

The color of the skin depends mainly on the inherent yellow coloring, the vascular bed, and the pigment melanin. Melanin occurs chiefly in the epidermis, usually in the basal layer as fine brown to black granules. Strong (1927) observed the presence of larger amounts of melanin in the dermis when pigment of the epidermis was sparce. In dark skinned individuals it was found in all layers of the epidermis (Maximow and Bloom, 1948). Dukes (1947) found that melanin was formed in melanoblasts of the stratum germinativum by the action of

certain enzymes on tyrosine or a tyrosine derivative. Dukes added that after it was formed, melanin was then deposited into intercellular spaces of the dermis, taken up by other cells and stored.

Nui and Twitty (1950) found that in addition to origin from the neural crests, melanophores also originated through the transformation of macrophages. This transformation resulted from ingestion of pigment which was released by degenerating melanophores of crest origin. The pigment was in clumps, instead of being evenly dispersed as in those of neural crest origin. The melanophores of crest origin were called melanoblasts and the melanophores originating as a result of phagocytosis were called chromatophores (Laidlaw, 1932; Maximow and Bloom, 1948). Laidlaw (1932) concluded that the melanoblasts reacted positively with the "dopa" reaction because of the presence of an oxidase, while the chromatophores did not.

Dermis

It is generally known that the dermis or corium lying directly beneath the epithelium consists of two layers which

are not sharply separated from one another. The outer portion, called the papillary layer, is raised into numerous elevations or papillae which invaginate the deep surface of the epidermis. The papillary layer is thinner than the deeper portion, the reticular layer.

Both layers of the dermis consist of dense, irregularly arranged fibrous tissue. The stroma is formed by collagenous bundles arranged in different directions. The collagenous fibers of the papillary layer are finer than those of the reticular layer. Between the collagenous bundles are found elastic and reticular fibers. Lowery et al. (1941) devised a simple method for measuring the collagen and elastin content of skin. Haas (1939) pointed out the fact that elastic fibers formed a wide-meshed network in the reticular layer. A more closely meshed network characterized the area immediately beneath the epidermis. Trautmann and Fiebiger (1931) described elastic fibers which crossed in every direction and formed fine meshes in the upper layer of the dermis. Dick (1947) found large elastic fibers composing the deeper network and a fine network of small fibers lying close under the epidermis. The fine fiber plexuses followed indentations of the epidermis which surrounded hair

sheaths. Between papillae the elastic fibers were thin. He concluded that the deeper layer was more important in the elasticity of skin.

Though elastic fiber networks closely underlay the epithelial layer, there was no continuation of the fibers into the epidermis (Dick, 1947). Dick further stated that the elements concerned in the actual binding together of dermis and epidermis were the reticular layer and the bases of the epithelial cells. Using silver impregnation methods, the reticular fibers of the skin were shown by Dick (1947) to be distinct from elastic fibers. Robb-Smith (1946) described the merging of fine argyrophil reticular fibers with the nonargyrophil collagenous fibers. Odland (1950) demonstrated that the cytoplasmic processes of the basal epidermal cells fitted into the spaces of a continuous meshwork of dermal reticulum.

The tela subcutanea, located beneath the dermis, consists of loose connective tissue. Bands of connective tissue consisting of collagenous and elastic fibers passed from the dermis through the subcutaneous fat (Dick, 1947). Trautmann and Fiebiger (1931) found a thick panniculus adiposus in the pulp-like area on the plantar surface of digits of carnivores.

Sisson and Grossman (1938) and St. Clair (1949) confirmed the findings of Trautmann and Fiebiger.

Hair

Ellenberger (1906), Trautmann and Fiebiger (1931), Sisson and Grossman (1938), St. Clair (1949) all agreed that the hair of dogs occurred mainly in groups of threes. Ellenberger (1906) gave a detailed description of the structure of hair follicles. He described three-hair groups which consisted of a main hair and two smaller secondary hairs. In the deeper portion, groups of as many as twenty hairs were seen but nearer the surface two to three interposed sebaceous glands divided the hairs so that the three-hair grouping was evident. The division was more evident because of circular connective tissue fibers surrounding the three-hair groups. Trautmann and Fiebiger (1931) reported that the follicles of the secondary hairs arose from the follicle of the main hair. Wilcox (1950) found clusters of as many as seventy-five hairs (a single guard hair and two lateral groups of wool hairs) all emerging through a common pore in the skin of the chinchilla. Light (1949) correlated baldness or absence of hair in the human species with

age and amount of infiltration of connective tissue into the fat layer surrounding the hair roots.

Sebaceous Glands

Sebaceous glands were found in all breeds of dogs by Ellenberger (1906). They were relatively better developed in dogs having short rough hair. Sebaceous glands were best developed in the lip, the dorsal side of the rump and in the sternal region. Trautmann and Fiebiger (1931) pointed out that larger fat glands characterized thin-haired areas and that hairless areas were free of sebaceous glands. Sisson and Grossman (1938) agreed with Ellenberger and also found well developed glands in the anus and digital pads.

A group of hair follicles was accompanied by a group of sebaceous glands of approximately the same number (Trautmann and Fiebiger, 1931). Wilcox (1950) reported that each guard hair of a group had its own sebaceous gland, while a lateral group of wool hairs had three to four glands.

Sweat Glands

It is believed by many that dogs have no sweat glands, consequently very little attention has been paid to their structure. The presence of sweat glands in the dog not only in the foot pads but also over the body surface covered with hair was described by Gurlt in 1835 (Aoki and Wada, 1951). In 1868, Harms found numerous large sweat glands in the dog (Speed, 1941). According to Speed, Harms stated that the dog can sweat, but the sweat drops are not visible because the hairs are too numerous. This fact probably explains the common misbelief that the dog sweats only on the muzzle and foot pads. Speed (1941) gave a very good account of the literature previous to his study.

Ellenberger (1906) found sweat glands in all breeds of dogs. Although it was difficult to find them in thick haired individuals, they were easily seen in the Rat terrier, the Griffon, the Dachshund and the Leonburger. Trautmann and Fiebiger (1931) observed very small tubular glands which were better developed in the back, the mouth, the anus and the foot pads. No tubular glands were found in the end of the nose. Muto (1925) called the sweat glands of dogs bag-formed as

opposed to the coiled type in the human species. According to Sisson and Grossman (1938), sweat glands were relatively better developed in the long and fine haired breeds with the largest glands being found in the foot pads. In the perineum and the paranal pouches, glands were coiled. They added that in the muzzle, glands were absent or few. St. Clair (1949) agreed that sweat glands were few in number and were better developed in long-haired breeds with the foot pads having the greatest number. Romer (1949) found sweat glands generally much reduced in number.

Speed (1941) examined six breeds of dogs—the Airedale, the Cairn terrier, the Collie, the Greyhound and the Fox terrier. He found numerous sweat glands though in some areas glands were absent. There were no glands in the scrotum. The forms varied in different regions but occurred mainly as flexuous tubules which ran nearly parallel with the hair follicles. Those of the digital pad were the typical coiled glands. All glands opened into hair follicles with the exception of those of digital pads.

Aoka and Wada (1951) tested the functional activity of sweat glands in the dog. They produced active sweating with

intradermal injections of pilocarpine, acetylcholine and epinephrine, by local applications of heat and by direct exposure to excessive heat of the sun. Their results were substantiated by histological findings.

Ellenberger (1906) reported funnel-shaped ducts which opened into hair follicles. Trautmann and Fiebiger (1931) described sweat glands that had a common duct with sebaceous glands opening into follicles. Speed (1941) confirmed Ellenberger's findings but found separate openings for sweat and sebaceous glands. He further stated that the ducts of glands of the foot pads opened on the surface of the skin.

MATERIALS AND METHODS

Experimental material was obtained from thirteen live mongrel dogs which included eight males and five females. The dogs were anesthetized with sodium pentothal. Specimens ten millimeters square, including all layers of the skin and adjacent subcutaneous tissue, were taken from thirty-four areas over the body as indicated in Table 1. Hansen, et al. (1950) confined their studies to the dorsal surface of the thigh (Hansen, 1951).

The tissues were fixed in Bouin's fluid, and were dehydrated and cleared in dioxan. Infiltration was accomplished by three changes of low-melting point paraffin in the oven for one-half hour periods. Tissues were embedded in a mixture of one part low-melting point paraffin to two parts "Tissuemat."[1]

Sections of seven to ten microns were made and stained. The majority of the sections were cut longitudinally, others were transverse sections.

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[1] "Tissuemat" - Fisher Scientific Company, Pittsburgh, Pennsylvania.

TABLE 1

DESIGNATION OF AREAS FROM WHICH TISSUES WERE TAKEN

Lip (upper)	Digital pad
Lip (lower)	Back (thoracic region)
Nasal septum	Back (lumbar region)
Maxillary region	Back (rump)
Mandibular region	Ventral abdominal region
Temporal region	Flank
Dorsum of head	Hip
Pinna (outer)	Tail (base)
Pinna (inner)	Tail (middle)
Pinna (tip)	Tail (tip)
Neck (dorsum)	Anal region
Neck (venter)	Inguinal region
Shoulder	Prepuce
Axillary region	Scrotum
Forearm (lateral)	Vulva
Forearm (medial)	Mammary gland (female)
Interdigital region	Sternal region

Stains used were: Harris' hematoxylin and eosin as a routine stain, Weigert's and van Gieson's connective tissue stains for elastic and white fibrous tissues respectively, and Foot's stain for reticulum (Foot and Menard, 1927).

Measurements of epidermis were made at the highest and lowest points in a representative field for each area, and the average of the two figures was recorded in microns. The dermis was measured with average figures being recorded in millimeters.

RESULTS AND DISCUSSION

The skin varied in thickness over the body. Generally, the thickest dermal areas were found beneath the thinnest epidermis. The thickest skin was found in the neck and head regions. The inguinal and axillary regions and the inner lining of the pinna were characterized by the thinnest skin. All of these areas had a thin epidermal covering. The digital pad, which had the thickest epidermis, also had a thick dermis.

The widest variations were seen in height of the epidermis. Epidermis measuring up to 100 microns was considered to be thin epidermis. That of more than 100 microns was called thick epidermis.

The thinnest epidermis, 26.5 microns in height, was found in the sternal region. The lip, nasal septum and digital pad presented a thick epidermis. In the lip it was thickest near the buccal membrane and thinnest at the skin junction. That of the digital pad reached 1,685.4 microns at the highest point observed. All other areas were characterized by thin epidermis. The epidermis of the prepuce, the scrotum, the

vulva and the interdigital area ranged in height from 67.5 to 90 microns.

In keeping with descriptions of the skin by Ham (1950), thin skin referred to in this paper were areas which had a thin dermis. The term "thin skin" was specifically applied by the author to areas having a dermis which measured less than one millimeter in height. Areas which had a dermis of more than one millimeter were designated thick skin.

Due to variations in age and nutritional status of the experimental animals, no measurements were made of the fat layer. However, the author observed a general increase in thickness of the fat layer in females. No other sex differences were distinguished.

Epidermis

Four distinct epidermal layers were found, stratum germinativum, stratum granulosum, stratum lucidum and stratum corneum. The layers were similar to descriptions of those of the human species.

The stratum germinativum, which consisted of the basal layer and the stratum spinosum, was present in all areas. It

varied in thickness from the two cell rows of the mandibular, maxillary and temporal regions, the dorsum of the head, the ear and the back (Plate I) to as many as thirty-five rows of cells in the nasal septum (Plate V). The cells of the basal layer were columnar in shape with some cells being lower in height than others. In the thicker areas, the deeper cells of the stratum spinosum were dome-shaped. Those more superficially located were polyhedral in shape. Tonofibrils characteristic of this region were evident (Plate VI).

The stratum granulosum was generally present. It consisted of a single row of cells in the venter of the neck, the abdominal, sternal, axillary and shoulder regions, the flank, the tail and the back (Plate I). It was absent in the mandibular and temporal regions, dorsum of the head, and outer covering of the ear. The stratum granulosum in the digital pad, which was the thickest observed, consisted of fifteen rows of cells. The cells contained keratohyalin granules in their cytoplasm. In the thickest epidermis, shapes ranged from polyhedral in the deepest row to diamond-shaped in the most superficial row. Diamond-shaped cells characterized areas having but a single row of cells.

The stratum lucidum was best developed in the digital pad (Plate IV). It was absent in the head, neck, shoulder, axillary, sternal and abdominal regions, the back, the tail and the prepuce.

Observations showed a stratum corneum in all areas studied. It varied from 5.3 microns in the lip to 1.5 millimeters (1,526.4 microns) in the digital pad. The stratum corneum of the nose was 106 microns in width. That of the ear, mandibular region, prepuce, scrotum and anus was approximately 21.2 microns wide. The stratum corneum of all other areas averaged 60 microns in width. In the digital pad, cell boundaries were seen. Faint appearing nuclei were in the layers nearest the stratum lucidum (Plate IV). The stratum corneum of the lip was reduced to a pale staining line (Plate III).

White or light colored skin was characterized by a few melanin granules in the cytoplasm of the basal layer of the stratum germinativum. The amount of pigment increased with darkness of skin. Black skin had melanin in all layers of the epidermis (Plates V and VI).

The author was able to impregnate the basement membrane with silver. This was in agreement with Dempsey (1948) and Odland (1950) that it was a reticulum.

Dermis

The surface of the dermis was raised into numerous ridges forming both secondary and primary papillae. There was no distinct separation into layers but the arrangement of fibers differed in the superficial and deep portions of the dermis.

In the superficial or papillary zone, elastic fibers were generally finer and were woven into a network, though single fibers were found. Bundles of collagenous fibers varied in thickness and arrangement. Small, deeply staining fiber bundles, located nearer the epithelial covering, were parallel to the surface. A few fibers extended in every direction.

The fibers of the deep or reticular layer of the dermis were coarser than those of the papillary layer. Elastic fibers were more numerous and fewer networks were seen. The collagenous bundles were wider and fibers stained paler than in the papillary zone.

Fine reticular fibers were seen throughout the dermis. Numerous fibers appeared just beneath the basement membrane and around hair follicles.

In areas where the skin was most pliable, such as the axillary and flank regions, and the dorsum of the neck, collagenous bundles were smaller and more loosely arranged. Elastic fibers in the same areas were relatively more numerous in the superficial layer than in the deep layer. Wider, more closely packed collagenous bundles and fewer elastic fibers characterized the superficial layer in areas of least movable skin such as the tail, the ear and the digital pad. Plate VII shows the elastic fibers of the deep layer of the inguinal region to be larger than in the superficial layer.

Although collagenous fibers passed in every direction, large pale staining bundles which were roughly parallel to the surface occurred in areas of thick skin such as the head regions, digital pad, lip, nasal septum and dorsal surfaces of the body. Bundles, which were smaller and dark staining, characterized thin areas for the most part.

In many sections pigment laden cells were seen in portions of the dermis near the basement membrane (Plates

V and VI). No correlation was made between amounts of pigment in the dermis and pigment content of epidermal cells.

Numerous large nerve trunks were observed, especially in the deep layer of the dermis and in the subcutaneous tissue. Smaller nerve trunks were seen in both dermal layers. No specialized nerve endings appeared in the sections examined by the author. Such endings probably are located in the dermis, but stains other than those employed in this experiment as well as other methods of study should be used. Serial sections probably would be of value in such a study.

Hair

The author's findings agreed with those of Ellenberger (1906) as to grouping of hair follicles. Ellenberger found up to twenty hairs in a single group located deeply in the dermis. Higher up they were separated into three hair groups by two to three sebaceous glands and circular connective tissue fibers. The author found more sebaceous glands separating the follicle groups than did Ellenberger as shown by Plate VIII. This could have been due to the plane of sectioning or Ellenberger may have been referring to groups of sebaceous glands. Plate IX

shows one main hair and five accessory hairs in a single group. Although the arrangement of hair into groups was the general picture (Plates VIII, IX and X), single hairs were found in the lip. Occasionally, single hairs were also found in areas which showed a definite grouping as the rule (Plates XIII and XIV). The digital pad, nasal septum, and portions of the lip were free of hair.

Sebaceous Glands

Sebaceous glands were always associated with hair follicles, consequently no glands were seen in hairless areas. Observations made on the sebaceous glands indicated that they were generally larger than those of the human species (Plate VIII). Glands of approximately the same size as those in man as well as smaller ones were seen. The general structure compared with that of glands described by Bailey (1948), Lambert (1948), Maximow and Bloom (1948) and Ham (1950). Sebaceous glands opened into hair follicles (Plate XIII).

Sweat Glands

Every area studied presented sweat glands with the exception of the nasal septum. In the lip, glands were only evident in hairy portions. Speed (1941) described the scrotum as being free of sweat glands. The author found sweat glands in each section of the scrotum from eight dogs.

Sweat glands in the dog were of two main types. One was the typical coiled arrangement described by previous authors (Plates VIII, XI and XIII), the other was a simple tortuous tube or non-coiled type with a large lumen (Plates XII, XIV and XV). The structure of the tubular type compared with that of the bag form described by Muto (1925). The lip and digital pad had the coiled type only. Coiled and non-coiled glands were found in all other areas in which sweat glands were observed. The glands of the digital pad opened onto the surface of the skin (Plate IV). All other glands opened into hair follicles (Plate XIV).

Plate I. Section from the back (rump) showing thin epidermis. H and E. stain. 150X.

Plate II. Section from the back (rump) showing thin epidermis. H and E. stain. 600X.

A. Stratum corneum
B. Stratum granulosum
C. Stratum germinativum
D. Dermis

A

B

C

D

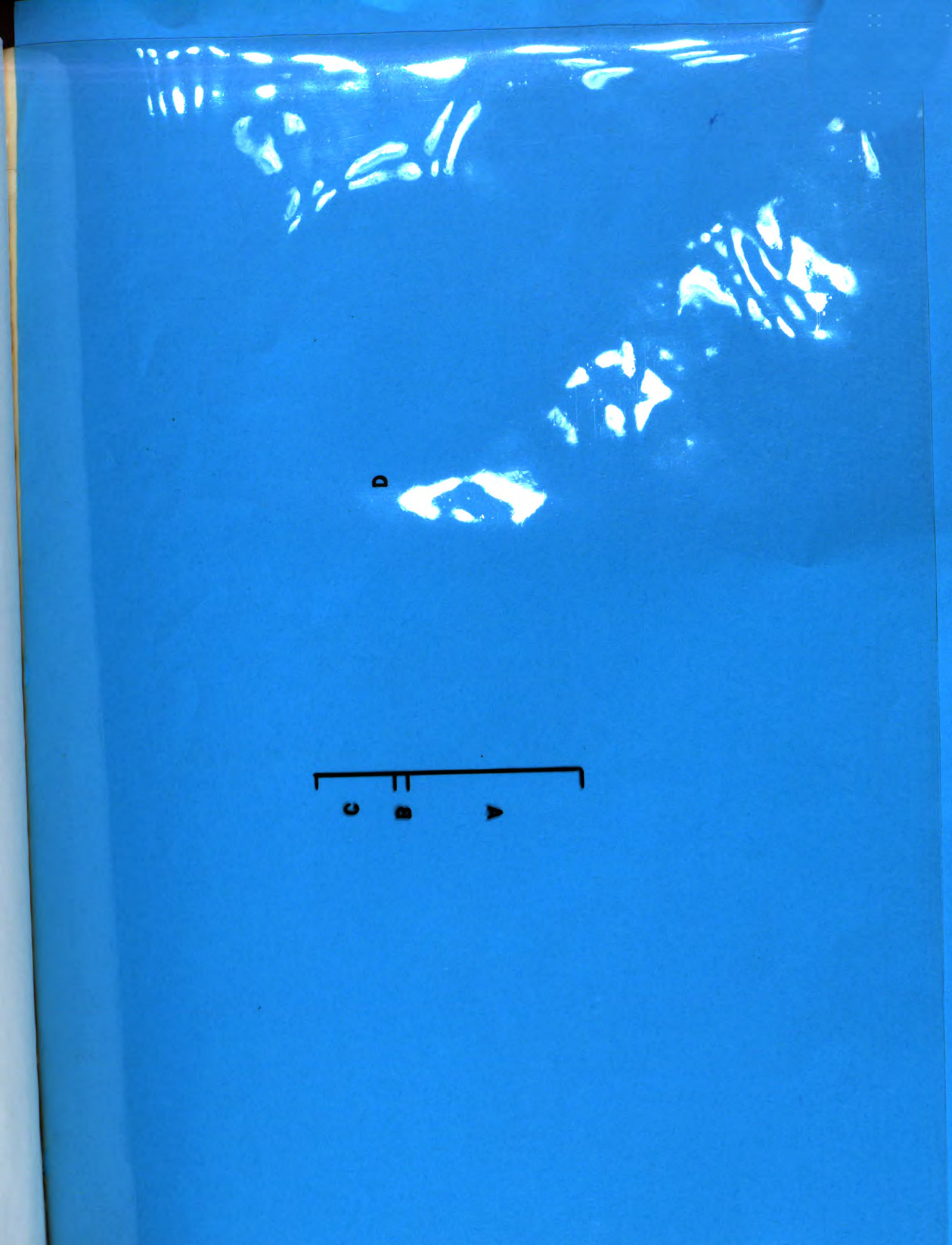

D
C
B
A

Plate III. Skin of the lip. H. and E. stain. 200X. Note thin stratum corneum.

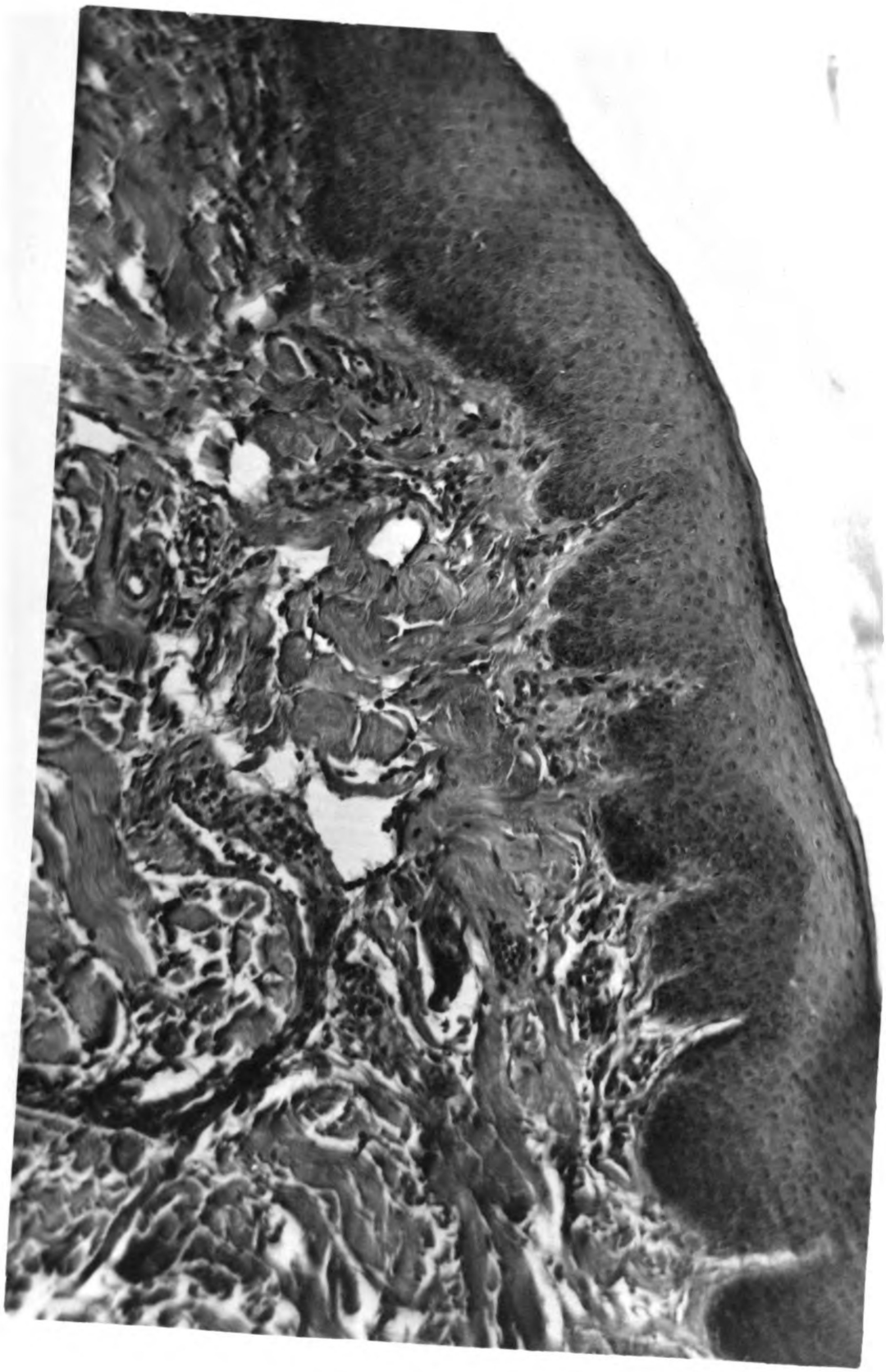
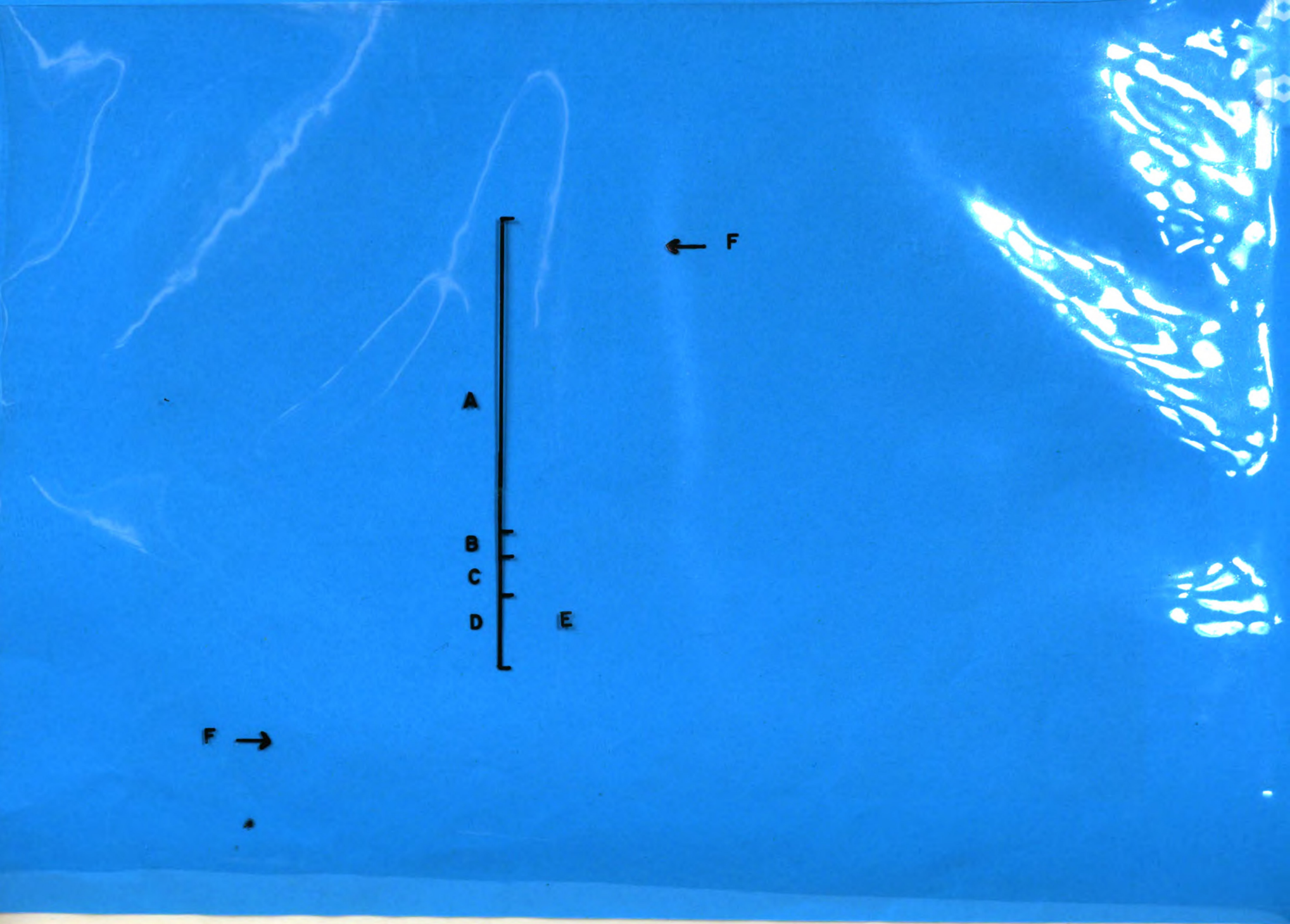


Plate IV. Epidermis of the digital pad showing the thick stratum corneum and stratum lucidum. H. and E. stain. 150X.

A. Stratum corneum
B. Stratum lucidum
C. Stratum granulosum
D. Stratum germinativum
E. Dermis
F. Duct of sweat gland


F
A
B
C
D
E
F

F
A
B
C
D
E
F

Plate V. Section from the nose showing pigment in all epidermal layers and in the dermis. H. and E. stain. 160X.

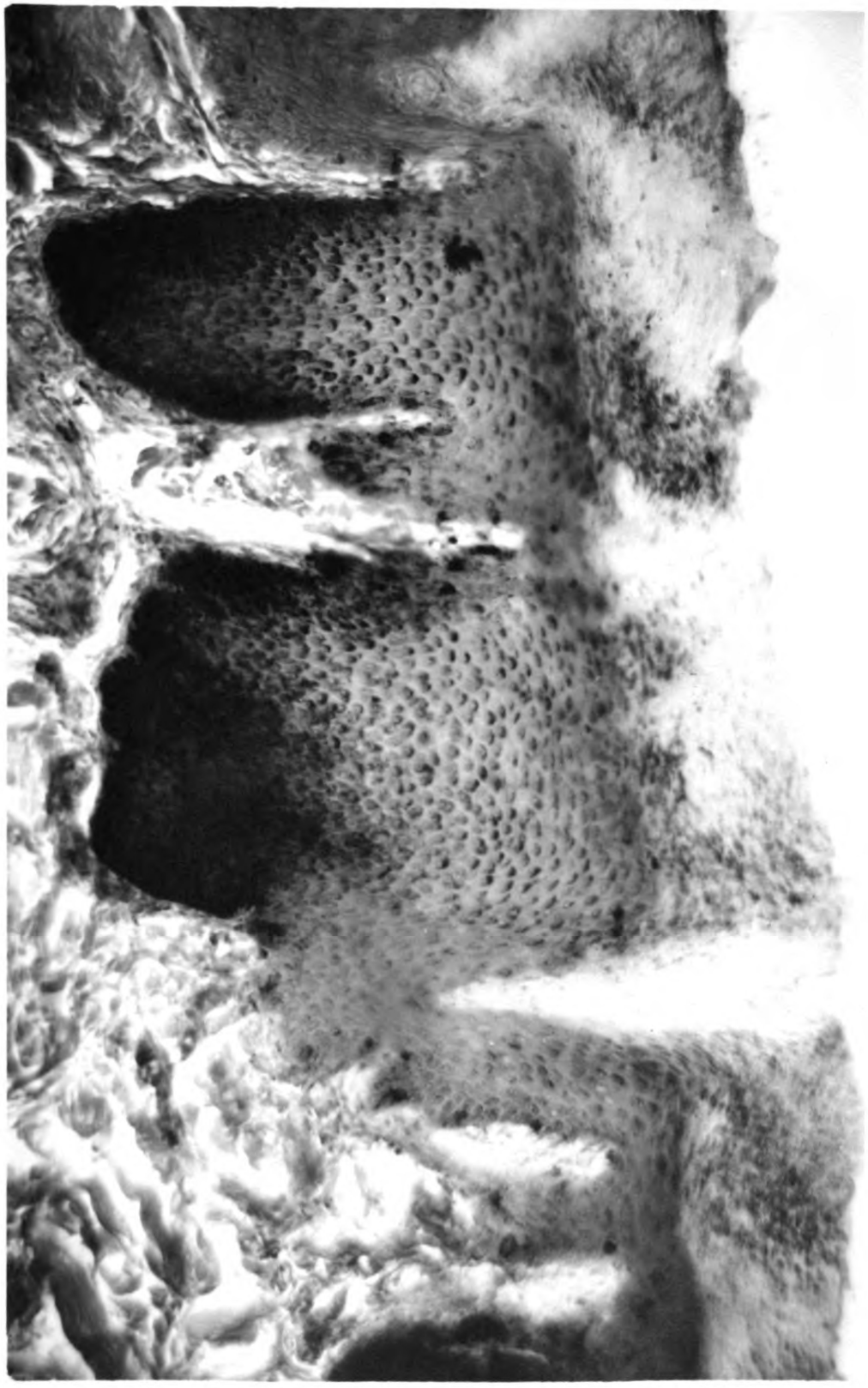
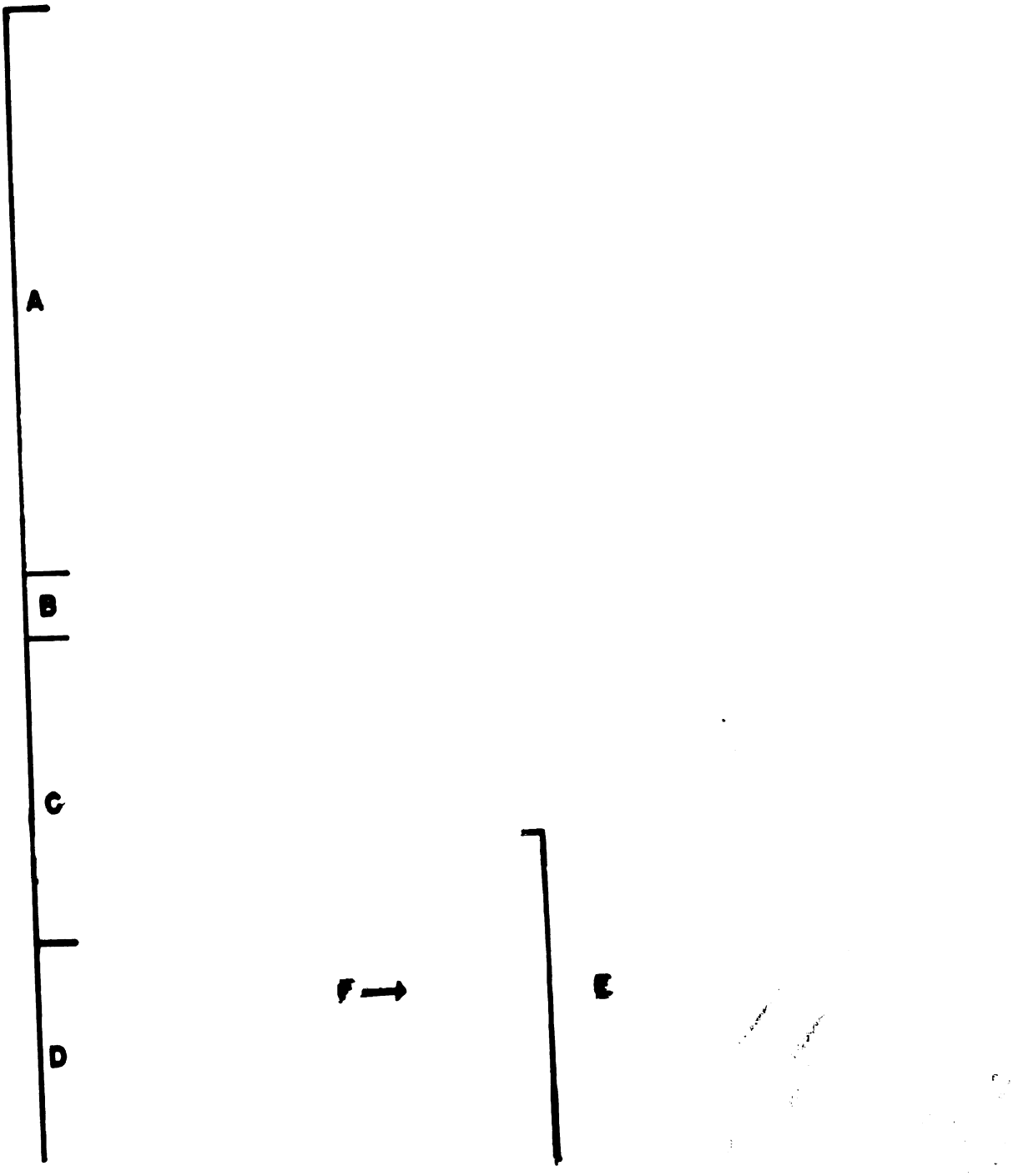


Plate VI. Section from the nose showing pigment in all epidermal layers and in the dermis. H. and E. stain. 550X. Note intercellular bridges.

A. Stratum corneum
B. Stratum lucidum
C. Stratum granulosum
D. Stratum germinativum
E. Dermal papilla
F. Pigment cell


A
B
C
D
F
E

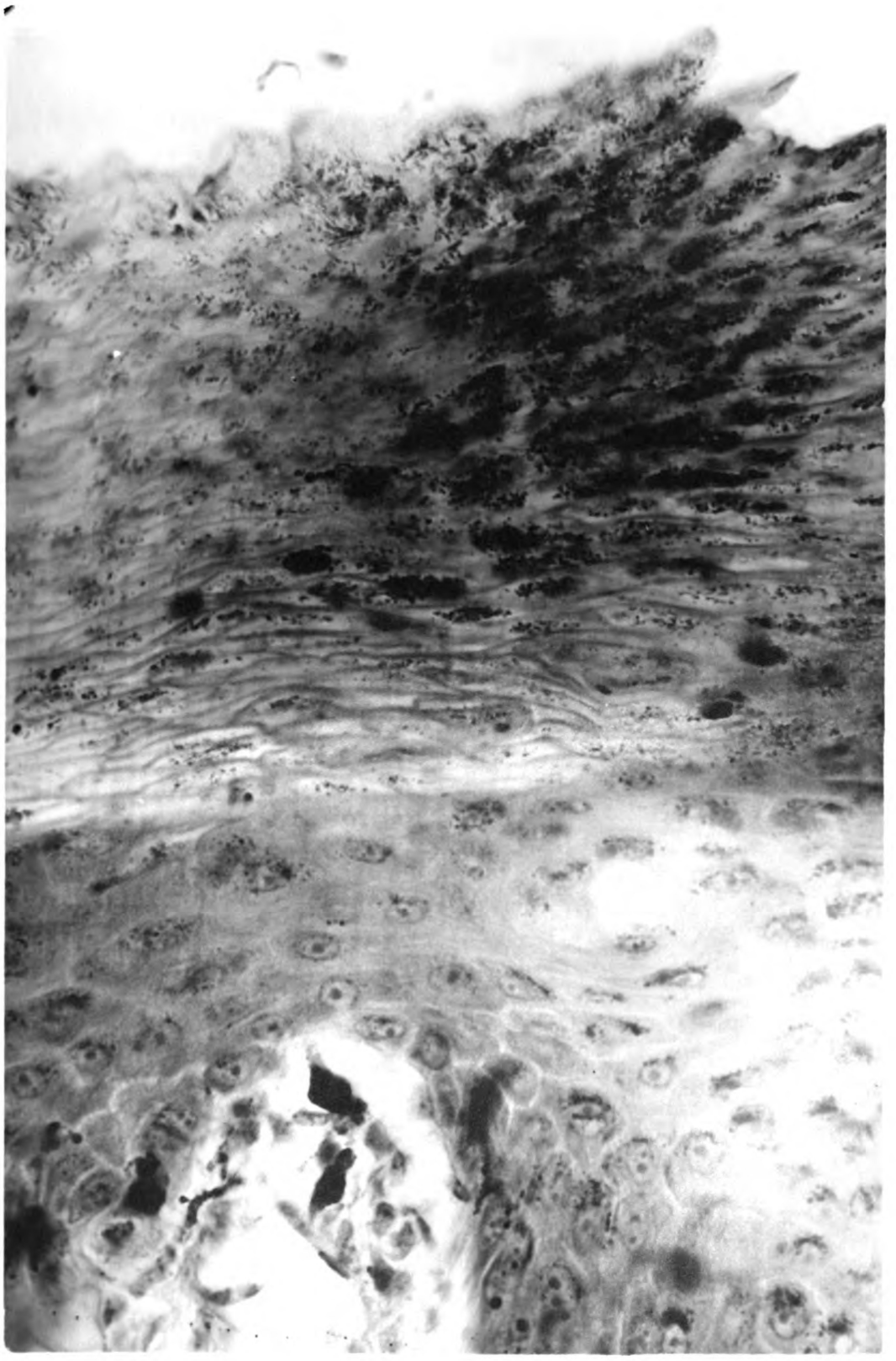


Plate VII. Dermis of the inguinal region showing elastic fibers in the reticular layer. Wiegert's stain (no counter-stain). 140X. Note large blood vessels in the deeper area.

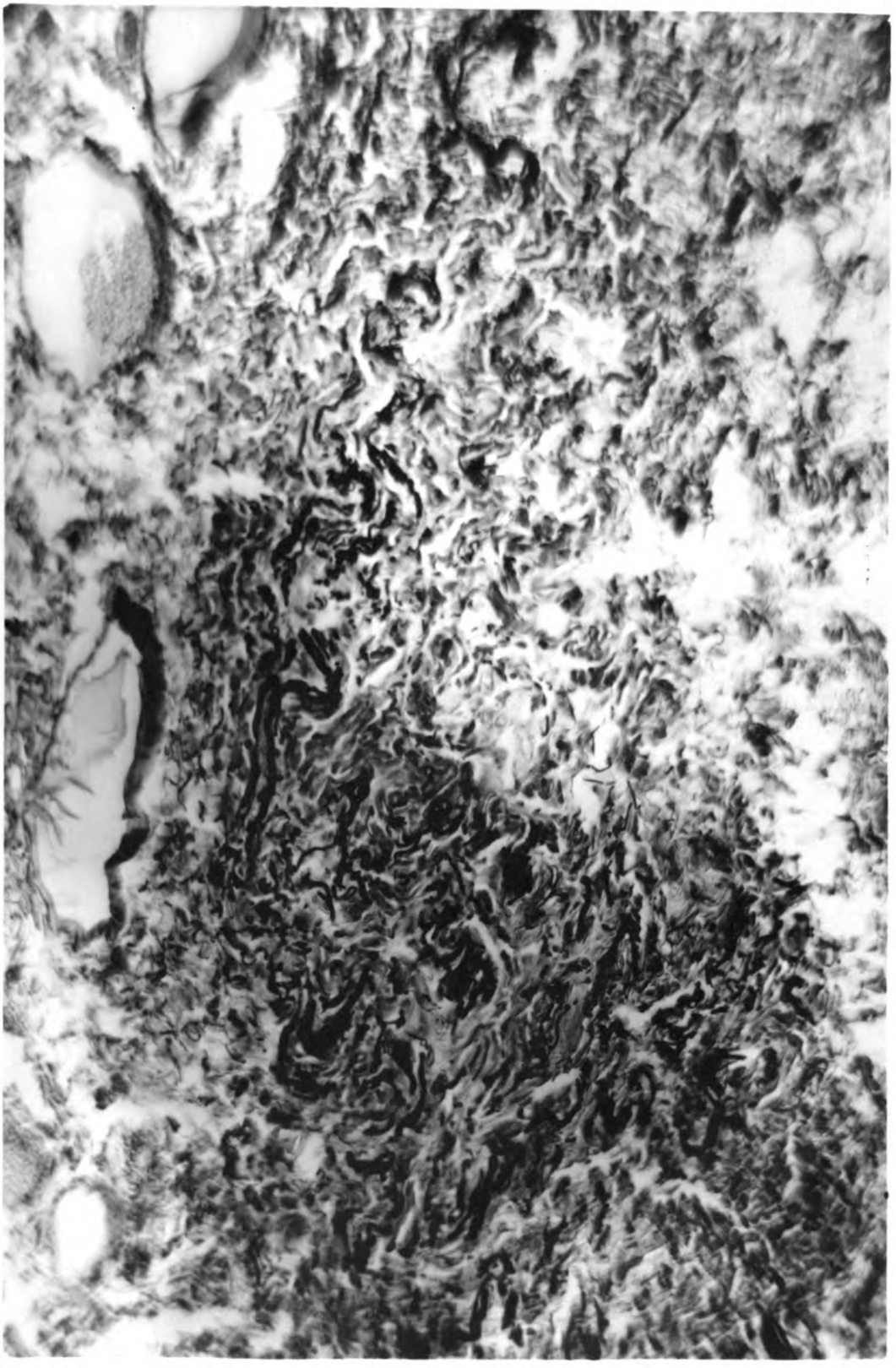


Plate VIII. Dorsum of head. Cross section showing a group of hair follicles, sebaceous and sweat glands. H. and E. stain. 170X.

A. Dermis
B. Hair follicle
C. Sebaceous gland
D. Sweat glands

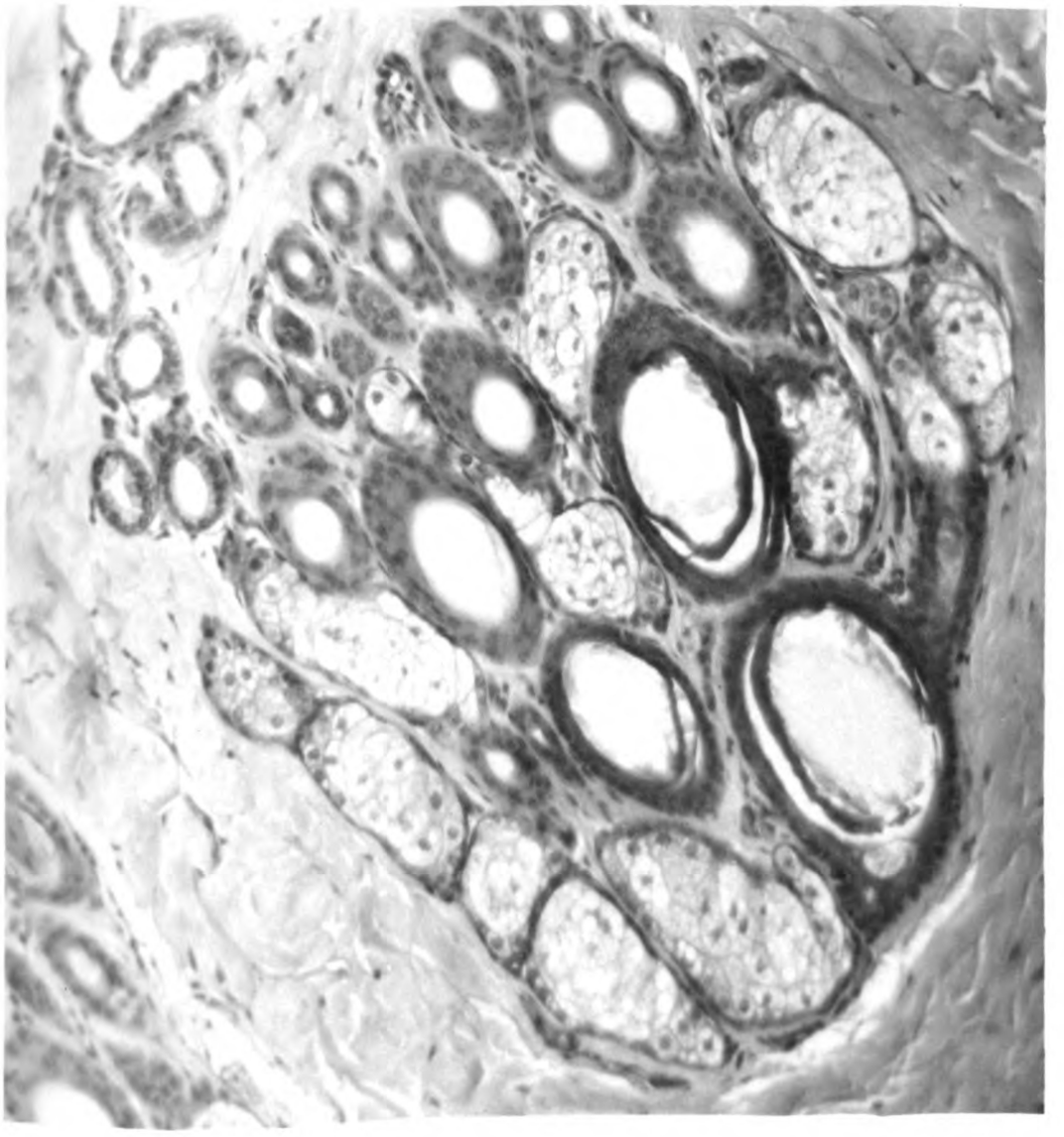
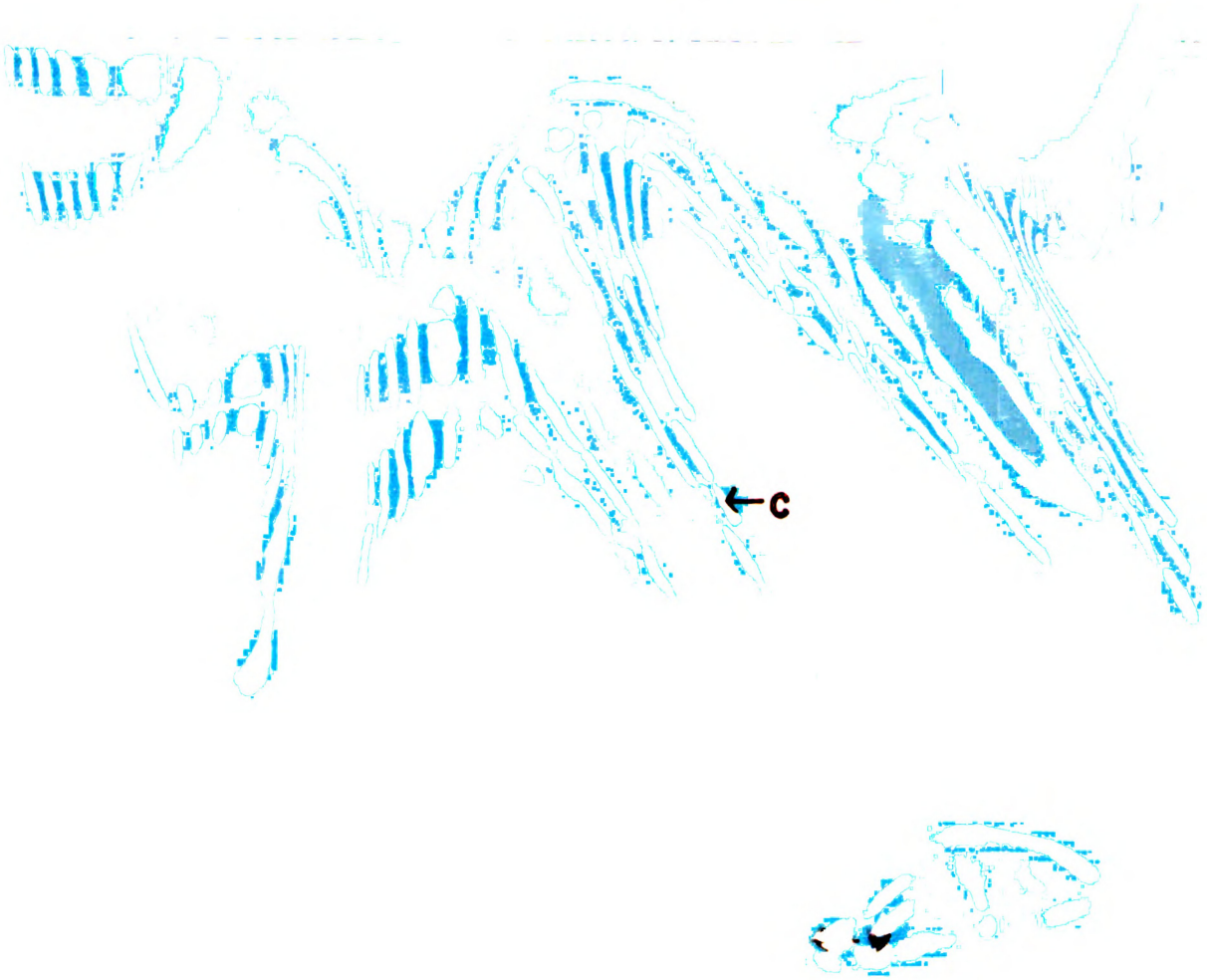


Plate IX. Back (rump). Cross section showing a group of six hairs in one hair follicle. H. and E. stain. 500X.

A. Hair follicle
B. Hair
C. M. arrector pili


B
A
C



B

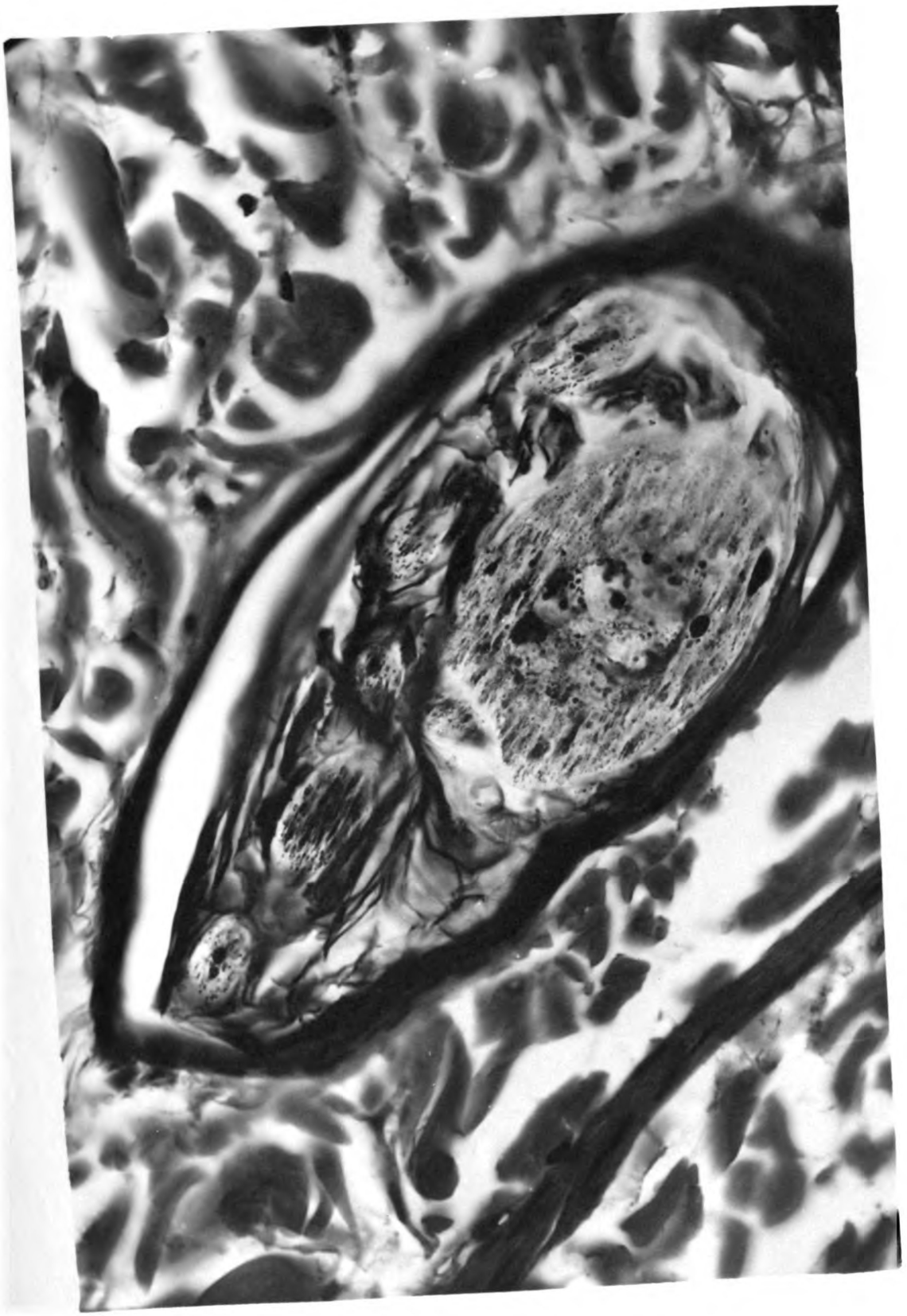


Plate X. Tail. Section showing five hairs emerging through a common opening in the skin. H. and E. stain. 230X. Note thin epidermis and densely arranged connective tissue bundles.

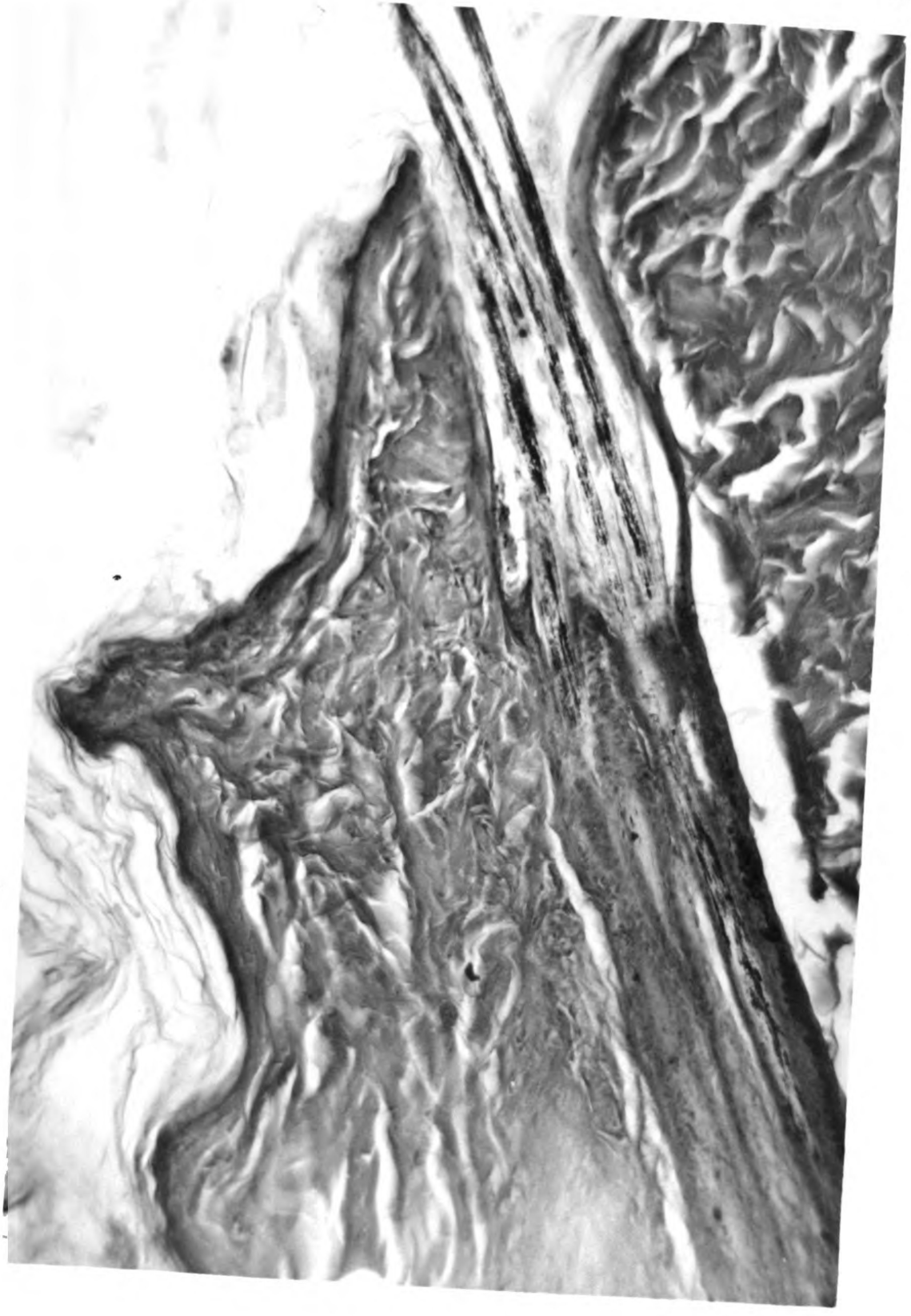


Plate XI. Digital pad. Section showing groups of coiled sweat glands in the dermis and the tela subcutanea. H. and E. stain. 180X.

A. Dermis
B. Tela subcutanea

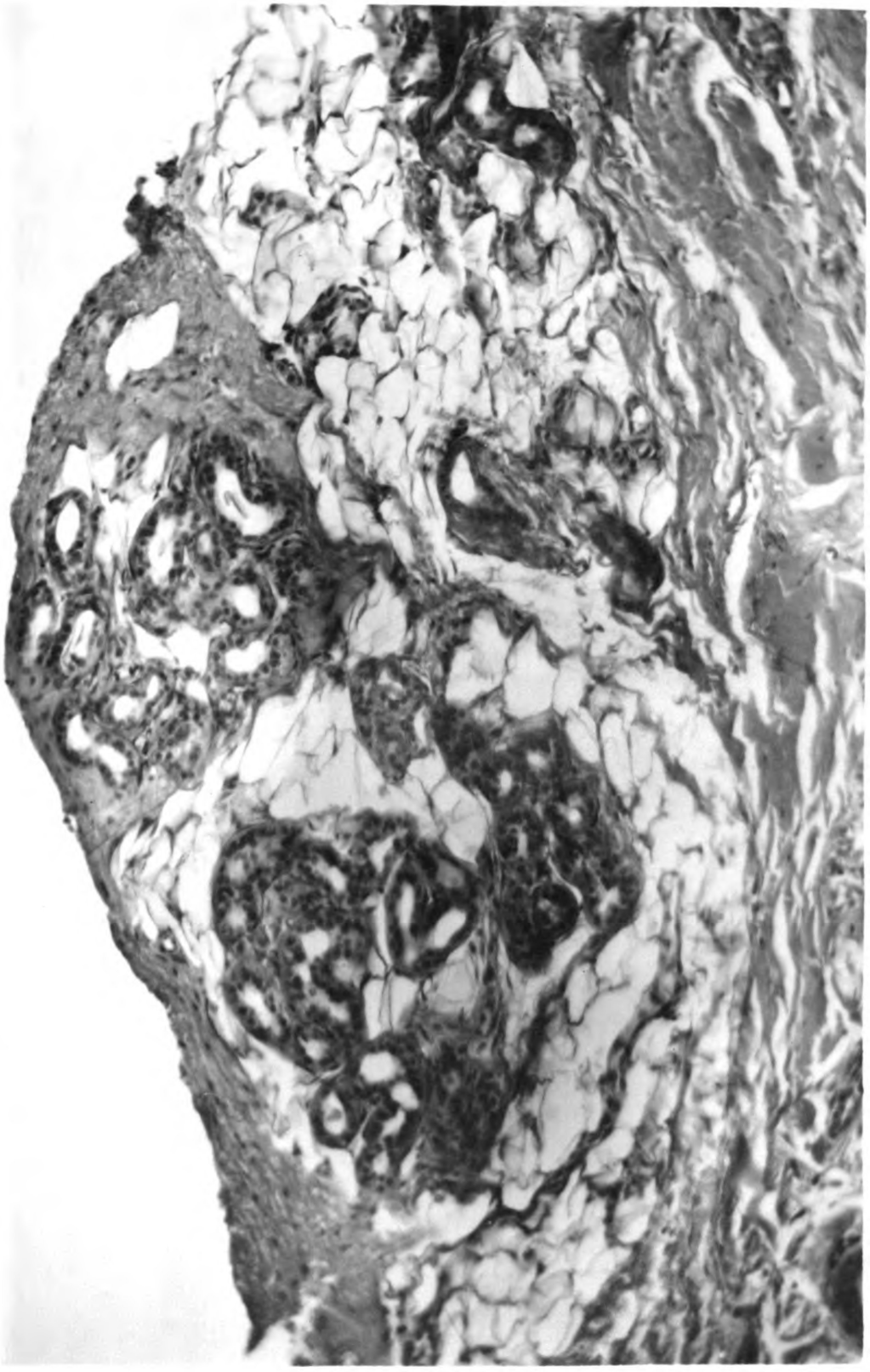
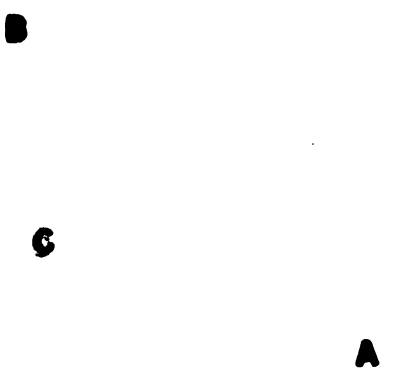
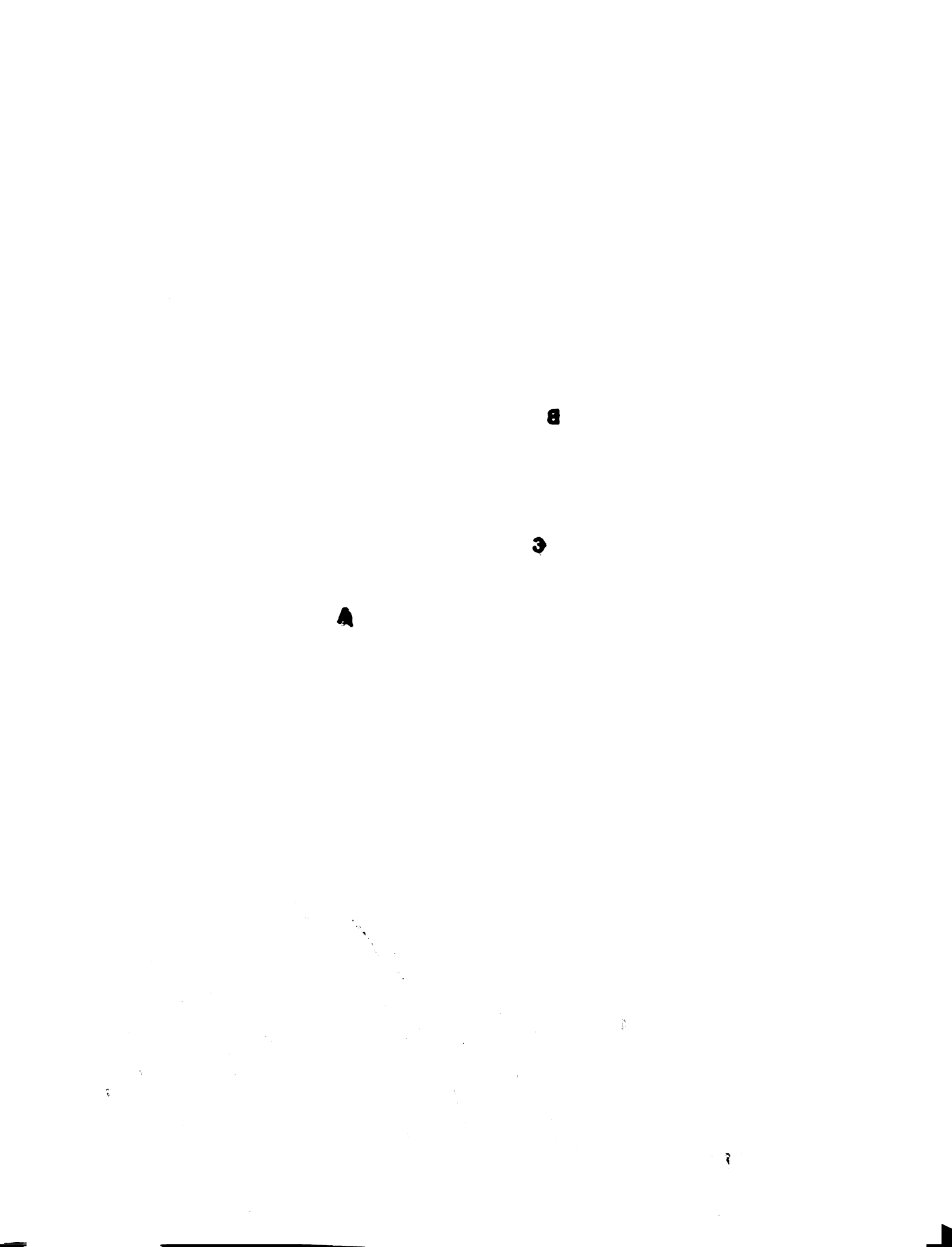


Plate XII. Temporal region showing tubular (non-coiled) sweat glands in the dermis. Cross section. H. and E. stain. 180X.

A. Hair follicle
B. Sweat gland
C. Fat


B
C
A


B
C
A

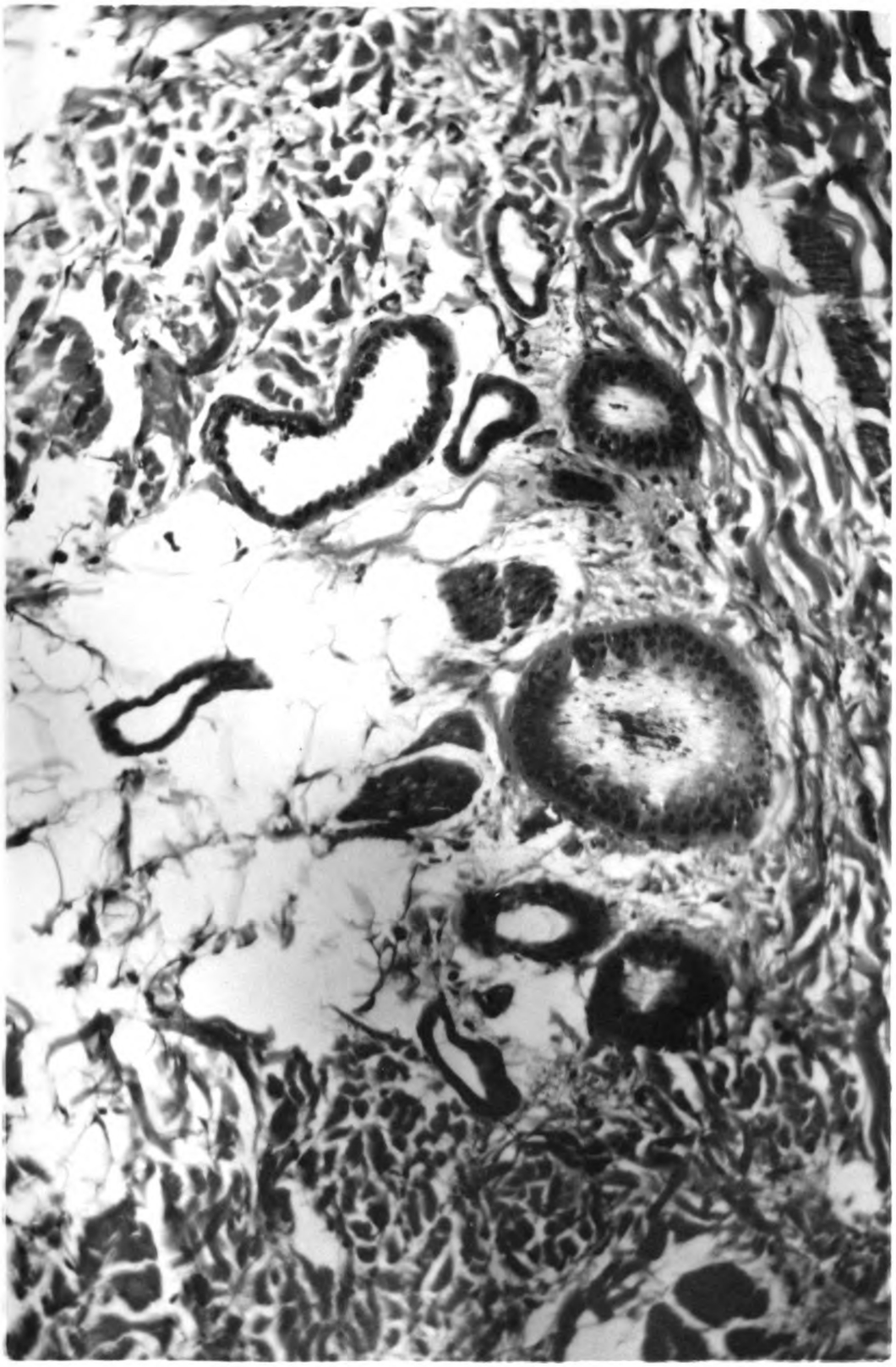
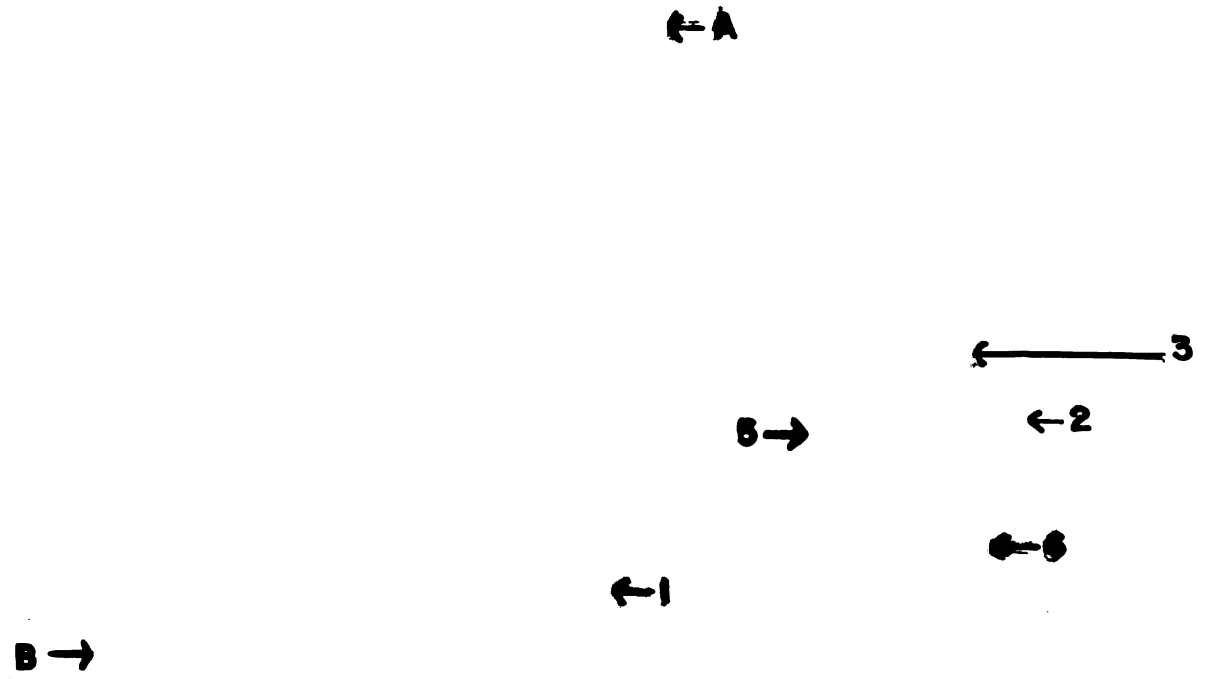


Plate XIII. Skin from back (rump). H. and E. stain. 90X. Note coiled sweat gland, three sebaceous glands opening into hair follicle at same level.

A. Epidermis
B. Dermis
C. Tela subcutanea
1. Hair follicle
2. Sebaceous gland
3. Opening of sebaceous gland
4. Sweat gland
5. Duct of sweat gland
6. M. arrector pili



4

C

A →

B ——————→

C →

D ←

E →

F →

G ←

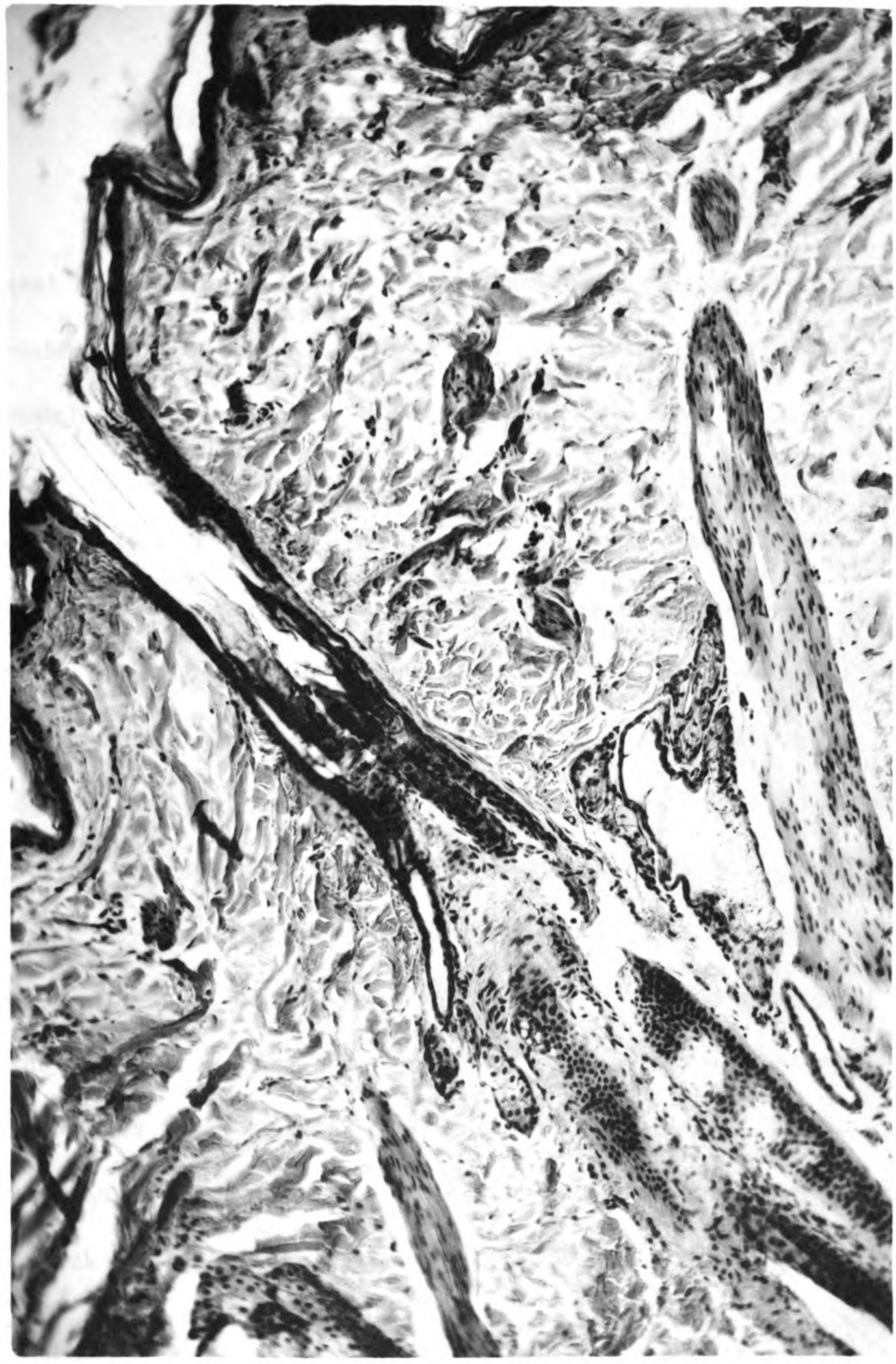
Plate XIV. Section showing hair follicle, sweat and sebaceous glands. H. and E. stain. 100X. Note ducts of sweat glands opening into hair follicle (secretory portion not shown).

A. Epidermis
B. Dermis
1. Hair follicle
2. Sebaceous gland
3. Sweat gland
4. Duct of sweat gland
5. M. arrector pili
6. Blood vessel

A
B
C
D
E
1
2
3

Plate XV. Back (rump). H. and E. stain. 100X.

A. Epidermis
B. Dermis
1. Hair follicle
2. Sebaceous gland
3. Sweat gland
4. M. arrector pili



SUMMARY AND CONCLUSIONS

Specimens of skin from thirty-four body areas of mongrel dogs were studied. Experimental animals included eight males and five females. Other than a thicker fat layer in females, there were no sex differences observed.

Thick skin generally had a thin epidermis and a thick dermis (one millimeter or more). The skin was thickest in the head and neck regions although the dorsal and lateral surfaces of the body also were characterized by thick skin. The thinnest skin was found in the lining of the pinna and the inguinal and axillary regions. There seemed to be no consistent pattern as to thickness or thinness of epidermis over thin dermal areas. The thin dermis of the lining of the pinna, the axillary and inguinal regions were covered by thin epidermis. The head, neck, shoulder, axillary, sternal and abdominal regions, the back, tail and prepuce consisted of thick dermis underlying thin epidermis. The lip and the nasal septum had a thick epidermal covering over thin dermis. Thick epidermis covered the thick dermis of digital pads. Skin covering ventral and medial surfaces was about one millimeter thick,

some areas being more and some less, but in all of these areas the epithelium was thin.

The layers of the epidermis compared with general descriptions by other authors. All four layers were found in thick epidermis. The stratum germinativum was present in all areas though it varied from two cell rows in the head and neck regions to thirty-five rows in the nasal septum. The number of cell rows increased with thickness in epidermis. With the exception of its absence in the head regions, the stratum granulosum was present in all areas. It consisted of a single row of diamond-shaped cells on ventral surfaces of the body, the tail and the shoulder. At its thickest point, the digital pad had fifteen rows of cells in the stratum granulosum. The thin epidermis of the head, neck, shoulder, axillary, sternal and abdominal regions, the back, the tail and the prepuce had no stratum lucidum. It was thickest in the digital pad. The stratum corneum, which was thinnest in the lip, attained its greatest development in the digital pad. It was present in all sections studied.

The amount of pigment varied with skin color. In white or light colored areas, pigment was found mainly in the

stratum germinativum but in black skin it was found in all layers of the epidermis. It was also observed in the papillary layer of the dermis.

The dermis showed no distinct separation into layers. Fine elastic and collagenous fibers characterized the superficial dermal layer in all areas. Coarser fibers were found in the deep layer. Throughout the dermis were fine reticular fibers. They were more numerous around hair follicles and the basement membrane. In thick-skinned areas, bundles of collagenous fibers were generally larger and stained lighter. In thinner areas fiber bundles were smaller and took a deeper stain. Fibers extended in all directions but in thicker areas were more parallel to the surface. Bundles were loosely packed in the flank and inguinal regions as compared with densely packed bundles of less movable areas.

Hair was absent in the digital pad, nasal septum, and portions of the lip. All other areas had hair. Hair follicles occurred mainly in groups of threes. Deep in the dermis, groups were massed together giving the appearance of as many as twenty hairs in a single group. More superficially sebaceous

glands and circular connective tissue fibers separated hairs into smaller groups.

Sebaceous glands compared with descriptions of those of the human species. All hairy portions of the body presented sebaceous glands. They were generally larger than in the human species but glands of several sizes were found.

Numerous sweat glands were found in all areas studied with the exception of the nasal septum and non-hairy parts of the lip. The glands were of two types—coiled and non-coiled. Both coiled and non-coiled glands were distributed over the entire body with the exception that non-coiled glands were not found in the digital pad and hairy parts of the lips.

From this study it was concluded that several basic types of skin were present over the body of the dog. In order to obtain representative specimens of each type of skin in the dog, future investigators could confine their sections to the following areas:

Dorsal surface of the neck
Digital pad
Lip
Nose
External genitalia
Ventral surface of the body
Axillary or inguinal region

It is hoped that this investigation may be followed by similar studies on the various breeds of dogs to determine if any breed differences exist.

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